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The Impact of Financial Inclusion on Banking Efficiency: Mediating Effects of Stability Risk and Moderating Effects of Economic Growth

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ABSTRACT

Article History:		<i>Availability and usage of the various financial services, classified as financial inclusion, have been identified as a major contributor to economic growth and stability, which is expected to lessen poverty, increase savings, and make the banking underserved population participate more in the economy by mitigating the barrier between the formal financial sector and the population not availing banking facilities. The current study investigates how financial inclusion, in turn, affects bank efficiency, with moderating effects of economic growth (measured by GDP) and mediating effects of instability risk in BRICS countries. Prior literature has overlooked the mediating and moderating roles of stability risk and economic growth, respectively, in relation to financial inclusion and banking efficiency. Econometric models applied include Panel fixed effects and GMM to address unobserved bias. The dataset consists of 24 years of annual data for the BRICS countries from 2000 to 2023. The research provides a renewed understanding of the relationship between financial inclusion, banking efficiency, economic growth, and financial stability, with a statistically significant p-value of 0.0001 and a coefficient of 0.120, which means financial inclusion increases the efficiency of the banking system, but the degree of its efficiency depends on the macroeconomic environment and bank stability in the financial system, as there exists partial mediation. The study helps in addressing the debate surrounding financial inclusion, since it recommends efforts toward policymakers and banking institutions in emerging nations to substantially increase financial inclusion for enhancing the performance of the banking industry.</i>
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1. Introduction

Financial inclusion (FI) is the process of providing individuals and businesses with fair access to and effective use of affordable financial services and products, including savings, credit, insurance, and payments, in a responsible and sustainable way, no matter

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what their income level or social status may be (World Bank, 2018). By connecting the formal financial system with unbanked citizens, FI has been a key driver of inclusive economic progress.

Increasing the accessibility and inclusion of disadvantaged groups within financial systems, thereby promoting savings behavior, reduces poverty and enables people to invest in education, health, and entrepreneurship. FI is a policy instrument of importance to policymakers for advancing financial equity and resilience, especially in developing economies. With the growing spread of digital technologies and fintech innovation, FI is increasingly perceived not only as a provider of banking services but also as the process of integrating people and companies into a formal financial system that enables them to participate fully in economic processes (Demirguc-Kunt et al., 2022).

Financial inclusion (FI) cannot be imagined without the part played by the banking sector. Banks channel deposits, lend money, and execute payments, and as such form the main institutional machinery through which FI initiatives have been deployed. However, the effects of FI on banking efficiency (BE) are debatable. In this research, the ability of banks to allocate resources, minimize costs, and remain profitable is defined as the concept of BE. Return on Equity (ROE) and Return on Assets (ROA) are very common indicators of efficiency. Expansion in FI would ensure that banks enjoy a broader customer base and a stable portfolio of deposits. However, it may also expose institutions to higher operational hazards and liquidity risks, adversely affecting efficiency. The tradeoff underscores the need for empirical analysis.

The past decade, especially through fintech, would seem to put financial inclusion front and center as an underpinning of economic development and inequality reduction. Fintech companies leveraging advances in AI and machine learning were, in a very short period, transforming what was achievable regarding bridging the financial gap for previously underbanked consumers. Innovations like peer-to-peer lending, real-time credit scoring, and cross-border payments have significantly transformed the financial landscape. However, there remains a significant gap in understanding the complex relationship between financial inclusion and banking efficiency, particularly in emerging economies (Heng & Tok, 2022; Rahayu & Rahadi, 2023).

The literature has focused on the role of FI in alleviating poverty or driving an increase in aggregate growth (Ratnawati, 2020). Earlier studies have addressed whether FI boosts or cripples the efficiency of banks themselves. Given the predominance of banks as institutional agents of FI, it is important to understand their efficiency.

The research mostly treats FI and BE as directly correlated, without considering the impacts of stability risks and macroeconomic conditions. Some works consider financial stability (Morgan & Pontines, 2014) or growth (Aghion et al., 2004); however, no coherent framework has been proposed that jointly considers: (i) Stability risk as a mediator through proxy liquidity risk and (ii) Economic growth as a moderator through proxy GDP

Over the past decade, ample focus has been on developing financial inclusion policies to address economic growth and financial inequality, but their impact on BRICS countries has remained unexplored. The main idea behind financial inclusion is the expansion of financial services for the underprivileged; however, the aftermath and allied effects of this expansion are yet to be known. It is important to note that, on one side, expansion in financial inclusion enhances banking sector deposits, the number of customers, and effective resource utilization, but at the same time, disoriented expansion

may result in increased costs, operational risks, and ultimately decreased bank efficiency (Demirgüç-Kunt et al., 2022).

Prior studies have independently examined financial inclusion and banking efficiency to evaluate their roles in developed economies, but studies on their nexus remain very limited, especially in developing economies. Results of available studies are inconclusive due to methodological differences, institutional policies, and regulations. Moreover, there is a diverse economic structure and operating environment across BRICS countries, suggesting that the impact of financial inclusion on banking efficiency in BRICS countries will differ from that in other developed economies (Ozili, 2021; Sahay et al., 2020).

Over the last two decades, the BRICS countries have emerged as an important group of promising economies. Members of the BRICS countries possess a big share of global trade, population, GDP, and investment. Their growing economic integration, increasing role in global governance, and diversity in development trajectories provide a suitable setting for examining economic and financial dynamics. Based on importance and role in global affairs, the BRICS countries hold major economic significance and policy relevance. Lastly, BRICS countries have ensured reliable, consistent, and accurate data for research (International Monetary Fund, 2024; World Bank, 2024).

The current study seeks to answer the following questions: What is the impact of financial inclusion on banking efficiency in BRICS countries? Does economic growth moderate the relationship between financial inclusion and banking efficiency? Do stability risk factors, namely, liquidity risk, mediate the relationship between financial inclusion and banking efficiency?

The aim of the study is to investigate the impact of financial inclusion on banking efficiency in emerging economies, with reference to BRICS countries. To achieve this aim, the study pursues the following three objectives: (1) To examine the direct impact of financial inclusion on banking efficiency in BRICS. (2) To assess the moderating role of economic growth indicators—GDP growth in the financial inclusion–banking efficiency relationship. (3) To investigate the mediating role of stability risks, namely liquidity risk, in the financial inclusion–banking efficiency relationship.

This research situates itself at the confluence of financial inclusion, banking efficiency, economic growth, and financial stability. By considering economic growth as a moderator and stability risks as mediators, the study develops a comprehensive model that captures the dynamic nature of banking systems in emerging economies. This line of inquiry not only makes a timely contribution to knowledge by closing a relevant research gap but also offers a pragmatic recommendation to policymakers, regulators, and banking practitioners seeking to adjust the tension between the twin priorities of accessibility and efficiency.

2. Literature Review

To understand how banking efficiency and financial inclusion interact, it is crucial to draw on several theoretical perspectives that will provide insight into how the primary variables, in this case, financial inclusion, influence banking efficiency, and how the moderating and mediating variables of economic growth, measured through GDP and stability risk, and liquidity risk, affect these main variables. The moderator variable is used to assess the direction and strength of the relationship between the independent and dependent variables, while the mediator variable explains how the independent variable predicts the dependent variable (Baron & Kenny, 1986; Hayes, 2017).

The use of moderators and mediators in the model's research scope is increasing. On one side, the moderator will check the strength of the relationship between financial inclusion and banking efficiency by including GDP as a proxy of economic growth, whereas, on the other hand, mediator stability risk through proxy liquidity risk will check the impact of the independent variable, financial inclusion, on the dependent variable, banking efficiency, to verify whether there is any full mediation or partial mediation.

2.1 Theoretical Framework

The theoretical framework is based on information theory, Resource Base View theory, and institutional theory, which together explain the impact of financial inclusion on banking efficiency under the moderating effect of economic growth and the mediating effect of stability risk.

Information theory (Akerlof, 1978; Stiglitz & Weiss, 1981) refers to the inefficiencies in the market due to incomplete and inaccurate information related to financial services. Financial inclusion has an ample role in reducing the asymmetry of information by including the unbanked population in financial systems, which enables the banking sector to have access to accurate and timely provision of data related to customers, historical records related to loans, repayments, and defaults, resulting in enhanced credit screening techniques, minimizing risk of defaults, and ultimately improving banking efficiency. Expanding financial services to the unbanked population will initially increase liquidity and credit risk, as it entails providing loans to customers without historical credit-screening data, which may increase the NPL ratio.

Resource-Based View (RBV) theory (Barney, 1991) focuses on the importance of scarce resources of financial institutions and how effectively and efficiently they use these resources to minimize cost and enhance profitability. RBV gives you a strategic competitive advantage through digital banking infrastructure, human resources, and technological advancement for state-of-the-art customer analysis. Banks with a competitive advantage in resource allocation tend to offer low-cost services to customers. Therefore, RBV argues that banks' internal resources play a role in enhancing financial inclusion, minimizing risks, and improving banks' profitability. The resource-based view links financial inclusion with banking efficiency via scarce resources, continuous innovation, and optimization. Treating digital financial services as strategic resources enables better risk assessment management, especially in developing economies. Recent studies by Shukur & Sufian (2025) highlighted the significant role of digitally enabled financial inclusion in strengthening the banking sector by converting in-house capabilities into competitive advantages.

Institutional Theory (Meyer & Rowan, 1977; DiMaggio & Powell, 1983) highlights the role of governance, regulatory frameworks, and the internal environment of institutions in achieving organizational desired outcomes. Strong institutional frameworks support financial inclusion by developing confidence, ensuring compliance, and minimizing risks associated with systemic procedures. Weak institutional regulations may increase credit and liquidity risks associated with rapid, short-term enhancements in financial inclusion.

2.2 Summary of Previous Empirical Studies

This section presents a summary of the most relevant empirical studies related to the variables examined in this study. It highlights the research context, methodologies, key findings, and identified gaps in the existing literature. The review determines the need

for the present study by identifying inconsistencies, underexplored relationships, and contextual limitations that justify further investigation.

Table 1: Empirical Evidence and Research Gaps

Author(s), Year	Country/Context	Methodology	Key Findings	Gap/Link
Demirgüç-Kunt & Klapper, 2012	Global	Findex survey	FI lowers exclusion, increases access.	Bank efficiency not studied → H1 gap
Burgess & Pande, 2005	India	Policy panel	Branch expansion reduced poverty.	Did not measure bank efficiency → H1 gap
Berger & Mester, 1996	U.S./EU	DEA/SFA	Methods to measure bank efficiency.	Efficiency metrics exist but not linked to FI.
Casu & Girardone, 2006	Europe	DEA/SFA	Competition & efficiency relations.	No FI dimension → H1 gap
Lal et al., 2024	Pakistan	Survey/panel	Fintech boosted access.	No bank efficiency outcomes tested.
King & Levine, 1993	Cross-country	Econometric growth model	Financial development spurs GDP growth.	Foundation for H2.
Ratnawati, 2020	Indonesia	Time-series	FI positively influences GDP growth.	Moderation on efficiency not tested.
Emara & El-Said, 2021	MENA	Panel	FI-growth link depends on institutional quality.	Efficiency outcomes omitted.
Louzis et al., 2012	Greece	Bank panel	Unemployment strongly affects non-performing loans.	Suggests unemployment moderation.
Allen et al., 2012	BRICs	Household survey	Education drives FI adoption and financial literacy.	Moderation via education on efficiency untested.
Ofoeda et al., 2024	Ghana	Regional panel	Prosperity conditions	Moderation role acknowledged

				amplify benefits.	FI	but no efficiency link.
Beck, Demirgüç- Kunt & Levine, 2007	Global	Cross-country panel		FI reduces poverty and inequality, but excessive credit may increase risk.		No mediation tested.
Cihak et al., 2012	IMF, 132 countries	FI index & stability indicators		FI contributes to stability if supervised well.		Mediation not tested.
Louzis et al., 2012	Greece	Bank panel		Credit risk rises in downturns.		Suggests mediation (H4).
Khan et al., 2021	Pakistan	Panel		FI increased credit use but also default rates.		Mediation link missing.
Sahay et al., 2015	IMF	Global		FI helps stability until threshold, beyond which risks rise.		Non-linear mediation untested.
Musau et al., 2018	Kenya	Bank panel		FI expanded credit; liquidity issues emerged.		Supports liquidity risk mediation (H3).
Adegbite & Machethe, 2020	Nigeria	Panel		FI raised access, spurring volatility in interest margins.		The mediating effect of IRR is ignored

2.3 Financial Inclusion and Banks' Efficiency

Financial inclusion (FI) is increasingly a key policy priority for emerging economies, regarded as a pillar of equitable growth, poverty alleviation, and sustainable development. Both the World Bank and the IMF have cited the revolutionary power of FI in encouraging people and businesses to engage more deeply with the formal financial system (Demirguc-Kunt & Klapper, 2012).

In simple terms, FI is the process of providing people and businesses with affordable, useful financial products and services, such as payments, savings, credit, and insurance, delivered in a responsible and sustainable manner. Although a body of literature has been developed to explain the welfare, social, and macroeconomic impacts of FI, a gap remains in linking FI to efficiency outcomes at the bank level. This is the foundation of Hypothesis 1 (H1), which states that FI has a positive and significant impact on banking efficiency in BRICS countries.

Han et al. (2025) conducted a study on the impact of financial inclusion on bank stability, using data from 36 emerging economies for the period from 2023 to 2024, comprising 1500 commercial banks. Econometric methodology included fixed effects and a GMM model; results highlighted that financial inclusion has a positive influence on bank operational efficiency and overall stability by generating consistent funding.

Moreover, highlighted the negative impact of weak financial policies, regulations, and unnecessary government involvement, which could undermine bank stability.

Another study comprising 1740 banks covering the period from 2004 to 2015 found a positive and significant relationship between financial inclusion and banking efficiency. Results showed that with increased financial inclusion, banks enjoy a reduction in uncertainty regarding deposits, as financial inclusion helps banks to generate long-term stable funds (Ahamed et al., 2021). Another important aspect highlighted by research was the role of regulations, as countries with fewer restrictions and better government regulation tend to generate more funds.

Kharabsheh (2023) conducted research analyzing the impact of financial inclusion on the performance of commercial banks in Jordan, covering the period from 2011 to 2018. Three proxies, operating income, operating expenses, and net interest income, were used for measuring bank efficiency, while performance was measured through two proxies: return on equity and return on assets. Research results revealed that financial inclusion positively and significantly impacted bank efficiency in terms of net interest margin, whereas it negatively decreased efficiency in terms of operating expenses.

Ozili (2025) argued that banking sector performance is directly linked to financial inclusion, as the banking sector experiences increased deposits, financial stability, and profitability by reducing risks. An important point highlighted in the study is related to governance and regulatory limitations, which may affect the impact of financial inclusion on banking efficiency.

On the contrary, banking efficiency studies that began in the 1990s established robust methodological procedures for calculating efficiency using frontier analyses, including Data Envelopment Analysis (DEA) and stochastic frontier analysis (SFA). Berger (1997) and Mester (1996) released two seminal papers that addressed how efficiency is affected by competition, regulation, and governance. However, even the sophisticated models tended to omit FI as an explanatory variable. This has led to a research gap: access and usage studies focus on FI, whereas efficiency studies neglect the information-intensive operational, managerial, and regulatory determinants. It is relevant to bridge this gap because FI and efficiency are probably interdependent.

Simultaneously, it is important to assume a non-linear relationship. One reason why an increase in FI has an upper bound on effectiveness is suggested by the IMF (Sahay et al., 2015), which states that inefficient risk management may undermine the efficiency and growth of a financial system. To illustrate, high loan growth in under-catered parts can lead to delinquencies, forcing the banks to use more resources in risk management and collection. It is therefore possible that the efficiency gains of FI also rely on complementary factors such as regulatory quality, risk controls, and digital literacy.

The existing literature provides valuable information related to financial inclusion, bank performance and economic outcomes (Okunlola et al., 2020). Financial services are beneficial not only at the individual level but also to the banking sector. A case study on Nigeria revealed that financial inclusion has a significant impact on sustainable bank efficiency in the short run, though its long-term effects are less pronounced. Similarly, research on sub-Saharan Africa has revealed that financial inclusion enhances bank efficiency. On the other hand, the usage dimension has a less significant influence. These findings emphasize the importance of policy interventions that promote financial inclusion, particularly in developing regions (Ahamed & Mallick, 2019; Ifediora et al., 2022; Okunlola et al., 2020).

H1: Financial inclusion has a positive and significant impact on banking efficiency in BRICS countries.

2.4 Moderating Role of Economic Growth (GDP)

Financial inclusion (FI) and banking efficiency are highly moderated by economic growth, which can be defined as GDP (Gross Domestic Product). The success of financial inclusion policies relies heavily on the economic conditions prevailing at a country's national level. Countries with high GDP tend to have good infrastructure, enhanced digitalization, high financial literacy, and a stable institutional framework, hence leading to efficient provision of financial services. People in these countries tend to embrace formal financial systems and utilize digital platforms for their transactions.

According to theoretical approaches such as the endogenous growth model (Romer, 1986), financial inclusion is essential for economic growth because it stimulates entrepreneurial activity, investment, and consumption. On the other hand, improved economic growth results in better institutions, technological development, and improved financial markets, hence improving banking efficiency. According to Kim & Lin (2011), the role of financial development in improving financial stability and efficiency is more significant in countries with high income levels and strong institutions.

Moreover, empirical findings also indicate a moderating influence of GDP. According to Djalilov and Piesse (2016), financial development had a more positive impact on bank performance in Central and Eastern Europe during periods of economic growth. Furthermore, according to Han and Melecky (2013), FI is effective in achieving stability and efficiency under a favorable macroeconomic environment. In India, for example, the high rate of GDP growth from 2014 to 2019 enabled the implementation of various innovations in financial infrastructure, including digital KYC through Aadhaar, the creation of credit bureaus, and mobile banking solutions. Many studies highlight the importance of economic growth as a catalyst for enhancing the impact of financial inclusion on bank efficiency. Han et al. (2025) highlighted that in the presence of robust and consistent policies, stable economic growth enhances the positive impact of financial inclusion on banking efficiency.

Shukar & Sufian (2025) concluded in their research on ASEAN economies that the impact of financial inclusion on efficiency is highly dependent on the country's overall economic conditions. According to the results, countries with high- and middle-income levels tend to benefit from the positive effects of financial inclusion on banking efficiency, as financial infrastructure can more easily adjust to and absorb new customers. On the other hand, countries with low income levels and low, inconsistent economic growth face the negative impact of financial inclusion on banking efficiency because enhanced financial inclusion is not backed by infrastructure, and the additional costs of financial inclusion growth may negatively affect banking efficiency.

It is important to highlight that the success of financial inclusion depends on the institution's ability to manage its liquidity and adopt technological advancements. Banna et al (2021) studied OIC countries and proposed the size hypothesis, based on the idea that institutions with more resources and technological investment are better equipped to avail the benefit of fintech-based financial inclusion. While inclusive financial sectors contribute to macro-level benefits like employment generation and financial literacy, the high costs of establishing technology infrastructure can be a barrier for smaller institutions.

On the other hand, in cases of low GDP growth, poor infrastructure, insufficient technological capabilities, low financial literacy, and institutional inefficiency can hamper the effectiveness of FI. According to Beck et al. (2019), it is common for financial organizations to incur high operational costs, face debt repayment challenges, and struggle to scale up their financial services in low-income countries.

The relationship between financial inclusion (FI) and economic growth is well documented in the financial literature, confirming that finance is a key driver of long-run economic growth. King and Levine (1993) demonstrated the positive Effect of financial deepening on GDP growth through heightened resource allocation, increased investment efficiency, and greater innovation. With these studies as background, recent studies have focused on analyzing how FI, as a specific aspect of financial development, determines growth performance in developing countries. As an example, Ratnawati (2020) showed that inclusive finance in Indonesia has a very positive impact on GDP growth, reinforcing the importance of the sector to national development targets.

Additionally, although there is some consensus on the FI-growth relationship, a major research shortcoming remains regarding how growth-related factors mediate the relationship between FI and the banking sector's efficiency. This can be a critical point, since FI could lead to gains for households and firms as a group, but how much of the efficiency gains is captured by banks is probably path-dependent on the broader macro environment. Therefore, Hypotheses 2 (H2) indicate that commercial growth (GDP) mediates the FI-to-efficiency relationship.

The empirical evidence so far is not Italian. As noted by Mishra and El Gammal (2022) and even more so by Mishra and El Gammal (2023), FI in MENA countries has a significant relationship with growth, but this relationship is conditional on the quality of the institutions in place. In line with this, Ofoeda et al. (2024) indicate that prosperity positively multiplies the impact of FI in Ghana and exclude bank efficiency. Taken together, these studies point to the importance of not only specifying linear relations but also explicitly testing the moderation (interaction) effects.

This application of GDP as a moderator is supported by the Contingency Theory of Organizational Performance, which opines that the quality of different strategies (such as financial inclusion) varies depending on the external environment within which such strategies are implemented (Donaldson, 2001). Better infrastructure, financial literacy, regulatory enforcement, and technology penetration will characterize high-GDP contexts and further enhance the favorable impact of inclusion on efficiency. The opposite is true in low-GDP settings, where poor institutions and erratic income levels can invert or wash out this relation.

Among the defined proxies for economic growth, this research used GDP as the proxy. The GDP factor provides insight into product market price stability, the labor force, and the development of enriched human resources, all of which are considered direct inputs to economic stability and growth. Whereas economic factors like GDP, GNI, and investment are indicators of financial activity in the country, not directly related to economic growth.

H2: Economic Growth moderates the relationship between financial inclusion and banks' efficiency, such that higher economic growth strengthens the positive impact of financial inclusion on banks' efficiency in the BRICS region.

2.5 Mediating Role of Financial Stability Risk

Existing literature studied the effects of financial inclusion on financial stability. They highlighted the importance of complete financial systems in lowering systemic risks (e.g., Ahamed & Mallick, 2019; Le et al., 2019). The benefits of digital financial inclusion in boosting resilience were proposed (Shen et al., 2021). They proposed that digital financial ecosystems can help safeguard against economic fluctuations. Khera et al. (2021) emphasized the connection between economic hardships and digital financial inclusion. Individuals as well as organizations may adapt to financial inclusion utilizing digital financial instruments and infrastructure. The connection between financial stability and inclusion, as examined by Morgan and Pontines (2018), states that lower credit risk and the chance of financial institution default mean that increased financial inclusion helps to preserve financial stability. This viewpoint highlights how financial inclusion reduces risks and boosts the overall resilience of financial institutions, acting as a stabilizing influence within the financial system (Morgan & Pontines, 2018).

Bank liquidity risk means that a bank will not be able to meet its financial obligations within a prescribed period (Apostolik et al., 2009). Banking is a revered and esteemed profession and revolves around two key concepts: asset-liability mismatch and liquidity risk management (Choudhry, 2018). Banks generate liquidity by converting short-term, liquid liabilities into long-term, illiquid assets through off-balance-sheet loan agreements and obligations. Liquidity creation, alongside risk transformation, is a fundamental reason for the existence of banks (Gupta & Kashiramka, 2020). According to Skoglund and Chen (2015), liquidity risk arises from market or specific events of a bank. It becomes crucial to identify potential sources that could diminish cash inflows and increase cash outflows in such scenarios. Typically, deposit volumes and a financial institution's committed lines of credit remain stable under normal conditions. However, during severe liquidity stress, depositors might rapidly withdraw funds, and institutions may draw heavily from their credit lines. Additionally, banks' counterparties may attempt to retract committed credit lines. The instability of liquidity risk can often serve as an early indicator of a banking crisis (Waemustafa & Sukri, 2016). Liquidity issues can thrust a solvent bank towards insolvency (Beja, 1972). To meet the immediate obligations, the Bank may be compelled to sell its assets at significantly reduced prices. These deficiencies have led to the downfall of numerous banks, with their failures spilling over to other banks and the broader economy (Gupta & Kashiramka, 2020).

Liquidity is closely linked to profitability and capital adequacy. The Global Financial Crisis 2007-2008 emphasized the role of liquidity risk in the banking sector and its wider implications for the financial system. Recent empirical analyses have proved that banks that effectively manage their liquidity are better able to resist external pressures, thereby fostering not only their financial health but also enabling them to extend services to underbanked populations.

H3: Financial inclusion negatively influences liquidity risk, which in turn positively affects banks' efficiency in the BRICS region.

2.6 Theoretical Theories and Hypothesis Linkage

With respect to the resource-based view theory, financial inclusion provides banks with a suitable environment to develop their own resource base at low cost. Banks enjoy more secure funds by increasing their reach to the previously unbanked population; all these give banks a strategic advantage. Moreover, the size hypothesis also suggests that big banks use their technological infrastructure and liquidity as leverage to gain strategic resources to enhance their efficiency through fintech-based inclusion.

Information theory argues that financial inclusion helps reduce information asymmetry. Techniques based on fintech and digital tools provide banks with more reliable and accurate information regarding the unbanked population, so that banks are in a better position to evaluate the customer. As a result, reduced information costs help improve efficiency and profitability (Anton & Nucu, 2024).

Institutional theory suggests that institutions with strict, robust, and updated rules, regulations, and policies tend to be more efficient than institutions with weak controls. This theory focuses on the role of evaluation criteria, i.e., credit scoring of customers. Institutions with a strong institutional environment enjoy a strong, significant positive association between financial inclusion and banking efficiency, whereas those with a weak institutional environment do not. The administrative burden of FI can lead to an "unfavorable influence" on efficiency, highlighting that institutional maturity is a prerequisite for inclusion-led gains (Shukur & Sufian, 2025). The summary of theoretical support is presented below:

<u>Theory</u>	<u>Link to Financial Inclusion</u>	<u>Impact on Efficiency</u>
Resource-Based View	Access to stable, low-cost deposit funding.	Reduces funding volatility and lowers capital costs.
Information Theory	Fintech tools reduce data gaps and asymmetry.	Improves cost-income ratios and operational soundness.
Institutional Theory	Regulatory frameworks and income levels.	Dictates whether FI yields gains or operational burdens.

2.7 Conceptual Framework

During this research phase, Financial Inclusion (FI) is considered an independent variable. Bank Efficiency (BE) acts as a dependent variable. Economic Growth (EG) acts as a moderator through the proxy GDP, and Stability Risk (SR) as a mediator through the proxy liquidity risk.

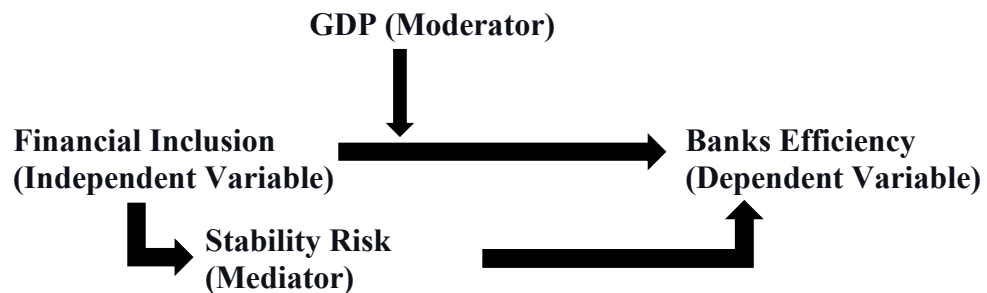


Figure 1: Research Model

3. Methodology

3.1 Criteria for Selection of Sample

The selection of nations used in this research work is based on a purposive sampling method that has been built on both theoretical importance and empirical practicality. This sample has been chosen and consists of the five BRICS economies (Brazil, Russia, India, China, and South Africa). In the recent past, the BRICS bloc has gained momentum in global economic discussions due to its strategic implications for world trade, finance, and development. Convergence and divergence among these countries are observed along with some major macro-financial aspects. On one hand, their

interests overlap in economic self-reliance, digital financial reform, and liberalization of the banking sector. Conversely, they vary in regulatory maturity, politics, and susceptibility to systemic financial shocks. That is why they are considered ideal candidates for a comparative empirical study (Nayyar, 2013).

Second, data on all the needed variables, including financial inclusion variables, banking efficiency variables, economic growth variables, and risk proxies, had to be available during the period between 2000 and 2023. Panel data econometric methods, which require balanced or semi-balanced data covering a sufficiently long-time horizon, are applicable using this 24-year panel to consider both short-term dynamics and long-run equilibrium relationships.

Sample selection is based on three critical criteria. The first is that the countries should be classified by top bodies such as the IMF and the World Bank as emerging market economies. It will ensure that the countries face similar macroeconomic conditions regarding financial depth, market fluctuations, and their development objectives. The second criterion is that there must be data availability for all variables needed for the study, such as those relating to financial inclusion, banking efficiency, economic growth, and proxies for risk, within the time range of 2000-2023. Lastly, countries should show evidence of national-level policies or programs that promote financial inclusion. This involves regulatory aspects, digital finance solutions, and central bank actions for poor citizens.

Although the sample consists of five countries with 120 observations, the selection of BRICS countries was deliberate because these countries have had a significant impact on global economic activities, given their advancement in financial inclusion and sustainable growth. As a limited number of countries may constrain the breadth of view and statistical significance of moderation and mediation analyses, the panel structure of the dataset overcomes this problem by providing adequate cross-sectional and time-based historical variation for analysis. Lastly, the results of this research must be interpreted with respect to the BRICS environment, and future research may include a wider set of countries to improve the validity and robustness of findings.

3.2 Data and Variables

This research is based on secondary data collected from a variety of internationally recognized and empirically verified databases. This is the main strength of the research, as the integrity, reliability, and comparability of such sources are the basis for panel analysis conducted over 24 years (2000-2023) in five cases involving emerging economies, namely Brazil, Russia, India, China, and South Africa. Secondary data is especially applicable to macroeconomic studies and policymaking, where national-level indicators, rather than individual business statistics, are more important (Gujarati & Porter, 2009).

The data sources were chosen for their international recognition, time-series consistency, and significance to the variables of primary interest: financial inclusion, banking efficiency, economic growth, and systemic risk. The major sources used, and the variables they provided, are highlighted in Table 2 below.

Table 2: Data Sources

VARIABLE	CONCEPTUAL ROLE	MEASUREMENT DESCRIPTION	SOURCE
ROE	Dependent Variable	Return on Equity (%): net income/equity	IMF Financial Soundness Indicators
ROA	Robustness DVs	Return on Assets (%)	IMF FSI
FI_ATM	Independent Variable	ATMs per 100,000 adults	World Bank Global Findex
GDP GROWTH	Moderator	Annual % change in real GDP	World Bank WDI
LIQUIDITY RISK	Mediator	Liquid Assets / ST Liabilities (%)	IMF FSI
BANK SIZE	Control	Natural log of total banking sector assets	Global Financial Development Database, National Reports
LEVERAGE	Control	Total debt/equity (%)	IMF FSI
UNEMPLOYMENT	Control	% of unemployed in total labour force	WDI

The reason ATM density is selected as a proxy for financial inclusion is that it is the primary source of open, measurable access to financial services. Not unlike composite indices, which include many dimensions such as usage, quality, and access. ATM density is often used as a proxy for financial inclusion and as a consistent indicator, especially in studies on the relationship between financial inclusion and banking efficiency (Sarma, 2008; Demirgüç-Kunt et al., 2022).

Without a doubt, financial inclusion is multidimensional, based on the notions of usage, quality, and access to financial services. The reason for selecting ATM density as a proxy is that it provides an objective, readily available, and quantifiable measure of the accessibility of financial services to the general population across regions over time. ATM density serves as an indicator of the percentage of the population that can access basic banking services.

Moreover, using ATM density as a proxy reduces the methodological complexity and potential bias associated with composite indices. Composite indices require subjective assessment of variable selection, normalization, and weighting, which, in turn, affect their strength and robustness, making the results incomparable to those of other regional studies. In developing economies, ATM density is a key factor, as tangible banking infrastructure is crucial to the successful implementation of financial inclusion. Lastly, ATM density, being a physical, tangible asset, provides greater clarity, consistency, and precision in data structure, especially in longitudinal cross-country studies where standardization of financial inclusion measures may not be possible.

3.3 Period Coverage

The choice of a limited set of time between 2000 and 2023 was premeditated to cover a broad range of macroeconomic occurrences, such as:

- Global Financial Crisis (2007-2009)
- European Sovereign Debt Crisis (2010-2012)
- Covid-19 pandemic and recovery post pandemic (2020-2023)

Through these events, it is possible to conduct longitudinal observations of the co-evolution of financial inclusion and banking resilience amid economic shocks, policy changes, and institutional reforms.

3.4 Econometric Model Specification

In this section, the author provides an overview of the econometric models used in the research to analyze the relationships among financial inclusion, bank efficiency, economic growth, and systemic risks in the BRICS countries. The choice of model types and their specification is guided by economic theories, previous literature, and lastly the nature of the assembled structured panel data set. There are three core models included in the analytical design: (1) the baseline model to measure the immediate impact of financial inclusion on banking efficiency, (2) a moderation model to determine the interaction between financial inclusion and economic growth, and (3) a mediation model to review the indirect relationship through the risk of systemic stability. Both models are estimated in a panel data specification to take advantage of the temporal and cross-sectional aspects of the data.

3.4.1 Baseline Model: Financial Inclusion and Banking Efficiency

The former measures the direct effects of financial inclusion on banks' efficiency. The Model can be written in the form:

Model 1:

$$ROE_{it} = \beta_0 + \beta_1 FI_{it} + \beta_2 Controls_{it} + \beta_3 Crisis_t + \mu_i + \lambda_t + \varepsilon_{it}$$

Where:

- ROE_{it} is an indicator of banking efficiency in country i during year t .
- FI_{it} is the proxy of financial inclusion and is measured by the ATM density indicator, the branch density indicator, or their complex indicator.
- $Controls_{it}$ is an array of control variables, including bank size, leverage, and unemployment.
- $Crisis_t$ is dummy variable (crisis year = 1 and non-crisis year = 0).
- μ_i denotes country-specific, unchanging parameters to moderate the time-stagnant diversity.
- λ_t The Symbols denote time fixed effects intended to capture shared shocks (e.g., financial crises).
- ε_{it} is the idiosyncratic error.

Based on the results of the Hausman test, this specification is estimated using a fixed-effects (FE) model, with the test assessing the consistency of FE relative to random effects (RE). FE decision estimators are recommended because country-level characteristics such as legal systems, cultural practices, and past banking behavior remain constant over time and may introduce bias if omitted as controls.

Table 3: Model Selection

Test	Statistic	p-value
F-test (FE vs Pooled OLS)	F(5,132)=14.21	0.000
Breusch-Pagan LM (RE vs pooled)	$\chi^2=24.83$	0.000
Hausman (FE vs RE)	$\chi^2(10)=36.40$	0.000

3.4.2 Moderation Model: Interaction with Economic Growth

To determine whether the effects of financial inclusion on banking efficiency depend on economic growth, interaction terms are included in the regression equation. The moderated model is;

Model 2

$$ROE_{it} = \beta_0 + \beta_1 FI_{it} + \beta_2 GDP_{it} + \beta_3 (FI_{it} \times GDP_{it}) + \beta_4 Controls_{it} + \beta_5 Crisis_t + \mu_i + \lambda_t + \varepsilon_{it}$$

The variable GDP_{it} represents the annual growth rate of the GDP in this model, and the interaction term $FI_{it} \times GDP_{it}$ tests whether the effect of financial inclusion on ROE differs across economic activities, where higher activity corresponds to a higher level of activity. A statistically significant positive coefficient on the interaction term would indicate that financial inclusion is more effective at increasing banking performance during periods of economic growth. On the other hand, a negative coefficient might imply that lending to animals alone cannot counter any macroeconomic slump and might even cause inefficiencies vis-à-vis economic downturns.

In the efforts to make the budget interpretable, the financial inclusion and GDP variables are to be mean centered before the interaction terms are created in the best practices in moderation analysis (Hayes, 2013).

3.4.3 Mediation Model: The Intervening Mechanism of Stability Risk

The third model examined the possibility that financial inclusion influences banks' indirect effects by affecting the systemic risk variable, namely liquidity risk. This assessment is framed within the causal mediation model of Baron and Kenny (1986), which is modified to accommodate panel data.

The test of the mediation effect is carried out in a two-step regression process. Step 1 tests the influence of financial inclusion on the mediating variable (risk), and Step 2 tests the joint influence of financial inclusion and the risk variable on banking efficiency. The models are defined as:

Model 3

Step 1:

$$Risk_{it} = \alpha_0 + \alpha_1 FI_{it} + \alpha_2 Controls_{it} + \mu_i + \lambda_t + \eta_{it}$$

Where:

- $Risk_{it}$ denotes the measure of bank risk for bank i in year t .
- FI_{it} represents the financial inclusion indicator, which is the primary explanatory variable of interest.
- $Controls_{it}$ is a vector of bank-specific and macroeconomic control variables included to account for other factors that may influence bank risk.
- α_0 is the intercept term, while α_1 and α_2 are the parameters to be estimated.
- μ_i captures unobserved bank-specific effects.
- λ_t represents time fixed effects.
- η_{it} is the idiosyncratic error term, which captures random disturbances not explained by the explanatory variables.

Step 2:

$$ROE_{it} = \gamma_0 + \gamma_1 FI_{it} + \gamma_2 Risk_{it} + \gamma_3 Controls_{it} + \mu_i + \lambda_t + v_{it}$$

What $Risk_{it}$ means by either liquidity risk in country i at time t . The mediating effect will be established in case the values of α_1 and γ_2 remain statistically significant, as well as in the case of the value of the coefficient of FI_{it} in the second step (γ_1) assumes a smaller value than in the basic model.

- Coefficient γ_1 measures the direct effect of financial inclusion on bank profitability.
- γ_2 captures the effect of bank risk on profitability after controlling for financial inclusion.
- μ_i represents unobserved bank-specific fixed effects.
- λ_t denotes time fixed effect.
- v_{it} is the idiosyncratic error term.

3.5 Endogeneity Problem

Endogeneity is a probable problem due to reverse causality between financial inclusion and banking efficiency. On the one hand, improved financial inclusion tends to enhance banking efficiency by increasing the number of customers and volume-wise transactions. Similarly, efficient, well-utilized banking systems also promote financial inclusion by improving accessibility and service delivery. In addition, unobserved heterogeneity and omitted variables may impact both constructs. To address endogeneity, we conduct a robustness check using system GMM to account for dynamic endogeneity, reverse causality, and potential simultaneity, with internal instruments derived from lagged variables.

4. Data Analysis Results & Discussions

This section provides a detailed description of the data used to conduct empirical estimation in this research. The data cover the Macro-financial and institutional indicators of 5 emerging economies, including Brazil, Russia, India, China, and South Africa, over the 24 years from 2000 to 2023. The dataset is suitable for panel data analysis due to its long-time horizon and the inclusion of these countries. These variables fall into five categories: dependent (banking efficiency), independent (financial inclusion), moderating (macroeconomic conditions), mediating (risk indicators), and control variables (structural financial characteristics).

Current research is based on a panel dataset of the BRICS countries, comprising 120 observations over a 24-year period. Despite being limited to cross-sectional dimensions, the lengthy time period improves adoptability and enables assessment of inter-chronological and cross-country dynamics. Moreover, the selection of BRICS countries for the research is thoroughly justified by their role in advancing financial inclusion through fintech, not only at the country level but also on the global stage. The dataset is robust and provides adequate structure for panel estimation techniques, though it is important to note that the results of this research should be interpreted within the contextual boundaries of BRICS economies.

4.1 Panel Descriptive Stats

Table 4: Descriptive Stats

Variable	Mean	Std. Dev.	Min	Max	Observations
ROE (%)	12.16	1.35	10.53	13.94	120
ROA (%)	1.25	0.10	1.14	1.35	120
Liquidity Risk (%)	39.21	3.67	36.93	42.69	120
FI_ATMs	58.35	7.89	47.00	66.48	120
GDP (billion USD)	100.85	6.87	93.48	107.81	120
Bank Size (log of Total Assets)	15.12	0.83	14.00	16.00	120
Bank Leverage	1.82	0.24	1.55	2.25	120
Unemployment Rate (%)	7.53	1.89	4.88	9.98	120
Crisis Dummy (1 = Crisis Year)	0.13	0.04	0	1	120

The Banking Performance of five countries is shown in Table 4, over 2000-2023. Profitability, Macroeconomics, Financial Inclusion, and Risk Exposure are included in this overview of banking. On the increase in profits, banks were very consistent and

somewhat moderate, given that the Return on Equity (12.16%) averages do not vary much across countries, on average, compared with the Return on Assets (1.25%). Banks earn lower yields than the assets they hold; thus, banks' Return on Assets was also low.

Financial inclusion measures reveal marked disparities (Yoon et al., 2025). On average, the sample countries recorded 58.35 ATMs per 100,000 adults, highlighting a stronger reliance on automated service channels. China and South Africa exhibited the highest levels of access, whereas India remained the least equipped in terms of ATM density. Macroeconomic conditions also varied substantially, with average GDP standing at \$100.85 billion but showing wide dispersion across economies.

There is more variance between banks than there is between different sizes of banks based on asset size (Log of the Bank's Total Assets). This could be due to differences in structure and regulation across banks, as well as how each bank's structure impacts its risk exposure (Gržeta et al., 2023). Most banks have managed their overall Debt levels reasonably well, with the average bank maintaining a Debt-Asset ratio of 1.82; however, the average bank has been exposed to a significant amount of Liquidity Risk (39.21%), indicating that banks are highly sensitive to the potential impact of Borrower Default and Funding Pressure. Much is also dependent on how the dynamics of the Labour Market have changed over time (Unemployment Rate = 7.53%). Systemic Stress occurred approximately 13% of the years observed. In fact, the statistics highlight the variation in banking systems, financial accessibility, and macroeconomic circumstances among the countries examined. These differences underscore the significance of including contextual, economy-specific elements when analyzing bank efficiency and considering the effects of financial inclusion strategies.

4.2 Correlation Matrix

Table 5: Correlation Matrix of Study Variables

Variables	ROE	ROA	Liquidity Risk	ATMs	GDP	Bank Size	Bank Leverage	Unemployment	Crisis
ROE	1.00								
ROA	0.82***	1.00							
Liquidity Risk	-0.31**	-0.29**	1.00						
ATMs	0.45***	0.40***	-0.22*	1.00					
GDP	0.36**	0.32*	-0.13	0.51***	1.00				
Bank Size	0.41***	0.37***	-0.19*	0.57***	0.42***	1.00			
Bank Leverage	-0.28**	-0.25*	0.37***	-0.25*	-0.18	-0.26*	1.00		
Unemployment	-0.24*	-0.21	0.28*	-0.20	-0.14	-0.18	0.22*	1.00	
Crisis	-	-	0.31**	-0.33**	-0.21*	-0.29**	0.25*	0.18	1.00

Table 5 shows a consistent trend in the relationships among study variables. The two profitability measures (ROE and ROA) have strong, positive correlations, all significant at the 1 percent level. This finding provides evidence for the theoretical expectation that these measures assess similar constructs associated with banking efficiency (Islam, 2021). Regarding financial inclusion, the density of bank branches and ATMs is positively associated with measures of bank performance, as banks with greater access, evidenced by enhanced branch and ATM networks, have higher ROE and ROA (e.g., Maama & Okofo-Dartey, 2023; Nguyen et al., 2025).

The evidence is consistent across measures. The risk measures had the opposite pattern. The risk exposure associated with liquidity risk measures is usually negatively correlated with profitability measures, i.e., not all risk has the same impact on profitability. Higher risk exposure is associated with lower performance across each profitability measure (Dinu & Bunea, 2022), with significance indicating that, even when statistically significant differences are present, they are typically considerable rather than a product of statistical error. The financial inclusion and GDP relationship shows a moderate positive correlation, all significant at the 1 percent level. The evidence suggests that economic growth and increased access to banking enhance a virtuous cycle that improves banking efficiency (Zehri et al., 2024). In addition, there is the size of the bank to consider - larger banks tend to be more profitable and generally have better indices for financial inclusion (e.g., Gržeta et al., 2023; Stewart & Chowdhury, 2021). This relationship is consistent with theoretical expectations, as large banks can spread fixed costs as volume increases and benefit from economies of scale (Ming et al., 2025). Leverage is a different matter. Higher leverage ratios are associated with lower returns on equity and assets, as well as lower net interest margins, and are consistent with greater risk. This suggests that leverage- creating debt harms banking performance (Arifaj et al., 2023). The macroeconomy is a major factor in banks' performance.

Higher unemployment and an economic downturn are associated with lower profitability and financial accessibility as risk measures increase. This evidence confirms that banking performance and the state of the economy are strongly connected. The correlation matrix suggests that banks perform best when they are large enough in scale, operate in accessible markets, and operate in stable economic environments. The opposite is seen in higher risk-taking, higher leverage, and an unhealthy economy, which negatively impact performance.

4.3 Diagnostic Tests

Various diagnostic tests are performed to confirm the results, which include Unit Root Tests, Cross-Sectional Dependence Test, Heteroskedasticity Test, Serial Correlation Test, Multicollinearity Test, and Normality Test.

4.4 Regression Analysis

4.4.1 Baseline Model: FI_ATM impact on Bank Efficiency

Table 6: Panel Regression Results (FE): FI_ATM impact on Bank Efficiency

Variable	Coefficient	Std. Error	t-stat	p-value
Financial Inclusion (ATMs per 1000 pop)	0.120	0.028	4.29	< 0.001
Bank Size (log total assets)	0.730	0.210	3.48	.001
Bank Leverage (Debt/Equity ratio)	-0.045	0.022	-2.05	.042
Unemployment rate (%)	-0.180	0.085	-2.12	.037
Crisis dummy (1 = crisis year for country)	-3.600	1.100	-3.27	.002
Year fixed effects	Yes	-	-	-
Country fixed effects	Yes	-	-	-
Constant	5.32	0.954	5.57	.000
Observations	120	-	-	-
Countries	5	-	-	-
Years	24	-	-	-
R-squared	.401	-	-	-
F-statistic	14.67	-	-	< 0.001

Strong empirical evidence for the study hypothesis H1, that higher financial inclusion measured by ATMs per 1,000 population significantly improves bank efficiency, comes from Table 6 of the fixed-effects panel regression findings for the BRICS countries. With a positive and statistically significant coefficient for financial inclusion ($\beta = 0.120$, $p < 0.001$), greater financial services access point availability is related to higher ROE among banks. This result is consistent with recent empirical evidence indicating that digital and physical financial access channels boost operational efficiency by increasing transaction volumes, reducing service delivery costs, and deepening customer engagement (e.g., Oladimeji & Owoade, 2024). The high t-value of 4.29 supports the robustness of this relationship and indicates that financial inclusion is a major driver of efficiency in developing banking countries.

The control variables behaved as expected. The bank's leverage negatively influences its overall efficiency ($\beta = -0.045$, $p < 0.05$). Therefore, as banks take on more debt, their profitability will decline. This is likely due to rising funding costs and risk-related inefficiencies, as noted in the existing literature on the correlation between institution size and efficiency in developing countries' financial systems. The demand for financial services is affected by the strength of the labour market. Thus, the effect on the unemployment rate is marginal with respect to efficiency and is negatively correlated ($\beta = -0.180$, $p < 0.05$). The size of a bank has a significant, positive, and statistically meaningful effect on its efficiency ($\beta = 0.730$, $p < 0.01$), suggesting that larger banks gain advantages from economies of scale, technological advancements, and improved management. Ultimately, in times of crisis, the impact of war on banks' efficiency is statistically significant ($\beta = -3.600$, $p < 0.01$), aligning with the adverse effects of macro-level instability on banks, as discussed in earlier sections.

With an R^2 of 0.401, the model's explanatory power and the jointly important fixed effects indicate that both country-specific institutional features and unobserved time-specific variables considerably influence the link. The model is statistically robust, as shown by the overall F-statistic ($p < 0.001$). Together, these findings support the main idea that expanding financial infrastructure, particularly ATM networks, improves the operational performance of banks in developing countries. This supports the broader argument in recent literature that inclusive financial ecosystems boost institutional efficiency, sustainability, and long-term competitiveness (e.g., Prokopenko et al., 2025; Cao & Zhang, 2022).

In BRICS countries, the positive impact of financial inclusion on banking efficiency can be attributed to rapid transformation in the field of fintech, ongoing regulations for financial sector reforms and lastly the large number of people being unbanked; all these factors contribute towards enhancement in the number of customers, growth in deposits and economies of scale. Effective resource allocation and cost cuts through reductions in operational costs provide a foundation and strengthen the bank's efficiency. Results are consistent with previously available literature emphasizing the positive role of financial inclusion in improving banking efficiency.

4.5 Mediation Analysis

4.5.1 FI_ATM: Liquidity Risk as Mediator

Table 7: Panel Regression (FE): Mediator Model: Risk (Liquidity Risk) as Mediator

Variables	Model 1 (Mediator: Liquidity Risk)	Model 2 (ROE without Mediator)	Model 3 (ROE with Mediator)
Financial Inclusion (ATM per 100,000 adults)	-0.032*** (0.009)	0.120*** (0.028)	0.093*** (0.026)
Liquidity Risk (Mediator)			-0.215*** (0.067)
Bank Size (log of Total Assets)	-0.058 (0.048)	0.730*** (0.210)	0.612*** (0.200)
Bank Leverage (Debt-to-Equity Ratio)	0.024** (0.010)	-0.045** (0.022)	-0.032* (0.019)
Unemployment Rate (%)	0.066** (0.030)	-0.180** (0.085)	-0.142** (0.072)
Crisis Dummy (1 = Crisis Year)	0.640* (0.330)	-3.600*** (1.100)	-3.120*** (1.040)
Year Fixed Effects	Yes	Yes	Yes
Country Fixed Effects	Yes	Yes	Yes
Constant	8.15*** (0.293)	7.53*** (0.910)	3.31*** (.098)
R-squared	.378	.320	.391
F-statistic	12.89***	14.67***	14.95***

The mediation analysis in Table 7 provides strong empirical evidence that financial inclusion improves bank efficiency, at least in part, by lowering liquidity risk in BRICS countries. Financial inclusion, measured by ATMs per 100,000 adults, has a negative and statistically significant effect on liquidity risk in Model 1 ($\beta = -0.032$, $p < 0.01$). This shows that more financial services strengthen liquidity positions by increasing deposit mobilisation, stabilizing funding sources, and reducing dependence on unstable external funding. Modern research showing that inclusive financial systems boost financial industry stability by expanding the deposit base (e.g., Al-Smadi & Al-Wadi, 2024; Sahay et al., 2023) aligns with these results.

Model 2 confirms a significant and positive link between financial inclusion and banking efficiency ($\beta = 0.120$, $p < 0.01$), supporting the original findings. Regarding liquidity risk, in Model 3, the estimated coefficient on financial inclusion decreased from 0.120 to 0.093, but it remained statistically significant ($p < 0.01$). Since liquidity conditions affect both liquidity and financial inclusion, it is plausible, based on these results, that there is a partial mediation effect, whereby much of the financial inclusion effect on improving efficiency occurs via improved liquidity conditions. Financial Inclusion negatively impacts ROE ($\beta = -0.215$, $p < 0.01$). These findings are consistent with several studies showing that liquidity constraints reduce banks' profitability by increasing borrowing costs and reducing lending capacity, especially in developing markets (Tran & Doan, 2024).

The control variables continue to exhibit signs consistent with the anticipated results of the baseline models, bolstering the model's stability. The increase in R^2 from 0.320 in Model 2 to 0.391 in Model 3, along with a higher F-statistic, further supports the conclusion that the model's explanatory power improves when liquidity risk is included. In conclusion, the findings provide substantial support for the core principle that financial

inclusion enhances banking efficiency, and this impact has been strengthened by its capacity to reduce liquidity risk in an emerging market setting.

Research results imply partial mediation, where financial inclusion can directly and indirectly impact banking efficiency through the mediating variable of liquidity risk. The indirect effect, though statistically significant, signifies a proportion of the total effect, meaning the mediator partially transmits the relationship but does not fully account for it. The above results conclude that financial inclusion positively impacts banking efficiency through multiple dimensions, including mediation, while other operational elements and direct structural factors remain instrumental.

4.6 Moderation Analysis

4.6.1 FI_ATM: Liquidity Risk as Moderator

Table 8: Panel Regression Results (FE): Moderator Model: GDP as Moderator

Variables	Model 1 (Base Model without Interaction)	Model 2 (Moderation Model with Interaction)
Financial Inclusion (ATM per 100k adults)	0.120*** (0.028)	0.092** (0.030)
GDP (Moderator)	0.265*** (0.090)	0.230*** (0.085)
FI × GDP (Interaction Term)		0.018** (0.007)
Bank Size (log of Total Assets)	0.730*** (0.210)	0.620*** (0.195)
Bank Leverage (Debt-to-Equity Ratio)	-0.045** (0.022)	-0.042** (0.020)
Unemployment Rate (%)	-0.180** (0.085)	-0.145** (0.073)
Crisis Dummy (1 = Crisis Year)	-3.600*** (1.100)	-3.020*** (1.000)
Year Fixed Effects	Yes	Yes
Country Fixed Effects	Yes	Yes
Constant	3.20*** (.700)	5.24*** (0.980)
R-squared	.320	.428
F-statistic	14.67***	16.12***

The moderation analysis reported in Table 8 provides clear empirical support for the contention that economic growth strengthens the positive influence of financial inclusion on bank efficiency across the BRICS economies (e.g., Boachie et al., 2023; Khan et al., 2022). In Model 1, financial inclusion proxied by ATM density exhibits a positive and highly significant association with ROE ($\beta = 0.120$, $p < 0.01$). Consistent with the view that robust macroeconomic conditions enhance the operational and financial performance of banks, GDP growth also exerts a positive and statistically significant effect on efficiency ($\beta = 0.265$, $p < 0.01$).

When the Interaction term was added to Model 2, it produced two key Interactions. One major Interaction is the Financial Inclusion coefficient of 0.092, which is statistically significant ($p < 0.05$), indicating a weakly positive direct effect, and shows an almost equal reduction when interacting with GDP (Al Sharif, 2023). The second major interaction, FI x GDP, has a positive relationship and is statistically significant ($\beta = 0.018$, $p < 0.05$). Financial Inclusion positively moderates Bank Efficiency and has a greater positive effect on Bank Efficiency when either the country has a higher GDP or when GDP increases rapidly, causing both increased speed of Financial Transactions and increased Consumer Trust, as well as increased Loan Demand and therefore higher levels of Bank Efficiency with respect to Financial Inclusion. More recent research has shown that Economic

Growth has a positive impact on Financial Inclusion and therefore decreases the Bank Efficiency of the Banking Sector in Emerging Markets (e.g., Boachie et al., 2023; Mbodj & Laye, 2025; Van et al., 2022). Control variables continue to exhibit stable patterns across Models, as in previous Models, confirming the same link between Control and Bank Efficiency. The increased explanatory power from $R^2 = 0.320$ to $R^2 = 0.428$, due to GDP being a Moderating Variable, confirms GDP's moderating role. Therefore, the findings reinforce the main argument that financial inclusion yields greater efficiency gains when macroeconomic growth is robust and substantial.

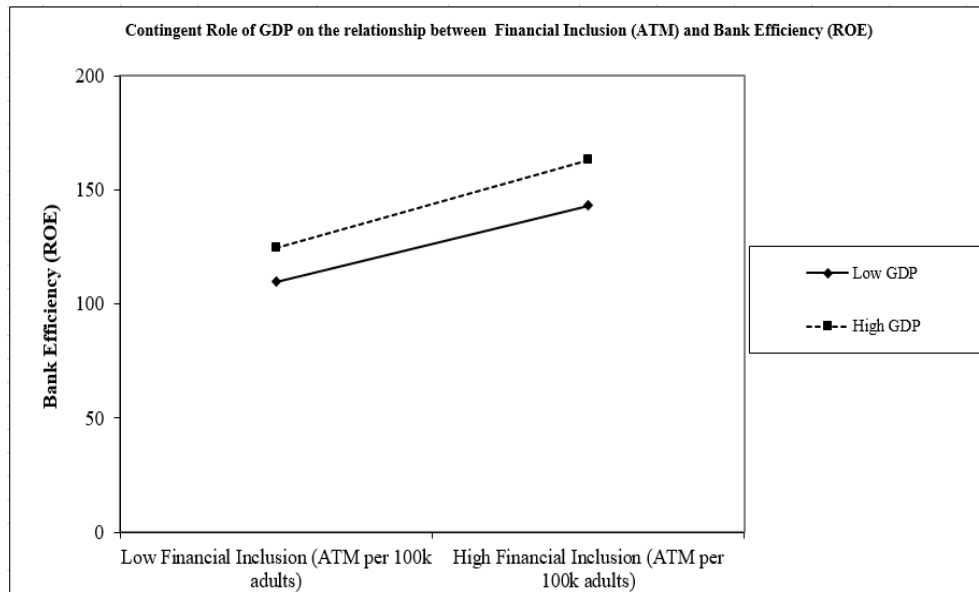


Figure 2: Bank Efficiency vs GDP

Research results highlight that the impact of financial inclusion on banking efficiency is contingent on prevailing economic growth in the country. Countries with a high-growth environment tend to enjoy stable investment, rising income levels, and rapid increases in business activity, which in turn create demand for greater utilization of financial services, thereby improving credit expansion and deposit utilization. All these activities enable the banking sector to improve its operational efficiency by achieving economies of scale. On the contrary, countries with a low growth environment tend to have low economic activity, creating less demand for financial services (Levine, 2005; Beck et al., 2015; Pradhan et al., 2018; Demirgüç-Kunt et al., 2018).

4.7 Robustness Analysis: Fixed Effect Regression

4.7.1 FI_Branches impact on Bank Efficiency

Branch density is used as a financial inclusion proxy in the robustness test to evaluate whether our original fixed-effect regression results are robust.

Table 9: Panel Regression Results (FE): FI_Branches impact on Bank Efficiency

Variable	Coefficient	Std. Error	t-stat	p-value
Financial Inclusion (Number of Branches per 100,000 adults)	0.085	0.024	3.54	< .001
Banking Size (log of Total Assets)	0.690	0.195	3.54	.001
Banking Leverage (Debt-to-Equity Ratio)	-0.052	0.019	-2.74	.008
Unemployment Rate (%)	-0.165	0.073	-2.26	.026
Crisis Dummy (1 = Crisis Year)	-3.250	0.980	-3.32	.002
Year Fixed Effects	Yes	-	-	-
Country Fixed Effects	Yes	-	-	-
Constant	3.62	0.401	9.02	< .001
Observations	120	-	-	-
Countries	5	-	-	-
R-squared	.411	-	-	-
F-statistic	13.90	-	-	< .001

Table 9 provides strong empirical support for the original regression tests, confirming that greater financial inclusion, measured by bank branch penetration, enhances banking efficiency within BRICS economies. The coefficient for branch density ($\beta = 0.085$, $p < 0.01$) is positive and highly significant, indicating that broader branch networks are associated with higher ROE. This relationship suggests that physical outreach strengthens customer access, stimulates deposit mobilization, and facilitates more efficient financial intermediation. These findings align with recent evidence showing that branch-based inclusion continues to play a vital role in promoting profitability and operational resilience in developing banking sectors (Sahay et al., 2023; Wang & Lu, 2024).

4.7.2 FI_ATM: ROA as Proxy of Bank Efficiency

Table 10: Robustness Check - FE Regression Results Using ROA as an Alternative Proxy for Bank Efficiency

Variables	Model 1 (Baseline)	Model 2 (With Mediator: Liquidity Risk)	Model 3 (With Moderator: GDP)	Model 4 (Full Model)
Financial Inclusion (ATMs per 100,000 adults)	0.043*** (0.014)	0.032** (0.016)	0.024** (0.012)	0.021** (0.011)
Liquidity Risk (Mediator 1)		-0.108*** (0.040)		-0.092*** (0.038)
GDP (Moderator)			0.142** (0.062)	0.130** (0.060)
FI × GDP (Interaction Term)			0.031** (0.015)	0.028** (0.013)
Bank Size (log of Total Assets)	0.486*** (0.150)	0.441*** (0.145)	0.430*** (0.144)	0.398*** (0.141)
Bank Leverage (Debt-to- Equity Ratio)	-0.036** (0.016)	-0.034** (0.015)	-0.037** (0.015)	-0.031** (0.014)
Unemployment Rate (%)	-0.118** (0.055)	-0.112** (0.053)	-0.110** (0.054)	-0.099** (0.050)
Crisis Dummy (1 = Crisis Year)	-2.290*** (0.780)	-2.080*** (0.740)	-2.010*** (0.720)	-1.950*** (0.710)
Year Fixed Effects	Yes	Yes	Yes	Yes
Country Fixed Effects	Yes	Yes	Yes	Yes
Constant	3.665*** (0.288)	4.570*** (0.194)	7.512*** (0.782)	5.512*** (0.883)
Observations	120	120	120	120
Countries	5	5	5	5
R-squared	0.372	0.398	0.421	0.447
F-statistic	13.22***	13.89***	15.02***	15.61***

All models support the finding that the number of ATMs per 100,000 adults is positively correlated with bank returns on assets, a relationship that is statistically significant at all levels (see Table 10). The robustness check of the original results using ROA as a measure of efficiency confirms their reliability. The findings confirm that liquidity is significant at the $p < 0.01$ level and has a negative relationship with ROI ($\beta = -0.108$), reflecting partial mediation. However, the interaction term between Financial Inclusion and GDP is statistically significant and positive ($\beta = 0.031$, $p < 0.05$), suggesting that the benefits of financial inclusion with respect to efficiency are diminished in areas of high GDP. The control variables maintained the anticipated signs and significance levels noted earlier. The results support earlier conclusions based on ROE and indicate that the positive link between financial inclusion and bank efficiency persists when an alternative measure of bank performance is used, though it is also partially influenced by risk factors and economic contributions.

4.8 Robustness Analysis: Two-Step System GMM

4.8.1 FI_ATM

Table 11: Robustness Check – Two-Step System GMM used as an Alternative Estimation Method

Variables	Model 1 (Baseline)	Model 2 (Liquidity Risk)	Model 3 (GDP as Moderator)	Model 4 (Full Model)
Lagged ROE (ROE_{t-1})	0.415*** (0.079)	0.398*** (0.080)	0.372*** (0.080)	0.368*** (0.078)
Financial Inclusion (ATMs per 100k)	0.092*** (0.029)	0.070** (0.028)	0.081** (0.030)	0.056** (0.026)
Liquidity Risk		-0.195*** (0.068)		-0.160*** (0.061)
GDP (Moderator)			0.275** (0.108)	0.258** (0.101)
ATM $\times$ GDP (Interaction)			0.011** (0.005)	0.010** (0.004)
Bank Size (log of Total Assets)	0.625*** (0.182)	0.601*** (0.185)	0.575*** (0.180)	0.552*** (0.176)
Bank Leverage (Debt-to- Equity)	-0.041** (0.016)	-0.039** (0.017)	-0.040** (0.015)	-0.037** (0.014)
Unemployment Rate (%)	-0.142** (0.062)	-0.135** (0.061)	-0.125** (0.058)	-0.118** (0.056)
Crisis Dummy (1 = Crisis Year)	-3.110*** (0.880)	-2.980*** (0.910)	-2.860*** (0.890)	-2.780*** (0.870)
Year Fixed Effects	Yes	Yes	Yes	Yes
Country Fixed Effects	Yes	Yes	Yes	Yes
Observations	120	120	120	120
Countries	5	5	5	5
Instruments	26	28	31	34
AR(1) p-value	0.003	0.003	0.002	0.002
AR(2) p-value	0.22	0.20	0.21	0.18
Hansen J (p-value)	0.20	0.22	0.15	0.13

Accounting for possible endogeneity and dynamic effects, the two-step System GMM estimation confirms the robustness of the primary results. The lagged dependent variable (ROE_{t-1}) is positive and highly significant across all models ($\beta = 0.368$ – 0.415 , $p < 0.01$), indicating strong persistence in bank efficiency over time. Financial inclusion, measured by ATMs per 100k population, remains positively and significantly associated with ROE ($\beta = 0.056$ – 0.092 , $p < 0.05$), supporting the baseline hypothesis that increased accessibility enhances bank performance. Liquidity risk ($\beta = -0.195$ to -0.160 , $p < 0.01$) retains negative and significant effects, confirming its mediating role. With $\beta = 0.010$ to 0.011 and $p < 0.05$, the interaction term $FI \times GDP$ is positive and significant, indicating a small quenching of the financial inclusion effect in higher-GDP environments. Consistent with the baseline models, the control variables preserve their anticipated signs and significance. Diagnostic tests prove model accuracy by revealing no second-order

autocorrelation (AR(2) $p > 0.18$) and valid instruments (Hansen J $p > 0.13$). These findings reinforce prior research on fixed effects and robustness, demonstrating that financial inclusion consistently enhances bank efficiency.

4.9 Sensitivity/ Robustness Analysis: Fixed Effect vs System GMM

Fixed effect controls for unobserved heterogeneity caused by time-invariant variables, whereas system GMM controls for reverse causality and endogeneity. Results from both robustness tests (fixed effects and system GMM) are consistent, indicating that model estimates are stable and structurally dependable and that the results are robust to different model specifications and estimation techniques, strengthening confidence that the relationship is not driven by a particular method. Results of research are consistent and more reliable, closer to a causal relationship, as system GMM validity tests (e.g., AR(2), Hansen test) are also satisfied.

5. Conclusion

Summarizes the research by synthesizing its main empirical findings, theoretical contributions, and practical implications within the broader framework of financial inclusion, banking system efficiency, and macroeconomic processes.

5.1 Key Findings

The primary finding of the research is the confirmation of the effect of financial inclusion on banking efficiency, evidenced by a statistically significant, direct positive relationship measured by Return on Equity (ROE). The proxy for inclusion (ATM density (FI ATM)) was positively correlated with ROE across various models. This finding is consistent with the literature, which indicates that expanded access to finance positively affects institutional performance by increasing sales, raising deposit levels, and improving the use of facilities (Beck et al., 2007; Hannig & Jansen, 2010).

The second significant finding relates to the role of macroeconomic conditions as a moderator. The study used GDP growth as a variable in interaction models and demonstrated that intervention outcomes in financial inclusion are more sensitive to the economic situations. Inclusion policies will work better during economic growth than during economic contractions. An increase in GDP growth strengthens FI_ATM's positive influence on ROE. This observation is consistent with contingency theory, which holds that performance in organizational contexts is determined by how well it aligns with environmental conditions (Donaldson, 2001). The research results show that financial inclusion cannot be considered a universal solution to the problem, but rather a policy instrument whose success depends on the current financial situation (Beck, Senbet, & Simbanegavi, 2015).

The third significant contribution can be traced to the mediation analysis. The research establishes that liquidity risk partially mediates the potential correlation between financial inclusion and banking efficiency. The findings support the hypothesis that inclusion reduces the risk of extending credit by lowering the risk concentration on the lender, making loans trackable, and increasing the likelihood of repayment. This is in line with past findings indicating that the availability of formal credit will reduce reliance on high-risk informal lending venues and improve portfolio quality (Cull, Demirgüç-Kunt, & Morduch, 2009). Similarly, the positive mediating effect of liquidity risk indicates that financial inclusion has enabled banks to access stable, low-cost assets by mobilizing household and small-business deposits. Increased liquidity helps banks to fulfill their short-term obligations and withstand market shocks, thereby increasing profitability (IMF, 2020).

Furthermore, the anchored combination of moderation and mediation models enables the development of a multidimensional picture of the inclusion-efficiency relationship. However, financial inclusion does not act independently of the surrounding macroeconomic situation and institutional imperfections. The discussion demonstrates that inclusion has direct performance benefits, supported by a decrease in systemic risk, and that these benefits increase under favorable economic conditions. Such an integrative view strengthens the argument for the risk-informed, context-sensitive approach to inclusion.

To conclude, empirical evidence also significantly supports the main research statement that financial inclusion enhances the efficiency of banks with direct and indirect effects. This cannot remain the same but is influenced by economic cycles and risk dynamics. The findings provide empirical support for moving beyond the status quo of models and for a broader theory of an alternative, conditional, mediating process of inclusion.

5.2 Theoretical Works

Paper is relevant to the field of development finance theory in that it redefines financial inclusion in terms of both its use as a social impact tool and its capacity to enhance multiple institutions and the stability of financial systems. Inclusion has been discussed in the traditional development models many times as a solution to poverty and inequality reduction (Allen et al., 2016; World Bank, 2014). Despite the importance of these social outcomes, this research provides evidence that inclusion also brings internal benefits to the institution itself, especially in asset quality and liquidity management. This way, it can bring inclusive finance into conformity with the broader aims of banking-sector reform, profitability, and the resilience of the system as a whole.

5.3 Practical and Policy Implications

For financial institutions, the available evidence indicates that financial inclusion should not be treated as a compliance requirement or a social responsibility campaign, but rather as an avenue to boost operational efficiency and profitability in the long term, particularly when accompanied by prudent risk management strategies. The paper finds that financial inclusion lowers credit risk and improves liquidity cushions, which directly increases balance sheet strength and equity turnover (ROE). Such results are consistent with those presented in previous studies by Beck, Demirguc-Kunt, and Levine (2010), which generally conclude that broader financial service coverage can enhance financial stability, provided that proper governance systems are in place. For banks, this implies that inclusion policies should be implemented alongside strategic choices regarding capital allocation, branch strategy, and digital infrastructure development. The cost-efficient method for building customer bases and strengthening deposit mobilization in high-growth areas may involve investing in ATMs and mobile platforms (Allen et al., 2016). Conversely, expansion in the high-unemployment regions might require some alternative revenue stream or government subsidies to justify branch-based growth.

The second major relevant implication concerns the necessity of variscite inclusion modalities and context-sensitive inclusion models. According to Beck, Senbet, and Simbanegavi (2015), inclusion strategies have diverse efficiency effects depending on geographical, economic, and demographic factors. The ATM density and mobile banking could be enough in urban and peri-urban locations. Agent banking, or the hybrid branchless model, can be more practical in far-flung and low-income areas. Policymakers and those who provide financial services must not pursue blanket approaches to inclusion;

instead, they must use their instruments to capture the real constraints and opportunities of local markets. Financial technology (fintech) and digital identity mechanisms also provide potential means to extend low-cost access to hard-to-reach areas and must be part and parcel of national inclusion strategies.

To sum up, the research confirms that the operational effectiveness of financial inclusion presupposes strategic alignment with macroeconomic conditions, risk management strategies, and institution-building. Financial institutions should regard inclusion as a long-term competitive performance driver, regulators as an aspect of system resilience, and governments as an element of planning and development. Stakeholders can unleash the power of inclusive finance by responding to these findings with structured, data-driven, and context-sensitive approaches.

5.4 Study Limitations

Despite the theoretical and empirical merits of the current research, a couple of limitations must be considered to maintain a refined interpretation of the results, which will allow further research on the topic. Such restrictions relate to the structure of the study data, the selection of variables, the scope of the methods used, and the generalizability of the situation under study. The use of a single proxy ATM density per 100,000 adults for financial inclusion is a limitation of the study, as the concept under observation may have multiple dimensions; reliance on a single proxy may not fully capture the concept and may lead to measurement errors.

Key among them is that it is based on macro-sector, countrywide data on all variables, including financial inclusion proxies, risk indicators, and banking efficiency. Although this kind of approach enables longitudinal and cross-country comparisons, it is bound to mask intra-country diversity and firm-level differences. The aggregate data fail to show inequality in access to finance across regions, income levels, or types of institutions within a country (Demirguc-Kunt et al., 2008). Say, financial inclusion can be advanced in central settlements but underdeveloped in the countryside, yet this difference is smoothed out in national figures. Consequently, the research may be biased by imbalances in inclusion and performance impacts across geographic and demographic subgroups.

Second, the current approach to financial inclusion proxies used in this research (ATM density) is widely used in the international literature (Demirguc-Kunt et al., 2016) and may not best represent the transformation in access brought about by the era of digital financial services. Financial inclusion has entered a new era as industry elements such as fintech, mobile banking, agent banking, and digital wallet have grown rapidly. Nevertheless, more regular and comparable statistics on these new modes of access are still unavailable, especially in low-income countries and in the earlier years of the panel. Therefore, in this study, the impact of digital financial services on banking efficiency may be underestimated if the physical and digital forms of inclusion are not distinguished (Demirguc-Kunt et al., 2018).

5.5 Recommendations for Future Research

Based on the identified limitations, the proposed study leaves directions for future research that may enhance and improve knowledge of the intricate involvement of financial inclusion, bank efficiency, and systemic risk. The purpose of these directions is to strengthen theories, increase the accuracy of empirical work, and broaden the policy relevance of inclusive finance studies.

Future research may use multiple proxies for financial inclusion, such as fintech, bank account ownership, mobile service use, and savings behavior. Using multiple proxies will help establish more general and practical results.

The application of micro-level data, such as data on individual banks or customers, is one of the main directions for future research. Although this study has used macro-sectoral indicators suitable for cross-country comparisons, microdata would allow testing of heterogeneity in inclusion impacts across different bank types, client demographics, and service delivery models (Demirguc-Kunt et al., 2008). The inclusion strategies would enable researchers to determine which bank features (including ownership structure, size, and business model) and client types gain the most, and how internal risk management (at the level of an individual institution) adjusts in response to activities (Cull et al., 2014).

Another valuable avenue is extending financial inclusion proxies to include digital financial services, i.e., mobile money penetration, agent banking, and fintech adoption. The dynamic change in financial technologies has altered access patterns, particularly in emerging and frontier markets (Demirguc-Kunt et al., 2018). Future studies must examine the relative strengths and merits of digital inclusion vis-à-vis conventional infrastructure in shaping bank efficiency and risk profiles. Longitudinal studies that monitor the digital uptake and its operational impact would be of great importance.

The theoretical development may be based on the creation of multidimensional mediation models that incorporate other internal channels, such as operational efficiency, customer retention, cost-to-income ratios, or the ability to innovate. Structural equation modelling or path analysis would facilitate the disaggregation of multilevel and concurrency mediation effects and capture the dynamic reciprocity among inclusion, risk, and performance (MacKinnon, 2012).

Conflict of Interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Data Fabrication/Falsification Statement

The author(s) declared that no data has been fabricated, falsified, or manipulated in this study.

Participant Consent

This study is based on secondary data obtained from publicly available sources and did not involve any human participants. Therefore, no participant consent was required, and all data was used in accordance with ethical standards for secondary data research.

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