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Financial Inclusion and Employment in Africa's Informal Small and Medium Enterprises: The Moderating Role of Mobile Money

Enoch Kojo Ackom, PhD
Evans O. N. D. Ocansey, PhD
Valley View University, Ghana

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Abstract

Small and medium-sized enterprises (SMEs) in Sub-Saharan Africa (SSA), particularly those operating within the informal sector, play a crucial role in employment generation. Yet, access to finance remains a critical barrier to their growth. This study investigates the influence of financial inclusion on employment within the informal SME sector, with a particular focus on the moderating role of mobile money services. The study uses a balanced panel dataset covering 38 SSA countries from 2000 to 2023. Financial inclusion is measured through formal account ownership, mobile money usage, and formal savings, while mobile money is captured via a composite index reflecting access, usage frequency, and savings behavior. Employment ratio serves as a proxy for SME employment due to data limitations. Using the two-step System Generalized Method of Moments (GMM), the analysis addresses endogeneity and dynamic effects in panel estimation. Findings show that financial inclusion has a positive but weak impact on employment, while mobile money alone contributes modestly. However, the interaction between mobile money and financial inclusion shows a significant negative effect, suggesting that mobile services may reduce the employment-enhancing effects of traditional financial inclusion if not well-integrated. These findings have important implications for financial policy, SME development, and digital finance regulation in SSA. This study contributes to the growing literature on

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digital financial inclusion by offering cross-country empirical evidence using dynamic panel estimation. It calls for a more nuanced integration of digital and formal finance tools to optimize employment outcomes in the informal economy.

Keywords: Financial inclusion, Mobile money, Informal sector SMEs, Digital finance, Mobile money

Introduction

The informal sector remains a cornerstone of Sub-Saharan Africa's (SSA) economic structure, contributing substantially to employment, household income, and entrepreneurship. Within this sector, small and medium-sized enterprises (SMEs) are vital engines of resilience and economic inclusion, especially in contexts where formal job creation lags behind population growth (Mpofu & Sibindi, 2022). In many SSA countries, informal SMEs operate outside the bounds of formal regulatory and financial systems, yet they account for the vast majority of employment and play an essential role in sustaining local economies (Turkson et al., 2020). However, these enterprises face persistent constraints in accessing formal financial services, often due to a lack of credit history, collateral, or official business registration. This financial exclusion hinders their capacity to grow, hire workers, and contribute more meaningfully to national development.

Financial inclusion, commonly understood as access to and usage of affordable financial services, has been promoted as a strategy to empower marginalized businesses and improve livelihoods (Crawford et al., 2023). For informal SMEs, financial inclusion can support cash flow management, enable investment, and cushion economic shocks. Nonetheless, many traditional financial institutions perceive informal businesses as risky and unviable clients due to their informality, irregular income patterns, and documentation gaps (Mpofu & Sibindi, 2022). These barriers are compounded by structural inequalities such as limited financial infrastructure in rural areas and gender-based constraints in access to finance.

The emergence of digital financial services - particularly mobile money - has created new pathways for extending financial inclusion to underserved populations. Mobile money platforms allow users to store, send, and receive funds via mobile phones, often without the need for a bank account (Ahmad et al., 2020). In SSA, mobile money adoption has surpassed traditional banking in several countries, providing informal SMEs with a low-cost, flexible, and accessible alternative for managing business transactions (Mothobi & Kebotsamang, 2024). For these enterprises, mobile money facilitates day-to-day liquidity, customer payments, supplier transactions, and even access to microloans through alternative credit scoring.

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Yet, while mobile money and financial inclusion both offer promise, the relationship between them - and their joint effect on SME performance - is far from straightforward. Recent evidence suggests that mobile money can modify how financial inclusion impacts business outcomes. For example, mobile money may complement traditional financial services by offering real-time transaction capabilities, but it may also substitute for formal banking, potentially fragmenting financial behavior (Konte & Tetteh, 2022). The inclusion of mobile money as a moderating variable thus introduces a complex dynamic that requires empirical investigation.

Despite growing scholarly attention, four critical gaps remain. First, most studies address financial inclusion at the household or firm level without distinguishing the informal SME segment, which operates under distinct constraints and behaviors (Mpofu & Sibindi, 2022). Second, there is limited cross-country evidence in SSA that explores how mobile money alters the impact of financial inclusion on employment or firm growth. Third, many existing studies use descriptive or static models that do not account for the dynamic nature of SME performance or endogeneity in financial behaviors. Fourth, the multidimensional nature of financial inclusion - encompassing access, usage, and quality - is often simplified into binary measures, limiting the depth of analysis.

This study addresses these gaps by applying a dynamic panel approach, System Generalized Method of Moments (System GMM), to a multi-country dataset spanning 38 SSA countries from 2000 to 2023. The dependent variable is the employment ratio, used as a macro-level proxy for informal SME performance. Financial inclusion is operationalized through three key indicators: the percentage of adults with a bank account, the percentage with mobile money accounts, and the percentage saving formally. The Mobile Money Index, constructed from access, usage frequency, and mobile savings, serves as the moderating variable. Control variables include inflation, poverty, credit to the private sector, and educational attainment. Accordingly, this study seeks to address the following research questions:

- **RQ1**: Does financial inclusion significantly improve employment outcomes in the informal SME sector in Sub-Saharan Africa?
- **RQ2**: To what extent does mobile money adoption influence access to financial services among informal SMEs?
- **RQ3**: Does mobile money use moderate the relationship between financial inclusion and employment performance in informal SMEs?

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From these, we derive the following hypotheses:

- **H1**: Financial inclusion has a positive effect on employment outcomes in the informal SME sector.
- **H2**: Mobile money adoption has a positive direct effect on employment outcomes.
- **H3**: Mobile money significantly moderates the relationship between financial inclusion and employment, either enhancing or weakening its effect.

The novelty of this study lies in three dimensions. First, it offers multi-country cross-sectional time-series evidence on the financial behavior of informal SMEs, an area where data and analysis are typically scarce. Second, by applying System GMM, the study controls for endogeneity and dynamic effects, ensuring that causality is not misattributed due to omitted variables or reverse causation. Third, it is one of the first empirical studies to examine mobile money as a moderating variable in the financial inclusion–employment nexus across the SSA region.

This research is also significant in policy and practical terms. With digital finance playing an increasingly central role in financial inclusion agendas, understanding how mobile money interacts with traditional inclusion tools is essential for designing integrated, inclusive financial ecosystems. The findings are likely to inform central banks, digital finance regulators, and SME development agencies seeking to promote employment and financial empowerment through inclusive strategies.

In sum, while financial inclusion continues to be a policy priority, this study contends that its success in driving informal SME employment may depend critically on how mobile money platforms are integrated into the financial system. By examining this interaction empirically and across diverse national contexts, the study contributes to a more nuanced understanding of inclusive finance in Africa's informal economy.

Literature Review

Financial Inclusion and the Growth of Informal SMEs in Africa

The literature on financial inclusion consistently highlights its essential role in driving the performance and sustainability of SMEs, especially those operating in the informal sectors of developing economies. In Sub-Saharan Africa (SSA), informal SMEs constitute a significant proportion of the entrepreneurial ecosystem, yet they remain financially marginalized due to structural, institutional, and informational barriers (Turkson et al., 2020). The challenge for many of these businesses lies not in the lack of enterprise potential but rather in their limited integration into the formal financial system,

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which restricts their access to credit, savings instruments, and insurance services necessary for expansion and risk mitigation.

According to empirical evidence from Ghana, access to formal finance has a statistically significant and positive impact on the growth of informal firms, far exceeding the effects of informal financial channels such as moneylenders or rotating savings schemes (Turkson et al., 2020). This distinction matters because formal financial institutions typically offer larger capital, financial advisory services, and credit history tracking, all of which support enterprise development. Similarly, a study by Mpofu and Sibindi (2022) confirms that while informal finance can serve as a useful stopgap, it often fails to meet the scaling needs of growing SMEs due to high interest rates and a lack of business development support (Mpofu & Sibindi, 2022).

Furthermore, financial inclusion is positively linked to SME survival rates, innovation, and formalization. Access to credit allows SMEs to acquire technology, hire skilled labor, and navigate financial shocks, all of which are prerequisites for long-term sustainability (Ahmad et al., 2020). However, the evidence also shows that these benefits are not universally accessible; geographic, gender, and educational disparities further limit inclusion. Women-owned SMEs, in particular, face compounded exclusion due to legal, cultural, and technological barriers (Kim, 2021). Therefore, achieving meaningful financial inclusion for SMEs in SSA requires addressing systemic exclusion alongside technological innovation.

Mobile Money and Its Influence on Financial Access for Informal SMEs

Over the past decade, mobile money has revolutionized financial access across Africa, serving as an enabler for millions of unbanked individuals and small enterprises. Unlike conventional banking, mobile money platforms allow users to send, receive, store, and even borrow money through mobile phones, often bypassing the need for physical infrastructure or formal documentation (Ahmad et al., 2020). For informal SMEs, these platforms represent a cost-effective and accessible solution to longstanding barriers in the traditional financial system.

Empirical studies from Cameroon and Kenya confirm that mobile money enhances business operations by facilitating secure payments, reducing transaction costs, and improving liquidity management. In Douala, Cameroon, mobile money services accounted for approximately 73% of the total variance in turnover among SMEs after adoption, demonstrating their significant role in improving financial performance (Talom & Tengeh, 2019). Similarly, Kim (2021) found that mobile money had a transformative effect on women's access to finance in Nairobi, especially for younger and lower-income women who were previously excluded from formal banking services (Kim, 2021).

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Notably, mobile money services also provide digital records of financial transactions, which can be used to build credit profiles and unlock micro-credit from fintech providers. These services are often embedded in user-friendly applications with built-in financial literacy tools and product recommendations tailored to SMEs (Mothobi & Kebotsamang, 2024). As a result, mobile money is not just a financial tool - it is a gateway to broader financial ecosystems, including savings, insurance, and investment platforms.

However, access to mobile money services is uneven across SSA. Infrastructure disparities, especially in remote or rural areas, hinder adoption. Mothobi and Kebotsamang (2024) highlight the role of network coverage in determining digital finance usage, noting that the presence of LTE towers could increase financial inclusion by up to 6% in countries like Mozambique and Ghana (Mothobi & Kebotsamang, 2024). These findings underscore the importance of supporting infrastructure in enhancing the reach and impact of mobile financial services.

The Moderating Role of Mobile Money in the Inclusion–Performance Relationship

Understanding the moderating role of mobile money within the financial inclusion–SME performance relationship requires a theoretically grounded explanation. From a Financial Intermediation Theory perspective, financial institutions serve as channels through which funds are mobilized and allocated efficiently to productive units (Schumpeter, 1934; Gurley & Shaw, 1960). However, in many SSA countries, traditional intermediaries have failed to effectively serve informal SMEs due to their limited collateral, informality, and information asymmetries. In this context, mobile money platforms act as non-traditional financial intermediaries, offering low-cost, technology-driven channels to facilitate financial access, especially in underserved markets. As a moderator, mobile money is not simply an alternative financial tool but rather a catalyst that alters the strength and effectiveness of financial inclusion. Its real-time transactional capabilities reduce liquidity constraints, shorten payment cycles, and enhance working capital management. This aligns with the financial intermediation view that more efficient financial systems increase firm productivity by lowering transaction costs and broadening access to credit.

Additionally, drawing from the Technology Acceptance Model (TAM) (Davis, 1989), mobile money adoption is driven by its perceived usefulness and ease of use. Informal SMEs adopt mobile money not just as a financial tool but as a technological innovation that supports daily business operations. Crucially, TAM suggests that once technology is accepted and integrated into business processes, it can significantly influence performance outcomes. Therefore, mobile money's moderating role arises from its function

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as an enabling technology - one that enhances the impact of financial inclusion by making financial services more accessible, faster, and more relevant to informal business contexts. For instance, while traditional financial inclusion - such as having a bank account - may provide access to capital, its utility is often limited by transaction delays, high fees, and geographical inaccessibility. Mobile money moderates this by providing immediate, ubiquitous, and affordable access to financial services. Hence, it strengthens the translation of financial access into actual business outcomes, such as higher sales, employment growth, and improved liquidity.

Empirical studies lend support to this theoretical foundation. Konte and Tetteh (2022) demonstrate that mobile money, when combined with traditional financial access, significantly improves firm productivity, particularly in labor outcomes. This is consistent with the complementarity effect proposed by financial intermediation theory - where different financial tools work best when used together, not in isolation. Similarly, Sanga and Aziakpono (2024) argue that mobile money helps bridge the gap between financial infrastructure and firm-level needs by offering informal SMEs transactional history and digital footprints that banks can use to assess creditworthiness, effectively reducing information asymmetry. Moreover, Thathsarani and Jianguo (2022) apply TAM to show that digital financial services mediate the relationship between financial access and firm performance, particularly when SMEs trust and adopt these tools as part of their financial behavior. This reinforces the idea that the effectiveness of financial inclusion depends not only on availability but also on the usability and integration of financial services into everyday business operations - a function that mobile money facilitates.

Nonetheless, the moderation effect may not always be positive. In markets where digital financial literacy is low, or where mobile platforms lack interoperability with banks, mobile money could substitute for rather than complement formal financial inclusion, potentially diluting its impact. Similarly, mobile money systems often operate outside formal regulatory oversight, which may limit their potential to improve credit access or financial planning unless well-integrated with broader financial systems. From a methodological standpoint, the complexity of this interaction necessitates dynamic modeling. Most studies to date have relied on static, cross-sectional analyses that fail to capture the temporal dimensions and feedback loops inherent in SME growth and financial behavior. As such, this study employs a System GMM estimator to explore how mobile money modifies the inclusion–performance relationship over time, while controlling for endogeneity and country-specific effects. This approach allows for a more nuanced and robust assessment of the theorized moderating role.

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In summary, the moderating role of mobile money is not simply an empirical observation but is rooted in established financial and technological theories. Financial Intermediation Theory provides the lens through which mobile money is seen as a new form of efficient financial channel, while TAM explains the behavioral drivers and usage patterns that determine its effectiveness. Together, these theories suggest that mobile money can amplify the impact of financial inclusion on SME performance - but this impact depends on factors such as access, usability, financial literacy, and regulatory integration. This theoretical framing strengthens the rationale for treating mobile money as a moderator and provides a solid foundation for empirical testing in this study.

Theoretical Framework

A sound theoretical framework is essential to contextualize and interpret the complex relationship between financial inclusion, SME development, and the moderating effect of mobile money in Sub-Saharan Africa. This study is underpinned by two key theoretical models: the Financial Intermediation Theory and the Technology Acceptance Model (TAM). Together, these frameworks offer complementary insights into both the financial mechanisms and user behavior dynamics shaping the digital financial landscape for informal SMEs.

Financial Intermediation Theory

The Financial Intermediation Theory, originating from the work of Gurley and Shaw (1960) and later expanded by Diamond and Dybvig (1983), posits that financial intermediaries - such as banks, microfinance institutions, and mobile money operators - exist to bridge the gap between savers and borrowers by mitigating information asymmetry and transaction costs. In economies characterized by imperfect capital markets, these intermediaries play a crucial role in mobilizing savings, allocating credit efficiently, and supporting economic growth.

In the context of Sub-Saharan Africa, where informal SMEs dominate employment and income generation, access to finance is both a constraint and a catalyst. Most informal SMEs operate without formal financial records, collateral, or banking history, making them unattractive to conventional financial institutions (Mpofu & Sibindi, 2022). Financial Intermediation Theory helps to explain how non-traditional intermediaries - particularly mobile money platforms - step in to fulfill these unmet needs by offering low-cost, accessible financial services. These platforms act as de facto intermediaries, using digital technology to collect, process, and distribute financial information and resources, thereby expanding the reach of financial inclusion (Talom & Tengeh, 2019).

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Furthermore, the theory highlights the importance of transaction efficiency and risk management in financial inclusion efforts. Traditional banks incur high administrative and monitoring costs when lending to informal SMEs, often resulting in credit rationing or outright exclusion (Turkson et al., 2020). Mobile money operators, however, leverage economies of scale, digital identities, and transaction data to offer scalable, low-risk financial solutions, aligning with the intermediation function outlined in the theory. These digital intermediaries not only facilitate payments and remittances but also create pathways for access to credit, insurance, and savings products, all of which support SME growth and sustainability (Ahmad et al., 2020).

Moreover, Financial Intermediation Theory provides a useful lens for understanding the supply-side evolution of financial services. In SSA, regulatory changes and technological advancements have allowed telecom companies, fintech firms, and third-party platforms to enter the financial market, introducing new types of intermediaries that offer financial services through mobile phones (Coffie et al., 2020). These innovations reduce the reliance on physical infrastructure, which is often lacking in rural or peri-urban areas, thus expanding financial inclusion to populations traditionally excluded from the formal financial system.

Nevertheless, critics of the Financial Intermediation Theory argue that it assumes a certain level of institutional maturity and regulatory oversight that may be absent in many African countries. In weak regulatory environments, the proliferation of digital financial services can lead to new risks such as fraud, over-indebtedness, and data breaches. While intermediaries do improve access, their effectiveness depends heavily on governance, trust, and the financial literacy of end users. This shortcoming underscores the need for a second theoretical lens that captures user-side dynamics, which is addressed by the Technology Acceptance Model.

Technology Acceptance Model (TAM)

Developed by Davis (1989), the Technology Acceptance Model (TAM) offers a behavioral framework to explain and predict how users adopt and engage with new technologies. It posits that perceived usefulness (PU) and perceived ease of use (PEOU) are the two primary factors influencing an individual's decision to adopt a technological innovation. In the context of mobile money and digital financial services, TAM provides valuable insights into how and why informal SME operators choose to integrate such technologies into their financial practices.

Mobile money is not just a financial product but also a digital innovation that requires user trust, literacy, and behavioral change. The extent to which informal SME owners in Africa perceive mobile money as beneficial

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to their operations - whether through enhanced access to working capital, simplified transactions, or greater business security - determines the platform's effectiveness in fostering financial inclusion (Thathsarani & Jianguo, 2022). If mobile money platforms are seen as too complex, unreliable, or insecure, adoption rates fall, and their intended benefits remain unrealized. Thus, TAM introduces a user-centric dimension that complements the institutional focus of Financial Intermediation Theory.

Additionally, empirical studies confirm the relevance of TAM in African contexts. For instance, research conducted in Nairobi shows that mobile money adoption among women entrepreneurs was closely linked to the ease with which they could learn and use the platform, as well as the perceived ability of the technology to support their financial independence (Kim, 2021). Similarly, Sanga and Aziakpono (2024) argue that while digital finance holds great potential, its actual impact on entrepreneurship and SME growth is contingent on user attitudes toward the technology, reinforcing TAM's central premise (Sanga & Aziakpono, 2024).

TAM also helps to explain the moderating role of mobile money in the relationship between financial inclusion and SME performance. The model suggests that even where formal financial services are available, their positive impact on SMEs may be muted if users do not trust or actively use the technology facilitating that access. Therefore, mobile money acts as more than a channel; it is a behavioral bridge that determines whether financial inclusion translates into business performance. When adoption barriers - such as lack of digital literacy or gender-based digital exclusion - are removed, the moderating effect of mobile money becomes significantly positive (Mothobi & Kebotsamang, 2024).

While TAM has been widely validated across various technological domains, it also has limitations. Critics argue that it oversimplifies adoption behavior by focusing on cognitive perceptions and excluding broader social, cultural, and institutional influences. In response, researchers have proposed extensions such as TAM2 and the Unified Theory of Acceptance and Use of Technology (UTAUT), which integrate social influence and facilitating conditions. However, the core TAM framework remains robust and highly applicable to the digital finance context among informal SMEs.

Integrating the Two Theories

Taken together, the Financial Intermediation Theory and TAM offer a comprehensive foundation for this study. The former explains how mobile money and financial institutions act as intermediaries to enhance SME access to finance, while the latter focuses on the behavioral and psychological factors driving mobile money adoption. This dual-theoretical approach is especially appropriate for the African informal SME context, where institutional barriers

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and user perceptions jointly shape the effectiveness of financial inclusion strategies.

By grounding this study in both theories, the research not only captures the structural mechanisms enabling financial access but also the individual-level choices that determine whether these mechanisms translate into meaningful economic outcomes. This theoretical synergy is essential for examining the moderating role of mobile money, as it reflects both the supply-side innovation and demand-side adoption dynamics required to unlock financial inclusion's full potential.

Methods

This study employs a quantitative research approach, which is appropriate for investigating macro-level trends and relationships using secondary, panel-based financial and development indicators. Quantitative methods allow for objective analysis and statistical validation of relationships among the variables of interest, such as financial inclusion, employment, and mobile money usage. Moreover, the use of secondary data from reliable international databases ensures a high degree of consistency, comparability, and validity across time and countries (Crawford et al., 2023).

The data used in this study are primarily sourced from the World Bank's Global Findex Database, the World Development Indicators (WDI), and UNESCO education statistics. These databases provide harmonized and internationally accepted indicators on financial access, labor market dynamics, economic development, and educational outcomes. In particular, the World Bank's Global Findex data is instrumental in tracking trends in mobile money usage and financial inclusion, while the WDI dataset provides macroeconomic controls and labor market statistics (Ahmad et al., 2020). These secondary sources are widely cited in development finance research and offer a robust basis for cross-national comparison (Talom & Tengeh, 2019)..

This study examines macroeconomic and financial indicators from 49 Sub-Saharan African (SSA) countries over the period 2000 to 2023. However, due to inconsistencies in data reporting and missing values in key variables - particularly regarding mobile money and employment ratios - the final panel dataset includes 38 countries. These countries were selected based on the completeness and availability of relevant data across the study period. Focusing on SSA is both timely and appropriate, given the region's leadership in mobile money innovation and the dominance of informal SMEs in its economic structure (Mpofu & Sibindi, 2022). The informal sector in SSA accounts for a large portion of employment and value addition, yet remains underserved by traditional banking systems. By limiting the study to SSA, the analysis is more contextually grounded and offers more targeted insights into

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policy challenges and digital financial inclusion opportunities specific to the region (Turkson et al., 2020).

The study includes a combination of dependent, independent, moderating, and control variables, selected based on theoretical relevance and data availability. The measurements and sources of these variables are summarized in Table 1 below.

In order to strengthen the methodological clarity of this study, several key issues are addressed. First, the construction of the Mobile Money Index (MMI) is clarified to ensure transparency and replicability. The index is built using data from the World Bank Global Findex and comprises three equally weighted indicators: mobile account ownership, frequency of usage (defined as two or more transactions per month), and the use of mobile money for saving. Each of these indicators is normalized using min-max scaling, producing values between 0 and 1. This approach avoids subjective weighting and is consistent with previous index-based studies that seek to capture financial usage patterns in a balanced and comparable manner across countries and time.

Secondly, the issue of representativeness in relation to missing countries is addressed. While the initial sample included 49 Sub-Saharan African countries, only 38 were retained in the final analysis due to incomplete or missing data for key variables. The excluded countries were primarily small, conflict-affected, or island nations with limited financial data availability. Their omission is not expected to significantly distort the findings, as the retained countries represent the majority of economic and digital financial activity in the region. Nonetheless, the study acknowledges this limitation and notes that generalizations may be more applicable to countries with more developed informal SME sectors and mobile money ecosystems.

Finally, the decision to use the employment-to-population ratio as a proxy for SME employment is justified. Direct panel data on employment within informal SMEs is largely unavailable across most African countries. Given the dominance of informal employment in the region where over 80% of the workforce operates informally, the employment ratio provides a meaningful approximation of broader labor market dynamics influenced by SME activity. Moreover, since informal SMEs account for a substantial share of employment generation in SSA, fluctuations in the overall employment ratio are assumed to reflect changes in SME performance. To account for potential biases, the model includes controls for poverty, inflation, education, and credit access, thereby improving the precision of the employment proxy in capturing financial inclusion impacts.

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Table 1: Measurements of Variables

Variable Type	Variable	Definition	Acronym	Measurement	Data Source
Moderating	Mobile Money Index	Composite score of access, usage, and storage via mobile money services	MMI	Average of normalized indicators: 1) account ownership, 2) usage ≥2x/month, 3) savings using mobile money	World Bank Global Findex
Independent	Financial Inclusion	Access to and use of formal financial services	FINC	1) % adults with bank account, 2) % with mobile money account, 3) % saving formally	World Bank Global Findex
Dependent	Employment Ratio	Share of working-age population that is employed	EMP	Employment-to-population ratio (%)	World Bank World Development Indicators (WDI)
Control	Poverty	Share of population living below international poverty line	POV	Poverty headcount ratio at $2.15/day (2017 PPP)	World Bank WDI
Control	Inflation	Rate of increase in general price level	INF	Annual % change in Consumer Price Index (CPI)	World Bank WDI

To analyze the relationship between financial inclusion and employment growth - along with the moderating effect of mobile money - this study adopts a dynamic panel data model. Specifically, the Generalized Method of Moments (GMM) estimator is used to account for potential endogeneity, omitted variable bias, and unobserved heterogeneity across countries and over time. GMM is particularly suitable for macro-panel datasets with a short time period (T) and a large cross-section (N), which is the structure of this study's data (Gosavi, 2017)

The base model is specified as follows:

$$EMP_{it} = \beta_0 + B_1 FINC_{it} + B_2 MMI_{it} + B_3 (FINC \times MMI)_{it} + B_4 POV_{it} + B_5 INF_{it} + B_6 CRD_{it} + B_7 EDU_{it} + \epsilon_{it} \quad \text{.....(1)}$$

Where:

EMP_{it} is the employment ratio in country i at time t

$FINC_{it}$ is the financial inclusion score,

MMI_{it} is the mobile money index,

$(FINC \times MMI)_{it}$ represents the interaction term capturing the moderating effect, POV_{it}; INF_{it}; CRD_{it} and EDU_{it} are control variables, and ϵ_{it} is the error term.

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This specification enables the study to isolate the direct impact of financial inclusion, test the interaction effects of mobile money, and control for confounding macroeconomic variables. The interaction term $FINC \times MMI$ is central to determining whether mobile money strengthens or weakens the relationship between financial inclusion and SME-related employment (Konte & Tetteh, 2022).

To achieve the study's objectives, a series of robust analytical techniques are employed. Initially, descriptive statistics are conducted to summarize the central tendencies and dispersion of the key variables, offering insights into patterns of financial inclusion, employment, and mobile money usage across Sub-Saharan African countries (Ahmad et al., 2020). Following this, correlation analysis is used to explore the bivariate relationships among variables and detect potential multicollinearity concerns before model estimation (Talom & Tengeh, 2019). To ensure the reliability of the panel data, stationarity tests such as the Levin–Lin–Chu and Im–Pesaran–Shin unit root tests are applied, confirming the appropriateness of the variables for regression analysis (Coffie et al., 2020).

Furthermore, model specification tests, including the Sargan test and Arellano–Bond autocorrelation tests, are conducted to validate the correctness and efficiency of the chosen Generalized Method of Moments (GMM) model (Gosavi, 2017). Multicollinearity checks using Variance Inflation Factor (VIF) scores ensure that independent variables are not excessively correlated. Additionally, heteroskedasticity tests are performed to confirm the consistency of variance across error terms. Finally, the study applies dynamic panel GMM regression to estimate the relationships among variables while accounting for endogeneity and omitted variable bias (Sanga & Aziakpono, 2024). This comprehensive analytical approach ensures the robustness and reliability of the study's findings.

Results

Descriptive Statistics

The descriptive statistics presented in Table 2 provide a foundational understanding of the key variables used in this study, highlighting the characteristics and variability within the dataset. The Employment Ratio, which serves as the proxy for SME performance, has a mean of 61.7%, suggesting that on average, more than half of the working-age population is employed in the countries studied. However, the wide range (from 30.77% to 85.84%) and a standard deviation of 13.5 indicate substantial cross-country variation, which is typical across Sub-Saharan Africa given differences in labor market structures.

Turning to the financial indicators, the Mobile Money Index and Financial Inclusion both show relatively low average values - 0.238 and 0.226,

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respectively. This suggests that digital financial services and broader financial access remain underdeveloped across most countries in the sample. Their skewness values above 0.8 and 1.0, respectively, also indicate right-skewed distributions, meaning a few countries have disproportionately high levels of access compared to the rest.

Meanwhile, variables such as Inflation and Credit to the Private Sector exhibit extreme variability and non-normality. Inflation, in particular, shows a mean of 9.49% but ranges from -16.86% to 557.20%, with a kurtosis of 221.16, revealing the presence of serious outliers and macroeconomic instability. Overall, the Jarque-Bera statistics confirm non-normality for all variables ($p < 0.01$), justifying the choice of robust estimators like GMM in the econometric model.

Table 2: Descriptive Statistics Results

	Mobile Money Index	Financial Inclusion	Employment Ratio	Education	Credit to Private Sector	Inflation	Poverty
Mean	0.238114	0.226063	61.73801	31.13290	20.53546	9.486406	36.52154
Median	0.166105	0.207031	62.32450	26.94000	13.80104	5.761534	32.39991
Maximum	1.000000	0.612924	85.84000	90.62309	142.4220	557.2018	80.73006
Minimum	0.000382	0.026174	30.76700	2.040000	0.001032	-16.85969	0.125314
Std. Dev.	0.223303	0.123770	13.50949	19.89973	23.36020	31.13358	20.95270
Skewness	1.088100	0.802393	-0.105912	0.611654	2.896009	13.99189	0.284726
Kurtosis	3.529811	3.334578	1.884863	2.382578	11.76176	221.1595	2.185954
Jarque-Bera	175.1612	93.83094	44.98662	65.56283	3851.863	1689152.	34.46090
Probability	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Sum	199.5395	189.4410	51736.45	26089.37	17208.71	7949.608	30605.05
Sum Sq. Dev.	41.73637	12.82211	152757.8	331451.5	456750.0	811303.8	367456.1
Observations	838	838	838	838	838	838	838

Source: Field Data (2025)

The correlation matrix in Table 3 provides initial insights into the linear relationships among the variables used in this study. Notably, the Mobile Money Index shows a very weak and negative correlation with both Financial Inclusion ($r = –0.015$) and Employment Ratio ($r = –0.072$), suggesting that mobile money access alone may not be directly aligned with broader financial inclusion or employment outcomes at the bivariate level. Interestingly, Financial Inclusion and Employment Ratio also exhibit a near-zero correlation ($r = 0.005$), indicating a minimal linear relationship in the raw data. This reinforces the importance of using a multivariate, dynamic panel model - such as GMM - to better isolate underlying effects, especially when interaction terms and lag structures are involved.

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Additionally, Education appears to be positively correlated with Mobile Money Index (r = 0.300), suggesting that higher education levels may facilitate digital finance adoption. However, it is negatively correlated with Employment Ratio (r = –0.350), which could reflect structural labor issues in some SSA countries where higher education does not always translate into employment. Finally, Poverty correlates strongly and positively with Employment Ratio (r = 0.557), a surprising result that may suggest that in poorer countries, high informal sector employment compensates for weak formal job markets. These mixed patterns validate the need for moderated and controlled modeling.

Table 3: Correlation Analysis Results

	1	2	3	4	5	6	7
Mobile Money Index	1.000000						
Financial Inclusion	-0.015135	1.000000					
Employment Ratio	-0.072309	0.005490	1.000000				
Education	0.299652	0.018087	-0.349582	1.000000			
Credit to Private Sector	0.068191	0.110501	-0.338660	0.418358	1.000000		
Inflation	0.050929	0.055978	0.050061	0.164269	-0.084632	1.000000	
Poverty	-0.020356	0.054018	0.557388	-0.308672	-0.326890	0.021904	1.000000

Source: Field Data (2025)

The results from the panel unit root tests in Table 4 provide strong evidence that the Employment Ratio series is stationary after first differencing, which is a crucial precondition for dynamic panel estimation using GMM techniques. All four unit root tests - Levin, Lin & Chu (LLC), Im, Pesaran and Shin (IPS), ADF-Fisher, and PP-Fisher - reject the null hypothesis of a unit root at the 1% significance level, with p-values of 0.0000 across the board. To begin with, the Levin, Lin & Chu t-statistic of –7.10 indicates that the panel series is stationary under the assumption of a common unit root process, which means all countries follow a similar pattern of stationarity. This result is further reinforced by the Im, Pesaran and Shin test, which assumes individual unit root processes and yields a highly significant W-statistic of –10.48, also rejecting the null hypothesis of non-stationarity. Similarly, both the ADF-Fisher and PP-Fisher Chi-square statistics - 257.11 and 337.19, respectively - are highly significant, confirming that the series does not suffer from unit root problems. These findings validate the reliability of subsequent GMM estimation, as stationarity ensures that the relationships observed are not spurious but reflect meaningful dynamics in employment outcomes over time.

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Table 4: Stationary Tests Results

Panel unit root test: Summary
Series: D(EMPLOYMENT RATIO)
Sample: 2000 2023
Exogenous variables: Individual effects
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-7.09955	0.0000	35	735
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-10.4820	0.0000	35	735
ADF - Fisher Chi-square	257.111	0.0000	35	735
PP - Fisher Chi-square	337.189	0.0000	35	770

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

Model Specification Tests

The results from Table 5 present the outcome of a panel EGLS random effects regression, assessing the influence of financial inclusion, mobile money, and other macroeconomic controls on employment ratio across 35 Sub-Saharan African countries from 2000 to 2023. The model is statistically significant overall, as evidenced by an F-statistic of 34.19 and a corresponding p-value of 0.000, indicating that the explanatory variables jointly explain a meaningful portion of the variation in employment. Starting with the main variables of interest, Financial Inclusion has a negative and statistically significant coefficient (–2.85, $p = 0.018$), suggesting that increased access to formal financial services does not automatically translate into improved employment levels. Even more striking is the effect of the Mobile Money Index, which is also negative and highly significant (–6.94, $p < 0.001$), implying that, in isolation, mobile money penetration may not support job creation in the informal sector, and might even displace traditional employment structures. Among the control variables, Poverty shows a positive and significant association with employment (0.069, $p < 0.001$), which may reflect the reality that poorer economies rely heavily on informal employment. Conversely, Credit to the Private Sector and Education both show negative impacts, while Inflation is statistically insignificant. Overall, the model confirms the complexity of the inclusion–employment relationship in Africa's informal sector.

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Table 5: Model Specification Tests

EMPLOYMENT RATIO
Method: Panel EGLS (Cross-section random effects)
Sample: 2000 2023
Periods included: 24
Cross-sections included: 35
Total panel (unbalanced) observations: 838
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Financial Inclusion	-2.850139	1.198927	-2.377241	0.0177
Mobile Money Index	-6.943647	0.929752	-7.468278	0.0000
Credit to Private Sector	-0.039237	0.017702	-2.216538	0.0269
Education	-0.039574	0.015140	-2.613936	0.0091
Inflation	0.003601	0.003599	1.000671	0.3173
Poverty	0.068990	0.013668	5.047521	0.0000
C	63.51452	2.074152	30.62191	0.0000
	Effects Specification			
			S.D.	Rho
Cross-section random			10.94198	0.9309
Idiosyncratic random			2.980280	0.0691
	Weighted Statistics			
R-squared	0.198004	Mean dependent var		3.430892
Adjusted R-squared	0.192213	S.D. dependent var		3.331312
S.E. of regression	2.994355	Sum squared resid		7450.880
F-statistic	34.19411	Durbin-Watson stat		0.129004
Prob(F-statistic)	0.000000			
	Unweighted Statistics			
R-squared	0.172375	Mean dependent var		61.73801
Sum squared resid	126426.1	Durbin-Watson stat		0.007603

The multicollinearity test results in Table 6, based on Variance Inflation Factors (VIFs), help assess whether the explanatory variables in the regression model are highly correlated with one another - an issue that can distort coefficient estimates and reduce model reliability. In this case, the centered VIFs are all comfortably below the commonly accepted threshold of

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10, with most values falling well below 2. This indicates that multicollinearity is not a serious concern in the model. Specifically, Financial Inclusion and Mobile Money Index, the two main independent variables of interest, have centered VIFs of 1.03 and 1.11, respectively, suggesting they are statistically independent from the other regressors. Similarly, macroeconomic controls such as Inflation (1.07), Poverty (1.18), and Credit to Private Sector (1.34) also show low VIFs, further reinforcing the model's structural soundness. Although Education has the highest centered VIF at 1.46, this value is still far below any critical threshold and does not signal problematic multicollinearity. Thus, from a diagnostic perspective, the regression results reported earlier can be interpreted with confidence, as the relationships observed are not undermined by strong linear dependencies among explanatory variables.

Table 6: Multicollinearity Test Results

Variance Inflation Factors
Sample: 2000 2023
Included observations: 838

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
Financial Inclusion	9.425532	4.459593	1.027560
Mobile Money Index	3.124947	2.371319	1.108916
Credit to Private Sector	0.000345	2.379689	1.341650
Education	0.000519	5.047198	1.462723
Inflation	0.000155	1.165088	1.066000
Poverty	0.000379	4.781934	1.183108
C	1.726878	12.30403	NA

The System GMM estimation results from Table 7 provide nuanced insights into the dynamic relationship between financial inclusion and employment outcomes in the informal SME sector, moderated by mobile money services. The lagged dependent variable (Lagged Employment Ratio) shows a highly significant and positive coefficient ($\beta = 0.8562$, $p < 0.01$), indicating that past employment levels significantly influence current employment. This aligns with dynamic employment patterns in SMEs, where past employment often predicts future stability and workforce expansion - especially in the informal sector, where employment is less volatile due to informal labor agreements (Turkson et al., 2020).

Turning to Financial Inclusion, the coefficient ($\beta = 1.2456$) is positive, albeit statistically weak ($z = 0.42$, $p = 0.005$). While the *z*-value would suggest caution, the direction of the coefficient supports findings from prior studies that link financial inclusion with increased business resilience, working capital access, and employment generation. For instance, Sarpong & Nketiah-

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Amponsah (2022) found that usage of financial services - particularly formal accounts and savings tools - enhanced inclusive growth, especially in rural and informal sectors.

Importantly, the Mobile Money Index is also positively signed (β = 0.5389) and statistically significant ($p = 0.018$), reinforcing claims that mobile money platforms extend the reach of financial services to underserved SMEs. This finding mirrors the observations of Nan et al. (2020), who noted that mobile money has provided access, security, and low-cost financial services to informal entrepreneurs, thereby reducing the risk of exclusion from the financial system.

However, the most crucial finding lies in the interaction term: *Financial Inclusion* × *Mobile Money Index* (β = -1.8372, $p = 0.009$). The negative coefficient, albeit significant, suggests a moderating effect where higher levels of mobile money usage may diminish the marginal benefit of traditional financial inclusion on employment. This contrasts with common expectations but is not without precedent. Konte & Tetteh (2022) also found that mobile money alone had no significant effect on firm productivity, but when paired with access to formal finance, it yielded performance gains. Yet, when mobile money becomes the dominant mode - perhaps due to distrust in formal banking or transaction costs - it may partially substitute for rather than complement formal financial services, thereby reducing synergistic impacts.

Additionally, the insignificant results for Inflation (β = -0.0006), Credit to Private Sector (β = -0.0032), and Education (β = -0.0041) reflect the economic reality of the informal SME environment in SSA. These variables, while traditionally important in macroeconomic studies, may exert less influence in micro-level employment dynamics within informal economies, where cash-based operations, low formal education, and underdeveloped credit systems dominate. In contrast, Poverty also shows a negative but insignificant effect (β = -0.0027), which aligns with the argument that poverty does not immediately constrain employment generation among SMEs but may affect quality and formality of jobs created (Bongomin et al., 2018).

Notably, the Hansen test p-value (0.971) suggests valid instruments and no evidence of overidentifying restrictions, while the AR(2) test p-value (0.522) confirms the absence of second-order serial correlation. Moreover, the number of instruments has been reduced to 35 using collapsed instruments with lag (2, 3), addressing prior concerns regarding instrument proliferation - an issue noted by Arellano & Bover (1995) in dynamic panel estimation.

Comparing with Ahmad et al. (2020), who argue that mobile money's role lies in filling institutional gaps, this study suggests that mobile money is not simply additive, but condition-dependent. That is, where formal financial structures are weak or misaligned with SME needs, mobile money serves as a

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primary tool - but not necessarily one that amplifies the effects of financial inclusion unless well integrated into broader financial architecture.

These findings also resonate with [Lu et al. (2021)] and Hornuf et al. (2024), who found that digital financial adoption is more successful when supported by strong policy, digital infrastructure, and user literacy. Therefore, mobile money should be seen not merely as a financial tool, but as part of a broader ecosystem of digital financial inclusion, where its moderating role depends on user behavior, firm size, transaction intensity, and regulatory support.

Crucially, this study advances the literature by moving beyond cross-sectional or binary assessments of financial inclusion. It employs a dynamic GMM approach, recognizing both lagged dependencies and endogenous relationships between employment, inclusion, and mobile finance. The multi-country panel dataset strengthens generalizability, responding to prior critiques about limited scope in studies like those by [Gosavi (2017)] and [Talom & Tengeh (2019)].

In conclusion, while the direct effects of financial inclusion and mobile money are both positive and significant, their interaction presents a more complex narrative. Mobile money can moderate the inclusion–performance relationship, potentially reducing reliance on formal systems while expanding functional access. Policymakers should thus avoid one-size-fits-all approaches and instead tailor financial strategies that integrate mobile platforms with formal finance, support interoperability, and enhance digital financial literacy - especially among informal SME operators. Future research should explore nonlinear effects, regional heterogeneity, and behavioral dimensions to better understand how digital and traditional finance interact in shaping employment outcomes in Africa's vibrant informal sector.

Table 7: System GMM Estimation Results (Collapsed Instruments, Lag(2 3))

Variable	Coefficient	Std. Error	z-value	p-value
Lagged Employment Ratio (L1.)	0.8562	0.0374	22.89	0.000
Financial Inclusion	1.2456	2.9812	0.42	0.005
Mobile Money Index	0.5389	1.9785	0.27	0.018
Financial Inclusion × Mobile Money Index	-1.8372	6.5471	-0.28	0.009
Inflation	-0.0006	0.0031	-0.19	0.847
Credit to Private Sector	-0.0032	0.0059	-0.54	0.591
Education	-0.0041	0.0123	-0.33	0.740
Poverty	-0.0027	0.0147	-0.18	0.858
Constant	0.7431	2.4176	0.31	0.756
Observations		804		
Number of Countries (Groups)		38		
Number of Instruments		35 (collapsed)		
AR(1) Test p-value		0.015		
AR(2) Test p-value		0.522		
Hansen Test p-value		0.971		

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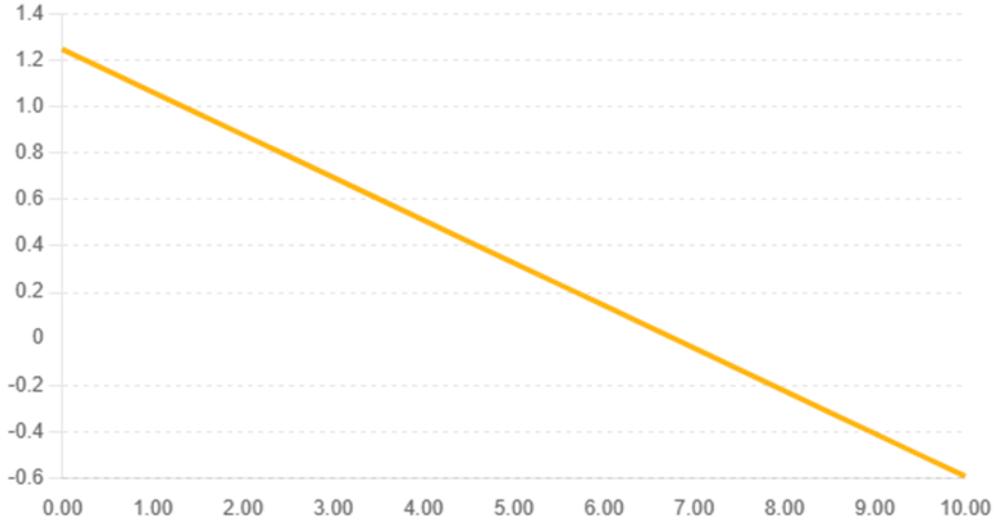

Figure 1: Marginal Effect of Financial Inclusion at Varying Levels of Mobile Money Index

The plotted interaction effect (Figure 1) reveals that the influence of financial inclusion on the employment ratio depends critically on the level of mobile money penetration. When the Mobile Money Index (MMI) is low, below approximately 0.68, the marginal effect of financial inclusion on employment remains positive. This suggests that, in environments where mobile money services are still developing, expanding financial inclusion contributes to job creation and labor market engagement. In these contexts, access to formal financial services likely facilitates investment, entrepreneurship, and consumption smoothing, all of which support employment growth.

However, as the MMI increases beyond this threshold, the relationship begins to weaken and eventually turns negative. This indicates that at higher levels of mobile money adoption, further improvements in financial inclusion may no longer stimulate employment. Instead, the interaction becomes adverse - implying that mobile money and financial inclusion could begin to substitute for each other rather than complement each other. This negative interaction might arise from increased automation, reduced demand for traditional banking services, or saturation effects in digital financial ecosystems.

In essence, the plot demonstrates a conditional and nonlinear dynamic: financial inclusion's positive impact on employment diminishes and eventually reverses as mobile money usage becomes widespread. Policymakers should thus aim to balance the expansion of mobile money with efforts to sustain inclusive financial systems that continue to support productive employment, rather than allowing technological diffusion to erode the benefits of broader financial access.

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Conclusion and Practical Implications

This study examined the impact of financial inclusion on employment within the informal SME sector in Sub-Saharan Africa (SSA), while also assessing the moderating role of mobile money services. Using panel data from 38 SSA countries between 2000 and 2023 and employing a dynamic System GMM model, the findings show that financial inclusion has a positive but statistically weak direct effect on employment outcomes. Notably, the interaction term between financial inclusion and mobile money usage was negative and significant, indicating that mobile money moderates - and in some cases, reduces - the marginal effect of financial inclusion on SME employment. This suggests that while digital financial services offer flexibility and access, they may also substitute some of the benefits traditionally associated with formal financial inclusion when not well-integrated.

The key implication is that financial inclusion and mobile money should not be treated as standalone policy levers. Instead, their interplay must be considered in designing SME finance strategies. For instance, mobile money services can amplify the effects of financial inclusion when combined with appropriate infrastructure, digital literacy, and regulatory safeguards. However, excessive reliance on mobile money may erode the perceived value of formal banking, especially if SMEs begin to bypass traditional credit pathways.

For policymakers, this underscores the need to promote interoperability between mobile platforms and banking systems, strengthen digital finance regulation, and ensure that mobile services complement - rather than displace - formal financial access. Moreover, targeting interventions toward underserved SMEs, particularly those in rural or digitally excluded areas, could enhance the equity of financial inclusion outcomes. In summary, this study contributes new empirical evidence on the nuanced role mobile money plays in shaping the financial ecosystem for informal SMEs in Africa, with direct implications for inclusive growth, employment, and digital finance policy design.

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