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Digital financial inclusion and SME performance in post-pandemic Freetown: Evidence from mobile money adoption and business resilience

Abdulai Sillah [1, *], Mariatu Abionor Swaray [2], Finda Martha Magaret Fillie Faboe [2], Issa Sesay [3], Malachy Chinedu Onyike [4] and Abdulrahman Sillah [5]

[1] *Department of Agribusiness Management, School of Agriculture and Food Sciences, Njala University, Njala, Sierra Leone.*
[2] *Department of Social Sciences and Law, University of Makeni, Makeni City, Sierra Leone.*
[2] *School of Economics and Management, Harbin Institute of Technology, Campus of University Town of Shenzhen, Shenzhen, China.*
[3] *Department of Social Sciences, War Wounded Secondary School, Grafton-Freetown, Sierra Leone.*
[4] *School of Economics and Management, Harbin Institute of Technology, Harbin City, China.*
[5] *Faculty of Economics and Administrative Science, Department of Economics, Cyprus International University, Haspolat, Lefkosa, Turkish Republic of Northern Cyprus.*

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Abstract

This study examines the relationship between digital financial inclusion, particularly mobile money adoption, and small and medium enterprise (SME) performance in Freetown, Sierra Leone, during the post-pandemic recovery period (2021-2024). Using a mixed-methods approach with survey data from 385 SMEs across six municipal districts, the study employs multiple regression analysis and structural equation modeling to investigate how digital payment systems influence business resilience, revenue growth, and financial sustainability. The study findings reveal that mobile money adoption is positively associated with SME revenue growth ($\beta = 0.412$, $p < 0.001$) and operational resilience ($\beta = 0.368$, $p < 0.001$), with this relationship moderated by owner education level and business formalization status. The study contributes to the growing literature on financial inclusion in West Africa and provides empirical evidence for policymakers seeking to enhance SME development through digital transformation initiatives in post-conflict economies.

Keywords: Digital Financial Inclusion; SMES; Mobile Money; Business Resilience; Sierra Leone; Emerging Markets

1. Introduction

Small and medium enterprises (SMEs) constitute approximately 90% of businesses in Sierra Leone and contribute nearly 60% to national employment, yet they face persistent challenges in accessing formal financial services (World Bank, 2023). In Freetown, the capital city housing over 1.2 million residents, SMEs represent the economic backbone of urban commerce, with informal sector activities accounting for approximately 70% of non-agricultural employment (Statistics Sierra Leone, 2023). The proliferation of mobile money services in West Africa has created unprecedented opportunities for financial inclusion, particularly in countries recovering from conflict and health crises (Asongu & Odhiambo, 2023).

The COVID-19 pandemic accelerated digital payment adoption across Sub-Saharan Africa, with Sierra Leone experiencing a 156% increase in mobile money transactions between 2020 and 2023 (Bank of Sierra Leone, 2024). This

* Corresponding author: Abdulai Sillah

digital transformation presents a unique natural experiment for examining how technological leapfrogging can address traditional barriers to SME development in frontier markets. Despite growing interest in digital financial services, empirical evidence on their impact on SME performance in post-conflict West African contexts remains limited (Asongu & Odhiambo, 2023).

This study addresses three critical gaps in the literature. First, while extensive research exists on mobile money adoption in East Africa, particularly Kenya and Tanzania, West African experiences remain understudied despite distinct institutional and cultural contexts (Batista & Vicente, 2023). Second, existing studies predominantly focus on household-level impacts rather than business outcomes, overlooking the entrepreneurial dimension of financial inclusion (Riley & Kulathunga, 2022). Third, the moderating effects of business characteristics and owner demographics on the relationship between digital finance and SME performance warrant further investigation in fragile-state contexts.

2. Literature Review and Hypothesis Development

2.1. Theoretical Framework

The study's theoretical framework integrates the Technology Acceptance Model (TAM) with the Resource-Based View (RBV) of the firm to explain how digital financial inclusion enhances SME performance. The TAM, originally developed by Davis (1989) and extended by Venkatesh and Davis (2000), posits that perceived usefulness and ease of use determine technology adoption intentions. In the context of Sierra Leonean SMEs, mobile money represents a technological innovation that reduces transaction costs and enhances operational efficiency (Kamara & Sesay, 2023).

The RBV perspective suggests that firms achieve competitive advantage through unique resource configurations that are valuable, rare, inimitable, and non-substitutable (Barney, 1991). Digital financial capabilities can constitute such resources in emerging markets where traditional banking infrastructure remains underdeveloped. Recent empirical work by Mensah et al. (2023) in Ghana demonstrates that digitally enabled SMEs exhibit higher productivity and survival rates compared to traditional cash-based enterprises.

2.2. Digital Financial Inclusion in Sierra Leone

Sierra Leone's financial inclusion landscape has transformed dramatically since the introduction of mobile money services in 2009. According to the Bank of Sierra Leone (2024), mobile money account ownership increased from 12% in 2017 to 48% in 2023, surpassing traditional bank account penetration of 20%. This expansion occurred despite infrastructure challenges, with only 23% of the population having reliable electricity access, and internet penetration remaining at 18% (ITU, 2023).

The regulatory environment has evolved to support digital financial services, with the National Strategy for Financial Inclusion 2022-2026 prioritizing SME access to formal financial services (Government of Sierra Leone, 2022). However, adoption patterns vary significantly across demographic and geographic segments, with urban areas like Freetown showing adoption rates exceeding 65% while rural regions lag at 31% (FinScope Sierra Leone, 2023).

2.3. SME Performance and Constraints

SMEs in Freetown operate within a complex ecosystem characterized by infrastructure deficits, regulatory uncertainty, and limited access to formal credit markets. Previous studies have identified access to finance as the primary constraint to SME growth in Sierra Leone, with only 7% of SMEs receiving formal bank loans (IFC, 2023). Traditional collateral requirements, high interest rates averaging 22% annually, and complex documentation processes exclude most small businesses from formal financial systems (Conteh & Bah, 2023).

Performance measurement for SMEs in developing countries requires context-appropriate indicators beyond traditional financial metrics. Following recommendations by Agyapong and Muntaka (2022), the study adopts a multidimensional performance framework encompassing revenue growth, employment generation, business survival, and operational resilience. This approach acknowledges the heterogeneous nature of SME objectives in informal economy contexts.

2.4. Hypothesis Development

Based on the theoretical framework and empirical literature, the study proposes the following hypotheses:

- **H1:** Mobile money adoption is positively associated with SME revenue growth in Freetown.

- **H2:** The relationship between mobile money adoption and SME performance is moderated by owner education level.
- **H3:** Business formalization status moderates the relationship between digital financial inclusion and operational resilience.
- **H4:** SMEs utilizing mobile money for supplier payments demonstrate higher inventory turnover rates than cash-only businesses.

3. Methodology

3.1. Description of the Study Area

Freetown, the capital and largest city of Sierra Leone, with approximately 1.2 million residents, serves as the primary commercial and economic hub, accounting for over 60% of the nation's formal economic activities and hosting an SME sector that constitutes approximately 85% of registered businesses (Statistics Sierra Leone, 2021; World Bank, 2022). The study area encompasses Freetown's four primary business districts: Central Business District (CBD), Lumley, Wellington, and Eastern Freetown, selected for their diverse representation of business types and varying levels of digital infrastructure penetration in both formal and informal sectors (Ministry of Trade and Industry, Sierra Leone, 2022). The post-pandemic financial landscape has witnessed a remarkable transformation, with mobile money penetration rising from 32% in 2019 to approximately 58% by 2023, driven by major operators including Orange Money, Afrimoney, and QMoney, despite only 23% of adults holding formal bank accounts (Bank of Sierra Leone, 2023; International Monetary Fund, 2023). This context is further shaped by the government's National Financial Inclusion Strategy (2021-2025), which targets 70% mobile money adoption and emphasizes digital payments as mechanisms for economic resilience, creating a unique setting characterized by limited traditional financial infrastructure but growing mobile connectivity exceeding 87% penetration (Central Bank of Sierra Leone, 2021; GSMA, 2023). This environment provides valuable insights into how mobile money adoption influences SME performance metrics, including revenue stability, operational efficiency, and business resilience in a developing country recovering from pandemic-related disruptions.

Figure 1 Map of Sierra Leone showing Freetown (2026)

3.2. Research Design and Sampling

This study employs a cross-sectional survey design with stratified random sampling across Freetown's six municipal districts: Central, East, West, North, South, and Rural. The sampling frame was constructed using the 2022 Business Establishment Census conducted by Statistics Sierra Leone, which identified 8,743 registered SMEs within the Freetown municipality. Following Krejcie and Morgan's (1970) sample size determination formula, the study calculated a minimum sample of 368 enterprises for a 95% confidence level with a 5% margin of error.

To account for potential non-response and ensure representativeness, the study oversampled by 15%, targeting 423 SMEs. The stratification criteria included business sector (manufacturing, services, trade), enterprise size (micro: 1-5 employees, small: 6-20 employees, medium: 21-100 employees), and geographic location. Data collection occurred between September 2023 and February 2024, utilizing trained enumerators fluent in Krio and English.

3.3. Variables and Measurements

3.3.1. Dependent Variables

The primary outcome variable, SME performance, is operationalized through fthe study indicators: (1) Revenue growth, calculated as the percentage change in monthly revenues between 2022 and 2023; (2) Employment growth, measured as the net change in full-time equivalent employees; (3) Business resilience index, a composite measure incorporating survival through external shocks, recovery speed, and adaptive capacity; (4) Financial sustainability ratio, calculated as operating income divided by operating expenses.

3.3.2. Independent Variables

Mobile money adoption is measured using a multi-item scale capturing adoption intensity (frequency of use), adoption scope (variety of transaction types), and adoption depth (proportion of business transactions conducted digitally). Control variables include firm age, sector, owner demographics (age, gender, education), access to electricity, distance to nearest bank branch, and previous credit history.

3.3.3. Moderating Variables

Owner education level is coded as an ordinal variable (no formal education, primary, secondary, tertiary). Business formalization status is operationalized as a binary variable based on business registration with the Office of the Administrator and Registrar General (OARG).

3.4. Data Analysis

Statistical analysis was conducted using STATA 17.0 and R 4.3.0. Descriptive statistics characterize the sample profile and variable distributions. Correlation analysis examines bivariate relationships between key variables. Multiple regression models test the hypothesized relationships, with robust standard errors clustered at the district level to account for potential spatial correlation.

The base regression model is specified as:

Performance (i) = $\beta_0 + \beta_1$ (Mobile Money Adoption) + β_2 (Education) + β_3 (Formalization) + $\beta_4 X + \varepsilon$

Where X represents the vector of control variables, and ε is the error term. Interaction terms test moderation effects. The study conducts robustness checks using instrumental variable regression with distance to the nearest mobile money agent as an instrument for adoption.

4. Results

4.1. Descriptive Statistics

The final sample comprises 385 SMEs, representing a 91% response rate. Table 1 presents the sample characteristics and key variables.

Table 1 Descriptive Statistics of Sample Characteristics (N=385)

Variable	Mean	SD	Min	Max
Revenue Growth (%)	18.3	42.7	-67.2	234.5
Mobile Money Adoption Index	0.54	0.31	0	1
Firm Age (years)	6.8	5.2	0.5	28
Number of Employees	8.4	12.3	1	96
Owner Age (years)	38.2	11.4	19	72
Owner Female (%)	41.3	-	-	-
Tertiary Education (%)	23.4	-	-	-
Business Formalized (%)	34.8	-	-	-
Uses Mobile Money (%)	68.6	-	-	-
Distance to Bank (km)	3.7	4.1	0.1	18.5
Has Electricity Access (%)	71.4	-	-	-
Previous Bank Loan (%)	12.7	-	-	-

The sample exhibits considerable heterogeneity, with firm age ranging from 6 months to 28 years and employment varying from sole proprietorships to medium enterprises with 96 employees. Mobile money adoption is widespread, with 68.6% of SMEs utilizing digital payment systems for at least some business transactions. However, adoption intensity varies significantly, with only 31% conducting more than half their transactions digitally.

4.2. Correlation Analysis

Table 2 presents the correlation matrix for key variables.

Table 2 Correlation Matrix of Key Variables

	1	2	3	4	5	6	7	8
1. Revenue Growth	1.00							
2. MM Adoption	0.38***	1.00						
3. Education	0.29***	0.42***	1.00					
4. Formalization	0.24***	0.31***	0.36***	1.00				
5. Firm Age	0.15**	0.18***	0.09	0.27***	1.00			
6. Employees	0.21***	0.26***	0.19***	0.34***	0.31***	1.00		
7. Female Owner	-0.08	0.04	-0.11*	-0.14**	-0.06	-0.17***	1.00	
8. Electricity	0.19***	0.34***	0.28***	0.22***	0.11*	0.18***	-0.03	1.00

Note: *** p<0.001, ** p<0.01, * p<0.05

The correlation analysis reveals significant positive associations between mobile money adoption and revenue growth ($r = 0.38$, $p < 0.001$), supporting the study primary hypothesis. Education and formalization show moderate positive correlations with both adoption and performance measures. Notably, female-owned businesses show no significant correlation with mobile money adoption but negative associations with formalization and firm size, suggesting potential gender-based barriers to business growth.

4.3. Regression Analysis

Table 3 presents the regression results testing the study hypotheses.

Table 3 Regression Results - Dependent Variable: Revenue Growth

	Model 1	**Model 2**	**Model 3**	**Model 4**
Mobile Money Adoption	28.34***	24.67***	18.92**	16.43**
	(6.82)	(6.54)	(7.21)	(7.89)
Education (Tertiary)		15.23***	8.46*	7.92*
		(4.91)	(4.38)	(4.42)
Formalization		12.87**	10.34**	9.21*
		(5.12)	(4.96)	(5.03)
MM × Education			21.43***	19.82***
			(6.73)	(6.81)
MM × Formalization				14.26**
				(5.94)
Firm Age	0.82*	0.71	0.68	0.65
	(0.43)	(0.44)	(0.43)	(0.44)
Log(Employees)	4.36**	3.92*	3.74*	3.68*
	(1.98)	(2.01)	(1.97)	(1.99)
Female Owner	-3.21	-2.84	-2.91	-2.76
	(4.23)	(4.19)	(4.14)	(4.15)
Electricity Access	8.74**	6.28*	5.93	5.81
	(3.86)	(3.79)	(3.82)	(3.84)
Sector FE	Yes	Yes	Yes	Yes
District FE	Yes	Yes	Yes	Yes
Constant	-12.43	-18.76**	-16.24*	-15.89*
	(8.91)	(9.24)	(9.18)	(9.21)
N	385	385	385	385
R^2	0.31	0.36	0.39	0.41
Adjusted R^2	0.28	0.33	0.36	0.37
F-statistic	14.82***	16.94***	17.63***	18.21***

Note: Robust standard errors in parentheses. *** p<0.001, ** p<0.01, * p<0.05

The regression results provide strong support for the study hypotheses. Model 1 establishes the baseline relationship between mobile money adoption and revenue growth, with a one-unit increase in the adoption index associated with a 28.34 percentage point increase in revenue growth ($p < 0.001$), confirming H1. Model 2 introduces education and formalization, both showing significant positive effects while slightly attenuating the mobile money coefficient.

Model 3 tests the moderation effect of education (H2), revealing a significant positive interaction term ($\beta = 21.43$, $p < 0.001$). This suggests that the performance benefits of mobile money adoption are amplified for SME owners with tertiary education. Model 4 adds the formalization interaction, also significant ($\beta = 14.26$, $p < 0.01$), supporting H3. The full model explains 41% of the variance in revenue growth, with all hypothesized relationships maintaining statistical significance.

4.4. Robustness Checks

To address potential endogeneity concerns, the study employ instrumental variable (IV) regression using distance to the nearest mobile money agent as an instrument for adoption. The first-stage F-statistic of 42.7 exceeds conventional thresholds, suggesting instrument strength. The IV estimates ($\beta = 32.46$, $p < 0.001$) are slightly larger than OLS estimates, indicating that endogeneity may lead to downward bias in the study main results.

We also test alternative performance measures. Using employment growth as the dependent variable yields qualitatively similar results, with mobile money adoption associated with 1.8 additional employees on average ($p < 0.01$). The business resilience index shows even stronger associations ($\beta = 0.412$, $p < 0.001$), suggesting that digital financial inclusion enhances SME adaptability to external shocks.

5. Discussion

5.1. Theoretical Implications

The study findings contribute to several theoretical domains. First, the study extends the Technology Acceptance Model to the West African SME context, demonstrating that perceived usefulness transcends individual adoption to influence organizational performance outcomes. The significant moderation effects of education and formalization suggest that complementary capabilities are necessary to fully realize technology benefits, consistent with the absorptive capacity literature (Cohen & Levinthal, 1990).

Second, the study results support the Resource-Based View's emphasis on resource complementarity. Mobile money adoption alone does not guarantee performance improvements; rather, its value is contingent on human capital (education) and institutional legitimacy (formalization). This finding aligns with recent work by Asongu and Odhiambo (2023) on the conditional effects of financial inclusion in African markets.

Third, the study contributes to the growing literature on digital transformation in developing economies. Unlike studies from more developed African markets like Kenya or South Africa, the study Sierra Leonean evidence highlights the importance of basic infrastructure (electricity access) as a prerequisite for digital finance benefits. This suggests a hierarchy of constraints that policymakers must address sequentially.

5.2. Practical Implications

For SME owners and managers, the study results underscore the importance of digital capability development. The 68.6% adoption rate indicates widespread recognition of mobile money's potential, but the modest 31% conducting majority-digital transactions suggests implementation challenges. Business support organizations should prioritize digital literacy training alongside traditional business skills development.

The strong moderation effect of formalization ($\beta = 14.26$) has important policy implications. Currently, only 34.8% of sample SMEs are formally registered, missing opportunities for enhanced digital finance benefits. Streamlining registration processes and reducing compliance costs could accelerate both formalization and digital adoption, creating positive spillovers for economic development.

Financial service providers can leverage these insights to design targeted products. The significant relationship between mobile money use and inventory turnover (supplementary analysis, $\beta = 0.287$, $p < 0.01$) suggests demand for working capital solutions. Digital credit products linked to transaction histories could address the 87.3% of SMEs lacking formal bank loans.

5.3. Gender Dimensions

While female business ownership showed no direct effect on performance, supplementary analysis reveals interesting gendered patterns in technology adoption. Female-owned businesses using mobile money show 42% higher revenue growth compared to female-owned cash-only businesses, versus 31% for male-owned enterprises. This suggests that digital finance may help overcome gender-based barriers to traditional financial services, warranting further investigation.

Limitations and Future Research

Several limitations warrant acknowledgment. First, the study's cross-sectional design precludes causal inference despite robust associations and instrumental variable approaches. Longitudinal studies tracking SMEs over time would strengthen causal claims and illuminate adoption dynamics. Second, the study focuses on Freetown limits generalizability to rural contexts where infrastructure constraints are more severe and adoption patterns differ. Third, the study relies on self-reported performance measures, potentially introducing measurement error or social desirability bias. Future research could triangulate survey data with administrative records or mobile money transaction data, though privacy concerns and data availability remain challenges in the Sierra Leonean context. The study analysis does not fully capture the informal economy's complexity. Many micro-enterprises operate partially outside formal systems, potentially underestimating mobile money's reach and impact. Ethnographic approaches could complement quantitative methods to understand informal sector dynamics.

Future research directions include examining spillover effects on supply chain partners, investigating the role of mobile money in building credit histories for future formal finance access, and exploring how digital finance influences women's economic empowerment in patriarchal societies. Comparative studies across West African countries could identify context-specific versus generalizable patterns.

6. Conclusion

This study provides robust empirical evidence that digital financial inclusion through mobile money adoption is significantly associated with improved SME performance in Freetown, Sierra Leone. Analysis of 385 SMEs reveals that mobile money adoption is linked to an average revenue growth increase of 28.34 percentage points, with effects amplified for educated and formalized businesses. These findings have important implications for policymakers, development practitioners, and financial service providers working to enhance SME development in post-conflict West African economies.

The conditional nature of mobile money's benefits, moderated by education and formalization, suggests that digital finance is not a panacea but rather one component of a comprehensive SME development strategy. Investments in human capital, regulatory reform, and basic infrastructure must accompany financial inclusion initiatives to maximize development impact. As Sierra Leone and similar countries pursue economic transformation, understanding these complementarities becomes crucial for evidence-based policymaking.

This study's contribution extends beyond the specific Sierra Leonean context to inform broader debates on technology's role in developing country entrepreneurship. By demonstrating that digital financial services can partially overcome traditional credit constraints while highlighting the importance of absorptive capacity, the study provides nuanced evidence for the potential and limitations of technological leapfrogging in frontier markets.

Compliance with ethical standards

Disclosure of conflict of interest

The author(s) declare that there are no conflicts of interest relevant to this work.

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