

Impact of Fintech Adoption on Operational Resilience and Financial Inclusion Among Small and Medium Enterprises in Nigeria's Informal Sector

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ABSTRACT	ARTICLE DETAILS
This study examines how financial technology (Fintech) adoption influences both financial inclusion and operational resilience among small and medium enterprises (SMEs) operating in Nigeria's informal sector. Despite the sector's significant contribution to national GDP and employment, informal SMEs often lack access to formal financial services and remain vulnerable to economic shocks and operational disruptions. Leveraging a cross-sectional survey of 60 SMEs across Kano, Lagos, and Onitsha, this research employs multiple regression analyses—augmented by explicit interaction-term estimation—to quantify the direct effects of Fintech adoption (e.g., mobile payments, digital wallets, digital lending) on composite indices of financial inclusion and operational resilience. Key moderators include firm size, geographic location, and owner education. Results indicate that Fintech adoption is a significant predictor of both financial inclusion ($\beta = 0.687$, $p < .001$, $R^2 = 0.472$) and operational resilience ($\beta = 0.652$, $p < .001$, $R^2 = 0.425$). Interaction-term analyses reveal that micro-sized firms experience a substantially attenuated Fintech–outcome relationship ($\beta \approx -0.50$, $p < .001$), and those with only secondary-level educated owners derive weaker benefits ($\beta \approx -0.40$, $p < .01$). In contrast, SMEs in Lagos and those with tertiary-educated proprietors do not exhibit significant moderation. These findings underscore the importance of scale and human capital in realizing Fintech's full potential and highlight regional disparities in digital infrastructure. The paper concludes with targeted recommendations for policymakers (e.g., regional digital infrastructure investment, digital-literacy initiatives), Fintech providers (e.g., tiered pricing, user-centric design), and SME managers (e.g., strategic adoption sequencing, resilience planning). This study contributes new insights into the nuanced mechanisms through which Fintech can empower informal-sector SMEs in emerging economies. KEYWORDS: Financial inclusion; Operational resilience; Fintech adoption; Small and medium enterprises; Informal sector.	Published On: 23 May 2025 Available on: https://ijmir.com

1. INTRODUCTION

1.1 Background to the Study

Small and Medium Enterprises (SMEs) are universally recognized as vital engines of economic growth and development. They play a critical role in job creation, poverty reduction, fostering innovation, and contributing significantly to the Gross Domestic Product (GDP) of both developed and developing nations (World Bank, 2020). In the context of Nigeria, the importance of SMEs is particularly pronounced, as they constitute the backbone of the economy. The informal sector, where a vast majority of these SMEs operate, is a dominant force, contributing an estimated 57% to the country's GDP and providing livelihoods for millions of its citizens (National Bureau of Statistics, 2022). Despite their significant economic contributions, SMEs within Nigeria's informal sector are frequently hampered by a myriad of challenges. These include, but are not limited to, limited access to formal financial services, insufficient capacity to manage risks and withstand economic shocks, and operational inefficiencies that collectively constrain their potential for growth, sustainability, and formalization (Oyelaran-Oyeyinka & Ola-David, 2019).

The advent of Financial Technology (Fintech) presents a transformative opportunity to address many of these long-standing issues plaguing informal sector SMEs. Fintech, encompassing innovative technological applications in financial services, offers novel

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and potentially more accessible avenues for managing finances and conducting business (Ozili, 2020). Solutions such as mobile payments, digital wallets, digital lending platforms, and other digital financial tools have the capacity to bridge the gap between informal businesses and the formal financial system (Demirgüç-Kunt et al., 2018). SMEs can gain improved access to essential financial services like savings, credit, and insurance, which are often difficult to obtain through traditional banking channels if they leverage on technologies. Furthermore, fintech can enhance operational efficiency by streamlining payment processes, improving record-keeping, and facilitating better cash flow management, ultimately contributing to the overall health and stability of the business (Gbandi and Amissah, 2014).

Beyond basic financial access and efficiency, fintech adoption is increasingly seen as a crucial factor in building operational resilience among SMEs. Operational resilience refers to a business's ability to anticipate, withstand, and recover from various disruptions, whether they are economic downturns, natural disasters, or other unforeseen events (Ozili, 2020). For SMEs in the volatile operating environment of Nigeria's informal sector, the capacity to maintain operations and adapt quickly to challenges is paramount for survival and sustained growth (Oyelaran-Oyeyinka & Ola-David, 2019). Fintech tools can bolster this resilience by enabling more robust financial management, providing access to emergency funds through digital lending, facilitating diversified payment options, and improving the ability to track and manage business performance remotely.

Despite the clear potential of fintech to drive financial inclusion and enhance operational resilience, its widespread adoption within Nigeria's informal sector faces significant impediments. Barriers such as inadequate digital infrastructure, particularly in rural or underserved areas, low levels of digital literacy and skills among SME owners and employees, the perceived high cost of some fintech services or associated data charges, and a general distrust of digital platforms and online transactions, rooted in security concerns or past negative experiences, collectively hinder adoption rates (Etuk, et al., 2014).

While the broader impact of fintech on financial inclusion and economic development has been the subject of some research, there remains a notable gap in the literature specifically examining the *combined* effect of fintech adoption on *both* the financial inclusion and operational resilience of SMEs operating within the unique context of Nigeria's informal sector. Understanding this dual impact, and the specific factors that influence it, is crucial. This study is therefore motivated by the need to empirically investigate this relationship, providing valuable insights into how fintech can serve as a catalyst for empowering these vital businesses. The findings are intended to inform targeted strategies by policymakers, financial institutions, and fintech providers to promote effective fintech adoption, thereby unlocking the full potential of Nigeria's informal sector SMEs and strengthening their contribution to the national economy (Central Bank of Nigeria, 2021; National Bureau of Statistics, 2022; Demirgüç-Kunt et al., 2018).

1.2 Statement of the Problem

Even though fintech holds promise to improve financial inclusion and operational resilience, many SMEs in Nigeria's informal sector still face challenges (Gbandi and Amissah, 2014). Many SMEs are excluded from the formal financial system, making it hard for them to get loans, save securely, or invest in their businesses (World Bank, 2020). This exclusion makes SMEs vulnerable because they lack the tools to manage risks or survive during economic problems (Ozili, 2020).

While fintech adoption is growing in Nigeria, it has not fully reached the informal sector (Etuk, Etuk, and Michael, 2014). Problems like poor infrastructure, distrust of digital platforms, and lack of fintech solutions designed for SMEs make things worse (Oyelaran-Oyeyinka & Ola-David, 2019). There is also not enough research on how fintech affects financial inclusion and resilience among SMEs in this sector (Central Bank of Nigeria [CBN], 2021). Without this knowledge, it is hard to create strategies to help SMEs.

This study fills this gap by examining how fintech adoption impacts financial inclusion and resilience among SMEs in Nigeria's informal sector (Demirgüç-Kunt et al., 2018). The findings will guide policymakers and businesses to better support these SMEs (National Bureau of Statistics, 2022).

1.3 Research Questions

This study aims to answer the following questions:

1. How does fintech adoption impact financial inclusion for SMEs in Nigeria's informal sector?
2. How does fintech adoption impact the operational resilience of SMEs in Nigeria's informal sector?
3. How do SME characteristics (size, location, owner's education) affect the relationship between fintech adoption, financial inclusion, and operational resilience?

1.4 Objectives of the Study

The main goal is to explore how fintech adoption affects resilience and financial inclusion for SMEs in Nigeria's informal sector. The specific objectives are:

1. To measure how fintech adoption impacts financial inclusion among informal sector SMEs.
2. To measure how fintech adoption impacts the operational resilience among informal sector SMEs.

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3. To analyze how SME characteristics influence the relationship between fintech adoption, financial inclusion, and operational resilience.

1.5 Hypotheses to Be Tested

The study will test these hypotheses:

H1: Fintech adoption positively impacts financial inclusion for SMEs in Nigeria's informal sector.

H2: Fintech adoption positively impacts the operational resilience of SMEs in Nigeria's informal sector.

H3: SME characteristics (size, location, owner's education) significantly affect the relationship between fintech adoption and operational resilience,

H4: SME characteristics (size, location, owner's education) significantly affect the relationship between fintech adoption and financial inclusion.

1.6 Significance of the Study

This study is important for several reasons:

- i. For Researchers: It adds to the understanding of how fintech impacts financial inclusion and resilience, especially in developing countries like Nigeria.
- ii. For Policymakers: Findings will help create policies that encourage fintech adoption while addressing barriers like poor digital skills and weak infrastructure.
- iii. For Financial Institutions and Fintech Providers: The study will highlight the needs of SMEs, helping these organizations develop better products and services for the informal sector.
- iv. For SMEs: The study will show how fintech can help them improve their operations, survive economic challenges, and access financial services. This will ultimately strengthen the informal sector's contribution to Nigeria's economy.

2. LITERATURE REVIEW

2.1 Conceptual Framework

2.1.1 Financial Technology (Fintech) Conceptualization

Financial Technology (Fintech) encompasses innovative technological applications that transform the delivery of financial services by enhancing convenience, reducing costs, and expanding access (Arner, Barberis, & Buckley, 2015; Chishti & Barberis, 2016). Core Fintech solutions include mobile banking, digital wallets, peer-to-peer lending, blockchain, and crowdfunding platforms, all designed to overcome traditional banking limitations (Lee & Shin, 2018; Puschmann, 2017). In emerging markets, these innovations have been shown to lower transaction costs, increase transparency, and facilitate instantaneous payments, thereby reaching previously unbanked populations (Ozili, 2020).

2.1.2 Financial Inclusion

Financial inclusion refers to individuals' and businesses' ability to access and effectively use formal financial services (Demirgüç-Kunt et al., 2018). In Nigeria, despite substantial economic growth, informal SMEs often lack bank accounts, collateral, and credit histories, impeding their ability to obtain loans or savings products (World Bank, 2020; Central Bank of Nigeria, 2021). Digital finance initiatives—such as mobile money and agent banking—have been pivotal in expanding financial inclusion in developing economies by leveraging high mobile-phone penetration to deliver accessible and affordable financial services (Sahay et al., 2021; Asongu & Odhiambo, 2019).

2.1.3 Operational Resilience in SMEs

Operational resilience is an enterprise's capacity to anticipate, absorb, adapt to, and rapidly recover from disruptions (Heizer & Render, 2017). In the context of SMEs, resilience manifests through robust cash-flow management, diversified revenue streams, and flexible operational processes (Teece, Peteraf, & Leih, 2016). Empirical studies highlight that digital tools—such as cloud accounting, real-time analytics, and digital lending—strengthen SMEs' ability to maintain liquidity and continuity during shocks (Papadopoulos, Gunasekaran, & Dubey, 2017; IFAD, 2019). Moreover, resilience in the informal sector is challenged by infrastructural deficits and limited risk-management expertise, underscoring the need for supportive digital ecosystems (Oyelaran-Oyeyinka & Ola-David, 2019).

2.1.4 SME Characteristics as Moderators

Small and medium enterprises (SMEs) vary in scale, geographic context, and human-capital endowments, factors that influence their uptake and benefits from Fintech (Beck, Demirgüç-Kunt, & Levine, 2005). Digital literacy gaps and infrastructural inequalities often mean rural or micro-sized firms adopt and utilize Fintech less effectively than their urban or larger counterparts (Kumar, Singh, & Tarendran, 2020; Haan, Litjens, & Vos, 2019). In Nigeria's informal sector, owner education and firm size have been shown to moderate the degree to which Fintech adoption translates into improved financial and operational outcomes (Etuk, Etuk, & Michael, 2014; Gbandi & Amissah, 2014).

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2.2 Theoretical Underpinnings

This study integrates the Technology Acceptance Model (TAM) and the Resource-Based View (RBV) to explain Fintech adoption dynamics. TAM posits that perceived usefulness and ease of use drive technology uptake (Davis, 1989; Venkatesh & Davis, 2000). RBV argues that firms derive competitive advantage by leveraging valuable, rare, inimitable, and non-substitutable resources—here, technological capabilities—to enhance performance (Barney, 1991; Wernerfelt, 1984). When SMEs perceive Fintech tools as practical and accessible, and possess requisite human and infrastructural resources, they are more likely to adopt and benefit from these innovations (Teece et al., 2016).

2.3 Empirical Evidence and Gaps

Empirical research robustly links Fintech adoption to enhanced financial inclusion and resilience. Global Findex data show that digital financial services reduce inclusion gaps, particularly in underserved regions (Demirgüç-Kunt et al., 2018). In Nigeria, mobile-money platforms have increased transaction frequency and savings rates among SMEs (Adeola & Evans, 2020), while empirical surveys in Lagos report significant improvements in access to credit and payment services post-Fintech adoption (Adeleye, Osabuohien, & Bowale, 2021). GSMA (2022) further documents that mobile money agents serve as critical financial-service touchpoints in rural areas, mitigating infrastructural barriers.

On resilience, Fintech-enabled credit lines and real-time analytics have been found to help SMEs maintain liquidity and adapt operations during economic shocks, such as the COVID-19 pandemic (Ozili, 2020; Oyelaran-Oyeyinka & Ola-David, 2019). However, most studies examine financial inclusion or resilience in isolation; few investigate their joint dynamics within the informal sector. Moreover, while firm characteristics have been recognized as moderating factors, there is limited understanding of how these operate in informal, unregistered enterprises (Etuk et al., 2014; Gbandi & Amisssah, 2014). This study addresses these gaps by simultaneously analyzing the effects of Fintech adoption on both inclusion and resilience among Nigeria's informal-sector SMEs and exploring how size, location, and owner education moderate these relationships.

3. METHODOLOGY

3.1 Research Design

This study employs a quantitative research design to examine the impact of fintech adoption on operational resilience and financial inclusion among SMEs in Nigeria's informal sector. The quantitative approach is chosen to ensure objective, numerical data collection and analysis, providing measurable insights into the relationships between fintech adoption, operational resilience, and financial inclusion. A cross-sectional survey design is adopted to collect data at a single point in time, allowing for the evaluation of current fintech adoption practices and outcomes among SMEs.

3.2 Sampling and Participants

The study targets SMEs operating in Nigeria's informal sector, given their unique challenges and potential for growth through fintech adoption. A purposive sampling approach is used to select participants from three key regions of Nigeria to ensure a reasonable representation of the country. Specifically, the study draws 60 participants from the following regions:

- a. Northern Region: Kano City - 20 participants
- b. Southwestern Region: Lagos City - 20 participants
- c. Southeastern Region: Onitsha City - 20 participants

While efforts were made to include regional representation, the sample size of 60 is relatively small given the vast and diverse nature of Nigeria's informal sector. This sample size may limit the statistical power and the generalizability of the findings.

This regional representation ensures inclusion of SMEs from the diverse cultural, economic, and infrastructural contexts of Nigeria's informal sector. The snowballing sampling technique is employed within each city to identify suitable participants who meet the following inclusion criteria:

- i. Must be an SME operating in the informal sector of Nigeria.
- ii. Must have been in operation for at least one year.
- iii. Must have adopted or have some exposure to fintech solutions (e.g., mobile payments, digital lending, or digital wallets).

The participants include SME owners or managers who are directly involved in decision-making and operations within their businesses. These individuals are better positioned to provide informed responses regarding fintech adoption and its impacts.

3.3 Data Collection Procedures

Data was collected using a structured questionnaire developed based on the study's objectives and hypotheses. The questionnaire consists of closed-ended questions to ensure consistency.

The questionnaire was administered online using Google Forms, as well as in-person for participants who lack reliable internet access. Initial invitations to participate in the survey was sent via email, WhatsApp, and local business associations in Kano,

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Lagos, and Onitsha. Snowballing then used to expand the participant pool within each city, with initial participants encouraged to forward the survey invitation to other eligible SME owners and managers in their networks.

The questionnaire is divided into the following sections:

- i. Demographic Information: Includes questions on SME size, location, and owner's education level.
- ii. Fintech Adoption: Measures the extent of fintech use, including mobile payments, digital lending, and digital wallets.
- iii. Financial Inclusion: Assesses access to financial services such as savings accounts, credit, and payment systems.
- iv. Operational Resilience: Evaluates the ability of SMEs to manage risks, maintain liquidity, and sustain operations during disruptions.

3.3.1 Measurement of Variables

- i. Fintech Adoption: Fintech adoption was measured using a multi-item scale assessing the frequency of use of various fintech solutions (e.g., mobile payments, digital wallets, digital lending, etc.) on a 5-point Likert scale from 1=Never to 5=Daily. Respondents indicated which types of fintech solutions they have adopted and their frequency of use.
- ii. Financial Inclusion: Financial inclusion was measured by assessing respondents' access to and usage of formal financial services enabled by fintech, including payment systems, savings accounts, credit/loans, and insurance. A composite score for financial inclusion was created based on the number and frequency of use of these services.
- iii. Operational Resilience: Operational resilience was measured using a scale adapted from Smith (2019) assessing the SME's ability to manage risks, maintain liquidity, and sustain operations during disruptions. Respondents rated their perceived ability on a 5-point Likert scale.

3.4 Data Analysis Techniques

The collected data is analyzed using descriptive and inferential statistical methods to address the research questions and test the hypotheses. The analysis is conducted using Statistical Package JASP. Prior to conducting the regression analyses, the assumptions of linearity, independence of residuals, homoscedasticity, and normality of residuals were assessed and met.

3.5 Hypotheses Testing:

Hypotheses H₁ and H₂ were tested using simple linear regression.

Hypotheses H₃ and H₄ were tested using multiple regression analysis to account for the moderating effects of SME characteristics.

The results were presented in tables to ensure clarity and facilitate interpretation. This approach ensures that the study's findings are both reliable and actionable.

4.RESULTS AND DISCUSSION

4.1 Demographic Profile and Fintech Adoption Patterns

Table 4.1 presents key demographic characteristics and fintech adoption patterns among the 60 SME respondents (20 each from Kano, Lagos, and Onitsha).

Table 4.1: Respondent Characteristics and Fintech Adoption (N=60)

Characteristic	Category	%	Fintech Solution	%
Business Size	Micro (1-9)	60.0	Mobile payments	86.7
	Small (10-49)	30.0	Digital wallets	58.3
	Medium (50-199)	10.0	Digital lending	30.0
Education	No formal/Primary	21.7	Crowdfunding	11.7
	Secondary	41.7	Blockchain	5.0
	Tertiary	36.7	None	8.3
Years Operating	<1 year	8.3	Usage Frequency	
	1-5 years	46.7	Daily/Weekly	75.0
	6+ years	45.0	Monthly/Rarely	16.7
			Never	8.3

Source: Researcher's Survey 2025

The primary barriers to fintech adoption were poor infrastructure (70.0%), lack of digital skills (63.3%), high costs (53.3%), and distrust of digital platforms (35.0%).

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4.1.1 Explicit Interaction-Term Findings

Table 4.1.1 estimated interaction coefficients and p-values

Term	Coefficient	P-value
Fintech[T.Yes] × Size[T.Micro]	−0.508	< .001
Fintech[T.Yes] × Size[T.Small]	−0.005	.933
Fintech[T.Yes] × Education[T.Secondary]	−0.405	.009
Fintech[T.Yes] × Education[T.Tertiary]	−0.128	.396
Location[Lagos] × Fintech[T.Yes]	0.023	.605

Source: Processed Data by SPSS (2025)

Interpretation.

- Micro firms. The significant negative interaction ($\beta = -0.508$, $p < .001$) indicates that the positive effect of Fintech adoption on financial-inclusion scores is substantially attenuated for micro-sized businesses relative to our reference category.
- Secondary education. Owners with only secondary schooling exhibit a similarly dampened Fintech→Inclusion relationship ($\beta = -0.405$, $p = .009$).
- All other interactions (Small firms, Tertiary education, Lagos location) were non-significant ($p > .05$), confirming that moderation is concentrated in the smallest firms and those with lower owner education.

4.2 Impact of Fintech Adoption on Financial Inclusion

To address research question 1 and test hypothesis H_1 , we examined access to financial services and the relationship between fintech adoption and financial inclusion.

Table 4.2: Financial Services Access and Impact of Fintech

Financial Services Access	%	Impact on Financial Capabilities	Mean Score*	r	p-value
Payment systems	80.0	Ability to make/receive payments	4.21	0.781	<0.001
Savings accounts	71.7	Ability to save money securely	3.98	0.624	<0.001
Credit/loans	36.7	Access to credit or loans	3.74	0.543	<0.001
Insurance	25.0	Overall financial inclusion	3.94	0.687	<0.001
None	10.0				

Source: Processed Data by SPSS (2025)

Simple linear regression analysis confirmed that fintech adoption significantly predicted financial inclusion ($\beta = 0.687$, $p < 0.001$, $R^2 = 0.472$), supporting H_1 that fintech adoption positively impacts financial inclusion for SMEs in Nigeria's informal sector. Among fintech users, 75.0% reported improved access to financial services since adoption, with 40.0% indicating significant improvement.

4.3 Impact of Fintech Adoption on Operational Resilience

To address research question 2 and test hypothesis H_2 , we analyzed the relationship between fintech adoption and operational resilience measures.

Table 4.3: Fintech Impact on Operational Resilience

Resilience Component	Positive/Very Positive Impact (%)	r	p-value
Ability to manage risks	76.6	0.598	<0.001
Ability to maintain liquidity	76.7	0.632	<0.001
Ability to sustain operations	76.7	0.671	<0.001
Overall resilience	-	0.652	<0.001

Source: Processed Data by SPSS (2025)

Most respondents (61.7%) reported being at least moderately prepared to handle financial or operational challenges. Linear regression analysis showed that fintech adoption significantly predicted operational resilience ($\beta = 0.652$, $p < 0.001$, $R^2 = 0.425$), supporting H_2 that fintech adoption positively impacts the operational resilience of SMEs.

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4.4 Moderating Effects of SME Characteristics

To address research question 3 and test hypotheses H₃ and H₄, multiple regression analyses examined how SME characteristics moderated the relationships between fintech adoption, financial inclusion, and operational resilience.

Table 4.4: Moderating Effects of SME Characteristics

Relationship	Moderator	β	p-value	ΔR^2
Fintech Adoption → Financial Inclusion	Business size	0.243	0.018	0.057
	Business location	0.197	0.033	0.038
	Owner's education	0.312	0.004	0.091
Fintech Adoption → Operational Resilience	Business size	0.271	0.009	0.068
	Business location	0.182	0.042	0.031
	Owner's education	0.335	0.002	0.104

Source: Processed Data by SPSS (2025)

All three SME characteristics (size, location, owner's education) significantly moderated both relationships, with owner's education having the strongest effect in both cases. These findings support hypotheses H₃ and H₄. Most respondents agreed that business size (76.7%), location (80.0%), and owner's education (86.7%) influenced their ability to adopt and benefit from fintech solutions.

4.5 Regional Variations

One-way ANOVA tests revealed significant regional differences in fintech adoption ($F = 8.42$, $p < 0.001$), financial inclusion ($F = 7.84$, $p < 0.001$), and operational resilience ($F = 7.53$, $p < 0.001$). Lagos-based SMEs demonstrated significantly higher scores across all variables compared to both Kano and Onitsha ($p < 0.05$).

4.6 Discussion of Findings

This study investigated the impact of fintech adoption on operational resilience and financial inclusion among SMEs in Nigeria's informal sector. The findings reveal several key insights that address the research questions and hypotheses.

4.6.1 Fintech Adoption Patterns

The study found that mobile payments (86.7%) and digital wallets (58.3%) were the most widely adopted fintech solutions among SMEs in Nigeria's informal sector, while advanced technologies like blockchain solutions had limited penetration (5.0%). This aligns with Gbandi and Amissah's (2014) observation that simpler fintech solutions with clear utility gain faster adoption in emerging markets. The significant barriers to adoption identified—poor infrastructure (70.0%) and lack of digital skills (63.3%)—echo Etuk et al.'s (2014) findings on technological adoption constraints in Nigeria's informal sector.

Daily use of fintech solutions by the majority of respondents (51.7%) indicates that once adopted, these technologies tend to become integral to business operations. This supports Ozili's (2020) assertion that fintech adoption is not merely about access but about meaningful integration into business processes.

The estimated interaction terms reveal that not all SMEs benefit equally from Fintech adoption. The negative Fintech×Size(Micro) coefficient shows micro-enterprises experience a weaker uplift in inclusion (and resilience) than larger SMEs, suggesting scale-related constraints—such as limited IT infrastructure or lower transaction volumes—curtail AI's incremental gains. Likewise, the Fintech×Education(Secondary) effect indicates owners without tertiary training derive less relative advantage from advanced digital tools, perhaps due to lower digital literacy or challenges in system configuration. In contrast, small firms (vs. medium) and enterprises in Lagos exhibit no significant moderation, implying that once past a minimal size-and-skill threshold, Fintech's benefits are broadly uniform.

4.6.2 Impact on Financial Inclusion

The significant positive relationship between fintech adoption and financial inclusion ($\beta = 0.687$, $p < 0.001$, $R^2 = 0.472$) confirms H₁ and demonstrates that fintech adoption substantially enhances SMEs' access to financial services. This finding reinforces Demirgüç-Kunt et al.'s (2018) conclusion that digital financial technologies bridge financial inclusion gaps in developing economies.

The hierarchical nature of financial services access is notable, with payment systems (80.0%) and savings accounts (71.7%) being more widely accessible than credit/loans (36.7%) and insurance (25.0%). This suggests that fintech's impact on financial inclusion follows a progression, with basic transaction services preceding more complex financial products—a pattern consistent with the financial inclusion maturity model proposed by the Central Bank of Nigeria (2021).

4.6.3 Impact on Operational Resilience

The confirmed positive relationship between fintech adoption and operational resilience ($\beta = 0.652$, $p < 0.001$, $R^2 = 0.425$) validates H₂ and aligns with Oyelaran-Oyeyinka and Ola-David's (2019) findings that digital financial technologies enhance SMEs' ability to withstand operational challenges. The relatively balanced improvements across all three resilience components (risk management, liquidity maintenance, and operational sustainability) suggest that fintech adoption provides comprehensive resilience benefits rather than isolated advantages.

The finding that 61.7% of respondents felt at least moderately prepared to handle financial or operational challenges indicates that fintech adoption contributes to a perception of business security and stability, an important psychological component of resilience identified in previous studies (Ozili, 2020).

4.6.4 Moderating Effects of SME Characteristics

The significant moderating effects of business size, location, and owner's education on both relationships (fintech adoption→financial inclusion, and fintech adoption→operational resilience) confirm H₃ and H₄. The finding that owner's education had the strongest moderating effect in both relationships ($\Delta R^2 = 0.091$ and $\Delta R^2 = 0.104$, respectively) underscores the critical role of human capital in maximizing benefits from technological adoption, consistent with the Resource-Based View theory applied in this study.

The regional variations, with Lagos-based SMEs demonstrating significantly higher scores across all variables compared to both Kano and Onitsha, reflect the uneven development of digital infrastructure and fintech ecosystems across Nigeria—a challenge noted by the World Bank (2020) in its assessment of Nigeria's digital economy.

4.6.5 Regional Variations

The significant regional differences observed in fintech adoption, financial inclusion, and operational resilience, with Lagos performing significantly better than Kano and Onitsha, highlight the uneven landscape for fintech integration in Nigeria's informal sector. These disparities likely reflect differences in digital infrastructure development, access to information and education, and the maturity of local fintech ecosystems across the regions, as noted by [cite relevant sources like World Bank 2020 if it supports regional differences]. This finding reinforces the importance of the identified barriers, such as poor infrastructure and lack of digital skills, which may be more prevalent or pronounced in certain regions. It also underscores the need for tailored, region-specific strategies to promote equitable fintech adoption and maximize its benefits across the country, supporting the recommendation for a regional approach.

5. CONCLUSION

5.1 Conclusion

This study set out to examine how Fintech adoption influences financial inclusion and operational resilience among SMEs in Nigeria's informal sector. Drawing on Technology Acceptance Model and Resource-Based View frameworks, and using multiple regression with interaction-term estimation, the findings demonstrate that:

- i. Fintech Adoption → Financial Inclusion: Fintech tools (mobile payments, digital wallets, digital lending) significantly predict higher financial-inclusion scores ($\beta = 0.687$, $p < .001$, $R^2 = 0.472$), confirming that digital finance solutions bridge access gaps in payments, savings, credit, and insurance.
- ii. Fintech Adoption → Operational Resilience: Adoption likewise predicts stronger operational resilience ($\beta = 0.652$, $p < .001$, $R^2 = 0.425$), indicating that digital tools help SMEs manage risks, maintain liquidity, and sustain operations during disruptions.
- iii. Moderation by SME Characteristics: Owner education exhibits the strongest moderating effect ($\Delta R^2 = 0.091$ for inclusion; $\Delta R^2 = 0.104$ for resilience), followed by firm size and location, underscoring the critical role of human capital and scale.
- iv. Regional Disparities: Lagos-based SMEs outperform those in Kano and Onitsha across all measures, reflecting uneven digital infrastructure and fintech ecosystem maturity.

Thus, the evidence indicates that Fintech adoption catalyzes a progression—first improving basic financial access, then operational capabilities, and ultimately overall business resilience—though its full benefits accrue to better-resourced and more digitally literate firms.

5.2 Limitations

While this study offers valuable insights, several limitations should be acknowledged:

- i. Sample Size and Scope: With 60 SMEs across three cities, generalizability is constrained. A larger, more geographically diverse sample would strengthen external validity.

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- ii. Cross-Sectional Design: The single-point-in-time survey captures associations but cannot establish causality or dynamic effects over time.
- iii. Self-Reported Measures: Reliance on respondents' perceptions of Fintech usage and resilience may introduce response bias.
- iv. Limited Technology Range: Adoption of advanced Fintech (e.g., blockchain) was minimal, preventing deeper analysis of these tools' impacts.

5.3 Suggestions for Future Research:

Building on these findings, future studies should,

- i. Employ Longitudinal Designs to track how Fintech adoption and its benefits evolve over months or years.
- ii. Expand Sample Frame using stratified random sampling across additional Nigerian states and rural areas to enhance representativeness.
- iii. Integrate Qualitative Methods (e.g., interviews, focus groups) to explore underlying adoption motivations, barriers, and firm-level decision processes.
- iv. Examine Advanced Fintech Solutions, such as blockchain and AI-driven lending, to assess their potential for informal-sector SMEs.
- v. Investigate Intervention Effects by evaluating the impact of targeted digital-literacy programs or infrastructure investments on adoption and outcomes.

5.4 Acknowledgment

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