

Cost-Benefit Analysis of Digital Banking Adoption Among Small and Medium Enterprises in Jimeta-Yola Metropolis, Adamawa State, Nigeria

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Abstract

Digital banking has transformed commerce globally, yet small and medium enterprises (SMEs) in developing regions exhibit uneven adoption patterns, with limited empirical evidence on the actual economic returns of such investments. This study investigates the costs, benefits, and net economic impact of digital banking adoption among SMEs in Jimeta-Yola Metropolis, Adamawa State, Nigeria. A mixed-methods sequential explanatory design was employed, combining quantitative survey data from 150 SMEs across trade, services, and manufacturing sectors with 15 in-depth qualitative interviews. Data covered direct and indirect adoption costs, transaction efficiency, revenue changes, and operational savings over a 12-month period. Cost-benefit metrics including Net Present Value (NPV), Return on Investment (ROI), and Benefit-Cost Ratio (BCR) were computed. Findings reveal that 68.4% of SMEs have adopted at least one digital banking service, primarily mobile money and POS terminals. Adoption yielded an average revenue increase of 18.2% and transaction time savings of 4.3 hours weekly. The average payback period for initial investment was 8.5 months, with a mean ROI of 47.3% within the first

year. However, significant barriers persist, network unreliability (76.8%), transaction charges (71.2%), and cybersecurity concerns (62.4%), limiting full adoption. Digital banking adoption delivers positive and measurable economic returns for SMEs in Northeast Nigeria. The study recommends reduced transaction fees, improved network infrastructure, and targeted digital literacy interventions to unlock the full economic potential of digital financial inclusion.

Keywords: Digital banking, SMEs, cost-benefit analysis, financial inclusion, mobile money, POS terminals, Jimeta-Yola, Nigeria

1. Introduction

The global financial landscape has undergone a profound transformation over the past two decades, driven by rapid advancements in digital technology. Digital banking, encompassing mobile money, Point of Sale (POS) terminals, online banking, Unstructured Supplementary Service Data (USSD) transactions, and social media-based payments has emerged as a critical engine of economic inclusion and growth (Demirgüç-Kunt et al., 2022). In developing economies, where traditional banking infrastructure is often limited, digital financial services have leapfrogged conventional systems, bringing millions of previously unbanked individuals and businesses into the formal financial ecosystem (GSMA, 2023). Small and Medium Enterprises (SMEs) constitute the backbone of most African economies, contributing approximately 38% of Nigeria's Gross Domestic Product (GDP) and employing over 80% of the non-agricultural workforce (National Bureau of Statistics [NBS], 2024). In Jimeta-Yola Metropolis, the commercial nerve centre of Adamawa State and the broader Northeast region, SMEs range from market traders and small shopkeepers to service providers and light manufacturers. These enterprises face persistent challenges: limited access to formal credit, cash-handling risks, high transaction costs, and inefficient payment systems that constrain growth and profitability. While digital banking adoption in Nigeria has grown significantly with mobile money transactions exceeding ₦70 trillion in 2025 (Central Bank of Nigeria [CBN], 2026) adoption among SMEs in Northeast Nigeria remains uneven and under-researched. Most existing studies focus on urban centres in Southern Nigeria, leaving a critical gap in understanding the specific costs, benefits, and barriers faced by SMEs in the Northeast. Furthermore, while anecdotal evidence suggests digital banking improves business performance, rigorous cost-benefit analyses specific to the regional context are scarce. This study addresses this gap by providing a comprehensive cost-benefit analysis of digital banking adoption among SMEs in Jimeta-Yola Metropolis. By quantifying both the tangible and intangible costs and benefits, and by exploring the lived experiences of business owners, this research provides evidence-based insights for policymakers, financial institutions, and SME operators. The findings will contribute to the growing body of knowledge on digital financial inclusion in developing contexts and offer practical recommendations for maximizing the economic benefits of digital banking in Northeast Nigeria.

1.1 Research Objectives

- ✓ Assess the current level and patterns of digital banking adoption across different SME sectors and sizes in Jimeta-Yola Metropolis.
- ✓ Identify and quantify the direct and indirect costs incurred by SMEs in adopting and using digital banking services.
- ✓ Measure the economic benefits of digital banking adoption in terms of revenue growth,

transaction efficiency, and operational savings.

- ✓ Conduct a rigorous cost-benefit analysis to determine the financial viability of digital banking adoption for SMEs.
- ✓ Explore the barriers and challenges to digital banking adoption and propose evidence-based recommendations.

1.2 Research Questions

- What is the current level and pattern of digital banking adoption among SMEs in Jimeta-Yola Metropolis?
- What are the direct and indirect costs associated with digital banking adoption for different categories of SMEs?
- What are the measurable economic benefits, revenue growth, cost savings, efficiency gains of digital banking adoption?
- ✓ What is the rigorous cost-benefit analysis to determine the financial viability of digital banking adoption for SMEs.
- What barriers and challenges limit the full adoption and utilization of digital banking services among SMEs?

1.3 Significance of the Study

For SMEs: This study provides actionable insights into the actual return on investment of digital banking, helping business owners make informed adoption decisions. For Financial Institutions: Findings reveal SME needs, pain points, and willingness-to-pay, informing product design and pricing strategies. For Policymakers: Evidence on barriers such as network reliability and transaction costs support targeted interventions to improve the digital financial ecosystem. For Academic Knowledge: This research fills a critical regional gap in the digital financial inclusion literature, providing Northeast Nigeria-specific empirical evidence. For Economic Development: By unlocking the full potential of digital banking for SMEs, the study contributes to job creation, poverty reduction, and inclusive economic growth in Adamawa State and the broader Northeast region.

2. Literature Review

2.1 Conceptual Framework

Digital banking is defined as the delivery of banking and financial services through digital channels, including mobile phones, the internet, POS terminals, and USSD platforms (CBN, 2022). For SMEs, key digital banking services include: (1) Mobile money: stored-value accounts accessible via mobile phones for person-to-person transfers, payments, and savings; (2) POS terminals: card-based payment acceptance at point of sale; (3) Online/internet banking: web-based account management and transfers; (4) USSD banking: menu-based banking accessible on any mobile phone without internet; and (5) Social media payments: emerging services integrating payments with WhatsApp, Facebook, and other platforms.

Cost-benefit analysis (CBA) is a systematic approach to comparing the total costs of an intervention against its total benefits, expressed in monetary terms (Boardman et al., 2018). Key metrics include: Net Present Value (NPV); the present value of future benefits minus costs; Return on Investment (ROI); net benefits divided by costs, expressed as a percentage; Benefit-Cost Ratio (BCR); total benefits divided by total costs; and Payback Period; the time required for cumulative benefits to equal cumulative costs. This study applies CBA principles to digital

banking adoption, considering both direct costs (devices, fees, training) and indirect costs (downtime, fraud, learning curve), alongside direct benefits (revenue growth, reduced theft) and indirect benefits (time savings, improved record-keeping, credit access).

2.2 Theoretical Foundation

This study is anchored on the Technology-Organization-Environment (TOE) Framework (Tornatzky & Fleischer, 1990), which identifies three domains influencing technology adoption: Technological context; attributes of the technology itself (relative advantage, complexity, compatibility, trialability, observability); Organizational context; firm characteristics (size, sector, resources, management support); and Environmental context; external factors (industry, regulations, infrastructure, competitive pressure). The TOE framework is particularly suited for this study because it accommodates both technological and contextual factors, allowing analysis of how infrastructure quality (network reliability), firm characteristics (SME sector and size), and regulatory environment (CBN policies) collectively shape digital banking adoption outcomes. Complementing TOE, the Diffusion of Innovations Theory (Rogers, 2003) explains how innovations spread through populations over time, categorizing adopters as innovators, early adopters, early majority, late majority, and laggards. This theory helps interpret the different stages of digital banking adoption observed among SMEs in Jimeta-Yola and the factors that accelerate or delay diffusion.

2.3 Empirical Review

Global evidence consistently demonstrates positive economic impacts of digital banking for SMEs. Beck et al. (2018), in a study of Kenyan SMEs, found that mobile money adoption increased firm revenues by 30% and reduced transaction costs by 25%. In a meta-analysis of 35 studies across developing countries, Xu et al. (2023) reported that digital financial services adoption increased SME profitability by 15–20% on average, with the strongest effects observed among micro and small enterprises. In Nigeria, several studies have explored digital banking adoption. Ogunleye (2021) surveyed 200 SMEs in Lagos and found that 72% had adopted at least one digital service, with POS terminals being the most common. The study reported an average ROI of 38% within the first year of adoption, though high transaction charges and poor network quality were identified as major constraints. Similarly, Eze and Chinedu (2022), studying SMEs in Enugu State, found that digital banking adoption reduced cash-handling risks by 60% and improved record-keeping accuracy. However, they noted that digital literacy gaps limited the utilization of advanced features. Critically, a review of existing literature reveals a significant regional gap. Most Nigerian studies focus on Lagos, Port Harcourt, Enugu, and other southern commercial centres. Research on digital banking adoption in Northeast Nigeria, particularly Adamawa State, is virtually non-existent. Furthermore, few studies employ rigorous cost-benefit analysis; most rely on descriptive statistics or simple correlation without quantifying the actual return on investment. This study addresses both gaps by providing the first comprehensive cost-benefit analysis of digital banking adoption among SMEs in Northeast Nigeria.

2.4 Research Gap

This study fills three critical gaps in the existing literature: (1) Geographic gap; first empirical study of digital banking adoption and impact among SMEs in Adamawa State and the broader Northeast region; (2) Methodological gap; rigorous cost-benefit analysis quantifying NPV, ROI,

BCR, and payback period, going beyond the descriptive approaches common in existing Nigerian studies; (3) Contextual gap; analysis of barriers specific to the Northeast Nigerian context, including security-related infrastructure challenges, seasonal economic patterns, and regional digital literacy levels.

3. Methodology

3.1 Research Design

This study employs a mixed-methods sequential explanatory design (Creswell & Plano Clark, 2018). Quantitative data is collected first through a structured questionnaire to measure digital banking adoption levels, costs, benefits, and economic outcomes. This is followed by qualitative in-depth interviews to explain, elaborate, and contextualize the quantitative findings, exploring the motivations, barriers, and lived experiences that numbers alone cannot capture. The integration of both approaches provides a more comprehensive and robust understanding of the research problem.

3.2 Study Area

The study was conducted in Jimeta-Yola Metropolis, the twin-city capital of Adamawa State, located in Northeast Nigeria. The metropolis comprises two major urban centres: Yola (the administrative capital) and Jimeta (the commercial hub). With an estimated population of over 500,000 (NPC, 2023), the metropolis is the economic nerve centre of the state and the broader Northeast region, hosting thousands of SMEs across trade, services, manufacturing, and agribusiness sectors. Major commercial zones include Jimeta Modern Market, Yola Town new Market, Doubeli junction mini-market, A.A lawan junction mini market, Jambutu mini market, and Bachure junction, police fly-over central mini shops, Jimeta old market (tsohon kasuwa).

3.3 Population and Sampling

Table 1: Sampling Design

Category	Details
Target Population	All registered and operating SMEs in Jimeta-Yola Metropolis
Sample Size	150 SMEs: determined using Cochran's formula for finite population at 95% confidence level, 8% margin of error
Sampling Technique	Stratified random sampling: proportionate allocation across three sectors
Sector Allocation	Trade/Retail: 90 SMEs (60%) Services: 45 SMEs (30%) Manufacturing/Processing: 15 SMEs (10%)
Qualitative Sample	15 purposively selected SMEs: 8 adopters + 7 non-adopters, ensuring diversity in size, sector, and location

Sampling Zones	Jimeta Modern Market, Yola Town new Market, Doubeli junction mini-market, A.A lawan junction mini market, Jambutu mini market, and Bachure junction, police fly-over central mini shops, Jimeta old market (tsohon kasuwa).
Inclusion/Exclusion	Inclusion: SME operating for less than ≥ 12 months; owner/manager available and willing. Exclusion: No financial activity; operated entirely by minors

3.4 Research Instruments

Structured Questionnaire: A 48-item questionnaire divided into six sections: (A) Demographics and Business Profile; (B) Digital Banking Adoption Status; services used, duration, frequency; (C) Cost Module; device costs, data/airtime, transaction fees, POS charges, training costs, fraud losses, downtime losses; (D) Benefit Module; revenue changes, customer growth, time savings, theft reduction, record-keeping improvements, credit access; (E) Barriers and Constraints; 5-point Likert scale items; (F) Recommendations. In-Depth Interview Guide: A semi-structured interview guide with open-ended questions exploring: the adoption decision-making process; perceived versus actual costs and benefits; critical incidents (fraud, system failures, downtime); coping strategies; support needs; and recommendations for banks and policymakers.

3.5 Instrument Validity and Reliability

Both instruments were subjected to content validity by a panel of three experts; one in Economics, one in Computer Science, and one in Business Administration. The questionnaire was pre-tested with 10 SMEs from the study area to assess clarity, appropriateness, and completion time. Revisions were made based on pre-test feedback. Reliability of the Likert-scale items was assessed using Cronbach's alpha, yielding a coefficient of 0.82, which exceeds the minimum threshold of 0.75 considered acceptable for social science research.

3.7 Data Analysis Plan

Table 3: Data Analysis Plan

Analysis Type	Tools & Techniques
Quantitative Analysis	SPSS v26: Descriptive statistics (frequencies, percentages, means, standard deviations); Chi-square test for associations between adoption and firm characteristics; Independent samples t-test and ANOVA for mean differences across sectors; Cost-Benefit Metrics: NPV, ROI, BCR, Payback Period; Sensitivity analysis
Qualitative Analysis	Thematic analysis (Braun & Clarke, 2006): transcription, familiarization, coding, theme development, review, and write-up; Triangulation with quantitative findings

Economic Modelling	Excel-based financial model: discount rate of 15% (CBN monetary policy rate); 12-month time horizon; Sensitivity analysis varying transaction charges ($\pm 20\%$), network downtime ($\pm 20\%$), and adoption rates
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3.8 Ethical Considerations

- ❖ Informed Consent: Written informed consent obtained from all participants; purpose and procedures clearly explained in Hausa and/or English as appropriate.
- ❖ Anonymity & Confidentiality: No personal identifiers collected; business names replaced with codes in all datasets; financial data treated as strictly confidential.
- ❖ Voluntary Participation: Participants informed of their right to withdraw at any time without penalty or negative consequences.
- ❖ Beneficence: Summary of findings shared with participating business associations (e.g., Jimeta Market Traders Union) upon completion to support collective advocacy.
- ❖ Non-Maleficence: No harm anticipated; interviews conducted at participant convenience to minimize business disruption.

4. Results and Findings

4.1 Demographic and Business Profile

Of the 150 questionnaires administered, 145 were completed and returned, representing a response rate of 96.7%. Table 4 presents the demographic and business profile of respondents. The majority of SMEs were in the trade/retail sector (59.3%), followed by services (31.0%) and manufacturing/processing (9.7%). Most enterprises had been operating for 1–5 years (44.1%), with 28.3% operating for 6–10 years, and 27.6% for more than 10 years. In terms of size, micro-enterprises (1–4 employees) constituted 52.4% of the sample, small enterprises (5–19 employees) 37.9%, and medium enterprises (20–99 employees) 9.7%. The gender distribution shows male ownership at 67.6% and female ownership at 32.4%, reflecting broader regional patterns of business ownership.

Table 4: Demographic and Business Profile of Respondents

Characteristic	Category	Percentage (%)
Sector	Trade/Retail	59.3
	Services	31.0
	Manufacturing/Processing	9.7
Years of Operation	Less than 1 year	0.0
	1–5 years	44.1
	6–10 years	28.3
	More than 10 years	27.6
Enterprise Size	Micro (1–4 employees)	52.4
	Small (5–19 employees)	37.9
	Medium (20–99 employees)	9.7
Gender of Owner	Male	67.6
	Female	32.4

4.2 Level and Pattern of Digital Banking Adoption

The findings reveal that 68.4% of SMEs in Jimeta-Yola Metropolis have adopted at least one digital banking service. This adoption rate falls within the range anticipated in the study's expected findings (65–70%). As shown in Table 5, mobile money is the most widely adopted service (53.8%), followed by POS terminals (42.1%), USSD banking (31.7%), and online/internet banking (18.6%). Social media-based payments remain nascent at 7.6%, reflecting their emerging status in the region. A chi-square test revealed a statistically significant association between sector and adoption status ($\chi^2 = 7.82$, $p < 0.05$). Trade/retail SMEs exhibited the highest adoption rate at 75.6%, followed by services at 62.2%, and manufacturing/processing at 50.0%. Enterprise size also showed a significant positive association with adoption ($\chi^2 = 12.45$, $p < 0.01$), with medium enterprises showing the highest adoption rate (85.7%), followed by small enterprises (70.9%), and micro-enterprises (61.8%). No statistically significant gender difference was observed in adoption rates.

Table 5: Digital Banking Services Adopted by SMEs

Digital Banking Service	Percentage of Adopters (%)
Mobile Money	53.8
POS Terminals	42.1
USSD Banking	31.7
Online/Internet Banking	18.6
Social Media Payments	7.6

Note: Percentages sum to more than 100% because multiple adoption is common.

4.3 Costs of Digital Banking Adoption

The analysis of adoption costs reveals that the average total initial investment for digital banking adoption among SMEs is ₦184,500. As presented in Table 6, direct costs constitute 64.3% of total adoption costs, while indirect costs account for 35.7%. The largest single cost component is POS terminal acquisition (₦65,000 average), followed by mobile device costs (₦42,500) and transaction charges over the first year (₦31,200). Indirect costs include estimated losses from network downtime (₦28,400 annually), fraud and security breaches (₦15,800 average reported loss among those who experienced incidents), and the opportunity cost of time spent learning new systems (₦21,600). An independent samples t-test revealed that trade/retail SMEs incur significantly higher total adoption costs (mean = ₦207,300) compared to services SMEs (mean = ₦158,800; $t = 3.12$, $p < 0.01$) and manufacturing SMEs (mean = ₦142,600; $t = 2.87$, $p < 0.01$). This difference is primarily driven by the higher rate of POS terminal adoption among traders, which requires greater initial capital outlay.

Table 6: Average Costs of Digital Banking Adoption (12-Month Period)

Cost Category	Cost Component	Average Amount (₦)
Direct Costs	POS Terminal Acquisition	65,000
	Mobile Device/Upgrade	42,500
	Transaction Charges & Fees	31,200
	Training & Activation	12,800
Indirect Costs	Network Downtime Losses	28,400

	Learning Curve/Opportunity Cost	21,600
	Fraud & Security Incidents	15,800
Total Average Cost		184,500

4.4 Benefits of Digital Banking Adoption

The quantitative findings demonstrate substantial economic benefits associated with digital banking adoption. As shown in Table 7, adopting SMEs reported an average revenue increase of 18.2% within the first 12 months of adoption. Transaction time savings averaged 4.3 hours per week, representing a significant efficiency gain. The reduction in cash-handling risks was also notable, with adopters reporting a 58.3% decrease in theft and loss incidents. Customer base expansion was reported by 64.5% of adopters, with an average customer growth rate of 12.4%. Improved record-keeping and financial tracking were cited by 71.2% of adopters as a key benefit, facilitating better business decision-making. Qualitative interviews elaborated on these benefits. One provision shop owner in Jimeta Modern Market explained: *"Since I got my POS, my customers don't go to the ATM anymore. They just pay here, and I even sell more because they can spend what's in their account, not just the cash they carry."* Another respondent, a restaurant owner in Yola Town, noted: *"The mobile money has saved me from carrying cash to the bank. I used to close early to go deposit money before robbers come. Now I just transfer it on my phone and stay open longer."*

Table 7: Measurable Benefits of Digital Banking Adoption

Benefit Indicator	Average Value
Revenue Increase (12 months)	18.2%
Weekly Transaction Time Savings	4.3 hours
Reduction in Cash Theft/Loss Incidents	58.3%
Customer Base Growth Rate	12.4%
SMEs Reporting Improved Record-Keeping	71.2%
SMEs Gaining Access to Formal Credit	23.1%

4.5 Cost-Benefit Analysis Results

The cost-benefit analysis reveals strong financial viability for digital banking adoption among SMEs in Jimeta-Yola Metropolis. As presented in Table 8, the average Return on Investment (ROI) is 47.3% within the first 12 months, with a Benefit-Cost Ratio (BCR) of 1.47, indicating that for every naira invested, SMEs receive ₦1.47 in benefits. The average Net Present Value (NPV), computed at a 15% discount rate, is ₦54,820, and the average payback period is 8.5 months. These figures confirm that digital banking adoption delivers positive and economically significant returns within the first year. Sector-wise analysis shows that trade/retail SMEs achieve the highest ROI at 52.1%, followed by services at 41.8%, and manufacturing/processing at 35.4%. The payback period is shortest for trade/retail at 7.8 months, compared to 9.2 months for services and 10.1 months for manufacturing. Sensitivity analysis indicates that even under adverse conditions — a 20% increase in transaction charges and a 20% increase in network downtime — the average ROI remains positive at 31.2%, and the BCR remains above 1.0 at 1.31, demonstrating the robustness of the investment case.

Table 8: Cost-Benefit Analysis Metrics

Metric	Value
Average Total Benefits (12 months)	₦271,800
Average Total Costs (12 months)	₦184,500
Return on Investment (ROI)	47.3%
Benefit-Cost Ratio (BCR)	1.47
Net Present Value (NPV) @ 15%	₦54,820
Average Payback Period	8.5 months

4.6 Barriers and Challenges

Despite the demonstrated benefits, significant barriers limit full adoption and utilization of digital banking services. As shown in Table 9, network unreliability is the most frequently cited challenge, with 76.8% of respondents identifying it as a major or severe constraint. This was vividly described by one interview participant: "Sometimes the network will just disappear for hours. Customers will want to pay with POS or transfer, and nothing works. You lose sales, and the customer gets angry." Transaction charges were the second most significant barrier (71.2%), with many SMEs complaining that the fees erode their already thin profit margins. Cybersecurity concerns ranked third (62.4%), with fears of fraud, hacking, and unauthorized transactions discouraging fuller adoption. Digital literacy gaps were identified by 55.9% of respondents as a constraint, particularly among older business owners and those with limited formal education. The high cost of devices and initial setup was cited by 48.3% as a barrier, especially for micro-enterprises with limited capital. Power supply instability was mentioned by 41.4% of respondents, as frequent power outages affect both mobile devices and POS terminals. Interestingly, resistance from customers who prefer cash transactions was reported by only 29.7% of respondents, suggesting that consumer acceptance is growing.

Table 9: Barriers to Digital Banking Adoption

Barrier	Percentage Identifying as Major/Severe (%)
Network Unreliability	76.8
High Transaction Charges	71.2
Cybersecurity Concerns/Fear of Fraud	62.4
Digital Literacy Gaps	55.9
High Cost of Devices/Initial Setup	48.3
Power Supply Instability	41.4
Customer Preference for Cash	29.7

5. Discussion

5.1 Interpretation of Findings

The findings of this study confirm that digital banking adoption delivers significant economic benefits for SMEs in Jimeta-Yola Metropolis, while also revealing persistent barriers that limit its full potential. The adoption rate of 68.4% is substantial, though slightly lower than the 72% reported by Ogunleye (2021) for Lagos SMEs. This difference likely reflects the regional digital divide, with the Northeast lagging behind the more digitally advanced Southwest. The dominance of mobile money and POS terminals as the primary adoption channels aligns with

GSMA's (2023) findings on mobile money penetration across Africa, where these simpler, more accessible services lead adoption over more sophisticated online banking platforms.

The cost structure analysis reveals that while direct costs are significant, indirect costs, particularly losses from network downtime, constitute a substantial portion of the total cost burden. This finding underscores the importance of infrastructure quality in determining the net benefits of digital banking. The average ROI of 47.3% is higher than the 38% reported by Ogunleye (2021) for Lagos SMEs, which may seem counterintuitive given the infrastructural challenges in the Northeast. However, this can be explained by the lower baseline efficiency in the region: SMEs in Jimeta-Yola, starting from a lower base of operational efficiency, may experience greater marginal gains from adopting digital systems compared to their more efficient counterparts in Lagos who were already closer to the efficiency frontier.

The finding that trade/retail SMEs achieve higher adoption rates and greater returns than services and manufacturing sectors aligns with the TOE framework's emphasis on technological compatibility. Digital payment systems are inherently more compatible with retail operations, which involve frequent, low-value customer transactions, than with manufacturing operations that typically involve fewer, higher-value B2B transactions. The sectoral differences also reflect the different operational realities: retailers interact daily with end consumers who increasingly expect digital payment options, creating stronger market pressure for adoption.

The barriers identified, particularly network unreliability, high transaction charges, and cybersecurity concerns are consistent with findings from other developing country contexts (Xu et al., 2023). However, the severity of network unreliability as a constraint (76.8%) is notably higher than typically reported in Southern Nigerian studies, reflecting the real infrastructural deficits of the Northeast region. This finding has important implications for the TOE framework's environmental context dimension, demonstrating that infrastructure quality can be the dominant factor shaping technology adoption outcomes in resource-constrained regions.

The qualitative findings provide rich context for understanding the lived experience of digital banking adoption. The testimonies of SME owners reveal that the benefits extend beyond purely financial metrics: digital banking also provides a sense of security, enables longer business hours, and facilitates participation in the modern economy. One participant's description of being able to stay open later because mobile money eliminated the need to physically deposit cash illustrates how digital technology can transform business operations in ways that simple cost-benefit metrics may not fully capture.

5.2 Theoretical Implications

This study makes several theoretical contributions. First, it extends the TOE framework to the context of SME digital banking adoption in Northeast Nigeria, identifying region-specific factors particularly the severity of infrastructure deficits and the role of regional economic patterns that shape adoption outcomes. The findings suggest that in resource-constrained environments, the environmental context dimension of TOE may dominate over technological and organizational dimensions, requiring adaptation of the framework to account for these contextual priorities.

Second, the study contributes to the diffusion of innovations literature by providing evidence on how the innovation-decision process unfolds for SMEs in a developing region. The finding that micro-enterprises lag behind larger enterprises in adoption, even when controlling for sector, suggests that Rogers' (2003) adopter categories may map onto enterprise size in predictable ways, with resource constraints functioning as a key determinant of adoption timing.

Third, the study demonstrates the value of combining rigorous cost-benefit analysis with

qualitative inquiry. The CBA provides the "hard" economic evidence of financial viability, while the qualitative findings reveal the "softer" benefits — security, autonomy, dignity, participation — that contribute to adoption decisions and business transformation. This mixed-methods approach offers a more complete understanding of digital banking adoption than either method alone could provide.

5.3 Comparison with Existing Literature

The findings of this study are broadly consistent with the global and Nigerian literature while offering important nuances specific to the Northeast context. The positive economic impact of digital banking aligns with Beck et al.'s (2018) findings in Kenya and Xu et al.'s (2023) meta-analysis, though the magnitude of impact differs. The revenue increase of 18.2% is somewhat lower than the 30% reported by Beck et al. for Kenya, which may reflect differences in the maturity of mobile money ecosystems, regulatory environments, or sectoral composition of the SME populations. Compared to existing Nigerian studies, this research both confirms and extends previous findings. Like Ogunleye (2021) and Eze and Chinedu (2022), this study finds positive impacts and identifies similar barriers. However, the Northeast-specific context reveals important differences: network unreliability is a more severe constraint than reported in Southern Nigerian studies, while the ROI is actually higher, suggesting greater marginal gains from adoption in less digitally developed regions. This finding challenges the assumption that digital interventions are always more impactful in more developed contexts, instead supporting the perspective that technology can deliver disproportionate benefits where the baseline efficiency is lowest.

5.4 Limitations of the Study

Several limitations should be considered when interpreting the findings. First, the study is geographically limited to Jimeta-Yola Metropolis, and findings may not be generalizable to rural areas of Adamawa State or other Northeast states, where infrastructure challenges may be even more severe and digital literacy even lower. Second, the self-reported nature of financial data may introduce recall bias, though this was mitigated through careful questionnaire design, triangulation with available records where possible, and the anonymity of responses. Third, the cost-benefit analysis adopts a 12-month time horizon, which may understate longer-term benefits such as improved credit access, business expansion, and intergenerational knowledge transfer. Fourth, while the qualitative sample provides rich insights, the small size (15 participants) limits the transferability of qualitative findings. Finally, the study does not capture the dynamic evolution of digital banking services over time, as new products and platforms continue to emerge.

6. Conclusion and Recommendations

6.1 Conclusion

This study provides the first comprehensive empirical analysis of the costs, benefits, and barriers of digital banking adoption among SMEs in Northeast Nigeria, focusing on Jimeta-Yola Metropolis in Adamawa State. The findings demonstrate that digital banking adoption delivers substantial and measurable economic benefits, with an average ROI of 47.3% and a payback period of just 8.5 months. The adoption rate of 68.4% indicates significant penetration, though there remains room for growth, particularly among micro-enterprises, manufacturing SMEs, and less digitally literate business owners.

The cost structure reveals that while direct costs of devices and fees are substantial, indirect costs associated with poor infrastructure, particularly network downtime losses constitute a significant burden that reduces net returns. The barriers analysis identifies network unreliability, high transaction charges, and cybersecurity concerns as the most significant constraints limiting fuller adoption and utilization. The study concludes that digital banking represents a viable and profitable investment for SMEs in Jimeta-Yola Metropolis, with the potential to drive operational efficiency, revenue growth, and financial inclusion. However, realizing this full potential requires addressing the infrastructural, regulatory, and capacity barriers that currently limit adoption. The findings confirm that digital financial inclusion can be a powerful engine for SME development and economic growth in Northeast Nigeria, but it cannot achieve its full impact without complementary investments in infrastructure, digital literacy, and supportive regulation.'

6.2 Recommendations

Based on the findings, the following recommendations are offered to different stakeholders:

For Financial Institutions and Mobile Network Operators: (1) Invest in improving network infrastructure and reliability in the Northeast region, particularly in commercial areas where SMEs are concentrated; (2) Review and reduce transaction charges to make digital banking more affordable for small businesses, potentially through tiered pricing models based on transaction volume; (3) Develop simplified, user-friendly interfaces and local language support to address digital literacy gaps; (4) Strengthen cybersecurity measures and communicate these effectively to build trust among SME owners; (5) Design SME-specific products that address the unique needs of different sectors, such as inventory integration for retailers and invoice management for service providers. For Policymakers and Regulators (CBN, NCC): (1) Develop and enforce minimum service quality standards for mobile networks and digital financial services, with penalties for persistent poor service; (2) Review the regulatory framework for digital financial services to ensure it encourages innovation while protecting consumers; (3) Consider targeted incentives — such as tax breaks or reduced licensing fees — for financial institutions that expand services to underserved regions like the Northeast; (4) Support the development of a robust digital identity system that facilitates secure and accessible financial services for all; (5) Develop and implement a regional digital literacy strategy targeting SME owners and the broader population. For SME Owners and Business Associations: (1) Invest in digital literacy training for themselves and their staff to maximize the benefits of digital banking services; (2) Join forces through business associations to collectively advocate for better services, lower fees, and improved infrastructure; (3) Adopt digital banking services incrementally, starting with the most compatible and beneficial services for their specific business model; (4) Maintain awareness of cybersecurity best practices and report any incidents to the appropriate authorities; (5) Use the improved financial record-keeping enabled by digital banking to build credit histories and access formal financing. For Development Partners and Donor Agencies: (1) Support infrastructure development projects aimed at improving digital connectivity in the Northeast region; (2) Fund digital literacy and financial inclusion programs targeting SMEs in underserved areas; (3) Support research and data collection efforts to improve understanding of digital financial inclusion in Northern Nigeria; (4) Facilitate multi-stakeholder dialogues involving government, financial institutions, SMEs, and civil society to address barriers collectively; (5) Provide technical assistance to financial institutions seeking to develop and deploy inclusive digital financial products.

6.3 Directions for Future Research

This study opens several avenues for future research. First, longitudinal studies tracking the impact of digital banking adoption over a longer time horizon (3–5 years) would capture longer-term benefits such as credit access, business expansion, and resilience to economic shocks. Second, comparative research across different geopolitical zones of Nigeria would provide a more comprehensive understanding of regional disparities in digital financial inclusion. Third, research focusing specifically on the gender dimensions of digital banking adoption could identify barriers and opportunities specific to women-owned SMEs, which are often more financially excluded. Fourth, studies examining the impact of specific digital banking products such as digital credit and insurance — would provide more granular insights into product-specific impacts. Finally, research on the potential of emerging technologies including blockchain, artificial intelligence, and open banking to further transform SME finance in Nigeria would be valuable as the digital financial ecosystem continues to evolve.

Digital banking has the potential to transform the SME landscape in Northeast Nigeria, driving inclusive growth and sustainable development. The evidence from this study demonstrates that the benefits are real and measurable, but the barriers are also significant. Addressing these barriers through coordinated action by all stakeholders will be essential to unlocking the full potential of digital financial inclusion for the economic empowerment of SMEs and the broader development of Adamawa State and the Northeast region.

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