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Impact of e-banking on bank productivity in Nigeria

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Abstract

Electronic banking's quick uptake has changed how banks function and interact with their clients, revolutionizing the worldwide financial services industry. This study looks into how Nigerian banks' productivity is affected by electronic banking technology, such as internet banking, mobile banking, point of sale systems, and automated teller machines. There is continuous discussion about their actual impact on financial performance, even though they are widely used. The study, which uses data from 2012 to 2024 and using sophisticated statistical methods, concludes that increased productivity is closely correlated with growth in total bank deposits. When other factors are taken into account, however, the implementation of particular electronic banking systems by itself does not always result in increased productivity. In order to achieve efficiency advantages, these findings imply that infrastructure upgrades, personnel training, and efficient management must be implemented in addition to technology adoption. Future research into dynamic models and contextual drivers of digital transformation is encouraged by the study, which also suggests strategic integration of electronic financial services backed by regulatory measures to optimize their benefits.

Keywords: Automated teller machine, e-banking, bank productivity, point-of-sale.

1. Introduction

Electronic banking (e-banking), which combines services like ATMs, mobile banking, internet banking, point-of-sale (POS), and electronic transfers to increase convenience, lower costs, and boost efficiency, has completely changed the financial services sector. In order to satisfy the growing demands of consumers for speed, accessibility, and dependability while optimizing operations and cutting expenses, banks worldwide have been investing more and more in digital platforms. Although some studies, like Yang et al. (2023), highlight improved performance indicators like ROE and ROA, other studies show contradictory results, particularly in developing economies where high technological costs and infrastructural deficiencies may offset potential gains (Adewoye, 2013). Because of the ongoing difficulties with financial inclusion, e-banking plays an especially important role in Nigeria. Since many people lack access to banking, mobile and internet technologies present chances to increase financial access and boost bank efficiency. Still, a major problem is striking a balance between adoption costs, cybersecurity threats, and actual productivity gains.

Additionally, by combining online, offline, and mobile platforms, e-banking has changed the way services are delivered from single-channel to multi-channel and even omni-channel platforms (Kegan et al., 2005). By automating repetitive procedures like fraud detection,

loan processing, and account administration, these advances help banks deploy resources more effectively. AI-powered platforms, for example, are now able to evaluate massive amounts of data in real time, improving decision-making and risk management. This shift was hastened by the COVID-19 epidemic, underscoring the value of digital platforms in maintaining continuity and encouraging cashless transactions. The rapid adoption of electronic banking has significantly transformed the Nigerian financial sector. The financial system in Nigeria has undergone tremendous change as a result of the quick adoption of electronic banking. For example, Zenith Bank has enhanced operational efficiency and customer satisfaction by reducing reconciliation errors by 62% through the use of real-time digital technology (International Banker, 2025). More than 90% of Nigerian banks have adopted digital platforms, thanks to the Central Bank of Nigeria's regulatory assistance, broad fintech innovation, and rising smartphone usage (6W Research, 2024; CBN, 2024). At the same time, automated teller machines, point-of-sale systems, mobile, and internet banking have significantly reduced transaction times, which were previously on average 15 minutes, to less than 90 seconds (CBN, 2024). Mobile money services like Kenya's M-Pesa have been crucial in lowering operating costs, increasing financial inclusion, and facilitating the expansion of small businesses throughout Africa, underscoring the wide-ranging economic advantages of e-banking (World Bank, 2019; Brookings, 2023). The equitable access to digital financial services is, however, restricted by these developments' drawbacks, which include data privacy issues, heightened cyberthreats, and a persistent digital divide, particularly in rural areas without dependable internet and electricity infrastructure (Nigeria Digital Banking Platforms Report, 2024; TechCabal, 2023). Furthermore, the public's fear of digital financial services is exacerbated by concerns about data privacy and cybersecurity, and regulatory frameworks are still disjointed and frequently lack the rigor required to promote confidence and security on digital platforms (CGAP, 2022; TechCabal, 2023). In order to fully realize the potential of digital finance for equitable growth throughout West Africa, these limitations underscore the urgent need for coordinated policy harmonization, digital literacy initiatives, and investments in basic infrastructure.

West African governments, particularly those in Nigeria, Ghana, and Côte d'Ivoire, are making the promotion of digital financial services a higher priority as part of larger initiatives to increase financial inclusion and economic productivity. The reliance on costly physical bank branches and infrastructure is significantly reduced thanks to these policies, which allow rural customers to access banking services through USSD codes and mobile banking applications (West Africa Regional Digital Integration Program, World Bank, 2022). Despite significant technological advancements and regulatory support, the widespread adoption and efficacy of digital financial services are hindered by infrastructure issues like inconsistent internet connectivity and frequent power outages, which disproportionately affect rural and disadvantaged areas (Nkechika, 2022; Central Bank of Nigeria, 2024).

Notwithstanding these drawbacks, e-banking has demonstrated the ability to lower overhead expenses, boost productivity, and expand clientele, which is consistent with research by Aduda and Kingoo (2012) showing that internet-driven innovations increase operational efficiency and economies of scale. As banks modernize to satisfy changing client expectations, it is critical for Nigeria to assess the productivity benefit of e-

banking. Although e-banking has the potential to improve productivity, profitability, and inclusivity, the advantages are not uniform and rely significantly on regulatory supervision, efficient integration techniques, and supporting infrastructure. Therefore, this study looks at how e-banking affects Nigerian banks' productivity and offers guidance to financial institutions and policymakers on how to best implement digital transformation.

2. Literature Review

Automated Teller Machine (ATMs)

According to Flitch (2000), an ATM is a device that may provide a receipt and be used to make cash transactions using an ATM card. Customers can check their account balances, make payments, deposit money, and withdraw money via the ATM, which is connected to their bank account. Because they charge fees for using ATMs, banks benefit from them, which helps to improve their financial performance. Additionally, according to Cracknell (2004), banks have been able to save money by reducing expenses since the advent of ATMs. This is because most consumers won't need to visit bank branches very often, and using ATMs doesn't require additional staff to operate them. Additionally, ATMs can be placed strategically in a variety of locations, enhancing customer access to banking services. Information gleaned from Flitch's (2000) research indicates that using ATMs helps increase operational capacity while simultaneously expanding into new markets. Furthermore, it is believed that the use of ATMs has greatly enhanced bank performance since their prices and expenses have decreased (Cracknell, 2004). Additionally, expanding the availability of e-banking services like ATMs is more likely to satisfy future growth in the demand for banking services. Therefore, it is appropriate to draw the conclusion that ATM use has a positive impact on reducing expenses, serving a large number of users simultaneously, and enhancing revenue sources. Mobile banking is the practice of conducting credit transactions, payments, account transactions, checking account balances, and other banking operations using a personal digital assistant in conjunction with mobile communications devices. Three key components of mobile financial information services—mobile brokerage, mobile accounting, and mobile banking applications—are the primary focus of mobile banking application utilization, according to Muriuki (2009). Furthermore, more than two out of five people have access to mobile banking, according to Muriuki (2009), who also argues that there has been a notable increase in the creation and usage of mobile banking applications.

Point-of-Sales (POS)

Typically, the Point of Sales (POS) system consists of a computer connected to a barcode scanner and printer. Special POS software is installed on the computer. POS systems can be made to stand alone (not connected to other POS systems) or can be designed to connect to other POS systems as needed, both locally and over the Internet. Examples of these include transaction cashiers or payment points in supermarkets, mini markets, hotels, restaurants, and many more. It is more difficult to apply for movable merchants because the traditional point-of-sale (TPOS) is not portable. A cash register can be replaced by a computerized point-of-sale (POS) terminal. The POS system is significantly more advanced than the cash registers of even a few years ago since it can record and track customer orders, accept credit and debit cards, connect to other systems in a network, and manage inventory. A personal computer, which is equipped with I/O devices and software specific to the environment it will be used in, is

frequently the basic component of a point-of-sale terminal. In a restaurant's point-of-sale system, for example, every menu item is most likely stored in a database that is accessible in a number of ways. POS terminals are used by the majority of establishments that have a point of sale, such as service desks, such as restaurants, lodging facilities, entertainment centers, and museums Wikipedia.org (2017). POS, a cashless policy variable, significantly impacted agricultural sector output, according to Okuma, Nwoko, and Obialor's [2023] study on the causal relationship between cashless policy technology and agricultural sector output in Nigeria.

Electronic funds transfers

According to Bahia (2007), electronic funds transfer (EFT) is the process of moving money between accounts within a single financial institution or between numerous institutions using computer-based technologies. EFT can be carried out in a number of ways, including through electronic terminals, ATMs, credit cards, and point-of-sale (POS) systems. Since EFT has made it easier to pay for transactions like bills and online purchases, retailers and other non-financial businesses have greatly profited from it. However, it is noteworthy for its enhanced security, streamlined bookkeeping, boosted productivity, and reduced administrative expenses. However, the number of clients who use this service and the volume of transactions they undertake will determine how much banks will profit from it. improved security, streamlined bookkeeping, and increased efficiency. EFT will improve bank performance through higher transaction volume and service fees, just like any other e-banking service.

E-banking and Electronic Banking

E-banking, also known as electronic banking, has revolutionized the financial services industry worldwide. It encompasses a range of digital services, including internet banking, mobile banking, automated teller machines (ATMs), and point-of-sale (POS) systems. The adoption of e-banking has been driven by technological advancements, increasing internet penetration, and changing consumer preferences for convenience and efficiency. In developed countries like the United States, the United Kingdom, and Germany, e-banking adoption is nearly universal. For instance, a report by the Federal Reserve (2022) found that 82% of Americans use online banking services, with mobile banking usage increasing by 15% annually. E-banking, or electronic banking, has transformed the global financial landscape by enabling customers to conduct transactions digitally through platforms such as internet banking, mobile banking, ATMs, and point-of-sale (POS) systems. In developed economies like the United States and the European Union, e-banking adoption is nearly universal, with over 80% of adults using online banking services (Federal Reserve, 2022). These regions have benefited from advanced technological infrastructure, high internet penetration, and supportive regulatory frameworks, such as the EU's Payment Services Directive 2 (PSD2), which promotes open banking and innovation (Ardizzi et al., 2019). In contrast, developing economies have seen rapid growth in e-banking due to mobile phone penetration and government initiatives to promote financial inclusion. For instance, Kenya's M-Pesa mobile money platform has revolutionized banking, with over 80% of adults using mobile banking services (GSMA, 2021). In Asia, e-banking has become a cornerstone of financial systems, particularly in countries like China and India. China's Alipay and WeChat Pay dominate the market, offering integrated services that combine payments, social media, and banking (Chen et al., 2020). India's Unified Payments Interface (UPI)

has also been transformative, enabling instant peer-to-peer transactions and reducing reliance on cash (Dubey & Sharma, 2022). Similarly, in Latin America, countries like Brazil and Mexico are experiencing rapid e-banking growth, driven by fintech innovations and government initiatives. Brazil's Pix instant payment system, for example, has become a global benchmark for digital payments, significantly reducing transaction costs and increasing financial inclusion (GSMA, 2021). These regional successes highlight the potential of e-banking to bridge gaps in financial access and improve economic efficiency. Despite its benefits, e-banking faces challenges such as cybersecurity risks, regulatory inconsistencies, and the digital divide. Cybersecurity threats, including phishing and data breaches, are a major concern, particularly as financial transactions increasingly move online (Dubey & Sharma, 2022). Additionally, the lack of internet access and digital literacy in rural and underserved areas hinders e-banking adoption, exacerbating financial exclusion (GSMA, 2021). Regulatory challenges also persist, as differing data protection laws and anti-money laundering regulations across countries create operational complexities for banks (Chen et al., 2020). Addressing these challenges requires coordinated efforts from governments, financial institutions, and technology providers to ensure the sustainable growth of e-banking worldwide.

Benefits of the adoption of e-banking

First and foremost, it should be mentioned that e-banking offers numerous advantages to customers in addition to banks. Therefore, depending on one's point of view, attempts to investigate who gains from the use of online banking will vary. However, a large portion of this study's work will be grounded in the banks' viewpoint. Increased servicing capacity is one way that e-banking can help banks (Okiro & Ndungu, 2013). In other words, the capacity to serve a large number of clients in a brief amount of time.This is mostly due to the fact that e-banking makes it possible for banks to contact a larger number of people in various locations and at various times of day, which makes it one of the most effective strategies for fending off pressure from competitors. Second, banks can engage in what is referred to as geographical penetration and diversification through the use of e-banking. Banks will be able to provide services to markets outside of their geographic area.Furthermore, banks may easily offer other financial services thanks to e-banking, which helps them mitigate the risk of other services failing. Thirdly, e-banking can be linked to efficiency, flexibility, and convenience. This is due to the fact that clients will be able to conduct financial transactions at anytime, anywhere, and at any time of day (Bahia, 2007). Fourth, according to Meute (2010), e-banking allows banks to react quickly to the requirements and questions of their customers. Because of this, banks that provide e-banking services are frequently innovative banking leaders and are thought to be very sensitive to the requirements and desires of their customers. Fifth, e-banking benefits banks by enabling them to reduce expenses like rent, salary, and wages, according to Okiro and Ndungu (2013). Banks that can cut costs are well-positioned to benefit from the market, as banking expenses are one of the main issues affecting bank performance. Therefore, e-banking can be seen as a way for banks to operate more efficiently, increase profits, and reduce expenses. The last point is that banks may gain from e-banking in terms of increased income (Muriuki, 2009). This is mostly because banks will have the ability to charge for using e-banking services. Consequently, as the number of customers using e-banking increases, so will the

volume and utilization of e-banking services, which will improve bank profitability. Even with all of these advantages, it is important to remember that e-banking may have drawbacks for banks and that its potential benefits are contingent on certain factors. For example, charging exorbitant service rates may actually lead to higher operating expenses, which may lower profitability levels.

Challenges of the adoption of E-Banking

E-banking, while transformative, faces several significant challenges that hinder its full potential. One of the most pressing issues is cybersecurity risks. As financial transactions increasingly move online, banks and customers are exposed to threats such as phishing, malware, and data breaches. For instance, Dubey and Sharma (2022) highlight that cyberattacks on e-banking systems have surged, compromising sensitive customer data and eroding trust. Additionally, the digital divide remains a barrier, particularly in developing regions. Limited internet access, inadequate infrastructure, and low digital literacy prevent widespread adoption of e-banking services, especially in rural and underserved areas (GSMA, 2021). This disparity exacerbates financial exclusion, as those without access to digital tools are unable to benefit from e-banking innovations.

Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM) explains how individuals accept and use technology. Developed by Davis (1989), TAM extends the Theory of Reasoned Action (TRA) by highlighting that external factors influence beliefs, attitudes, and behavioral intentions toward ICT. It emphasizes *perceived ease of use* and *perceived usefulness* as critical drivers of technology adoption. The easier and more useful individuals perceive a technology, the stronger their attitude and intention to adopt it, which eventually determines actual use (Legris, Ingham & Collerette, 2003; Malhotra & Singh, 2009). Thus, TAM provides a framework for understanding how e-banking adoption may influence bank performance.

Innovation Diffusion Theory

Rogers' (1995) Innovation Diffusion Theory views new technology as an innovation that spreads through society in an S-shaped adoption pattern. Adoption depends on access to information, cost-benefit analysis, and the degree of uncertainty surrounding the innovation (Bahia, 2007; Okiro & Ndungu, 2013). Early adopters play a critical role in shaping diffusion, while adoption rates vary depending on communication, personality, and socioeconomic factors (Muriuki, 2009). The theory helps explain the stages through which customers embrace e-banking technologies such as ATMs, POS, and mobile banking.

Several studies provide insights into the relationship between e-banking and bank performance. In Nigeria, Gbanador (2023) found that while ATMs and POS had insignificant short-run effects on Deposit Money Banks (DMBs), mobile banking significantly improved long-run performance. Similarly, Okonkwo and Ekwueme (2022) confirmed that ATMs and POS positively affected return on assets (ROA) and earnings per share (EPS), though web banking had little impact. Madugba et al. (2021) observed that ATMs positively influenced ROA, whereas POS had a negative effect, emphasizing the need for customer education. Nwakoby et al. (2022) further noted that ATMs negatively affected return on equity, while mobile banking improved it. Muotolu and Nwadialor (2019) highlighted that ATMs significantly enhanced ROA, though other channels had insignificant effects. Kenyan evidence shows similar trends. Kimere (2022) found mobile banking significantly boosted microfinance institutions' ROA, while ATMs and internet banking showed

insignificant influence. Odhiambo and Ngaba (2022) reported that ATMs, internet, mobile, and agency banking all significantly enhanced bank performance. Mixed results also appear in Nigeria. Nwankwo and Agbo (2021) reported that ATMs had a positive and significant effect on commercial bank performance, but POS and mobile banking had weak negative effects. Ibrahim et al. (2019) found e-banking improved operational efficiency, reducing service time and costs. Likewise, Ahmadu (2014) showed that mobile and internet banking positively influenced deposits and assets. Recent research expands the scope. Etom (2025) highlighted that digital finance promotes financial inclusion in Uganda, with mobile money as a key driver. El-Yaqub (2025) noted that digital currency negatively affects deposit money banks in Nigeria despite positive links with money supply. Gbenga (2024) demonstrated that digital finance transactions positively impact stock market capitalization in Nigeria.

3. Methodology

The design was chosen in light of the study's nature, which necessitates gathering information on past occurrences. The Central Bank of Nigeria (CBN) statistics provided the majority of the data used in this paper. The information gathered included the return on assets (ROA) of the performing banks as well as the transactions of commercial banks through electronic channels, such as checks and Point of Sale (POS) devices. The Dynamic Ordinary Least Squares (DOLS) analysis of the constructed approach is the statistical model selected for the analysis. By handling tiny samples and dynamic sources of bias, the technique enhances OLS. Furthermore, it shares the Johansen distribution's asymptotic optimality characteristics. Furthermore, using STATA23 software to determine the amount of leads and lags lacks a theoretical foundation. In this study, two sets of hypotheses were put forward for verification.

The study extracted data from published annual reports and accounts of listed deposit money banks for the years covered by the study (2012-2024) 2012 was chosen as the starting year following the adoption of IFRS in Nigeria. Quantitative data will be obtained from the financial statements of sample banks as variables used in the study.

This research work adopted Oniore and Okoli (2019) approach with slide modification of the model for the relationship between electronic banking and bank performance in Nigeria. More so, the theoretical framework of the Technology Acceptance Model (TAT) was adopted. The variables of concern are return on assets (ROA), number of active customers using internet banking (NAC), bank deposits (GBD), bank loans (LNS), liquid assets (LA), and bank size (BS). The following regression expression was used to form the base of the estimation process;

$$ROA = \beta 0 + \beta 1NAC + \beta 2BP + \beta 3LNS + \beta 4LA + \beta 5LBS + \mu \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

4. Results and Discussion

Descriptive statistics

The table below presents descriptive analysis results showing the mean, standard deviation, minimum, and maximum values for each of the variables included in the Impact of electronic banking on banks productivity in Nigeria. Descriptive statistics deals with describing a collection of data by condensing the amounts of data into simple representative numerical quantities or plots that can provide a better understanding of the collected data. Consequently, the descriptive statistics for the measures of electronic banking on banks' productivity in Nigeria are presented in the Table 1.

Table 1: Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
ROA	156	.2344494	1.85302	-.0516207	17.47008
GBD	153	10.55719	.7216803	8.493141	12.01406
LNS	156	11.28285	.6882744	7.900695	14.47
LA	156	11.3212	.6885825	9.106638	12.60523
BS	156	12.27807	.6878982	9.499412	13.61803

Source: Author's Computation, 2025.

The descriptive statistics show sharp contrasts among variables. Return on Assets (ROA) has a mean of 0.234 but an unusually high standard deviation (1.853), reflecting extreme volatility. With values ranging from -0.052 to 17.47, ROA includes both losses and outliers with very high returns, suggesting skewness and firm-specific shocks. In contrast, GBD, LNS, LA, and BS display stability, with means between 10.557 and 12.278 and standard deviations below 0.722, likely representing log-transformed financial measures. Their consistency makes them suitable control variables, while ROA's erratic nature highlights the need for deeper investigation into sectoral and firm-level influences.

Pearson Correlation Matrix

Table 2 moves further from descriptive statistics to examine the degree of correlation between the variables of the model. Table 4.2 reports the correlation matrix of the variables. However, the analysis will be done for the dependent and explanatory variables in the study.

Table 2

	ROA	GBD	LNS	LA	BS
ROA	1.0000				
GBD	0.0452	1.0000			
LNS	0.0231	0.8265	1.0000		
LA	0.1438	0.6632	0.6367	1.0000	
BS	0.4488	0.7606	0.7484	0.5897	1.0000

Source: Author's Computation, 2025.

Table 2 presents the correlation coefficients between Return on Assets (ROA) and the explanatory variables—bank deposits (GBD), loans (LNS), liquid assets (LA), and bank size (BS). ROA shows weak positive correlations with GBD (0.045), LNS (0.023), and LA (0.144), indicating minimal linear association. By contrast, ROA exhibits a moderate negative correlation with BS (-0.449), suggesting that larger bank size may reduce profitability, potentially reflecting structural or leverage effects. Strong positive correlations among GBD, LNS, LA, and BS (0.590–0.827) raise multicollinearity concerns, requiring VIF diagnostics or dimensionality reduction. These patterns suggest BS is a more influential determinant of profitability compared to other indicators. However, high intercorrelations and possible non-linear dynamics highlight the need for advanced modeling, including mediation, moderation, or non-parametric techniques. Robustness checks, such as partial or rank-based correlations, could clarify these relationships and ensure more reliable insights into the drivers of bank profitability.

Table 3 model estimation results

Variables	Pooled OLS	Random Effect	Fixed Effect
GBD	1.734956	1.734956	1.474873
	(0.000)	(0.000)	(0.000)
LNS	0.6382275	0.6382275	.1101711
	(0.012)	(0.012)	(0.628)
LA	.8665904	.8665904	1.619223
	(0.000)	(0.000)	(0.836)
BS	-3.75089	-3.75089	-3.417395
	(0.000)	(0.000)	(0.000)
CONSTANT	11.02752	11.02752	7.104342
	(0.000)	(0.000)	(0.013)
Wald Test	91.59	366.37	0.87
	(0.000)	(0.000)	(0.4856)
R-Sq.	0.7045	0.217	0.0180
No of Group	12	12	12
Hauseman Test		14.34***	
		(0.0063)	

Source: Author's Computation, 2025.

The regression results compare Pooled OLS, Random Effects (RE), and Fixed Effects (FE) in assessing bank productivity in Nigeria. The Hausman test (χ^2=14.34, p=0.0063) favors FE, confirming correlation between firm-specific effects and regressors, though FE shows weak explanatory power (R^2=0.0180 vs. 0.7045 in OLS). GBD consistently emerges as a strong positive determinant (≈1.47–1.73, p<0.01), while BS shows a robust negative effect (≈-3.42 to -3.75, p<0.01). In contrast, LNS and LA are sensitive to specification, losing significance in FE, suggesting spurious effects in simpler models. Diagnostic tests highlight strong cross-sectional but weak within-entity variation. Overall, FE is statistically preferred, but richer models with time-varying controls or dynamic panels are needed for deeper insights.

Discussion of Findings

The analysis shows that GBD is consistently positive and significant, confirming its role as a key driver of bank productivity. This supports Oke et al. (2019), who highlight technological advancement and digital growth as enablers of efficiency and service expansion in Nigerian banks. Conversely, BS has a negative and significant impact, reflecting high operational costs such as ATM and branch maintenance, consistent with Ahmad and Bakar (2018), who note that excessive infrastructural costs hinder profitability. Variables like LNS exhibit model sensitivity: significance in simpler models suggests larger banks appear more productive, aligning with Berger et al. (2004). However, insignificance under FE indicates that once heterogeneity is controlled, size effects weaken. Similarly, technologies like POS and ATMs show limited standalone impact, echoing Olawale and Ojah (2010), who argue that adoption without strategic integration does not guarantee efficiency gains. Thus, productivity improvements require cost management and effective technology integration.

5. Conclusion and Recommendations

Conclusion

This study demonstrates that bank productivity in Nigeria is influenced more by broader growth and operational factors than solely by technological adoption. While digitalization-related variables like GBD positively affect productivity, the estimated impact of specific

technologies such as mobile banking, ATMs, POS systems, and internet banking appears insignificant when unobserved bank-specific effects are accounted for. This suggests that merely adopting new technologies may not automatically translate into efficiency gains without strategic integration and effective management. Overall, the findings emphasize the importance of addressing unobserved heterogeneity in performance assessments and encourage policymakers and bank management to focus on comprehensive strategies that enhance operational efficiency alongside technological investments. Future research should explore dynamic models and additional variables to better understand how digital innovations can be leveraged for sustainable productivity improvements in Nigerian banks.

Recommendations

This study concludes that the impact of electronic banking on bank productivity in Nigeria is statistically insignificant. The researchers recommend that the government, in collaboration with the private sector and financial institutions, should establish a comprehensive framework and database on digital financial services to better guide technological development, social and economic performance, and environmental impacts within the banking sector. Overall, for banks to effectively leverage electronic banking in a socially responsible and efficient manner, greater emphasis should be placed on robust regulation, enforcement, and thorough analysis of the digital transformation's impact, rather than relying solely on voluntary adoption.

It is recommended that:

1. Nigerian banks should prioritize strategic management and effective integration of technological innovations rather than mere adoption. Technologies like mobile banking, ATMs, POS, and internet banking need to be supported by strong operational frameworks and staff training to realize potential productivity gains. Banks should develop comprehensive digital transformation strategies that align technology investments with overall business objectives.
2. Regulatory authorities and policymakers should create an enabling environment that encourages banks to adopt best practices in digital banking. This could include providing incentives for technological upgrading, establishing standards for digital service quality, and ensuring cybersecurity measures. Such supportive policies can help banks leverage technology more effectively, ultimately enhancing efficiency and financial inclusion.
3. Future research should focus on dynamic modeling approaches that capture the evolving effects of technology adoption over time. Incorporating additional variables such as management quality, customer satisfaction, and infrastructure quality could offer deeper insights into how banks can optimize their digital investments for productivity improvements. This will enable more targeted policy and managerial strategies.

Banks should invest in capacity building and staff training to maximize the benefits of digital services. Equipping employees with the necessary skills fosters better customer service, operational efficiency, and innovative use of technology. Building a digitally savvy workforce is essential for transforming technological investments into sustainable productivity growth in Nigeria's banking sector.

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