



CLOUD COMPUTING AND FINANCIAL PERFORMANCE OF LISTED DEPOSIT MONEY BANKS IN NIGERIA

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Abstract

The financial performance challenges encountered by Nigerian deposit money banks highlight the necessity for innovative solutions. The inefficiencies of conventional banking systems and elevated operating costs call for a transition to technology-driven strategies that can enhance profitability and sustainability. Cloud computing offers a promising solution to these issues, providing a flexible, scalable, and cost-effective alternative to traditional IT infrastructure. This study examines the impact of cloud computing technologies on the corporate performance of listed deposit money banks in Nigeria, focusing on Return on Assets (ROA) as the primary measure of performance. The analysis includes variables such as Automated Chatbot Banking Services (ACBS), Deep Learning Machine in Credit Risk Assessment (DLM), Machine Learning Solutions (MLS), and Return on Asset (ROA). The study utilizes panel EGLS (Cross-section weights) regression analysis to analyze data from a sample of ten (10) listed deposit money banks in Nigeria over a specified period. The results reveal that while ACBS, DLM, and MLS have statistically insignificant impacts on ROA, Firm Size (FSZ) shows a significant negative relationship with ROA. Specifically, the coefficient value and probability for each variable are as follows: ACBS (Coefficient = 0.005605, Probability = 0.7065), DLM (Coefficient = -0.001099, Probability = 0.9507), MLS (Coefficient = 0.007189, Probability = 0.7268), and FSZ (Coefficient = -0.116778, Probability = 0.0000). The study concludes that while cloud computing technologies hold potential for operational improvements, their current utilization does not significantly impact the financial performance of Nigerian deposit money banks as measured by ROA. The significant negative impact of firm size on ROA suggests that larger banks may encounter greater operational challenges that outweigh the potential benefits of cloud computing technologies.

Keywords: Automated Chatbot Banking Services, Cloud computing, Financial Performance, Firm Size, Machine Learning Solutions

INTRODUCTION

The financial services industry is a cornerstone of economic growth, with its performance significantly impacting the broader economy. In Nigeria, deposit money banks play a pivotal role in mobilizing savings, providing credit, and facilitating trade and investment. However, the financial performance of these banks has been a persistent concern, driven by high operational costs, inefficiencies in traditional systems, and increased competition. Financial performance majorly reflects a bank's ability to generate profit, manage costs, and sustain its competitiveness

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in a dynamic environment (Olokoyo et al., 2019). The financial performance challenges faced by Nigerian deposit money banks underscore the need for innovative solutions. The inefficiencies of traditional banking systems and high operating expenses demand a shift toward technology driven approaches to improve profitability and sustainability. Cloud computing presents an available opportunity to address these challenges by offering a flexible, scalable, and cost-effective alternative to traditional IT infrastructure (Akinola & Odhiambo, 2020).

Moreover, the Nigerian banking sector has faced challenges in maintaining robust financial performance due to structural and operational inefficiencies. Many banks continue to rely on outdated legacy systems that limit their ability to innovate, scale, and meet evolving customer expectations. Additionally, regulatory pressures, economic instability, and rising operational expenses compound these difficulties, reducing profitability and hampering long-term growth (Ogunleye, 2020). For instance, inefficient processes and high overhead costs account for a significant portion of the financial struggles faced by Nigerian banks, emphasizing the need for technological innovation to improve operational efficiency (Olokoyo et al., 2019).

Cloud computing has emerged as a transformative technology with the potential to address many of these challenges. By enabling banks to store, process, and manage data over the internet, cloud computing reduces the need for expensive on-premises infrastructure, thereby lowering operational costs and enhancing scalability (Mell & Grance, 2011). Moreover, cloud solutions provide real-time data analytics, improved resource allocation, and enhanced customer service capabilities. These features allow banks to optimize their operations, innovate faster, and adapt more effectively to market changes (Armbrust et al., 2010).

Cloud computing has revolutionized the global banking industry, becoming a vital tool for enhancing financial performance. Across developed and emerging economies, banks increasingly leverage cloud technologies to improve efficiency, reduce costs, and deliver innovative customer services. This global transformation provides valuable insights into how cloud computing can address operational challenges and enhance profitability in the banking sector. In developed economies, the adoption of cloud computing has been particularly impactful in driving digital transformation. For example, banks in the United States and the United Kingdom utilize cloud platforms to optimize operational processes such as payment systems, fraud detection, and data analysis. These innovations enable faster service delivery and lower operational costs, directly boosting financial performance (MIT Technology Review, 2024). Similarly, in the European Union, compliance with stringent data privacy regulations such as the General Data Protection Regulation (GDPR) has driven banks to adopt cloud solutions that ensure secure, compliant, and cost-effective data storage and processing (Accenture, 2023). This has allowed banks in these regions to achieve significant scalability and flexibility, enhancing their competitiveness in a dynamic financial environment.

In emerging economies, cloud computing has proven instrumental in overcoming infrastructural limitations and expanding access to banking services. For instance, in India, banks like the State Bank of India (SBI) utilize cloud-based platforms to extend digital banking services to rural areas, reducing operational expenses while increasing financial inclusion. Similarly, Brazilian banks have integrated cloud technologies to support mobile banking services, which have become a cornerstone of customer interaction and revenue generation in the country. South African banks,

on the other hand, leverage cloud computing to improve credit risk assessments and streamline lending processes, enabling faster and more efficient service delivery (N-iX, 2023; PwC, 2023). Cloud computing has become a transformative force in the banking sector, particularly in enhancing the financial performance of deposit money banks (DMBs). The integration of cloud technologies enables banks to streamline operations, reduce costs, and enhance customer engagement through innovative services (Audu & Abiola, 2022). Key innovations such as automated chatbot banking services, virtualized computing resources, and cloud-based deep learning machines have shown significant potential in improving efficiency and profitability within the banking industry.

Automated chatbot banking services, facilitated by cloud computing, are an essential innovation in improving customer service while reducing operational costs. In Nigeria, banks like Access Bank have adopted cloud-based chatbots to enhance their customer service operations. The chatbot, which is integrated into the bank's mobile app, assists customers by answering inquiries, providing account information, processing transactions, and offering personalized financial advice. This system not only streamlines customer interactions but also allows the bank to handle large volumes of requests simultaneously, thereby improving operational efficiency and reducing the need for human intervention. As a result, the bank can lower its service delivery costs, which in turn boosts profitability (PwC, 2023; N-iX, 2023). By deploying these cloud-based systems, Nigerian banks can enhance customer satisfaction, retain clients, and attract new ones, which directly impacts their bottom line.

Virtualized computing resources represent another key cloud computing advantage. By utilizing virtualized cloud resources, banks can scale their infrastructure more efficiently, optimizing the costs associated with IT maintenance and management. Rather than investing in expensive on-site hardware, banks can rely on cloud providers to manage their computing needs, reducing capital expenditures and operational costs. Virtualized systems also allow banks to adapt quickly to changing market conditions by offering flexible resources that can be adjusted as needed, facilitating the rapid deployment of new services. For instance, banks in Nigeria can utilize cloud computing to enhance their data management and reporting systems, improving decision-making and compliance with regulatory requirements. Research shows that virtualized computing reduces IT costs by up to 30%, which can lead to enhanced profitability through more effective resource utilization (MIT Technology Review, 2024; Accenture, 2023).

Also, cloud-based deep learning machines enable banks to harness the power of artificial intelligence (AI) to enhance their operational capabilities, particularly in areas such as credit risk assessment and fraud detection. These AI systems analyze vast amounts of data to identify patterns, predict customer behavior, and detect potential fraud in real-time. For example, Zenith Bank in Nigeria has begun integrating AI and machine learning into its operations, allowing the bank to improve its credit scoring models and enhance customer service. By using deep learning technologies, banks can make more accurate decisions, reduce the incidence of non-performing loans, and improve financial stability. Additionally, AI-powered systems enable more personalized product recommendations, which can increase customer satisfaction and drive revenue growth (Amdocs, 2023; N-iX, 2023). The ability to use deep learning for predictive analytics helps banks mitigate risks, improve decision-making, and, ultimately, improve their financial performance.

The adoption of cloud computing technologies such as chatbots, virtualized computing resources, and deep learning machines play a crucial role in enhancing the financial performance of DMBs. These innovations reduce operational costs, improve decision-making, and provide better customer experience, all of which contribute to improved profitability. Research indicates that banks that have adopted cloud technologies report a significant increase in profit margins within the first few years of implementation (N-iX, 2023; MIT Technology Review, 2024). In Nigeria, where banks face challenges such as high operational costs and intense competition, cloud computing offers a viable solution to improve operational efficiency and financial performance. Despite its proven benefits globally, the adoption of cloud computing in Nigeria's banking sector remains limited. Concerns over data security, regulatory compliance, high initial migration costs, and a lack of technological expertise have hindered wide spread adoption (Onyejiuwa&Eze,2022). Nigerian banks also face challenges in aligning cloud solutions with local regulatory requirements, particularly around data sovereignty and privacy. Furthermore, there is a dearth of empirical studies linking cloud computing adoption directly to financial performance in the Nigerian banking context, creating a critical knowledge gap.

This study aims to explore how cloud computing can be leveraged to enhance the financial performance of deposit money banks in Nigeria. By investigating this relationship, the study seeks to provide actionable insights for policymakers, banking executives, and technology providers, thereby fostering a more resilient and technologically advanced banking sector in Nigeria.

Objectives of the study

The broad objective of the study is to investigate the effect of cloud computing on financial performance of listed deposit money banks in Nigeria, the sub objectives of the study are to:

- i. Examine the effect of automated chatbot banking services on return on asset of deposit money banks in Nigeria.
- ii. Examine the effect of Virtualized Computing Resources on return on asset of deposit money banks in Nigeria.
- iii. Investigate the effect of Cloud Deep Learning Machine on return on asset of deposit money banks in Nigeria.

Research Questions

The following research questions are proposed in the study:

- i. What is the effect of automated chatbot banking services on return on asset of deposit money banks in Nigeria?
- ii. What is the effect of Virtualized Computing Resources on return on asset of deposit money banks in Nigeria?
- iii. What is the effect of Cloud Deep Learning Machine on return on asset of deposit money banks in Nigeria?

Hypotheses

The following hypotheses are formulated in the study

H₀₁: There is no significant effect of automated chatbot banking services on return on asset of deposit money banks in Nigeria

H₀₂: There is no significant effect of Virtualized Computing Resources on return on asset of deposit money banks in Nigeria

H₀₃: Cloud Deep Learning Machine does not have any significant effect on return on asset of deposit money banks in Nigeria.

LITERATURE REVIEW

Concept of Cloud Computing

According to Yan (2017), cloud computing refers to the provision of on-demand access to a shared pool of configurable computing resources—like servers, applications, and services—that can be quickly deployed and released with minimal effort. Niazmand (2015) describes it as the internet-based delivery of computing services, including servers, storage, databases, networking, software, analytics, and intelligence, aimed at fostering faster innovation, flexible resource allocation, and economies of scale. This model allows organizations to rent IT resources, thereby reducing costs associated with proprietary software, servers, and maintenance, while offering a combination of IT capabilities and scalability.

Abdulrahman (2021) defines cloud computing as a technology focused on accessing and processing data, along with providing storage space, through servers over communication networks. This represents a shift from software being stored locally to being delivered as a service. Collectively, these definitions highlight that cloud computing is a contemporary model that facilitates flexible access to physical resources via internet-based servers, granting users access to software and applications. A key aspect of cloud computing is its ability to provide access to data anytime and from anywhere.

Cloud computing involves storing, managing, and processing data on a network of remote servers that are accessible via the internet, in contrast to relying on local servers or personal computers. It enables users to access various computational resources such as storage, databases, networking, software, and analytics online. Cloud computing operates through several core service models: Infrastructure as a Service (IaaS), which offers virtualized computing resources like virtual machines and storage that can be rented on demand; Platform as a Service (PaaS), which provides a framework for users to develop, run, and manage applications without handling the underlying infrastructure; and Software as a Service (SaaS), which delivers software applications through a subscription model that is accessible via web browsers (O'Brien & Marakas, 2023).

There are different deployment models for cloud computing: public clouds provide services over the public internet, sharing resources among multiple organizations; private clouds are dedicated to a single organization, offering enhanced control over data, security, and compliance; and hybrid clouds combine both public and private models to deliver greater flexibility in data and application sharing (Mell & Grance, 2023). Ultimately, cloud computing allows individuals and organizations to utilize computing resources more efficiently, flexibly, and cost-effectively, shifting the focus from managing physical infrastructure to leveraging services for innovation and growth (Gupta and Misra, 2016).

Financial Performance

Financial performance is a critical indicator of a bank's ability to manage its resources effectively and sustain profitability over time. It is typically measured through a combination of profitability

ratios, efficiency ratios, liquidity metrics, and asset quality indicators. These factors reflect the bank's operational success, financial health, and capacity to generate revenue while controlling costs (Olokoyo et al., 2019; Kamau & Ochieng, 2020). Profitability, as a central aspect, is often assessed through ratios like return on assets (ROA) and return on equity (ROE), which provide insights into how well a bank utilizes its assets and capital to generate profit. Efficiency ratios, such as cost-to-income ratios, help gauge how effectively a bank controls its operating expenses relative to its revenue, thereby indicating its competitiveness in a dynamic market (O'Reilly & Li, 2021; Tetteh & Akwasi, 2021).

Banks also face numerous challenges in sustaining their financial performance, especially in the face of economic fluctuations, regulatory changes, and technological disruptions. As the financial industry becomes increasingly competitive and customer-centric, traditional banking practices may no longer suffice. Technological innovations, such as digital banking and cloud computing, have become essential in maintaining and improving financial performance (Adom & Asamoah, 2020). By enhancing operational efficiencies, these technologies enable banks to reduce costs, increase the speed of services, and provide more personalized offerings to customers. Studies have shown that banks embracing digital tools and modernized IT infrastructures tend to outperform their counterparts in both profitability and market share (Sulaimon & Ganiyu, 2020; Olusegun & Uche, 2021). This shift towards technological adoption is not only a response to market demands but also a proactive strategy for improving financial resilience.

Theoretical Framework

The relationship between cloud computing and the financial performance of deposit money banks in Nigeria can be analyzed through the lens of three prominent theories: the Resource-Based View (RBV), the Technology-Organization-Environment (TOE) framework, and the Diffusion of Innovation (DOI) theory. These theories provide a theoretical underpinning for understanding the adoption of cloud computing and its impact on organizational performance.

Resource-Based View (RBV)

The Resource-Based View (RBV) was propounded by Jay Barney (1991). The RBV asserts that a firm's sustained competitive advantage stems from its resources, which must be valuable, rare, inimitable, and non-substitutable (VRIN) (Barney, 2018). Cloud computing can be categorized as an intangible, technological resource that meets these criteria. The theory predicts that firms leveraging cloud computing can achieve cost efficiencies, operational flexibility, and innovation, which contribute to improved financial performance (Tornatzky & Fleischer, 2023). In the context of deposit money banks in Nigeria, RBV highlights how cloud computing enables cost savings through reduced reliance on physical infrastructure, streamlining operations, and offering scalable solutions for data storage and processing. Consequently, cloud computing becomes a source of competitive advantage, enhancing financial performance by reducing operational expenses and improving customer service delivery. However, critics argue that RBV focuses predominantly on internal resources while downplaying the significance of external factors such as market regulations or socio-economic conditions (Lockett et al., 2009). This limitation is pertinent in Nigeria, where regulatory frameworks and infrastructural challenges significantly influence banks' ability to adopt and benefit from cloud computing.

Technology-Organization-Environment (TOE) Framework

The Technology-Organization-Environment (TOE) framework was developed by Tornatzky and Fleischer (1990). This framework explains the adoption of technological innovations based on three interrelated contexts: the technological context (the perceived benefits and compatibility of the technology), the organizational context (the size, resources, and readiness of the firm), and the environmental context (external pressures such as competition, regulation, and market dynamics) (Thomas & Yao, 20223). Applied to cloud computing, the TOE framework suggests that Nigerian banks are likely to adopt cloud computing if it aligns with their technological capabilities, organizational readiness, and environmental factors. For instance, banks in highly competitive markets may be pressured to adopt cloud solutions to enhance efficiency and remain competitive. Similarly, the framework emphasizes how regulatory policies, such as those by the Central Bank of Nigeria, can shape the adoption process and subsequent impact on financial performance. While the TOE framework is useful for explaining the multidimensional drivers of cloud adoption, it has been criticized for assuming a direct correlation between adoption and performance. Studies such as Oliveira and Martins (2011) have noted that mere adoption of technology does not guarantee enhanced financial outcomes, as success often depends on proper implementation and alignment with strategic objectives.

Diffusion of Innovation (DOI) Theory

The Diffusion of Innovation (DOI) theory was introduced by Everett Rogers (1962). This theory explains how, why, and at what rate new technologies spread within a social system. According to Rogers, the adoption process is influenced by factors such as the perceived relative advantage, compatibility, complexity, trialability, and observability of innovation. Cloud computing fits well into the DOI framework as an innovation that offers relative advantages such as cost reduction, scalability, and enhanced data accessibility (Lu & Hsiao, 2022). For Nigerian deposit money banks, the DOI theory provides insights into the varying rates of cloud adoption across the industry. Early adopters, often the more technologically advanced or resourceful banks, are likely to benefit from first-move advantages, including improved operational efficiency and customer satisfaction, which directly contribute to financial performance. However, as adoption spreads, these advantages may become diluted, with subsequent adopters facing increased competition and reduced differentiation (Sunday & Chime, 2020). Critics of the DOI theory argue that it oversimplifies the adoption process by underestimating barriers such as socio-economic and infrastructural challenges, which are particularly relevant in developing economies like Nigeria. Furthermore, the theory has been critiqued for focusing more on the characteristics of innovation rather than the broader ecosystem in which adoption occurs (Sahin, 2006).

Empirical Review

Saddiki (2023) studied the effect of cloud computing on enhancing risk-based internal auditing in Egyptian banks. The research aimed to evaluate internal auditors' awareness and perceptions of the benefits of cloud computing while identifying the primary challenges they encounter. Using a descriptive-analytical method, a sample of 338 individuals was randomly selected from the target population. The findings revealed that cloud computing positively affects accounting by improving both the quality and speed of access to financial information. The study demonstrates that cloud computing significantly enhances risk-based internal auditing by improving the quality and speed of access to financial information. This emphasizes the transformative potential of cloud technologies in accounting processes. The findings underscore the need for internal auditors to

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leverage cloud computing to streamline operations, although addressing associated challenges is crucial for full adoption.

Masoudi (2023) analyzed the influence of financial technology on banking performance quality, emphasizing banks' recognition of its significance. A case study was conducted at the Local Development Bank agency in Adrar, employing a descriptive-analytical approach. Results highlighted the critical role of financial technology in enhancing banking performance, particularly through broader customer access, especially during the ongoing technological revolution across various sectors. The research highlights financial technology's critical role in enhancing banking performance quality, especially by increasing customer accessibility amidst rapid technological advancements. This case study affirms that banks must prioritize financial technology integration to remain competitive, particularly in reaching broader customer bases during technological revolutions.

Pibi (2022) examined cloud computing as a significant and impactful technology across different industries, assessing its global benefits, applications, and market size. Using a descriptive method, the researcher referenced relevant scientific studies and literature. The study concluded that "cloud-first" policies, along with associated regulations and incentives, have expedited the adoption and implementation of cloud services in key sectors of the Saudi economy, including banking, healthcare, and industry. This study emphasizes the strategic role of cloud computing in various sectors, particularly banking, healthcare, and industry in Saudi Arabia, driven by "cloud-first" policies and supportive regulations. The findings highlight the importance of policy-driven incentives to accelerate cloud adoption, demonstrating its benefits for national economic growth

Cheng (2022) investigated the impact of banks' strategic transition to cloud computing on their performance and risk management. By introducing a new index to assess banks' exposure to cloud computing, the study found that such adoption is associated with decreased cost efficiency, increased profit efficiency, and heightened operational risk, based on data from Chinese banks from 2008 to 2019. Additionally, cloud computing was shown to interact with other emerging technologies, leading to synergistic gains in cost efficiency and operational risk management, though it had a differing effect on profit efficiency when combined with blockchain technology. The study reveals that cloud computing adoption in Chinese banks enhances profit efficiency and operational risk management but poses challenges to cost efficiency. It also interacts with other technologies, yielding mixed effects. This research shows the duality of cloud computing, suggesting a need for strategic management to balance benefits and mitigate risks, especially when integrated with other technologies like blockchain.

Slovoda (2020) identified trends, challenges, and key risks in the collaboration between fintech companies and banks within the evolving global financial market. The study focused on challenges in the Ukrainian electronic technology market, including the regulatory landscape, slow adoption of innovation by traditional banks, limited open APIs in the banking sector, and restricted capital access for fintech firms. A key finding noted the rapid pace of technological evolution, allowing new tech companies to quickly capture market share, unlike established financial institutions, which often take years to introduce new services. The research identifies key barriers to fintech and banking collaboration in Ukraine, such as slow innovation adoption, limited open APIs, and capital access issues, amidst rapid technological evolution. The findings call for regulatory and

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infrastructural reforms to foster a supportive ecosystem for fintech and banking partnerships, addressing disparities between tech companies and traditional banks.

Masaaid (2019) assessed the level of trust among Jordanian industrial institutions in implementing cloud computing, identifying three categories of trust issues: trust in software and processes, trust in service providers, and trust in the security measures offered. Using a descriptive approach, a survey involving 81 industrial companies and 120 employees was conducted in Irbid. The study revealed a significant trust crisis regarding cloud computing implementation in Jordanian industrial institutions, particularly concerning operations and software. This study reveals a trust crisis in cloud computing adoption in Jordanian industrial institutions, particularly concerning software, service providers, and security measures. The results indicate that building trust through improved security and transparent processes is critical for cloud computing adoption in industrial sectors.

Alizadeh et al. (2020) explored the effects of cloud technology on user security and privacy. Employing a descriptive approach to develop the theoretical framework, the study identified major challenges related to cloud storage, architecture, user privacy, and services. A key finding was the presence of significant security issues that jeopardize user privacy, highlighting the need for cloud service providers to address these concerns. The study recommended that users implement effective security measures and rectify any identified vulnerabilities. The study highlights significant security and privacy issues in cloud computing, urging service providers to address vulnerabilities while recommending users implement effective security measures. This research underscores the critical need for robust security frameworks and proactive user practices to mitigate privacy risks in cloud technology adoption.

METHODOLOGY

Research Design

This study employs an *ex-post facto* research design; *ex-post facto* is adopted based on the fact that our data is partly secondary data that existed already, and which cannot be manipulated or controlled. Specifically, a panel data analysis, to examine the impact of cloud computing technologies on the corporate performance of listed deposit money banks in Nigeria. The panel data approach allows for the examination of both cross-sectional and time-series variations in the data, providing a more robust analysis of the relationship between independent and dependent variables over time. The population of this study consists of twenty-four listed deposit money banks in Nigeria. However, ten deposit money banks from the population will form the sample size. The ten deposit money banks were selected based on their market capitalization as at December 2023. The selected ten deposit money banks includes Zenith bank, Wema bank, aAccess bank, Union bank, FCMB, First Bank, United Bank of Africa, Guaranty Trust Bank, Ecobank and Fidelity bank and were sampled for the period of ten (10) years which cover the period of 2013 to 2022.

Model Specifications

The model adapts the work of Ekpa, Onuora and Sunday (2023) who study premised on evaluates the effect of artificial brain power on corporate performance of listed deposits money banks in Nigeria. The adaptation of this work is justified on the basis that the authors incorporated cloud

computing in their study since cloud computing provides the infrastructure needed to support artificial intelligence brain power demands.

The functional model for this study is specified as follows:

$$ROA_{it} = \beta_0 + \beta_1 ACBS_{it} + \beta_2 DLM_{it} + \beta_3 MLS_{it} + \beta_4 FSZ_{it} + \mu_{it}$$

Where:

ROA_{it} is the Return on Assets; Automated Chabot banking services (ACBS); Deep Learning Machine in Credit Risk Assessment (DLM); Machine Learning Solution (MLS); Firm Size (FSZ); i for bank; t is time. $\beta_0, \beta_1, \beta_2, \beta_3, \beta_4$ are the coefficients to be estimated, μ_{it} is the error term.

A' priori Expectations and Measurement of Variables

Based on existing literature, the study has the following apriori expectations:

ACBS, DLM, and MLS are expected to have a positive impact on ROA, indicating that the adoption of these cloud computing technologies leads to improved financial performance. FSZ is expected to have a negative impact on ROA, indicating that larger banks may face operational inefficiencies that negatively affect profitability.

Measurement of Variables

S/N	VARIABLES	MEASUREMENT
	Dependent variables	
1	Return on Assets (ROA)	ROA=(NPBIT)/Average Assets
2	Automated Chabot banking services (ACBS)	ACBS was measured using dummy variable thus; If ACBS are found and used in the bank in any of these years between 2013-2023 then, it equals 1, if not, it equals =0
3	Deep Learning Machine in Credit Risk Assessment (DLM)	DLM was measured using dummy variable thus; If DLM are found and used in the bank in any of these years between 2012-2021 then, it equals 1, if not, it equals =0
4	Machine Learning Solution (MLS)	MLS was measured using dummy variable thus; If MLS are found and used in the bank in any of these years between 2012-2021 then, it equals 1, if not, it equals =0
5	Firms Size	Log of Total Assets

Source: Authors, Compilation (2024)

Estimation Techniques

The study utilizes the panel regression for the analysis, both fixed effect models and random effect models were utilized. However, hausman test was used to select the preferred models. The fixed effect model was used. The fixed effect model estimation technique accounts for potential heteroscedasticity across cross-sections. This technique allows for the estimation of the coefficients in the panel data model while addressing issues related to unobserved heterogeneity and serial correlation in the error terms.

RESULTS AND DISCUSSION

Table 1: Descriptive Statistics

	ROA	ACBS	DLM	MLS	FSZ
Mean	0.056123	0.330000	0.110000	0.160000	8.129185
Median	0.042226	0.000000	0.000000	0.000000	8.129175
Maximum	0.264935	1.000000	1.000000	1.000000	8.824134
Minimum	-0.092373	0.000000	0.000000	0.000000	7.362421
Std. Dev.	0.070364	0.472582	0.314466	0.368453	0.386048
Skewness	0.699504	0.723077	2.492891	1.854852	-0.173652
Kurtosis	3.624658	1.522840	7.214505	4.440476	2.126382
Jarque-Bera	9.780929	17.80568	177.5836	65.98699	3.682618
Probability	0.007518	0.000136	0.000000	0.000000	0.158610
Sum	5.612304	33.00000	11.00000	16.00000	812.9185
Sum Sq. Dev.	0.490154	22.11000	9.790000	13.44000	14.75425
Observations	100	100	100	100	100

Source: Authors Analysis, (2024)

Note: Return on Assets (ROA) Machine Learning Solution (MLS): Automated Chatbot banking services (ACBS), Deep Learning Machine in Credit Risk Assessment (DLM), Firm Size (FSZ)

The descriptive statistics for the variables in the study are presented in Table 1. The mean Return on Assets (ROA) is 0.056123, with a median of 0.042226, indicating that the average profitability relative to total assets is around 5.6%. The maximum and minimum values for ROA are 0.264935 and -0.092373, respectively, suggesting that there are significant variations in the profitability of the firms in the sample. The standard deviation of 0.070364 highlights this variability. The skewness of 0.699504 indicates that the distribution of ROA is moderately skewed to the right, while the kurtosis of 3.624658 suggests a leptokurtic distribution. The Jarque-Bera test statistic of 9.780929 with a probability value of 0.007518 indicates that the ROA distribution deviates from normality. For Automated Chatbot Banking Services (ACBS), the mean is 0.33, suggesting that 33% of the observations have implemented ACBS. The median value is 0, with a maximum of 1 and a minimum of 0, indicating a binary distribution. The standard deviation is 0.472582, reflecting a high level of variability in the adoption of ACBS among the firms. The skewness of 0.723077 shows a moderate right skew, and the kurtosis of 1.522840 indicates a platykurtic distribution. The Jarque-Bera statistics of 17.80568 with a probability of 0.000136 suggest non-normality.

Deep Learning Machine in Credit Risk Assessment (DLM) has a mean of 0.11, a median of 0, and a maximum and minimum of 1 and 0, respectively, indicating a binary nature. The standard deviation is 0.314466. The skewness of 2.492891 and kurtosis of 7.214505 suggest a highly skewed and leptokurtic distribution. The Jarque-Bera statistic of 177.5836 with a probability of 0.000000 confirms significant non-normality. Machine Learning Solutions (MLS) shows a mean of 0.16 and a median of 0, with a range from 0 to 1, indicative of its binary character. The standard deviation is 0.368453. The skewness of 1.854852 and kurtosis of 4.440476 point to a positively skewed and leptokurtic distribution. The Jarque-Bera statistic of 65.98699 with a probability of 0.000000 indicates strong evidence against normality. Firm Size (FSZ), measured as the log of total assets, has a mean of 8.129185 and a median of 8.129175, suggesting that the data is fairly symmetric around the mean. The range of FSZ is from 7.362421 to 8.824134, with a standard deviation of 0.386048, indicating moderate variability in firm size. The skewness of -0.173652

indicates a slight left skew, while the kurtosis of 2.126382 is close to the normal distribution value of 3. The Jarque-Bera test statistics of 3.682618 with a probability of 0.158610 suggests that the distribution of FSZ does not significantly deviate from normality.

Table 2: Multicollinearity Test

	ROA	ACBS	DLM	MLS	FSZ
ROA	1				
ACBS	-0.2388	1			
DLM	-0.13286	0.500935	1		
MLS	-0.25066	0.621872	0.71835	1	
FSZ	-0.01765	0.206458	0.27535	0.252682	1

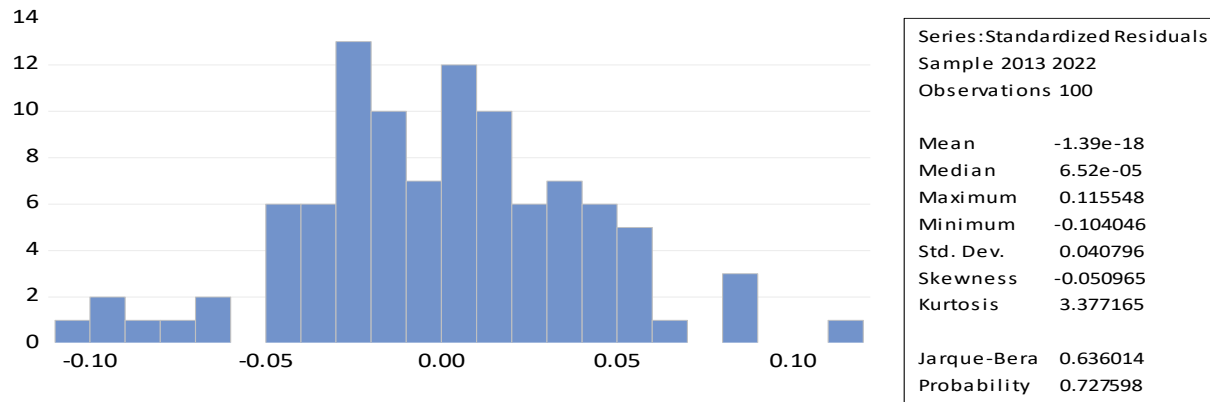
Source: Authors Analysis, (2024)

Note: Return on Assets (ROA) Machine Learning Solution (MLS): Automated Chabot banking services (ACBS), Deep Learning Machine in Credit Risk Assessment (DLM), Firm Size (FSZ)

Table 2 presents the results of the multicollinearity test among the variables (Return on Assets (ROA), Automated Chatbot Banking Services (ACBS), Deep Learning Machine in Credit Risk Assessment (DLM), Machine Learning Solutions (MLS), and Firm Size (FSZ)). The correlation matrix shows that ROA has a negative correlation with all the other variables. Specifically, the correlation between ROA and ACBS is -0.2388, indicating a weak negative relationship. The correlation between ROA and DLM is -0.13286, which also indicates a weak negative relationship. Similarly, ROA's correlation with MLS is -0.25066, suggesting a weak negative relationship. Lastly, the correlation between ROA and FSZ is -0.01765, indicating a very weak negative relationship. Looking at the relationships among the independent variables, ACBS and DLM have a correlation of 0.500935, suggesting a moderate positive relationship. ACBS and MLS have a higher correlation of 0.621872, indicating a moderately strong positive relationship. The correlation between ACBS and FSZ is 0.206458, which is a weak positive relationship. DLM and MLS have a strong positive correlation of 0.71835, indicating a high degree of collinearity between these two variables. The correlation between DLM and FSZ is 0.27535, which is a weak positive relationship. Finally, the correlation between MLS and FSZ is 0.252682, indicating a weak positive relationship.

Multicollinearity among variables is a concern when the correlation coefficient exceeds 0.8, as it can inflate the variance of the coefficient estimates and make the model unstable. In this case, none of the correlation coefficients among the independent variables exceed 0.8. Therefore, based on the correlation matrix presented in Table 2, there does not appear to be a severe multicollinearity issue among the variables.

Normality Test



The Jarque-Bera statistical test indicates 0.6360 and probability value of 0.7276 indicates that the model is normally distributed. Hence the study is viable for prediction.

HausmanTest

Test Summary	Chi-Sq.Statistic	Chi-Sq.d.f.	Prob.
Cross-section random	10.508872	4	0.0327

Source: Authors' Analyses(2024)

Note: Return on Assets (ROA) Machine Learning Solution (MLS): Automated Chat bot banking services (ACBS), Deep Learning Machine in Credit Risk Assessment (DLM), Firm Size (FSZ)

The Hausman Test results presented indicate a comparison between fixed effects and random effects models for panel data analysis. The test summary shows a Chi-Square statistic of 10.508872 with 4 degrees of freedom and a probability (p-value) of 0.0327. The null hypothesis for the Hausman Test is that the random effects model is appropriate and consistent, meaning that the unique errors are uncorrelated with the regressors. The alternative hypothesis is that the fixed effects model is the correct specification, implying that there is a correlation between the unique errors and the regressors.

Table 4: cloud computing and financial performance of listed deposit money banks in Nigeria

Dependent Variable: ROA				
Method: Panel EGLS (Cross-section weights)				
Variable	Coefficient	Std.Error	t-Statistic	Prob.
ACBS	0.005605	0.014837	0.377781	0.7065
DLM	-0.001099	0.017721	-0.062030	0.9507
MLS	0.007189	0.020512	0.350475	0.7268
FSZ	-0.116778	0.025461	-4.586600	0.0000
C	1.002556	0.205084	4.888503	0.0000
Root MSE	0.040591	R-squared		0.662092
Mean dependent var.	0.055204	Adjusted R-squared		0.611013
S.D. dependent var.	0.065858	S.E. of regression		0.043771
Sum squared resid	0.164765	F-statistic		12.96211
Durbin-Watsonstat	1.526085	Prob(F-statistic)		0.000000

Source: Authors Analysis,(2024)

Note: Return on Assets (ROA) Machine Learning Solution (MLS): Automated Chat bot banking services (ACBS), Deep Learning Machine in Credit Risk Assessment (DLM), Firm Size (FSZ)

The regression analysis presented in Table 4 investigates the effect of cloud computing on the corporate performance of listed deposit money banks in Nigeria. The coefficient for Automated Chatbot Banking Services (ACBS) is 0.005605, with a t-statistic of 0.377781, resulting in a p-value of 0.7065. This suggests that while ACBS has a positive relationship with ROA, the effect is statistically insignificant. Similarly, Deep Learning Machine in Credit Risk Assessment (DLM) has a coefficient of -0.001099 and a t-statistic of -0.062030, with a p-value of 0.9507. This indicates a negative and statistically insignificant negative effect on ROA. Machine Learning Solutions (MLS) also shows a positive but statistically insignificant impact on ROA, with a coefficient of 0.007189, a t-statistic of 0.350475, and a p-value of 0.7268. On the other hand, Firm Size (FSZ) exhibits a significant negative impact on ROA. The coefficient for FSZ is -0.116778, with a t-statistic of -4.586600, leading to a highly significant p-value of 0.0000. This suggests that larger firm size is associated with lower profitability, as measured by ROA, among the listed deposit money banks in Nigeria. The model's constant term (C) is also statistically significant, with a coefficient of 1.002556, a standard error of 0.205084, a t-statistic of 4.888503, and a p-value of 0.0000. This indicates a strong baseline level of ROA when all predictors are zero. The model's overall fit is indicated by the adjusted R-squared value of 0.611013, meaning that approximately 61.1% of the variance in ROA is explained by the model. The F-statistics of 12.96211, with a p-value of 0.000000, confirms the overall statistical significance of the model. The model is robust and explains a substantial portion of the variability in ROA.

Discussion of findings

The findings from the study on the effect of cloud computing on corporate performance of listed deposit money banks in Nigeria align with some previous empirical studies while contrasting with others. The result showing an insignificant impact of Automated Chatbot Banking Services (ACBS), Deep Learning Machine in Credit Risk Assessment (DLM), and Machine Learning Solutions (MLS) on Return on Assets (ROA) resonates with findings by Saddiki (2023), who highlighted the positive impact of cloud computing on internal auditing in Egyptian banks, particularly in terms of accounting quality and faster information access. However, Saddiki's study does not specifically link these improvements directly to financial performance metrics such as ROA, thereby aligning with the notion that while cloud computing can enhance certain operational aspects, these enhancements do not necessarily translate into immediate or significant financial performance gains. Similarly, Cheng (2022) found that cloud computing adoption in Chinese banks led to increased profit efficiency but also higher operational risk, suggesting that the benefits of cloud technology are nuanced and may come with trade-offs that impact overall financial metrics differently.

Conversely, the findings from this study diverge from the conclusions drawn by Masoudi (2023), who emphasized the significant positive impact of financial technology on banking performance, particularly through enhanced customer reach and service quality. Masoudi's work suggests that financial technology, which encompasses cloud computing, can markedly improve banking performance, a result not mirrored in the current study's insignificant coefficients for ACBS, DLM, and MLS. This discrepancy could be attributed to differences in the scope of technologies evaluated, regional banking practices, or the specific operational contexts of Nigerian banks compared to those in other regions. Additionally, Slovoda (2020) identified the rapid evolution

and market impact of financial technologies, contrasting with the modest and statistically insignificant impacts observed in the Nigerian context. Moreover, the significant negative impact of firm size (FSZ) on ROA observed in this study aligns with some of the challenges highlighted by Masaiid (2019) regarding trust in cloud computing in Jordanian industrial institutions. Masaiid's findings on the crisis of trust and operational challenges resonate with the negative implications of firm size on performance, suggesting that larger institutions might face greater complexities and inefficiencies in adopting and integrating new technologies like cloud computing. Devaraju and Woozeer's (2015) exploration of cloud security and privacy issues also supports the notion that the challenges associated with cloud technology can potentially outweigh its benefits, especially for larger organizations struggling with more intricate operational and security demands.

Implications of the study

The findings of this study have significant implications for the management and strategic planning of listed deposit money banks in Nigeria. The study reveals that the adoption of Automated Chatbot Banking Services (ACBS), Deep Learning Machine in Credit Risk Assessment (DLM), and Machine Learning Solutions (MLS) has an insignificant impact on Return on Assets (ROA). This suggests that these technologies, while adopted, may not yet be effectively integrated into bank operations or may require more time to realize their benefits. This aligns with the Resource-Based View (RBV), which emphasizes that technological resources alone do not guarantee performance improvements unless they are strategically integrated into the firm's operations. Additionally, the study finds a significant negative relationship between firm size (FSZ) and ROA, suggesting that larger banks may face diminishing returns due to inefficiencies or higher operational costs associated with their size. This aligns with Diffusion of Innovation (DOI) theory, which indicates that larger organizations often face challenges in adopting and diffusing innovations efficiently due to their complexity and established processes. Smaller banks may be more agile in adopting new technologies, which could explain why larger banks experience lower profitability as they scale.

The Technology-Organization-Environment (TOE) framework further helps to explain these findings. It highlights the need for alignment between technological, organizational, and environmental factors for effective technology adoption. In this case, the insignificant impact of ACBS, DLM, and MLS on ROA could be due to misalignment between these factors, such as insufficient organizational readiness or external environmental constraints, which prevents the technologies from realizing their potential benefits. Some studies in empirical literature, however, present contrasting views. For example, several researchers argue that the adoption of emerging technologies, such as automated banking services and machine learning, can lead to improvements in profitability, although this is typically observed over the long term. Scholz and Ziegler (2020), for instance, found that the application of automation and machine learning in banks improved profitability by enhancing decision-making processes, reducing operational costs, and improving risk management capabilities. This contradicts the findings of the current study, suggesting that while technological benefits might not be immediate, they could provide significant long-term value if implemented effectively.

Similarly, while this study finds that larger banks face diminishing returns, other research, such as Akinwale and Olorunfemi (2020), suggests that larger banks benefit from economies of scale,

which can lead to increased profitability. They argue that larger banks can leverage their size to negotiate better financing rates, reduce per-unit operational costs, and increase market share. This implies that larger banks may be able to realize greater profitability despite the challenges posed by size if they can effectively manage the complexities associated with their growth. In conclusion, the study's findings are consistent with certain theoretical frameworks, such as the Resource-Based View, Diffusion of Innovation Theory, and Technology-Organization-Environment (TOE) framework, which suggest that both technological integration and growth in size may not always lead to enhanced profitability. The application of these frameworks highlights the importance of aligning technological, organizational, and environmental contexts to successfully realize the benefits of technological innovations. At the same time, conflicting findings in the literature, particularly with respect to the benefits of technology adoption and firm size, highlight that the impact of these factors may depend on specific contextual and organizational conditions, such as the degree of technology integration, the maturity of the technologies, and how well large firms manage operational inefficiencies.

CONCLUSION AND RECOMMENDATIONS

This study examined the impact of cloud computing technologies on the corporate performance of listed deposit money banks in Nigeria between 2013 to 2022. with Return on Assets (ROA) as the primary measure of financial performance. The analysis incorporates variables such as Automated Chatbot Banking Services (ACBS), Deep Learning Machine in Credit Risk Assessment (DLM), Machine Learning Solutions (MLS), and Firm Size (FSZ). The study utilized panel regression models, precisely using fixed effect models analysis. The inferences were made at 5% significance level. The results indicate that ACBS, DLM, and MLS have statistically insignificant impacts on ROA, suggesting that these technologies, in their current implementation, do not significantly enhance financial performance. However, firm size (FSZ) shows a significant negative relationship with ROA, indicating that larger banks may face inefficiencies that adversely affect profitability. The findings of this study highlight that while cloud computing technologies hold potential for operational improvements, their current utilization does not significantly impact the financial performance of Nigerian deposit money banks as measured by ROA. The significant negative impact of firm size on ROA suggests that larger banks may encounter greater operational challenges that outweigh the potential benefits of cloud computing technologies.

Recommendations

In regard to the findings, the following recommendations were made

- i. Given the insignificant impact of Automated Chatbot Banking Services (ACBS), Deep Learning Machine in Credit Risk Assessment (DLM), and Machine Learning Solutions (MLS) on ROA, it is recommended that banks focus on optimizing the implementation and integration of these technologies. This could involve refining their use within specific departments, ensuring they align with the bank's overall goals, and scaling their use gradually to better align with performance metrics.
- ii. The limited impact of cloud computing technologies on profitability may be due to insufficient organizational readiness. Banks should invest in enhancing internal capabilities, such as staff training, changing management processes, and cross-departmental collaboration, to ensure that technological innovations are fully embraced and effectively integrated into the operational workflows.

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- iii. The adoption of technologies like ACBS, DLM, and MLS should be closely aligned with the bank's strategic operational objectives. Bank executives should focus on ensuring that these technologies are deployed in areas that directly support revenue generation, cost reduction, and operational efficiency.
- iv. Given the significant negative relationship between firm size (FSZ) and ROA, larger banks may face challenges in achieving profitability from technological investments due to operational inefficiencies. It is recommended that larger banks adopt cloud technologies incrementally, starting with specific functions or regions, to reduce complexities and improve efficiency across the organization.

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