International Journal of Innovative Information Systems & Technology Research 19(4):10-23, Oct-Dec, 2026

© SEAHI PUBLICATIONS, 2026 www.seahipublications.org ISSN: 2467-8562

DOI:10.5281/zenodo.23218868

Impact of ICT Investment on Financial Performance of Listed Deposit Money Banks in Nigeria

Ashiru Halilu[1], Maryam Muhammad[2], Mudassir Sani Yakubu3 & Usman Abdulkadir Umar[4]

[1&2]Department of Accountancy, School of Management, Katsina State Institute of Technology and Management (KSITM), Nigeria ashiru.halilu@ksitm.edu.ng
[3]Department of Electrical Electronics Engineering, School of Technology, Katsina State Institute of Technology and Management (KSITM), Nigeria
[4]Department of Library and Information Science, School of Technology, Katsina State Institute of Technology and Management (KSITM), Nigeria

ABSTRACT
The study investigated the impact of information and communication technology (ICT) investment on the financial performance of deposit money banks listed in Nigeria. The study uses return on assets (ROA) as a proxy of financial performance. The two components of ICT investment considered in this study are hardware and software. Bank size and capital adequacy ratios are controlled for. This study adopted an ex post facto research design and used secondary data from published annual reports and financial statements of listed deposit money banks. The study uses preliminary diagnostics such as pairwise correlation, variance inflation factor, skewness/kurtosis normality test, Breusch-Pagan/Cook-Weisberg heteroskedasticity test, Hausman specification test and Breusch-Pagan Lagrange multiplier test for random effects. The diagnostic evidence supports the pooling of OLS estimation. The results revealed that investment in ICT software has a positive and statistically significant impact on ROA, and investment in ICT hardware has a positive but statistically insignificant impact. Bank size has a negative but statistically insignificant relationship with capital adequacy ratio and financial performance. Results evidenced that the financial value of the ICT investment is a function of the functionality and use of technological resources and not of the money spent. The study recommends that listed deposit money banks should focus on software enabled digital transformation, integration of hardware with functional systems, improve ICT governance and complement technological investment with employee capability development.
Keywords: Information and Communication Technology, ICT Investment, ICT Hardware, ICT Software, Financial Performance, Return on Assets, Deposit Money Banks, Nigeria.

1.1 INTRODUCTION

The modern organisational activities have been merged with information and communication technology. Financial services are essentially information processing, communication networks, transaction platforms, data management and digital channels. The banking industry is seeing a significant contribution from technology. The shift from branch banking to automated and digitally mediated services has therefore made investment in ICT a crucial strategic consideration for deposit money banks. This investment value cannot be measured based on the volume that has been invested in technology but it is contingent on the way that the technological resources are combined with the company processes, human capabilities and

business objectives (Karim et al., 2022; Hanafizadeh & Tavakoli, 2026). The Nigerian banking sector provides a good setting for examining this relationship. The functions of deposit money banks include financial intermediation, mobilisation of savings, allocation of credit, facilitation of payment and economic activity. They increasingly utilise automated teller machines, mobile and internet banking, electronic payment systems, core banking applications, cyber security systems, databases, networking infrastructure and other digital platforms. Nevertheless, the Nigerian historical evidence has revealed that ICT has been embedded in the operations of the bank but not necessarily consistently impacting on the profitability and efficiency (Adegbie et al., 2020; Ezirim et al., 2018; Uzor et al., 2022).

Investment in technology is expected to improve organisational performance by reducing transaction costs, increasing the speed of processing, improving information availability, enabling service innovation and improving the quality and reach of financial services, in theory. Current RBV research indicates that ICT does not create value per se, but its impact depends on the type of technology and the combination with complementary organisational resources (Karim et al., 2022). New evidence on digital transformation also suggests that technology may enhance productivity but there are adjustment and operating costs so that the realisation of financial benefits depends on implementation capability (Guo et al., 2023; Hanafizadeh & Tavakoli, 2026).

The current technology-performance debate is whether there is a performance gap with technology spending. There is growing evidence that digital transformation can create productivity gains, but not necessarily short-term gains in overall firm performance, especially when operational costs and managerial adjustment costs are rising (Guo et al., 2023). This can help to explain why the financial effects of technology investment can be positive, negligible or even negative depending on the type of investment, the stage of implementation, the capability of the organization and the measure of performance. The evidence of Nigeria is mixed in character. Ezirim et al. (2018) found a positive impact of ICT development expenditure on bank performance and no correlation between ICT maintenance expenditure and ROA. Adegbie et al. (2020), report significant relationships between ICT and sustainable performance indicators of listed deposit money banks. Uzor et al. (2022) found that the effects of the major electronic banking channels on bank efficiency are insignificant. However, recent studies have established a positive relationship between technology investment/adoption and long-term growth of listed Nigerian banks (Nguemo & Ekokotu, 2025; Ekwunife, 2025). These conflicting results suggest the need to make a distinction between the type of ICT investment and the performance measure adopted. In this regard, this study aims to study the relationship between financial performance and ICT investment, divided into hardware and software parts. This distinction matters because the way physical infrastructure and functional software create value may differ. This study is therefore designed to provide evidence on the role of the expenditure on ICT to the profitability of listed deposit money banks in Nigeria.

1.2 Statement of the Problem

The Nigerian banking sector has embraced the use of information and communication technology (ICT) as a basic pre-requisite for transaction of business, provision of digital services, management of information, assurance of cyber security, provision of customer access and the co-ordination of operations. Expenditure on ICT is no longer a bureaucratic cost but a strategic allocation of resources as banks' digital transformation has reached a level where this is the case. There is new evidence that investment in technology can drive bank growth, operational efficiency and overall performance. Financial performance are not automatic however and not the same across technologies or institutions (Adegbie et al., 2020; Nguemo & Ekokotu, 2025; Papathomas & Konteos, 2024). The question managers should really ask themselves is not so much whether banks do invest in ICT, but whether the resources invested in the different categories of ICT lead to real improvements in the financial performance.

That becomes all the more important if the study break down the ICT investment into physical infrastructure and software-enabled functionality. Hardware is the technological capacity of digital banking. They include computer and server systems, automated teller machines, storage systems and networking equipment. Physical assets do not always mean higher profits. The software can directly support core banking operations, data processing, digital channels, cyber security, analytics and systems

integration. Recent studies have shown that the relationship between ICT and performance is heterogeneous and that the strategic value of technology is contingent on the type of technology and the organisational context in which it is deployed (Karim et al., 2022; Hanafizadeh & Tavakoli, 2026). This distinction raises an important empirical question: aggregate ICT spending may obscure differences between investments in building capacity and investments in providing functionality that can generate measurable economic gains.

Empirical evidence also indicates that there is no obvious relationship between investments in technology and financial performance. Ezirim et al. (2018) found a significant relationship between ICT development expenditure and bank performance in Nigeria. However, there was no significant relationship between ICT maintenance expenditure and return on assets (ROA). Nwala et al (2020) held the view that investment in ICT hardware and software has a positive and significant effect on the financial performance of listed insurance companies. The major electronic banking channels did not significantly improve the efficiency of the deposit money banks in Nigeria. Uzor et al., 2022 There are also more recent studies with contrasting evidence. The adoption or investment in technology has a positive impact on sustainable development (Nguemo and Ekokotu, 2025; Ekwunife, 2025). The study also reported a significant negative relationship between expenditure on the software of ICT and bank's profitability (Danladi et al., 2025) Similarly, Akanbi and Oyediran (2026) find that the impact of accounting information-system investment on performance is contingent on the investment component and performance measure. The mixed results show that the financial impact of ICT investment is an issue under debate, and that it might depend on the nature of the investment, the implementation conditions, the time horizon and the performance measure used.

The broader digital transformation literature provides mixed evidence. Guo et al. (2023) argue that the digital transformation can also cause a decline in the firm's performance when operational costs, managerial adjustment costs and other implementation costs are high, in addition to productivity improvements. Hanafizadeh and Tavakoli (2026) reviewed 245 empirical studies and found that the effect of technological resources on performance is dependent on the nature of the technology and the resources they are combined with. The digital transformation of financial institutions is a phased process and it is necessary to implement appropriate business metrics to evaluate whether technology initiatives bring value to the organization (Papathomas & Konteos, 2024). The results indicate that one cannot assume that investments in technology create financial value. The economic impact depends on what is bought, how it is incorporated and how the capability that results is used. However, despite the increasing literature, a significant gap in context and measurement still exists in the Nigerian listed banking sector. Research in Nigeria has mainly been on aggregate ICT investment, technology adoption, electronic banking channels, sustainable development or efficiency or general information-system investment. Few studies have examined the individual relationship between investment in ICT hardware and investment in ICT software with ROA as the dependent variable, using consistent archival data of listed deposit money banks as the explanatory variable. This is important as hardware and software are two different types of technology resources and may have different cost structures, utilisation patterns, implementation requirements and profitability paths. Hence the composite ICT measure constructed on the evidence may be masking the component that is in fact related to financial performance.

This question leaves open the implications for bank management and for research. Managers need evidence to distinguish spending on productive technology from spending that only builds capacity or incurs short-term costs when investment in hardware does not produce statistically significant gains in profits but investment in software does. However, if none of the components are significant or have different effects then this would imply that simply increasing ICT expenditure is not enough without the necessary complementary capabilities, integration, governance and effective use. Therefore, the study fills the gap by examining the effect of investment in ICT hardware and investment in ICT software individually on the financial performance of quoted deposit money banks in Nigeria proxied by ROA controlling for bank size and capital adequacy ratio. The study used data from 100 bank-year observations

from 10 listed banks to perform a focused archival test of the importance of the type of ICT investment to bank profitability.

1.3 Objectives of the Study

The broad objective is to examine the impact of ICT investment on the financial performance of listed deposit money banks in Nigeria.

The specific objectives are to:

1. examine the effect of ICT hardware investment on the financial performance of listed deposit money banks in Nigeria; and
2. determine the effect of ICT software investment on the financial performance of listed deposit money banks in Nigeria.

1.4 Research Questions

1. What effect does ICT hardware investment have on the financial performance of listed deposit money banks in Nigeria?
2. What effect does ICT software investment have on the financial performance of listed deposit money banks in Nigeria?

1.5 Research Hypotheses

H_{01}: ICT hardware investment has no significant effect on the financial performance of listed deposit money banks in Nigeria.

H_{02}: ICT software investment has no significant effect on the financial performance of listed deposit money banks in Nigeria.

1.6 Significance of the Study

The study has managerial relevance because bank managers need evidence on whether different categories of technology expenditure generate measurable financial returns. The results can support decisions concerning software development, hardware acquisition, system integration, and technology governance. Investors and shareholders may also use the evidence to understand whether technology spending is associated with profitability. For regulators, the findings provide evidence relevant to discussions of digital transformation, operational resilience, and efficient technology investment. Academically, the study contributes to the Nigerian literature by distinguishing hardware from software investment and relating both to ROA.

1.7 Scope of the Study

The study focuses on listed deposit money banks in Nigeria. ICT investment is represented by ICT hardware investment and ICT software investment, while financial performance is measured by return on assets. Bank size and capital adequacy ratios are included as control variables. The analysis is based on secondary data obtained from published annual reports and financial statements of the sampled listed banks. The empirical dataset comprises 100 bank-year observations from 10 sampled banks.

2. LITERATURE REVIEW

2.1 Concept of ICT Investment

ICT investment is the use of organisational resources to acquire, develop, upgrade, integrate and maintain digital technologies to support information processing, communication, transaction processing and managerial decision-making. Today technology investment is not only in software platforms, but also hardware, databases, digital channels, cyber security, data analytics and other technology enabled capabilities. Recent studies have shown that the effect of technology on performance is not only the amount spent on technology, but also how the technological resources are combined with the company's capabilities and used in the business processes (Karim et al., 2022; Hanafizadeh & Tavakoli, 2026). In this study the ICT investment is operationalised in the hardware and software components as per the project data structure.

'Investment in ICT hardware' means the purchase of physical technology resources such as computers, servers, networking equipment, automated teller machines, storage infrastructure and other related devices The hardware provides the physical capacity to carry out the digital banking activities.

However, the evidence we have indicates that generic technological resources in and of themselves may not be strategic resources. Karim et al. (2022) in a meta-analysis of 147 studies found that the performance outcomes of ICT depend on the type of technology and the technological context in which it is adopted. Hardware when used well together with complementary software, skills, processes and managerial capacities can improve performance.

Investment in ICT software includes applications, core banking databases, digital banking platforms, cyber security applications, analytical tools and customised software solutions. The software crucially translates the physical computing capacity into functional organisational capacity. Recent studies in banking and digital transformation suggest that software-enabled capabilities can improve process integration, service delivery, data utilisation and operational efficiency, but financial benefits may be contingent on the quality of implementation and organisational use (Papathomas & Konteos, 2024; Hanafizadeh & Tavakoli, 2026). This distinction is the conceptual basis for the separate analysis of hardware and software investment rather than as a homogenous construct of ICT expenditure.

2.2 Financial Performance

Financial performance refers to the degree to which an organization converts its resource base into economically meaningful returns. A common measure of profitability in banking research is the use of accounting measures such as the return on assets (ROA), return on equity and other profitability indicators . This paper employs ROA as a measure, as ROA reflects the profit generated relative to the asset base of the bank and is therefore directly relevant to the assessment of whether technology investment is associated with better asset utilisation. In this study, ROA is measured by profit after tax divided by total assets . Recent empirical studies still use ROA and the various measures of profitability to assess the financial consequences of banking technology and digitalisation (Ezirim et al., 2018; Ekwunife, 2025; Salawu & Abolarin, 2026).

2.3 Theoretical Framework

2.3.1 Resource-Based View

The resource-based view (RBV) provides a useful theoretical framework for explaining why similar investment in technology results in different organisational outcomes. Recent research on the RBV is not considering ICT as a valuable input per se but as a resource whose contribution is contingent upon its strategic characteristics, its deployment and its combination with complementary organisational capabilities. Karim et al. (2022) in a meta-analysis of 147 studies found that the relationship between the impact of ICT and performance was heterogeneous, with some enabling technologies having a larger performance effect than general purpose technologies. This evidence is directly relevant for the present study because we do not expect hardware and software to yield the same economic outcomes. Therefore, the RBV provides a good explanation for the expected difference in the investment in ICT hardware and software. Much of the work done by hardware is standard and therefore potentially reproducible, but it can provide essential infrastructure. This may be more embedded with software, data capabilities, system integration and technology enabled organisational routines. The business of a bank, some evidence suggests that digital transformation can produce productivity gains, but also large adjustment and operating costs. Therefore, the value of technology is not only a question of expenditure but also of implementation and management capability (Guo et al., 2023; Hanafizadeh & Tavakoli, 2026). Thus, RBV supports the argument that strategic use of ICT resources will lead to improved financial performance.

2.3.2 Technology Acceptance Model

The Technology Acceptance Model (TAM) is therefore used as a complementary lens on technology utilisation. Recent research in banking has shown that perceptions of usefulness, ease of use, trust, security and other user perceptions affect the adoption and successful use of digital banking systems (Awoniyi, 2022; Alnemer, 2022). Moreover, a recent review of research on digital financial transactions shows that TAM and related acceptance models remain popular in explaining digital financial adoption, and trust and perceived risk are important extensions of the basic acceptance logic (Kajol et al., 2022). The individual-level TAM constructs are not measured in the present research but the model provides a

context to better understand why the deployment of purchased technology can have different organisational outcomes depending on the actual use of the systems by employees and customers.

2.3.3 Socio-Technical Systems Perspective

The socio-technical perspective, which stresses that technology does not exist in a vacuum but within a social and organisational system, supplements RBV. Successful implementation of technology requires alignment of technical infrastructure, users, organisational processes, managerial arrangements as well as business objectives (digital transformation research; Papathomas & Konteos, 2024). This view is especially applicable to banking as the financial value of hardware and software depends on employee capabilities, process redesign, governance, system integration and customer use. Thus the socio-technical perspective supports the main argument of this study, i.e. that ICT expenditure is economically productive when translated into organisational capability.

2.4 Empirical Review

An early reference point in the period under review is provided by Imalingat (2015) who considers ICT investment and financial performance of Kenyan microfinance banks. The study recommends technology can enhance access and operating efficiency but the findings also show that ICT investment should not be considered as having the same financial impacts across all technology categories . Its microfinance context is different from the Nigerian banking sector that is referenced so it is not possible to compare directly but it does support the need for evidence specific to context.

Ezirim et al (2018) provide directly relevant evidence from Nigeria. In their panel-data analysis of banks, they separate ICT development and maintenance expenditure. It is important that ICT development was significantly related to bank performance while maintenance expenditure was not significant for ROA, as this suggests the economic effect of technology is dependent on the nature of the expenditure. This distinction is in line with the decision in the current study to disaggregate ICT investment rather than employing a single aggregate measure.

Adegbie et al. (2020) examined the effect of ICT and sustainable performance in selected listed deposit money banks in Lagos State. This study found a strong relationship between ICT related dimensions and customer orientated outcomes such as loyalty and satisfaction. Their research increases our knowledge about the value of technology besides the immediate accounting profitability. However, their results are based on survey evidence and focus on sustainable and customer-related performance, so they are not directly comparable to the archival ROA-based approach used in this study.

Nwala et al. (2020) studied listed insurance companies in Nigeria and found that investment in ICT hardware and software had positive and significant effects on financial performance. This is a major finding for cross-sector comparison, indicating that both physical and software elements can create financial value when appropriately used. But the service processes, regulation, revenue model and technology intensity are different from banking in insurance. Thus, the finding should be interpreted as supporting evidence, not direct evidence of the ICT – ROA relationship for listed Nigerian banks.

However, there is evidence from Nigerian deposit money banks by Uzor et al. (2022). The analysis of ATM, mobile banking, internet banking and POS channels failed to show any significant effect on bank efficiency. The result is theoretically important because it shows that technology availability or expansion of transaction-channel do not in itself result in efficiency gains. This finding is consistent with the broader evidence that the ICT–performance relationship is heterogeneous and dependent on technology type, organisational capability and implementation conditions (Karim et al. 2022).

Okeke (2024) investigated the ICT related expenditure of listed Nigerian consumer goods firms and found negative and insignificant effects on ROCE. But the sector is materially different from banking. The findings provide valuable evidence against the assumption that the expenditure on technology automatically improves financial performance. Results and mixed Nigerian banking evidence indicate that sector conditions, complementary capabilities, investment maturity and specific performance indicator could have material influence on the observed technology returns.

More recent Nigerian evidence is more mixed in magnitude and mechanism but tends to suggest positive technology effects. Under the framework of listed Nigerian deposit money banks,

Nguemo and Ekokotu (2025) established positive and significant relationships between technology investment and sustainable development. Likewise, Ekwunife (2025) observed a positive and significant relationship between technology adoption and sustainable development. In particular, Danladi et al. (2025) concentrated on the expenditure on ICT software in listed Nigerian deposit money banks further illustrating the importance of investment in software related assets. The relationship between information-technology investment and financial performance of Nigerian deposit money banks was empirically demonstrated by Salawu and Abolarin (2026). Akanbi and Oyediran examined the investment in accounting information-system via ROA, ROE and ROI. All in all, these recent works offer more and more evidence on the financial relevance of technology, but also show important differences in constructs, proxies, periods and estimation strategies.

2.5 Conceptual Model and Study Gap

The study's conceptual logic is that ICT investment affects financial performance through enhanced transaction processing, operational efficiency, information quality, service delivery, digital capability, and utilisation of resources. The hardware provides physical capacity, the software provides capacity in the form of functionality that translates that capacity into organisational capability. This logic is consistent with contemporary RBV evidence that the performance contribution of ICT is contingent upon technology type and complementary resources (Karim et al., 2022) and with digital transformation research that financial institutions progress through stages where technology, processes, people and performance indicators must be aligned (Papathomas & Konteos, 2024). The main gap is an empirical and measurement gap. Most of the Nigerian studies have utilised aggregate ICT expenditure, transaction channels, technology adoption or broad sustainable-growth measures. Few studies separate hardware and software investment and directly test their separate relationships with ROA using archival data of listed deposit money banks. The present study contributes by disaggregating ICT investment into hardware and software, and estimating their separate relationship with financial performance with control for bank size and capital adequacy.

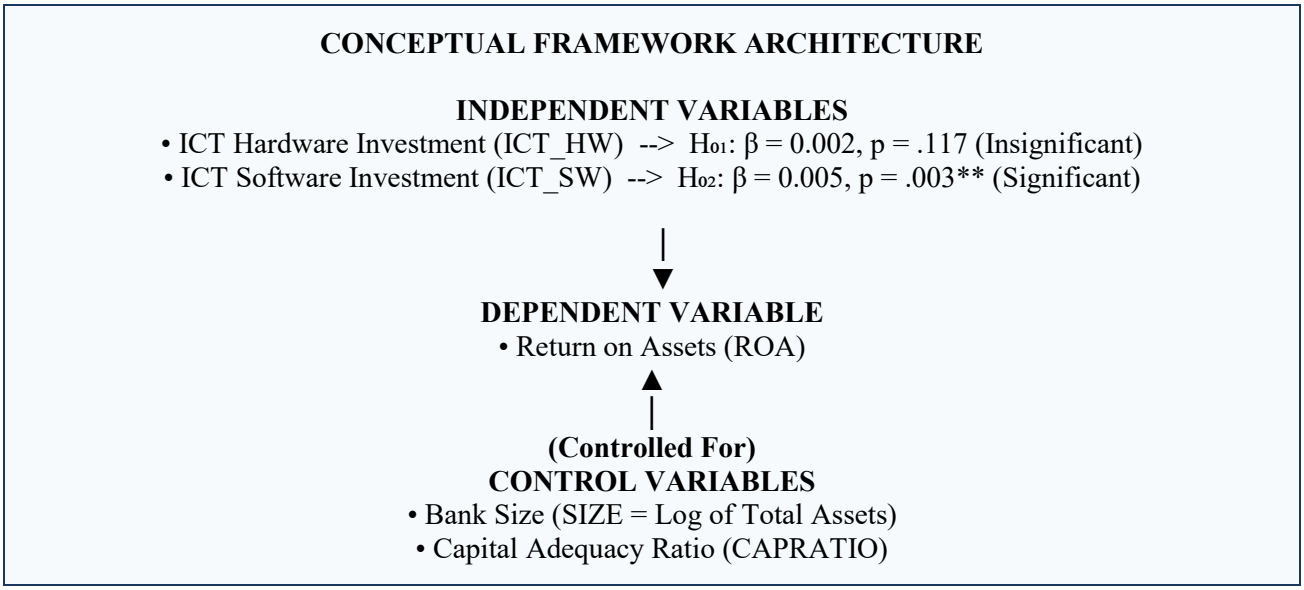

Figure 1. Conceptual framework illustrating the disaggregated components of ICT investment, control variables, and financial performance (ROA).

***Source**: Researcher's Design (2026)*

3. METHODOLOGY

This study is ex post facto in design. This design is appropriate because the study uses historical financial information that has already happened and cannot be manipulated by the researcher. This design is broadly applicable to accounting and financial research using archival data from published corporate reports. The population consists of listed deposit money banks quoted on the Nigerian Exchange Group within the period of study. The project identifies 13 listed banks in the population and purposively selects banks with complete and consistent data. The final sample consists of ten banks. The sample consists of Access Holdings Plc, Ecobank, FCMB Group Plc, Fidelity Bank Plc, First HoldCo Plc, GTBank, Jaiz Bank Plc, United Bank for Africa Plc, Wema Bank Plc and Zenith Bank Plc. The sample data set includes 100 bank-year observations. The study uses secondary data sourced from published annual reports and financial statements of the sampled listed deposit money banks, supplemented where necessary by relevant disclosures from the Nigerian Exchange Group. Published financial statements provide an auditable basis for measurement and reduce reliance on subjective responses.

Table 1: Operationalization and measurement of the dependent, explanatory, and control variables used in this study.

Variable	Acronym	Variable	Measurement	Source
Financial performance	ROA	Dependent	Profit after tax / total assets	Ogundele & Nzama (2025)
ICT hardware investment	ICT_HW	Independent	Expenditure on physical ICT infrastructure, including computers, servers, ATMs, and networking equipment	Danladi et al. (2025); Thakur et al. (2023)
ICT software investment	ICT_SW	Independent	Expenditure on software applications, core banking systems, digital platforms, and related ICT development costs	Danladi et al. (2025); Thakur et al. (2023)
Bank size	SIZE	Control	Natural logarithm of total assets	Ogundele & Nzama (2025)
Capital adequacy ratio	CAPRATIO	Control	Total regulatory capital / risk-weighted assets	Basel Committee on Banking Supervision (2026)

***Source**: Researcher's Design (2026).*

Model Specification

The relationship is specified as a linear panel-data model:

$$ROA_{it} = \beta_0 + \beta_1 ICT_HW_{it} + \beta_2 ICT_SW_{it} + \beta_3 SIZE_{it} + \beta_4 CAPRATIO_{it} + \varepsilon_{it}$$

Where ROA is return on assets; ICT_HW is ICT hardware investment; ICT_SW is ICT software investment; SIZE is bank size; CAPRATIO is capital adequacy ratio; ε is the error term; i denotes the bank (i = 1, …, 10); and t denotes the observation period (t = 1, …, 10).

The analysis combines descriptive statistics, pairwise correlation analysis, multicollinearity diagnostics, normality testing, heteroskedasticity testing, panel-model specification tests, and regression analysis. Stata was used for the statistical analysis. The Breusch–Pagan Lagrange multiplier test and Hausman test were used to determine whether panel-specific effects justified a random- or fixed-effects estimator. The reported results support pooled ordinary least squares estimation.

The study applies the variance inflation factor (VIF) to assess multicollinearity, the skewness/kurtosis test to examine distributional characteristics, the Breusch–Pagan/Cook–Weisberg test for heteroskedasticity, the Hausman test for fixed-versus-random effects, and the Breusch–Pagan Lagrange multiplier test for the presence of random effects.

4. RESULTS

4.1 Descriptive Statistics

Variable	Obs.	Mean	Std. Dev.	Min.	Max.
ROA	100	2.775	0.308	1.960	3.330
ICT_HW	100	124.927	22.907	85.940	178.960
ICT_SW	100	96.032	16.817	58.660	122.980
SIZE	100	15.301	0.532	14.420	16.140
CAPRATIO	100	12.398	1.694	9.250	15.700

***Source**: Stata Output (2026)*

The mean of ROA is 2.775 with standard deviation 0.308. This shows a relatively small dispersion in the profitability measure. The average ICT hardware investment is 124.927 with standard deviation 22.907 and the average ICT software investment is 96.032 with standard deviation 16.817. The mean bank size is 15.301 with a standard deviation of 0.532, indicating a relatively low variation in the logarithm of total assets. CAPRATIO is 12.398 (mean) and 1.694 (standard deviation).

4.2 Pairwise Correlation Analysis

Variable	ROA	ICT_HW	ICT_SW	SIZE	CAPRATIO
ROA	1.000				
ICT_HW	0.367	1.000			
ICT_SW	0.307	0.179	1.000		
SIZE	-0.133	-0.134	0.157	1.000	
CAPRATIO	-0.334	-0.622	-0.014	0.284	1.000

***Source**: Stata Output (2026)*

ICT hardware and ICT software are positively correlated with ROA at 0.367 and 0.307, respectively. SIZE and CAPRATIO have negative correlations with ROA. The largest absolute correlation among the explanatory variables is 0.622 between ICT hardware and CAPRATIO, which is below the conventional 0.80 screening threshold used in the project.

4.3 Variance Inflation Factor

Variable	VIF	1/VIF
CAPRATIO	1.761	0.568
ICT_HW	1.714	0.584
SIZE	1.120	0.893
ICT_SW	1.078	0.928
Mean VIF	**1.418**	

***Source**: Stata Output (2026)*

The VIF values range from 1.078 to 1.761, with a mean of 1.418. These low values provide no indication of problematic multicollinearity among the explanatory variables.

4.4 Normality Test

Variable	Obs.	Pr(Skewness)	Pr(Kurtosis)	Adj. $\chi^2(2)$	Prob > χ^2
ROA	100	0.267	0.151	3.390	0.184
ICT_HW	100	0.033	0.177	6.040	0.049
ICT_SW	100	0.047	0.051	7.110	0.029
SIZE	100	0.875	0.000	0.000	0.000
CAPRATIO	100	0.168	0.000	14.320	0.001

***Source**: Stata Output (2026)*

The normality diagnostics show that ROA is not significantly different from normality as the null hypothesis of joint normality is not rejected at the 5% significance level (p =.184). ICT_HW, ICT_SW, SIZE and CAPRATIO, in contrast, are evidence of non-normality. These departures, however, do not constitute a violation of the regression model because normality of the explanatory variables is not a strict requirement for ordinary least squares estimation. Therefore the normality test is discussed together with the other diagnostic tests and not as a basis for rejection of the model. The overall diagnostic evidence

supports the pooled ordinary least squares specification for estimating the relationship between ICT investment and financial performance.

4.5 Heteroskedasticity Test

Test	χ^2 Statistic	p-value
Breusch–Pagan / Cook–Weisberg	0.14	0.7119

***Source**: Stata Output (2026)*

Breusch-Pagan/Cook-Weisberg statistic = 0.14 with p-value = 0.7119 The null hypothesis of constant error variance is not rejected at conventional significance levels suggesting no evidence of heteroskedasticity in the reported model.

4.6 Hausman Specification Test

Test	χ^2 Statistic	p-value	Decision
Hausman specification test	0.90	0.925	Difference in coefficients not systematic

***Source**: Stata Output (2026)*

The Hausman test produced a chi-square statistic of 0.90 with a p-value of 0.925. The result shows no systematic difference between the fixed- and random-effects estimators. The following LM test is therefore relevant to decide whether a panel-effects model is preferred to pooled estimation.

4.7 Breusch–Pagan Lagrange Multiplier Test

Test	Test Statistic	p-value	Decision
Breusch–Pagan LM Test	0.09	0.3827	No significant panel variance; Pooled OLS preferred

***Source**: Stata Output (2026)*

The LM test has a p-value of 0.3827, so the null hypothesis of no random panel effect is not rejected. The result supports pooled OLS rather than a random-effects model for the reported specification.

4.8 Regression Results

Variable	Coefficient (β)	Std. Error	t-value	p-value	95% CI	Decision
ICT_HW	0.002	0.002	1.58	0.117	−0.001 to 0.006	Fail to reject H_{01}
ICT_SW	0.005	0.002	3.07	0.003	0.002 to 0.009	Reject H_{02}
SIZE	−0.058	0.055	−1.06	0.294	−0.167 to 0.051	Not significant
CAPRATIO	−0.034	0.022	−1.56	0.123	−0.077 to 0.009	Not significant
Constant	3.266	0.855	3.82	<.001	1.569 to 4.964	Significant

***Source**: Stata Output (2026)*

The regression model was statistically significant overall ($F = 7.158$, $p < .001$) and explained 23.2% of the variation in ROA ($R2 = .232$). ICT software investment has a statistically significant positive coefficient of 0.005 ($p = .003$). This means that, other things being equal, the higher the ICT software investment the higher the ROA in the sampled banks. The coefficient on investment in ICT hardware is positive (0.002) but not statistically significant ($p = .117$). CAPRATIO and SIZE are negative and statistically insignificant.

5. DISCUSSION OF FINDINGS

The coefficient on ICT hardware investment is positive but not significant and the stud do not reject H 01. The results show that the physical ICT infrastructure is not adequate the study also do not reject H 01. The coefficient on ICT hardware investment is positive, but not statistically significant. The results show that the physical ICT infrastructure is not sufficient to generate a statistically significant impact on the ROA of the banks of the sample. This is in line with the broader productivity-paradox argument that investment in technology may not result in measurable performance gains (Guo et al., 2023). Similarly, this is in agreement with evidence from Nigeria that some ICT investment or technology channels may be statistically weak in terms of financial or efficiency outcomes (Ezirim et al., 2018; Uzor et al., 2022). Another way to look at this is that hardware creates capacity not financial value. Computers, servers,

ATM's and networking equipment need the appropriate software, data, skilled people, maintenance, security and organizational processes. Similarly, the RBV argues that advantage is not based on resources but on the appropriate integration and exploitation of resources (Karim et al., 2022; Hanafizadeh and Tavakoli, 2026). This finding does not imply that hardware is unimportant, but rather that the financial contribution of hardware can be indirect or conditional on complementary resources.The positive coefficient of ICT software investment is statistically significant to reject $H0_2$.

Therefore, there was a positive correlation between software investment and ROA in the sampled listed deposit money banks. This finding supports the argument that functional technology systems are closer to the processes through which banks create and deliver services. Core banking applications, digital platforms, data management systems and other software can impact directly on transaction processing, information availability, service delivery, coordination of operations and use of resources. This finding confirms the findings of Ezirim et al (2018) who contended that investment in ICT development has significant positive relationship with bank performance. Nwala et al. (2020) found that ICT investment has positive impacts on listed Nigerian insurance companies. This is also in tandem with the recent finding that investment in technology is positively related to long term expansion in the listed Nigerian deposit money banks (Nguemo & Ekokotu, 2025; Ekwunife, 2025). In theory, the result is in accordance with RBV as software can be embedded to organizational routines and processes and therefore can be of higher functional value when combined with human and organizational capabilities. It also goes hand in hand with TAM; technological systems generate value when they are useful and used effectively (Alnemer, 2022; Awoniyi, 2022). The coefficient on bank size is negative but statistically indistinguishable from zero. The result suggests that the size of assets is not statistically significantly related to a higher ROA in this sample and specification. Scale may have some operational complexity and cost, but the data are insufficient to confirm this mechanism.

The coefficient of capital adequacy ratio is negative and not statistically significant. The result indicates that the relationship between variance of capital adequacy and variance of ROA in the estimated model is not statistically significant. Since the focus of the study is on ICT investment, the results for the control variables should be regarded as conditional relationships and not as general statements on bank capitalization. The overall evidence indicates a differentiated pattern of ICT and performance. The high software and low hardware coefficients suggest that the manner in which banks utilize technology may be more important to profitability than the amount of technology they acquire. This interpretation is in line with the IT business-value literature that stresses complementary resources and organizational context (Karim et al., 2022; Hanafizadeh & Tavakoli, 2026). This also explains the mixed findings in previous studies in Nigeria. Aggregate studies of ICT spending may be masking important differences across the technological components. to achieve statistically significant improvement in ROA of the banks in the sample. This is in agreement with the general argument of the productivity paradox that investment in technology might not lead to measurable gains in performance (Guo et al., 2023). This is also consistent with evidence from Nigeria that some of the channels of ICT investment or technology may be statistically weak in relation to financial or efficiency outcomes (Ezirim et al., 2018; Uzor et al., 2022).

Another way to look at this is that hardware creates capacity not financial value. Computers, servers, ATM's and networking equipment need the appropriate software, data, skilled people, maintenance, security and organizational processes. Similarly, the RBV argues that advantage is not based on resources but on the appropriate integration and exploitation of resources (Karim et al., 2022; Hanafizadeh and Tavakoli, 2026). This finding does not imply that hardware is unimportant, but rather that the financial contribution of hardware can be indirect or conditional on complementary resources. The positive coefficient of ICT software investment is statistically significant to reject H 0 2 . Therefore, there was a positive correlation between software investment and ROA in the sampled listed deposit money banks. This finding supports the argument that functional technology systems are closer to the processes through which banks create and deliver services. Core banking applications, digital platforms, data management systems and other software can impact directly on transaction processing, information availability, service delivery, coordination of operations and use of resources.

This finding confirms the findings of Ezirim et al (2018) who contended that investment in ICT development has significant positive relationship with bank performance. Nwala et al. (2020) found that ICT investment has positive impacts on listed Nigerian insurance companies. This is also in tandem with the recent finding that investment in technology is positively related to long term expansion in the listed Nigerian deposit money banks (Nguemo & Ekokotu, 2025; Ekwunife, 2025). In theory, the result is in accordance with RBV as software can be embedded to organizational routines and processes and therefore can be of higher functional value when combined with human and organizational capabilities. It also goes hand in hand with TAM; technological systems generate value when they are useful and used effectively (Alnemer, 2022; Awoniyi, 2022).

The coefficient on bank size is negative but statistically indistinguishable from zero. The result suggests that the size of assets is not statistically significantly related to a higher ROA in this sample and specification. Scale may have some operational complexity and cost, but the data are insufficient to confirm this mechanism. The coefficient of capital adequacy ratio is negative and not statistically significant. The result indicates that the relationship between variance of capital adequacy and variance of ROA in the estimated model is not statistically significant. Since the focus of the study is on ICT investment, the results for the control variables should be regarded as conditional relationships and not as general statements on bank capitalization. The overall evidence indicates a differentiated pattern of ICT and performance. The high software and low hardware coefficients suggest that the manner in which banks utilize technology may be more important to profitability than the amount of technology they acquire. This interpretation corresponds to the IT business-value literature which emphasizes the value of complementary resources and organizational context (Karim et al., 2022; Hanafizadeh & Tavakoli, 2026). It also provides a rationale for the conflicting results of earlier studies in Nigeria. Aggregating ICT spending across technology components can obscure meaningful differences.

6.0 CONCLUSION

The study investigated the impact of investment in ICT on financial performance of listed deposit money banks in Nigeria using ROA as the performance index and disaggregated investment in ICT into hardware and software components. Estimation was done with pooled OLS. This uses 100 bank year observations and the diagnostic tests reported . The results reveal that the ICT software investment is positively and statistically significantly related to ROA, while ICT hardware investment is positively but statistically insignificant related. There is a negative but insignificant relationship between bank size and capital adequacy ratio.

The primary finding is that the financial effect of ICT investment is not uniform but selective. The data suggests that software functionality is more closely related to profitability than just hardware spend. This is in line with the view that technological resources create economic value when they are embedded in effective organizational processes, supported by adequate human capabilities, and aligned with strategic goals.

Firstly, bank managers should focus their ICT software investments on transaction processing, digital banking, data analytics, cybersecurity and operational integration. Second, hardware acquisition should be evaluated in terms of use, integration, anticipated service benefits, and life-cycle cost, not in terms of acquisition volume. Third, decisions on technology investment should be aligned with ICT governance and business strategy; Fourth, technology investments should be complemented with investments in employee training and capability development, because without effective use technology cannot deliver its full value. These implications are in line with the literature that emphasizes the significance of complementary resources in achieving IT business value (Karim et al., 2022; Hanafizadeh & Tavakoli, 2026).

Regulators can drive value-based investment in technology through a focus on operational resilience, cybersecurity, reliability of digital services, consumer protection and sound governance of technology. The focus of regulation should not be on how much is spent on technology, but on whether the technology investments are enabling safe and efficient banking operations. The listed deposit money

banks should concentrate on software investments that have clear linkages to operational efficiency, digital service delivery, cyber security, data management and revenue generating activities. Banks should make best use of existing ICT hardware before embarking on further large scale procurement and should periodically review utilization and lifecycle costs. Investment in ICT should be driven by sound business cases, performance indicators, post-implementation reviews and technology-risk controls. Investment in technology should be accompanied by continuous staff training to equip staff to make best use of new systems. Bank management should evaluate the ICT projects on the basis of the business value they deliver rather than the size of the expenditure. Future studies should consider more financial-performance indicators such as ROE, cost efficiency, and market-based measures, and moderating factors such as digital adoption, managerial capability, cybersecurity readiness, and organizational capability.

The study is based on secondary financial data and is therefore subject to the quality and consistency of corporate disclosures. The financial performance is measured by ROA but it does not reflect all aspects of the bank performance. Furthermore, the study focuses on hardware and software investment, and therefore does not separately model ICT personnel expenditure, cybersecurity spending, digital adoption intensity or organizational capability. Future studies could overcome these limitations by using multiple performance measures, longer panels, alternative ICT proxies and interaction or moderation models. Qualitative evidence could also explain the differences in financial outcomes of banks' investments in similar technologies.

REFERENCES

Adegbie, F. F., Kehinde, O. K., & Owolabi, B. A. (2020). Information and communication technology and sustainable performance of selected listed deposits money banks in Lagos State, Nigeria. International Journal of Sustainability Management and Information Technologies, 6(1), 18–35. https://doi.org/10.11648/j.ijsmit.20200601.13

Akanbi, T. A., & Oyediran, A. O. (2026). Assessment of accounting information system investment and financial performance in Nigerian deposit money banks. FUOYE Journal of Accounting and Management.

Alnemer, H. A. (2022). Determinants of digital banking adoption in the Kingdom of Saudi Arabia: A technology acceptance model approach. Digital Business, 2(2), 100037. https://doi.org/10.1016/j.digbus.2022.100037

Awoniyi, O. (2022). Digital banking adoption in Nigeria: The place of Technology Acceptance Model. Asian Journal of Economics, Business and Accounting, 22(7), 59–72. https://doi.org/10.9734/ajeba/2022/v22i730579

Bank for International Settlements. (2026). Basel Framework: Risk-based capital requirements. Basel Committee on Banking Supervision.

Basel Committee on Banking Supervision. (2026). Basel Framework: RBC20—Calculation of minimum risk-based capital requirements. Bank for International Settlements. https://www.bis.org/committees/bcbs/basel-framework/standard/rbc.htm

Danladi, M. Z., Nengak, D. N., & Faka, N. A. C. (2025). Effect of ICT software expenditure on financial performance among listed deposit money banks in Nigeria. Management Sciences Horizon Journal, 1, 79–93. https://doi.org/10.67862/msh.2025.7tx78iu0

Ekwunife, E. N. (2025). Effect of technology adoption on sustainable growth of listed deposit money banks in Nigeria. Advance Journal of Management, Accounting and Finance, 10(6), 41–54.

Ezirim, C. B., Nnaji, K. I., Ezirim, U. I., & Elike, U. (2018). Investments in information and communication technology and banks' performance: Panel data evidence from Nigeria. American Journal of Information Technology, 8(1–2), 49–60.

Guo, X., Li, M., Wang, Y., & Mardani, A. (2023). Does digital transformation improve the firm's performance? From the perspective of digitalization paradox and managerial myopia. Journal of Business Research, 163, 113868. https://doi.org/10.1016/j.jbusres.2023.113868

Hanafizadeh, P., & Tavakoli, M. (2026). Impact of digital technologies in contrast to traditional IT on firm performance: From the resource-based view. Management Review Quarterly, 76, 2059–2095. https://doi.org/10.1007/s11301-025-00523-7

Imalingat, S. (2015). The effect of information and communication technology investment on financial performance of micro-finance banks in Kenya [Master's thesis, University of Nairobi]. University of Nairobi Repository. http://hdl.handle.net/11295/93825

Kajol, K., Singh, R., & Paul, J. (2022). Adoption of digital financial transactions: A review of literature and future research agenda. Technological Forecasting and Social Change, 184, 121991. https://doi.org/10.1016/j.techfore.2022.121991

Karim, M. S., Nahar, S., & Demirbag, M. (2022). Resource-based perspective on ICT use and firm performance: A meta-analysis investigating the moderating role of cross-country ICT development status. Technological Forecasting and Social Change, 179, 121626. https://doi.org/10.1016/j.techfore.2022.121626

Nguemo, O. E., & Ekokotu, R. N. (2025). Technology investment and sustainable growth of listed deposit money banks in Nigeria. International Journal of Innovative Social Sciences & Humanities Research, 13(2), 308–316. https://doi.org/10.5281/zenodo.15512391

Nwala, M. N., Abubakar, I. A., & Onibiyo, E. R. (2020). Effect of investment in information and communication technology on financial performance of listed insurance companies in Nigeria. Journal of Economics and Allied Research, 4(3), 125–139.

Ogundele, O. S., & Nzama, L. (2025). Risk management practices and financial performance: Analysing credit and liquidity risk management and disclosures by Nigerian banks. Journal of Risk and Financial Management, 18(4), 198. https://doi.org/10.3390/jrfm18040198

Okeke, C. E. (2024). Effect of information and communication technology (ICT) on financial performance of listed consumer goods firms in Nigeria. International Journal of Accounting, Finance and Information System, 4(2), 200–212. https://mpra.ub.uni-muenchen.de/121293/

Papathomas, A., & Konteos, G. (2024). Financial institutions digital transformation: The stages of the journey and business metrics to follow. Journal of Financial Services Marketing, 29, 590–606. https://doi.org/10.1057/s41264-023-00223-x

Salawu, M. K., & Abolarin, O. D. (2026). Trend of investment in information technology and financial performance of deposit money banks in Nigeria. Economic Insights – Trends and Challenges, 2025(3), 1–14. https://doi.org/10.51865/EITC.2025.03.01

Thakur, S., Rastogi, S., Parashar, N., Tejasmayee, P., & Kappal, J. M. (2023). The impact of ICT on the profitability of Indian banks: The moderating role of NPA. Journal of Risk and Financial Management, 16(4), 211. https://doi.org/10.3390/jrfm16040211

Uzor, K. N., Nwanna, I. O., Echekoba, F. N., & Ananwude, A. C. (2022). Effect of information and communication technology on the efficiency of deposit money banks in Nigeria. Journal of Innovations and Sustainability, 6(2), 08. https://doi.org/10.51599/is.2022.06.02.08