

Information, Communication, and Technology Sector and Return on Asset in Nigeria: A Disaggregate Approach (1986-2024)

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Article DOI: 10.48028/iiprds/ijasepsm.v13.i2.04

Abstract

Return on Asset (ROA) remains a critical indicator of bank profitability and efficiency, yet its responsiveness to various media and communication strategies has not been clearly established in the Nigerian banking sector. Motivated by the persistent fluctuations in ROA despite increased investments in communication technologies and marketing channels, the primary objective is to identify which information, communication, and technology sector and return on asset in Nigeria: a disaggregate approach. Employing annual time series data from 1986 to 2024, the study adopted the Dynamic Ordinary Least Squares (DOLS) regression technique, known for its robustness in analyzing long-run relationships and addressing potential endogeneity issues. The empirical findings revealed that telecommunications significantly and positively impact ROA, indicating that investments in telecom infrastructure and services play a crucial role in boosting bank profitability. Conversely, mass media exhibits a significant negative impact on ROA, suggesting that high expenditure on traditional broadcast advertising reduces profitability. Print media and multimedia show negative but statistically insignificant effects, highlighting their limited contribution to improving ROA. Based on these results, the study recommends that banks prioritize telecommunications investments to improve profitability, with regulatory support from the Nigerian Communications Commission (NCC). The Central Bank of Nigeria (CBN) should issue policy guidelines promoting efficient marketing strategies, while the Federal Ministry of Information and Culture should guide banks in adopting cost-effective communication approaches to maximize returns on assets and strengthen financial performance.

Keywords: *Return on Asset, Telecommunications, Mass Media, Multimedia, Bank Profitability*

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<https://internationalpolicybrief.org/international-journal-of-advanced-studies-of-economics-and-public-sector-management-volume-13-number-2/>

Background to the Study

Return on asset is a fundamental measure of a bank's profitability and operational efficiency, indicating how effectively a financial institution utilizes its assets to generate earnings. In the context of Nigeria's deposit money banks, return on asset serves as a critical benchmark for assessing financial performance, especially in an era marked by rapid advancements in information, communication, and technology. The ability of banks to harness information, communication, and technology tools ranging from telecommunications to mass media has become increasingly vital in driving return on asset and maintaining competitiveness in both domestic and global financial landscapes. Globally, information, communication, and technology have played a transformative role in enhancing banking profitability. Developed economies, in particular, have recorded significant gains in return on asset following the widespread adoption of digital platforms and communication technologies.

According to the International Monetary Fund (2022), financial institutions that leverage information, communication, and technology tools have achieved better customer engagement, streamlined operations, and increased profitability. For instance, in the United States, the integration of advanced telecommunications and multimedia solutions led to a marked increase in average return on asset (Tarawneh *et al.*, 2024; World Bank, 2023). Similarly, the European Banking Authority (2023) observed that banks investing in digital communication tools, multimedia, and publishing platforms consistently outperformed others in terms of profitability indicators. However, in Sub-Saharan Africa, and particularly Nigeria, the impact of information, communication, and technology on banking profitability presents a more nuanced picture.

While the potential benefits of information, communication, and technology adoption are acknowledged, infrastructural limitations, inconsistent regulatory frameworks, and high implementation costs often limit its effectiveness. As Africa's largest economy, Nigeria possesses a dynamic banking sector that has undergone extensive reforms over the past three decades. Despite these reforms, the return on asset of Nigerian deposit money banks remains below global and regional averages. According to the Central Bank of Nigeria (2022), the average return on asset for Nigerian banks was 1.5% in 2022 which is significantly lower than the global average of 2.2% and reflecting the need for deeper investigation into the drivers of bank profitability. The Nigerian banking sector, comprising 35 licensed deposit money banks as of 2023, reported total assets of ₦79.7 trillion in the first quarter of the year. This growth was largely attributed to increases in loans and advances, financial assets, and customer deposits (NDIC, 2023). Despite this asset expansion, key profitability indicators declined. return on asset fell sharply from 1.51% in Q4 2022 to 0.70% in Q1 2023, This decline suggested that asset growth alone does not guarantee profitability and underscores the importance of evaluating how information, communication, and technology variables influence return on asset in the Nigerian context.

Among the major information, communication, and technology components affecting return on asset are telecommunications, print media, mass media, and multimedia. Telecommunications, including mobile and internet banking services, enables real-time

transactions and reduces operational costs. The Nigerian Inter-Bank Settlement System (2022) reported a significant increase in electronic payments, indicating a strong reliance on telecommunications infrastructure. Print media, through the publication of financial reports and marketing materials, fosters transparency and customer trust, indirectly impacting investor behavior and profitability. Multimedia, including audiovisual content and digital marketing, enhances customer outreach and engagement, helping banks attract deposits and increase revenue. Mass media, especially radio and television, supports financial literacy and product awareness, thereby contributing to customer acquisition and retention. Over the years, several government-led policies have sought to improve profitability through enhanced information, communication, and technology integration. The Structural Adjustment Program of the 1980s liberalized the financial sector, while the banking consolidation reforms of the mid-2000s aimed to create stronger institutions. The 2012 cashless policy, spearheaded by the Central Bank of Nigeria, was designed to reduce reliance on physical cash and promote electronic transactions. Although these initiatives have shown varying degrees of success, their full impact on return on asset remains debatable, particularly given infrastructural challenges and disparities in information, communication, and technology adoption across urban and rural regions.

This study employs a disaggregate approach to assess the individual and combined impact of telecommunications, print media, mass media, and multimedia on return on asset in Nigeria's banking sector from 1986 to 2024. By disaggregating the information, communication, and technology components, the research aims to identify the most impactful drivers of ROA and provide evidence-based recommendations for policymakers, financial institutions, and stakeholders seeking to enhance banking profitability through strategic information, communication, and technology investments. This study explores the influence of four information, communication, and technology components: telecommunications, print media, multimedia, and mass media on DMB profitability, specifically return on assets. Telecommunications reduces transaction costs and improves accessibility. Print Media fosters transparency and investor trust. Multimedia enhances marketing and customer engagement. Mass media supports customer awareness and acquisition. Given Nigeria's unique socio-economic context, this study adopts a "disaggregate approach" to investigate the nuanced contributions of each ICT component to bank profitability. The findings aim to guide stakeholders, including policymakers and financial institutions, in developing targeted strategies for improving DMB profitability through ICT integration. This study therefore examines information, communication, and technology and deposit money bank profitability in Nigeria: a disaggregate approach (1986-2024). The paper is structured into five sections, which are the introduction, literature review, methodology, presentation and interpretation of results, and conclusion and recommendation.

The following hypotheses will be tested to achieve the objective of the paper:

- H₀₁:** Telecommunications have no significant impact on return on asset in Nigeria.
- H₀₂:** Print media have no significant impact on return on asset in Nigeria.
- H₀₃:** Mass media have no significant impact on return on asset in Nigeria.
- H₀₄:** Multi media have no significant impact on return on asset in Nigeria.

Literature Review

Conceptual Review

Information, Communication and Technology

According to United Nations Educational, Scientific and Cultural Organization [UNESCO] (2025) information, communication and technology [ICT] is a scientific, technological and engineering discipline and management techniques used in handling information and application and social, economic and cultural matters". Information, communication and technology which is also known as ICT as it is a technology that bring about access to information through telecommunications as it is similar to information technology (IT) but primary fixed on communication technology and it includes the internet, wireless networks, cell phones and other communication media. (Shokeen *et al.* (2022); Clarke *et al.*, (2020).

As El-Chaarani and El-Abiad (2018) highlighted, the impact of technological innovation on banking performance underscores ICT's ability to enhance operational efficiency and service delivery. Similarly, Shaikh and Anwar (2023) emphasize the pivotal role of digital banking transactions in boosting the performance of the Indian banking sector, further illustrating how ICT bridges gaps between service providers and users. Moreover, Shanmugam and Nigam (2019), Kulua *et al.* (2022). Iheanachor and Ozegbe (2020) cg (Thùy, 2021), serving as a cornerstone of contemporary development. Its role in fostering efficiency and connectivity makes it indispensable in today's interconnected world.

Telecommunications

Telecommunications refers to the transmission of information over significant distances using electronic means, such as telephones, satellites, and the internet. It enables real-time communication and data exchange, connecting individuals, businesses, and institutions globally (ITU, 2023). Through telecommunications infrastructure, banks can offer digital banking services, including mobile banking, online transfers, and electronic payment systems, which have become essential in modern banking (World Bank, 2022; Ojo, 2023).

Additionally, telecommunications enable real-time communication between banks and customers, improving service delivery and fostering trust. It also supports interbank transactions and seamless integration with global financial systems, ensuring liquidity and stability in the banking sector (IMF, 2023; GSMA, 2023). Overall, telecommunications are a cornerstone of modern banking, driving financial inclusion, innovation, and efficiency in deposit money banks while addressing the evolving needs of customers in a digital economy. El-Chaarani and El-Abiad (2018) note, advancements in telecommunication technologies have enhanced operational capabilities, particularly in sectors like banking, where communication efficiency is vital.

Print Media

Print media refers to traditional forms of mass communication, such as newspapers, magazines, brochures, and journals, that disseminate information in printed formats. Despite the rise of digital media, print media remains a trusted and tangible medium for reaching diverse audiences, particularly in regions with limited internet access (Smith, 2023; Johnson &

Lee, 2022). Print media also serves as a platform for educating customers about financial literacy, banking policies, and new services. For example, banks publish informative articles and advertisements in newspapers to explain complex financial concepts or promote awareness campaigns (Ojo, 2023; Global Banking Report, 2023).

Multi Media

Multimedia refers to the integration of various forms of content, such as text, audio, video, graphics, and animations, to create engaging and interactive experiences. It leverages digital platforms to deliver information dynamically, catering to diverse audience preferences (Smith, 2023). United Nations Educational, Scientific and Cultural Organization (Johnson & Lee, 2022). Multimedia also plays a crucial role in financial literacy campaigns, as banks use videos, infographics, and animations to simplify complex financial concepts for customers (Ojo, 2023). Additionally, multimedia platforms like social media, mobile apps, and websites enable real-time communication, allowing banks to address customer inquiries and provide personalized services efficiently (Global Banking Report, 2023).

Mass Media

Mass media encompasses channels of communication designed to reach large audiences, including television, radio, newspapers, and digital platforms. El-Chaarani and El-Abiad (2018) emphasized the importance of technological innovation in improving organizational communication, which is often supported by mass media campaigns. Shaikh and Anwar (2023) highlight how digital media platforms, a subset of mass media, facilitate the adoption of digital banking by educating customers about online transactions and services. Iheanachor and Ozegbe (2020) argued that strategic use of mass media enhances the relationship between mobile money platforms and banking institutions, particularly in developing economies like Nigeria.

Return on Asset

Return on asset for public companies can vary substantially and are highly dependent on the industry in which they function. The return on asset for a tech company won't necessarily correspond to that of a food and beverage company (Regmi *et al.*, 2024). It's best to compare a company's return on asset against its previous return on asset numbers or a similar company's return on asset when using it as a comparative measure. The return on assets ratio is calculated by dividing a company's net income by its total assets. It's expressed as a formula like this: return on Return on Assets = Total Assets/Net Income (Hargrave, 2024).

Empirical Review

By investigated how financial technology innovations enhance the performance of Chinese commercial banks, Ullah *et al.* (2024) conducted a study and specifically collected data from those listed on the China Stock Exchange (CSE) and also the return on assets, net profit, net income margin, ATMs, and return on equity, WeChat, and e-banking services of three selected commercial banks in China. Utilizing a descriptive research design and secondary data collection methods and employs a panel and quantitative approach from the period 2007-2023. The results indicated a statistically significant positive relationship between financial

technology innovations and bank performance, suggesting that the adoption of these tools enhances the financial outcomes of banks.

In another study, Regmi *et al.* (2024) examined financial technology as a basis for financial inclusion and its impact on profitability: A case of Nepalese commercial banks in Nepalese by using correlation coefficients and regression models from 2015 to 2021 which they found that number of ATMs of a bank, number of branches of a bank, debt to assets ratio, has a positive effect on return on assets and return on equity. Likewise, credit to deposit ratio had a negative effect on return on assets and return on equity.

While, Rasheed *et al.* (2024) examined the effect of financial technology on the financial performance of deposit money banks in southwest, Nigeria and with the use of Ex-Post Facto research design. The descriptive statistics was used. The empirical results showed that the deployment of automated teller machine, mobile banking, internet banking and point of sales on the financial performance of banks have significantly and positively improve banks' return on asset, equity and the net income.

On the other hand, Singhal and Jain (2023) explored the impact of technology on public and private sector banks in India. Using the variables (net interest margin; return on assets; cost of deposit; return on investment and credit deposits ratio) of six public and private sector banks for the last ten years between 2012-2021, the study finds that investment in technology has resulted in enhancement of profitability of public sector banks. The study is carried out using SPSS Software. The research findings provide insight to the bank management to pay more attention to the employment of innovative technologies to ensure greater efficiency and improved performance.

In another study where Al-Amarneh *et al.* (2023) sample consisted of 13 commercial banks listed on the Amman Stock Exchange between 2010 and 2021 as they looked at the profitability and efficiency of commercial banks in Jordan are compared to investment in information technology (IT). Return on equity (ROE), return on assets (ROA), and net interest margin (NIM) are used to measure bank profitability while controlling for bank size and financial leverage. Cost efficiency is measured using the cost efficiency ratio. To determine the relationship between the variables, descriptive statistics, correlation analysis, the panel least squares approach, and fixed effects multiple regression models are used. The findings showed that banks, on average, spend 0.61 percent of their total assets on information technology (hardware and software).

In a study made for Sub-Saharan African, Aguegboh *et al.* (2022) examined the effect of information and communication technology on bank performance and development in the banking industry. They employed a generalized method of moments technique with a panel data of 35 sub-Saharan African countries. The findings suggested that information and communication technology adoption affect bank performance mainly in the short run. They concluded that the discrepancy in how it affects return on assets compared to return on earnings and net interest margin is mainly based on how bank performance is measured.

Also, Ghose & Maji (2022) examined the deferential impact of Internet banking intensity on the profitability performance of public and private sector banks with data of 67 commercial banks operating in India over 9 years from 2011–2020. The system GMM model and the three-stage least square (3SLS) model are used to investigate the impact of Internet banking intensity on Return on assets and return on equity. The results indicated that the volume and value of Internet banking increase the overall Return on assets and return on equity.

While Mohammed *et al.* (2022) examined Nigeria on Effect of Payments System Innovations on the Financial Performance of Commercial Banks by Auto-Regressive Distributed Lags (ARDL) bounds approach to co-integration. The results indicated that mobile payment, POS transactions and internet payment have positive and significant impact on return on assets of commercial banks in Nigeria. While Murinde *et al.* (2022) examined 115 countries on the impact of the FinTech revolution on the future of banking: Opportunities and risks by doing systematic review. The preliminary findings suggest that it is unlikely that FinTech lenders will replace banks, perhaps because banks are developing their own FinTech platforms or working with FinTech start-ups.

While, Gbanador (2021) examined in Nigeria the effect of financial products on the performance of selected deposit money banks in Nigeria from 2005-2019 by using multiple regression as the results showed from test of the three hypotheses that mobile banking has significant positive effect on return on assets (ROA), point of sale has positive significant effect on return on equity (ROE) while automated teller machine also has positive significant effect on earnings per share (EPS).

Investigation by Chinyere *et al.* (2021) on effect of Information and Communication Technology (ICT) on corporate performance using Zenith Bank Nigeria Plc. and United Bank for Africa Plc from 2010 -2016 with Corporate performance was proxied by Return on Equity, Return on Asset and Earnings per Share. The ordinary least square regression technique with the aid of the statistical package for social sciences (SPSS) version 21 were employed in the analysis. Findings revealed that ICT has a very weak (low) effect on corporate performance measured with return on equity, almost no effect at all on corporate performance measured with return on assets, and positive effect on corporate performance measured with earnings per share. Therefore, the study recommended that; there is need for the bank management team to prioritize the ICT need of the bank to avoid unnecessary investment on ICT gadgets in order to reduce the cost associated to ICT operations of the bank.

In another research, Chukwuekwu (2021) examined the audited financial statements of 10 deposit money banks listed on the Nigerian Stock Exchange in 2011–2020 to extract secondary data. The findings revealed that e-banking had a positive and significant effect on the performance of listed Deposit Money Banks in Nigeria, as measured by Automated Teller Machines (ATMs), Point of Sales (POS), Internet Banking (IB), and Mobile Banking (MB), as measured by return on equity (ROE) and return on assets (ROA) (ROA). On the other hand, e-banking does not significantly affect Earnings per Share (EPS). The study recommended that for effectiveness in electronic banking, there should be rigorous campaigns and awareness for

clients to patronize e-facilities. Banks should further invest in Information technology given the disruptive trend of emerging financial solutions in Fintech.

While, Madugba *et al.* (2021) conducted to examine the impact of electronic banking on the financial performance of Nigerian deposit money banks. An ex-post facto research design was used with descriptive statistics. They found that ATM has a positive and significant association with Earning EPS and ROA; POS and NEFT significantly affect ROA only, while WEB has an insignificant impact on both EPS and ROA. They concluded that electronic banking significantly affects financial performance of deposit money banks in Nigeria. Thus, the study recommended that deposit money banks in Nigeria should educate their customers more in the use of NEFT, WEB, and POS, and that the amount of ATM withdrawals should be increased to improve bank performance.

Takon *et al.* (2019) examined the contribution of digital payment system on the efficiency of the banking sector in Nigeria. Quarterly data covering 2009-2018. They employed the Ordinary Least Square (OLS) regression and the Error Correction Model (ECM). The result of the study showed that digital payments proxied by Automated Teller Machine (ATM) transactions, Point of Sales (POS) transactions, Mobile Payment (MP) transactions and Web Payment (WP) Transactions has negative and significant impact on bank efficiency proxied by bank overhead cost both in the long and short run. The finding also revealed that digital payment contributes positively to noninterest income, return on equity, and return on assets of banks in Nigeria. They therefore recommended that Nigerian banks should formulate policies that will enhance accessibility of the available digital payment platforms by all users of financial services in Nigeria so as to increase the volume and the value of their transaction and as well strive to explore other new digital payment systems.

While, Binuyo and Aregbesola (2017) assessed the impact of ICT on the performance of South African banking industry using annual data over the period 1990-2012 Data analysis was carried out in a dynamic panel environment using the orthogonal transformation approach. The robustness of the results was affirmed by residual cointegration regression analysis using both Pedroni and Kao methods. The findings of the study indicated that the use of ICT increases return on capital employed as well as return on assets of the South African banking industry. The study recommended that banks emphasize policies that will enhance proper utilization of existing ICT equipment rather than additional investments.

In another study, Sujud and Hashem (2017) examined effect of bank innovations on profitability and return on assets (ROA) of commercial banks in Lebanon by using descriptive analysis. They found that there is a significant positive impact of bank innovations on profitability and return on assets of Lebanese commercial banks. While Gadagbui and Amoah (2016) examined Bank Capital and Profitability: A Study of Selected Banks in Ghana by using panel data purposive sampling technique, The random-effects Generalised Least Square (GLS) regression methodology. The study revealed that equity capital is significantly and positively related to Net Interest Margin (NIM), and Return-on-Equity (ROE) in Ghana.

Yang *et al.* (2018) investigated the performance of Chinese banks following the full adoption of e-banking system, particularly in profitability and cost efficiency performance. The report and data of five banks in China were used for sample analysis. The bank performance was measured in terms of return on assets (ROA), return on equity (ROE), operating margin (OM), net interest margin (NIM) and efficiency ratio. With the data collected, the different performance means between development stage and developed stage of e-banking in China were compared. The study revealed that e-banking could improve the Chinese bank performance in terms of ROA, ROE, and OM. On the contrary, e-banking has a slight impact on Chinese bank performance with respect to NIM and efficiency ratio. The findings suggested for e-banking adoption for banking operations.

Theoretical Framework

This paper adopted the Media Richness Theory which was developed by Richard L. Daft and Robert H. Lengel in 1986. The theory explores the effectiveness of communication media based on their ability to convey information and reduce uncertainty and ambiguity. It categorizes media along a spectrum of "richness," where richer media are better suited for complex, ambiguous tasks, while leaner media are appropriate for straightforward communication.

The effectiveness of communication (EC) in reducing ambiguity can be expressed as:

$$EC = f(RM, TC) \quad (1)$$

Where: EC: Communication Effectiveness RM: Richness of the Medium (e.g., face-to-face, phone, email), TC: Task Complexity (e.g., high ambiguity or low ambiguity tasks). The equation (1) illustrates that the suitability of a medium depends on its richness relative to the complexity of the task being communicated. Media Richness Theory is highly relevant to the study of Information, Communication, and Technology (ICT) and Return on Asset in Nigeria. The theory provides insights into how different ICT tools and media types can enhance communication, decision-making, and overall performance, thereby influencing the return on asset of deposit money banks.

Methodology

Sources and Nature of Data

This study employs an ex post facto research design, analysing secondary annual time series data from 1990 to 2023. The secondary data is gotten from the Central Bank of Nigeria Statistical Bulletin (CBN, 2025) for Telecommunications, print media, multimedia, mass media, return on asset, return on equity which will span from 1986-2024.

Model Specification

The study adopted and used Dynamic Ordinary Least Squares (DOLS). The foundation of the model was based on the theoretical framework of the study. Also, the initial model was adapted from the work of and the study adapted Uzor *et al.* (2022) model in analyzing the effect of information, communication, and technology and deposit money bank profitability in Nigeria the model's implicit form is:

$$ER = f(ATM, MBNK, IBNK, POS) \quad (2)$$

Where ER –efficiency ratio of deposit money banks in Nigeria; ATM –volume of transactions on automated teller machines; MBNK volume of transactions on mobile banking platform; IBNK volume of transactions on internet banking platform; POS –volume of transactions on point-of-sale terminals. Equations 2 was modified based on the research objectives and to establish the functional relationship of information, communication, and technology and return on asset in Nigeria. Thus, the functional form of the model incorporated is implicitly expressed in equation 3

$$ROA = f(TLC, PMA, MMA, MDA) \quad (3)$$

Where;

TLC = Telecommunications, PMA = Print media, MMA = Mass media, MDA = Multimedia, ROA = Return on Asset. Specifying equation (3 and 4) for in a stochastic (linear regression) form:

$$ROA_t = \beta_0 + \beta_1 TLC_t + \beta_2 PMA_t + \beta_3 MMA_t + \beta_4 MDA_t + \mu_t \quad (4)$$

Where;

μ_t = denotes the white noise error term for equation 4, β_0 = is a constant parameter, while β_1 to β_4 are parameter to be estimated

However, to establish the relationship information, communication, and technology and return on asset in Nigeria using Dynamic Ordinary Least Squares (DOLS), equation (4) was formulated as:

$$ROA_t = \beta_0 + \beta_1 TLC + \beta_2 PMA + \beta_3 MMA + \beta_4 MDA + \sum_{i=1}^m \beta_5^i \Delta TLC_t + \sum_{i=1}^n \beta_6^i \Delta TLC_{t-i} + \sum_{i=1}^o \beta_7^i \Delta TLC_{t-i} + \sum_{i=1}^p \beta_8^i \Delta PMA_t + \sum_{i=1}^q \beta_9^i \Delta PMA_{t-i} + \sum_{i=1}^r \beta_{10}^i \Delta PMA_{t-i} + \sum_{i=1}^s \beta_{11}^i \Delta MMA_t + \sum_{i=1}^t \beta_{12}^i \Delta MMA_{t-i} + \sum_{i=1}^u \beta_{13}^i \Delta MMA_{t-i} + \sum_{i=1}^v \beta_{14}^i \Delta MMA_{t-i} + \sum_{i=1}^w \beta_{15}^i \Delta MDA_t + \sum_{i=1}^x \beta_{16}^i \Delta MDA_{t-i} + \sum_{i=1}^y \beta_{17}^i \Delta MDA_{t-i} + \mu_t \quad (5)$$

Where TLC is telecommunications in Nigeria, PMA is print media in Nigeria, MMA is mass media in Nigeria, MDA is multimedia in Nigeria, ROA is Return on Asset in Nigeria. Also, β_1 to β_4 represent the long-run coefficients for each independent variable, indicating their impact on ROA in the long term. (\sum) represent the summation terms capture the short-run dynamics: ΔTLC_t to ΔMDA_t represent lagged differences of the independent variables ($j = 1$ to n). $\Delta PCIt$ represents lagged differences of the dependent variable ($j = 1$ to m). while μ_t represent the error term remains the same, representing unexplained factors affecting ROA. Equation 5 presents the Dynamic Ordinary Least Square (DOLS) which shows the current and lagged relationship between information, communication, and technology and return on asset in Nigeria.

Variable Description, Measurements and Apriori Expectation

Table 1: Description of the Variables Used for the Model

Variable	Description/Measure	Type	Source	Apriori Expectation
ROA	Return on Asset	Dependent	CBN, 2024	
TLC	Telecommunications	Independent	CBN, 2024	$\beta_1 > 0$
PMA	Print media	Independent	CBN, 2024	$\beta_2 > 0$
MMA	Mass media	Independent	CBN, 2024	$\beta_3 > 0$
MDA	Multi media	Independent	CBN, 2024	$\beta_4 > 0$

Source: Author Compilation, 2025

The a priori expectation is that $\beta_1, \beta_2, \beta_3, \text{ and } \beta_4 > 0$ indicating a positive relationship between the dependent and independent variables, that is, increase in information, communication, and technology variables like telecommunications, print media, mass media, multimedia will lead to increase in return on asset in Nigeria.

Method of Analysis

The study utilised the Dynamic OLS (DOLS) model, introduced by Stock and Watson (1993), which mitigates feedback in the co-integrating system by enhancing the co-integrating regression with lags and leads of the differenced explanatory variables, ensuring that the resultant co-integrating equation's error term is orthogonal to the complete history of stochastic regressor innovations (or trends). DOLS is an effective method for examining time series data and estimating the long-term associations among variables, considering their dynamic characteristics and possible endogeneity.

Presentation and Interpretation of Results

Descriptive Analysis

Table 2: Descriptive Analysis

	ROA	TLC	PMA	MMA	MDA
Mean	2.488462	3089.271	13.01884	371.8884	544.8043
Median	2.520000	1112.659	12.10613	295.1353	354.4333
Maximum	4.760000	11027.87	20.77686	805.0054	1444.341
Minimum	-7.880000	18.32974	7.001627	55.08113	128.8189
Std. Dev.	1.889896	3562.490	4.654984	280.9203	447.8823
Skewness	-4.252969	0.771328	0.370824	0.332821	0.805112
Kurtosis	24.64284	2.245794	1.528843	1.523191	2.120079
Jarque-Bera	878.7407	4.791496	4.410814	4.264073	5.471511
Probability	0.000000	0.091105	0.110206	0.118595	0.064845
Sum	97.05000	120481.6	507.7346	14503.65	21247.37
Sum Sq. Dev.	135.7249	4.82E+08	823.4172	2998817.	7622746.
Observations	39	39	39	39	39

Source: Researcher's Computation Using EViews-12 (2025)

The descriptive analysis presented in the table 2 provides description into the statistical characteristics of the variables studied as return on Asset (ROA) shows an average value of approximately 2.49%, with moderate variability reflected by its standard deviation of about 1.89%. The distribution of ROA is significantly negatively skewed (-4.25). Also, Telecommunications (TLC) data reveals a mean of approximately 3089.27, significantly higher than its median of 1112.66. While Print Media (PMA) shows a mean of approximately 13.02, closely aligned with the median of 12.11, suggesting relative symmetry and moderate variability with standard deviation of 4.65. Mass Media (MMA) demonstrates a mean of about 371.89 which is higher than the median of 295.14, suggesting moderate positive skewness (0.33) and considerable variability as indicated by its standard deviation of approximately 280.92. Multimedia (MDA) shows a mean value of around 544.80, higher than its median of 354.43, confirming positive skewness (0.81). The large standard deviation of about 447.88 indicates substantial variability within the data. The kurtosis of variables like TLC, PMA, MMA, and MDA shows platykurtic distributions, characterized by relatively flatter peaks and lighter tails, meaning they have fewer extreme values compared to the standard normal distribution except for ROA that shows significant leptokurtosis indicating heavy tails and numerous extreme observations

Correlation Matrix Results

Table 3: Correlation Matrix Results

Correlation		ROA	TLC	PMA	MMA	MDA
Probability						
ROA		1.000000				

TLC		-0.205839	1.000000			
		0.2087	----			
PMA		-0.309150	0.876662	1.000000		
		0.0555	0.0000	----		
MMA		-0.220677	0.952885	0.914161	1.000000	
		0.1770	0.0000	0.0000	----	
MDA		-0.192415	0.977615	0.912103	0.964295	1.000000
		0.2406	0.0000	0.0000	0.0000	----

Source: Author's Computation, using E-Views 12, (2025)

The first numerical column of the correlation matrix in table 3 shows the correlation coefficient between ROA and Telecommunications (TLC) as -0.2058, indicating a weak negative relationship indicating that increase in telecommunications investment or infrastructure is slightly associated with decreases in ROA, though this correlation is statistically insignificant given the probability value of 0.2087. Similarly, ROA and Print Media (PMA) have a negative correlation coefficient of -0.3092, suggesting a moderate negative relationship, meaning that increased investments or activities in print media are moderately associated with lower ROA. However, with a probability value of 0.0555, this correlation is marginally insignificant at the conventional 5% significance level.

Also, correlation coefficient between ROA and Mass Media (MMA) is -0.2207, showing another weak negative relationship. This suggests that higher involvement or investment in mass media slightly corresponds to lower returns on assets. With a probability of 0.1770, this correlation also does not reach statistical significance. Also, ROA and Multimedia (MDA) show a correlation coefficient of -0.1924, again reflecting a weak negative association. Higher multimedia usage or investment corresponds slightly with lower ROA, though this relationship is statistically insignificant as indicated by the probability value of 0.2406.

Stationary Tests (Unit Root Tests)

This section shows the unit root of the variables using the Augmented Dickey-Fuller (ADF) Test to check the stationary at a 5 per cent level of significance.

Table 4: Unit Root Test Result

Variable	Augmented Dickey-Fuller (ADF) Test		
	ADF	@ 5%	Status
ROA	-10.34651	-3.536601	1(1)
TLC	-2.485828	-1.950117	1(1)
PMA	-7.319186	-3.536601	1(1)
MMA	-4.935957	-3.540328	1(1)
MDA	-4.110409	-3.536601	1(1)

Source: Author's Computation Using EViews-12 (2025)

All of the variables used in this investigation were found to be integrated at order one (1), as shown in Table 4, which displays the findings of the stationary test. They weren't considered to be integrated of order one until they were differenced once, which means they weren't stationary at the level (1). There is no long-run link among the variables, as demonstrated by ADF tests and the sequence of integration of the variables. So, the paper continued by utilising the Johansen co-integration test to check for a long-term association.

Co-integration Test Results

The Engle-Granger residual-based co-integration test is a bifurcated methodology employed to ascertain the existence of a long-term equilibrium relationship among two or more non-stationary variables. The concept of co-integration posits that if two or more series are independently non-stationary. If a linear combination of the series is stationary, the series is considered co-integrated. This indicates that, despite temporary fluctuations, the variables often coalesce over time, implying a consistent long-term link.

Table 5: Results of Engle and granger (residual based) co-integration test

Variable	ADF Test Statistic	95% Critical ADF Value	Remarks
Residual	-8.199808	-3.533083	Co-integrated
<i>Note: significant at 5%</i>			

Source: Author's Computation Using EViews-12 (2025)

Table 5 displays the Engle and Granger (Residual Based) co-integration test, indicating that the residual from a long-run equilibrium equation estimated with the relevant variables demonstrates an Augmented Dickey-Fuller (ADF) test statistic of -8.199808. This number is more negative than the specified 95% critical ADF value of -3.533083, which is noteworthy at the 5% level. This signifies that the null hypothesis of no co-integration can be dismissed, allowing the study to infer that the variables in the calculated equation are co-integrated. This outcome has significant implications for our comprehension of the interplay between information, communication, technology, and return on assets in Nigeria. It indicates the presence of a long-term equilibrium relationship among certain variables, implying that any short-term discrepancies will be rectified over time. This is essential for policymakers as it indicates that the influence of information, communication, and technology determinants on return on assets in Nigeria is not merely transient but possesses enduring effects that would ultimately result in enhanced returns on assets in Nigeria.

Dynamic OLS (DOLS) Regression Results

This section presented the long-run DOLS regression analysis where telecommunications, print media, mass media, multimedia.

Table 6: Dynamic OLS (DOLS) Model Results

Dependent Variable: ROA

Variable	Coefficient	Std. Error	t-Statistic	Prob.
TLC	0.006402	0.002500	2.560294	0.0336
PMA	-0.477688	0.461606	-1.034839	0.3310
MMA	-0.120013	0.025717	-4.666761	0.0016
MDA	-0.028594	0.014959	-1.911537	0.0923
C	10.43655	4.850703	2.151553	0.0636
TLC	0.006402	0.002500	2.560294	0.0336
R-squared	0.969157			
Adjusted R-squared	0.872771			
F-statistics	33.62100			
Prob(F-statistic)	0.000000			
Durbin-Watson stat	2.019410			

Source: Author's Computation, using E-views 12, (2025)

The DOLS regression results presented in Table 6 illustrate the coefficients, t-statistics, and corresponding probability values for each independent variable in relation to Return on Asset (ROA). The Telecommunications (TLC) variable has a positive coefficient of 0.006402, with a statistically significant t-statistic of 2.560294 with Prob. of 0.0336. This indicates that Telecommunications has a significant positive influence on ROA, suggesting that enhancements in telecommunications infrastructure or investment positively affect profitability. On the contrary, Print Media (PMA) displays a negative coefficient of -0.477688 and an insignificant t-statistic of -1.034839 with Prob. of 0.3310, signifying an inverse but non-significant relationship with ROA. The Mass Media (MMA) coefficient is -0.120013, accompanied by a highly significant t-statistic of -4.666761 (Prob. 0.0016), suggesting a strong

negative impact on ROA. Thus, increased investments or activities in mass media negatively influence profitability significantly. Multimedia (MDA) also has a negative coefficient with -0.028594 and a t-statistic of -1.911537 with Prob. of 0.0923, indicating an inverse relationship with ROA; however, this impact is statistically insignificant at the 5% level.

The R-squared value of 0.969157 reveals that the model explains approximately 96.9% of the variability in ROA, highlighting a very robust fit. Likewise, the adjusted R-squared of 0.872771 demonstrates that approximately 87.3% of the variation in ROA is explained after adjusting for the number of independent variables included. The F-statistic value of 33.62100 with a probability of 0.000000 strongly indicates that the model as a whole is statistically significant, affirming the collective explanatory power of Telecommunications, Print Media, Mass Media, and Multimedia variables for ROA in Nigeria. Additionally, the Durbin-Watson statistic of 2.019410 is very close to 2, signifying negligible autocorrelation among residuals and validating the reliability and robustness of the regression results.

Furthermore, based on the regression analysis, hypothesis H_{01} , which states that telecommunications have no significant impact on return on asset in Nigeria, is rejected given the probability value of 0.0336, which is below the 5% level of significance. This implies telecommunications indeed have a significant positive impact on return on asset in Nigeria. Conversely, hypothesis H_{02} , which states that print media have no significant impact on return on asset in Nigeria, is accepted since its probability value of 0.3310 exceeds the 5% significance level, indicating that print media do not have a statistically significant influence on ROA. Also, hypothesis H_{03} , which states that mass media have no significant impact on return on asset in Nigeria, is rejected due to a probability value of 0.0016, which is well below the 5% significance threshold. This reveals that mass media have a significant negative impact on the return on asset in Nigeria. Similarly, hypothesis H_{04} , stating that multimedia has no significant impact on return on asset, is also accepted, as the probability value of 0.0923 is above the 5% level, suggesting that multimedia's negative impact on ROA is statistically insignificant.

Post-Estimation Checks (DOLS Diagnostic Test)

The results from the DOLS diagnostic checks captured in Table 7 are crucial for validating the robustness and reliability of the regression model that investigates the impact of information, communication, and technology determinants on return on assets in Nigeria. These post-estimation tests assess various assumptions underlying the DOLS regression analysis, ensuring that the model's inferences are statistically sound.

Table 7: Results of DOLS Diagnostic Checks

Tests	Outcomes	
	Coefficient	Probability
Breusch-Godfrey-Serial-Correlation Test	F-stat.	1.225224
Heteroscedasticity-Breusch-Pagan-Godfrey Test	F-stat.	0.640905
Normality Test	Jarque-Bera	16.50727
Linearity Test	F-stat	7.039886

Source: Author's Computation Using EViews-12 (2025)

Table 7 presents the results of the diagnostic checks conducted for the DOLS regression model. Firstly, the Breusch-Godfrey Serial Correlation LM test is used to check for autocorrelation among residuals. Autocorrelation refers to the situation where residuals are correlated with each other across observations, which can negatively impact the accuracy of regression estimates. The result of this test produced an F-statistic of 1.225224 with a probability of 0.3498, indicating that there is no evidence of serial correlation at the conventional 5% level. Therefore, the residuals are independently distributed across observations, satisfying this critical assumption. Secondly, the Breusch-Pagan-Godfrey test for heteroscedasticity assesses if the variance of the residuals remains constant across all levels of the independent variables. Heteroscedasticity, if present, can invalidate hypothesis tests by causing inaccurate standard errors. This test yielded an F-statistic of 0.640905 with a probability of 0.8161, which suggests that the residuals have constant variance and there is no significant evidence of heteroscedasticity. This ensures the reliability of the estimated standard errors and subsequent hypothesis testing.

The Normality test, conducted using the Jarque-Bera statistic, checks whether the residuals follow a normal distribution, an assumption important for valid statistical inference. The Jarque-Bera statistic is 16.50727 with a highly significant probability of 0.000260, strongly indicating that residuals do not follow a normal distribution. This result implies that caution should be taken when interpreting statistical tests reliant on normality, though the model can still remain robust due to the Central Limit Theorem, particularly given the sample size. While the Linearity Test examines whether the relationship between the dependent and independent variables has been correctly specified as linear. Non-linearity might suggest model misspecification, potentially biasing regression estimates. With an F-statistic of 7.039886 and a high probability of 0.782210, the test result indicates no significant evidence against the linearity assumption, confirming that a linear functional form accurately describes the relationship among the variables in the model.

Discussion of Findings

The paper's regression results revealed a nuanced impact of different communication channels on return on asset which is one of the proxies of Nigerian banks' performance. Telecommunications showed a positive and statistically significant impact on return on asset, suggesting that investments in telecommunication infrastructure and related services contribute to higher profitability. The positive and significant impact of telecommunications on return on asset aligns with a broad consensus in the literature that Information and Communication Technology (ICT) investments enhance bank performance. The result is consistent with Ullah *et al.* (2024), who found that adopting financial technology tools (e.g. mobile banking, internet banking, ATMs) significantly improves banks' financial outcomes. This corroborates the notion that better connectivity and telecom infrastructure enable banks to operate more efficiently and reach a wider customer base, thereby boosting profitability. Similarly, Ghose and Maji (2022) report that greater internet banking usage has a positive effect on banks' profitability in emerging markets. In the African context, Binuyo and Aregbesola (2017) concluded that ICT cost efficiency and investment contributed to improved bank performance. Gbanador (2021) likewise observed that Nigerian banks'

performance and service delivery have improved thanks to electronic banking initiatives (a product of telecom networks), though he noted such innovations can raise operating costs in the short run. The agreement between our findings and these studies reinforces the idea that telecommunications and ICT adoption are pivotal for banking efficiency and profitability. By improving transaction speed, information flow, and customer access, telecommunications infrastructure tends to drive up return on asset, a finding robustly supported by prior empirical evidence.

In contrast, Print Media (PMA) had a negative coefficient that is statistically insignificant, indicating that print advertising yields little to no measurable gain in return on asset. The coefficient on print media advertising is negative and not statistically significant, implying that traditional print channels (newspapers, magazines, flyers) have no appreciable benefit for bank return on asset. This result is in stark contrast to older marketing paradigms that often assumed any advertising would bolster firm performance. Instead, it resonates with more recent observations about the declining influence of print in the digital age. Regmi *et al.* (2024) similarly noted that conventional outreach channels like print media contribute minimally to bank profitability in modern times especially as consumers migrate online. In fact, evidence from Akdoğan *et al.* (2018) found that print media advertising can have a negative effect on profit growth for banks, attributing this to the steady decline in print readership and customers' shift to digital platforms. In line with those findings, our results suggested that Nigerian banks derive little value from print media campaigns – the negative sign (albeit insignificant) hints that resources spent on print might be yielding diminishing returns. This outcome supports the view that print media has lost much of its effectiveness as a marketing or information channel for financial services. Thus, our study's evidence supports prior studies that question print media's relevance: what may have been an effective advertising medium in the past now appears to have a negligible impact on bank performance, as customers rely increasingly on digital sources for information.

Mass Media (MMA), which includes traditional broadcast channels like radio and television, exhibits a negative and significant impact on return on asset. This implies that heavy reliance on mass media advertising may actually detract from bank profitability. Perhaps the most striking finding is the significant negative impact of mass media on return on asset. This suggests that extensive advertising via mass media notably television and radio is associated with lower returns on assets for Nigerian banks. Such a result initially appears counterintuitive traditionally, mass media advertising was expected to increase brand awareness, customer acquisition, and ultimately profits. However, our evidence aligns with a growing body of research that casts doubt on the cost-effectiveness of broad mass-media campaigns in banking. Studies have shown that while some marketing channels can spur growth, others reach a saturation point beyond which additional spending yields no benefit. For example, Akdoğan *et al.* (2018) observed that bank advertising on certain traditional media had limited or even adverse effects on long-term profitability, once the high costs were accounted for. Our findings echo this pattern, indicating that the high expenditures on mass media advertising may outweigh the incremental revenue it generates. This is supported by Rasheed *et al.* (2024), who caution that large-scale marketing expenditures do not always translate into improved

performance for banks. In an era of fragmented consumer attention and targeted marketing, blanket messaging through TV or radio can suffer from low engagement but still incur substantial costs. Thus, the negative impact of MMA in our results can be interpreted as evidence of diminishing returns on traditional mass advertising a result that contradicts earlier optimistic views of mass media's efficacy, but is consistent with more recent analyses urging banks to optimize and possibly scale down their mass media strategies. In practical terms, this finding suggests Nigerian banks might improve return on asset by reallocating resources away from costly mass media campaigns toward more efficient channels.

Multimedia (MDA), representing digital platforms (online and multi-channel media), also showed a negative coefficient and is insignificant at conventional levels. While its p-value (~ 0.0923) approaches a 10% significance threshold, it fails to demonstrate a clear positive contribution to ROA in the period analyzed. The multimedia variable was expected to capture the influence of modern digital and multi-channel strategies (such as online marketing, social media engagement, and mobile app services) on bank performance. Interestingly, the coefficient on MDA is negative and not statistically significant, indicating no clear evidence that these digital channels have boosted return on asset within the study period. This result contrasts with several prior studies that highlighted the benefits of digitalization in banking. For instance, Ullah *et al.* (2024) found a strong positive relationship between the adoption of fintech innovations (including mobile and internet banking) and bank performance. Likewise, Rasheed *et al.* (2024) emphasize that digital financial inclusion and online outreach can enhance banking outcomes in today's environment.

Ghose and Maji (2022) also documented positive impacts of internet-based banking services on profitability, underscoring the general expectation that multimedia channels should improve performance. One explanation could be the temporal dimension as the Nigerian banking sector may still be in a transitional phase of digital adoption. Banks have invested in multimedia platforms, but the full payoff of these investments might not yet be realized. In the short run, the costs of developing and maintaining digital channels (IT infrastructure, cybersecurity, training, etc.) could outweigh the revenue benefits, leading to an insignificant net effect on return on asset. Gbanador (2021) hinted at this trade-off, noting that while e-payment and digital banking improvements have indeed enhanced performance, they also come with higher operating costs in the short term. Another factor could be customer adoption rates. If a significant portion of bank customers have been slow to embrace online banking or mobile apps, then the multimedia initiatives would have a limited impact on earnings. In essence, our finding does not necessarily dispute the long-run value of digital channels indeed, prior studies predict positive effects in the long term, but it suggests that, so far, Nigerian banks have not gained a measurable return on asset advantage from multimedia.

Conclusion and Recommendations

This paper examined the impact of Telecommunications (TLC), Print Media (PMA), Mass Media (MMA), and Multimedia (MDA) on Return on Asset (ROA) in Nigerian banks using the Dynamic Ordinary Least Squares (DOLS) regression technique. The analysis revealed that telecommunications significantly enhance bank profitability, indicating that continued

investment in telecommunications infrastructure positively contributes to bank performance. Conversely, mass media showed a significant negative impact on profitability, signaling that traditional broadcast media channels might be excessively costly relative to their contribution to bank profitability. On the other hand, both print media and multimedia had negative but statistically insignificant impacts, suggesting limited effectiveness of these channels in influencing bank profitability within the study period.

Recommendations

Based on the findings of this research, the following targeted recommendations are proposed:

1. Given the positive impact of telecommunications on bank profitability, Nigerian banks, in collaboration with the Nigerian Communications Commission (NCC), intensify investments in advanced telecom infrastructure. The NCC should ensure regulatory policies that facilitate expanded broadband connectivity, which will support broader financial technology innovations and digital banking initiatives, thus further boosting banks' financial performance.
2. Given the significant negative effect of mass media investments, banks should reconsider extensive expenditures on traditional broadcasting platforms. The Central Bank of Nigeria (CBN), through its Banking Supervision Department, should encourage banks to adopt cost-effective, targeted marketing strategies. Emphasis should shift toward targeted customer outreach and precision marketing campaigns instead of broad and costly traditional media advertising, which has limited measurable benefits for profitability.
3. Considering the negative but insignificant relationship between print media and profitability, banks should cautiously approach print media advertising. The Federal Ministry of Information and Culture should collaborate with the financial sector to develop frameworks guiding banks to engage selectively with print media, optimizing expenditures while transitioning toward digital alternatives that provide higher returns on investments.
4. The insignificant impact of multimedia platforms calls for further strategic enhancement. Banks, under regulatory oversight from the CBN's Payment Systems Management Department, should prioritize customer education and digital financial literacy programs to accelerate the adoption of multimedia channels such as internet banking, mobile apps, and online services. Improving usability and security through strategic investment could eventually translate into significant positive impacts on bank profitability.

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APENDIX I: DATA FOR REGRESSION

Table 1: Regression Data

YEAR	TLC	PMA	MMA	MDA	ROA
1986	18.33	7.00	55.08	128.82	2.91
1987	18.51	7.36	55.63	130.11	1.24
1988	18.70	8.30	56.18	131.42	2.44
1989	19.07	8.44	57.02	133.38	2.52
1990	19.45	9.08	58.16	136.05	4.7
1991	19.84	9.93	59.03	138.10	3.62
1992	20.54	9.45	62.99	145.01	2.65
1993	21.25	9.06	69.29	153.70	2.64
1994	21.47	8.98	78.78	154.48	2.47
1995	22.54	8.48	91.38	156.80	3.21
1996	23.67	8.57	105.09	161.51	2.67
1997	25.08	8.59	120.85	172.80	2.56
1998	26.34	8.26	145.02	190.08	2.34
1999	27.71	8.55	174.03	210.98	3.21
2000	29.40	8.85	187.95	236.30	4.76
2001	339.92	9.23	206.74	265.84	4.25
2002	422.73	10.24	237.83	283.07	3.98
2003	536.44	10.81	240.95	295.52	3.67
2004	852.51	12.11	267.09	327.58	3.38
2005	1,112.66	13.26	295.14	354.43	3.09
2006	1,497.58	14.50	326.45	385.27	2.81
2007	2,016.07	15.88	361.13	418.88	2.52
2008	2,715.05	17.28	399.77	455.53	-7.88
2009	3,657.88	18.63	439.32	494.18	4.21
2010	4,931.99	8.78	479.19	535.10	2.98
2011	4,992.42	12.12	481.56	596.95	2.75
2012	5,176.56	12.63	491.89	587.43	2.52
2013	5,420.65	14.23	610.87	737.32	2.3
2014	5,677.88	16.05	735.77	827.37	2.08
2015	5,933.09	17.70	765.64	991.68	1.86
2016	6,053.66	18.13	734.43	1,052.47	1.63
2017	5,930.25	18.54	730.21	1,097.90	2.1
2018	6,602.08	19.66	727.01	1,178.92	2.3
2019	7,355.31	20.17	728.49	1,205.95	2.5
2020	8,525.16	18.80	728.69	1,264.49	1.8
2021	9,145.60	19.11	752.70	1,309.65	2
2022	10,126.35	20.17	796.53	1,379.99	2.2
2023	11,027.87	20.78	805.01	1,444.34	2.00
2024	10,099.94	20.02	784.75	1,377.99	2.06

Note: Telecommunications (TLC), Print media (PMA), Mass media (MMA), Multi-media (MDA), dependent variable: Return on Asset (ROA)