Research Article

Innovative Financial Services and Commercial Banks' Profitability in Africa

Edward Lambert[1], Kanbiro Orkaido Deyganto[2]

1. Academic Dean, Atlantic International University, Honolulu, United States; 2. Atlantic International University, Honolulu, United States

This paper aims to examine the effect of innovative financial services on bank financial performance in Africa. A mixed research method was used. Balanced panel data from thirteen years of audited financial statements of the seventeen oldest commercial banks in Africa were used by the researchers. The Hausman test was conducted to identify the best estimator. The random effects regression findings of the article suggested that automatic teller machine services, mobile banking services, and internet banking services have a positive effect on the profitability of commercial banks operating in Africa. The researchers recommended that commercial banks operating in Africa focus on these three innovative financial services to earn sustainable revenue.

Corresponding authors: Edward Lambert, edward@aiu.edu; Dr. Kanbiro Orkaido Deyganto, kanbiroorkaido@yahoo.com

1. Introduction

In today's rapidly evolving banking landscape, the adoption of innovative financial services has become crucial for commercial banks worldwide. This is especially true for African banks, which operate within unique economic, technological, and cultural contexts. The relationship between innovative financial services and profitability has garnered significant attention due to its potential to enhance the overall banking experience, increase customer loyalty, and drive business growth (Liang & Chen, 2009; Kumar et al., 2022). The objective of this introduction is to outline the key aspects of the relationship between innovative financial services and profitability in African commercial banks. By understanding this relationship, banks can strategically implement innovative solutions to meet the changing needs and expectations of their customers, resulting in improved customer satisfaction levels, and ultimately, improved profitability.

Innovative financial services encompass a wide range of digital and technology-driven banking solutions that enable banks to provide convenient, efficient, and personalized services to their customers (Narteh, 2018). These services include mobile banking, online banking, digital wallets, contactless payments, biometric authentication, and artificial intelligence-powered chatbots, among others. African commercial banks have increasingly adopted these solutions to overcome infrastructural challenges, reach unbanked populations, and drive financial inclusion (Abdulquadri et al., 2021). Financial performance is a critical factor in the success and growth of commercial banks in Africa. Satisfying customers requires not only meeting their basic banking needs but also delivering exceptional experiences that exceed their expectations. African customers have unique preferences and expectations, influenced by cultural, social, and economic factors. Enhancing customer satisfaction involves providing personalized services, seamless transactions, quick issue resolution, and effective communication channels to improve banks' profitability (Chauhan, Akhtar, and Gupta, 2022).

Research indicates a positive correlation between the adoption of innovative financial services and customer satisfaction, which increases profitability in commercial banks. For example, studies have shown that customers who use digital banking platforms report higher satisfaction levels due to the convenience, accessibility, and speed of transactions. Similarly, the implementation of innovative customer relationship management systems, AI-powered chatbots, and personalized recommendations can enhance customer satisfaction by providing tailored solutions and timely support (YuSheng and Ibrahim, 2019). The relationship between innovative financial services and customer satisfaction in African commercial banks highlights the importance of adopting digital solutions and customer-centric strategies to meet the evolving needs of customers. By leveraging innovative technologies and understanding the unique preferences of African customers, commercial banks can improve customer satisfaction levels, build trust and loyalty, and gain a competitive edge in the market.

The issue of innovative financial services on the profitability of banks in Africa is a hot agenda that has attracted the attention of researchers across the world. The study by Agolla et al. (2018) investigated the impact of banking innovations on customer attraction, satisfaction, and retention among commercial banks in Botswana. The results indicated that innovative banks are likely to attract and satisfy their customers. However, please note that this study focused on Botswana and might not directly address the African context.

Another study by Adeiza et al. (2022) explored the relationship between better bank performance in service delivery and customer satisfaction through effective customer relationship management (CRM).

The findings revealed that an increase in the number of working days and bank branches led to better levels of customer satisfaction. Although this study focused on Nigerian banks, it provides valuable insights into the relationship between service delivery and customer satisfaction. These studies offer a starting point for understanding the relationship between innovative financial services and profitability in commercial banks. However, it's important to conduct a comprehensive literature review to identify specific research gaps in the African context.

The aforementioned studies never adopted theories for triangulating research ideas, but this research adopted five theories of financial innovation, such as blockchain technology theory, financial technology (fintech) theory, Schumpeter's Theory of Innovation, Cryptocurrency and Central Bank Digital Currency theory, and Task-Technology Fit (TTF) theory, which support that internet banking service has a positive contribution to the financial performance of banks. The research gap in studying the effect of innovative financial services on the profitability of commercial banks in Africa is the limited focus on comprehensive and comparative analysis across different countries in the continent. Existing studies often concentrate on single-country case studies or provide generalized findings without considering the variations in market conditions, regulatory frameworks, and economic development levels. Consequently, there is a lack of a comprehensive understanding of how innovative financial services influence profitability within different African markets, hindering the identification of strategies that could be effective in specific contexts. Therefore, this research bridges this gap by conducting a study on the effect of innovative financial services and bank profitability at a continent level to provide a clear understanding of the contribution of ATM banking services, mobile banking services, and online banking services for banks' profitability in Africa.

2. Review of literature

2.1. Concept of Profitability

Profitability refers to a company's ability to generate profits from its operations by using its resources to generate revenues over its expenses (Jayathilaka, 2020). It is one of the four building blocks for analyzing financial statements and company performance as a whole (1). The other three building blocks are efficiency, solvency, and market prospects. Profitability is measured by examining the relationship between revenues and expenses to assess how well a company is performing and its future potential

growth. The profitability of a company can be analyzed using various ratios such as gross profit margin, net profit margin, and EBITDA.

The concept of bank profitability refers to the ability of a bank to generate profits from its operations. Profitability is a critical factor in determining the health and sustainability of a bank, as it impacts its ability to attract investors, retain customers, and invest in new technologies and services. Banks generate profits through various activities, such as lending, investing, and providing fee-based services (Linawati, Moeljadi, Djumahir, & Aisjah, 2022). Profitability is measured by various metrics, such as return on assets (ROA) and return on equity (ROE), which indicate the bank's ability to generate profits relative to its assets or equity. Factors that can impact bank profitability include interest rates, credit quality, liquidity, and operational costs. Maintaining a healthy level of profitability is crucial for banks to remain competitive and meet the needs of their stakeholders.

2.2. Innovative Financial Services & Profitability

This section covers three innovative services. The three major banking innovation services are ATM services, Mobile banking services, and Internet banking services. The study hypotheses have been developed based on three dimensions of banking services.

ATM service and profitability

The relationship between ATM service and profitability can be positive because ATMs provide services like cash withdrawals, cash deposits, check deposits, balance inquiries, funds transfers, statement printing, PIN changes, bill payments, prepaid card top-ups, and account updates (Jayathilaka, 2020). ATM services significantly contribute to the profitability of banks by reducing costs and increasing customer satisfaction. Firstly, ATMs automate the cash withdrawal and deposit processes, minimizing the need for personnel and manual interventions, thereby decreasing operational costs for banks. The utilization of ATMs also allows banks to extend their services beyond traditional banking hours, generating additional revenue without incurring additional costs. Moreover, the convenience of ATM services enhances customer loyalty and attracts new customers, contributing to increased usage of other bank products and services. Overall, the efficient and easily accessible nature of ATM services significantly improves bank profitability. The empirical evidence of the study by Singh, Malik, and Jain (2021) shows that ATM service has a positive effect on banks' profitability.

- H1: ATM machine service has a significant effect on profitability.

Mobile banking and profitability

The relationship between mobile banking and profitability is multifaceted. On one hand, mobile banking can significantly contribute to profitability by increasing customer convenience and accessibility to banking services. With mobile banking, customers can perform various transactions on their smartphones at their convenience, saving time and effort. This promotes customer satisfaction and loyalty, leading to increased usage and potentially higher revenues for banks. Additionally, mobile banking can reduce operational costs by digitizing and automating various processes, such as paperless transactions and online payments, leading to cost savings and improved efficiency. On the other hand, mobile banking also entails associated costs such as technology investments, security measures, and customer support. Therefore, banks need to strike a balance between these costs and the potential benefits to ensure profitability in the long run. Overall, a well-implemented and customer-centric mobile banking strategy can effectively enhance profitability for banks. The relationship between mobile banking and profitability can be complex and multifaceted. On one hand, mobile banking can contribute to profitability by enhancing customer convenience and satisfaction, increasing customer engagement and retention, and potentially reducing costs associated with traditional brick-and-mortar banking operations. On the other hand, mobile banking also requires significant investments in technology infrastructure, security measures, and ongoing maintenance, which can impact profitability in the short term (Medyawati, Yunanto, M., & Hegarini, 2021). This creates an opportunity for increased cross-selling and revenue generation, contributing to profitability (Bagudu et al., 2017). Mobile banking can facilitate the development of new revenue streams through value-added services like mobile payment solutions, personalized financial advice, or access to third-party offerings. These supplementary services can contribute to increased profitability. Mobile banking has a positive effect on bank business performance.

- H2: Mobile banking service has a significant effect on banking performance.

Internet Banking & Profitability

The relationship between Internet banking and profitability is complex yet significant. Internet banking, also known as online banking, has revolutionized the way individuals and businesses conduct their financial transactions. By providing convenient and accessible banking services through digital platforms, internet banking offers cost-saving benefits for both financial institutions and customers. It reduces operational costs by minimizing the need for physical branches and staff while allowing banks to leverage technology to streamline processes and improve efficiency. Additionally, internet banking

enables banks to reach a wider customer base, leading to increased customer acquisition and retention. This expanded reach and convenience result in higher transaction volumes, reducing the cost per transaction and driving profitability. Moreover, the integration of online services like bill payments, investments, and loan applications generates additional revenue streams for banks. Overall, internet banking plays a crucial role in enhancing profitability through cost reduction, increased customer engagement, and revenue diversification (Khalaf et al., 2023). Internet banking has transformed the banking sector by providing customers with convenient and efficient ways to conduct financial transactions. This shift has significantly impacted profitability as banks can reduce operating costs associated with physical branches and staff. With the increased adoption of Internet banking, banks can serve a larger customer base without significant investments in infrastructure. Moreover, internet banking allows banks to offer a wider range of products and services, cross-selling opportunities, and improved customer retention. This enhanced profitability stems from reduced overhead costs and increased revenue streams, making Internet banking a strategic tool for banks to improve their bottom line (Ghose and Maji, 2022).

- H3: Internet banking has a significant effect on profitability.

2.3. Theories of Financial Innovations

Blockchain Technology Theory

This theory suggests that the use of blockchain technology can revolutionize financial transactions by introducing decentralized and secure systems. Blockchain is a distributed ledger that ensures transparency, immutability, and trust in financial transactions. It has the potential to eliminate intermediaries, reduce costs, and increase efficiency in various financial sectors such as banking, payments, and supply chain management (Nakamoto, 2008).

Fintech and Artificial Intelligence

The theory suggests that the integration of financial technology (fintech) with artificial intelligence (AI) can significantly transform the financial industry. Fintech involves the use of technology to improve financial services, while AI can enhance decision-making, risk assessment, fraud detection, and customer experience (McKinsey & Company, 2017). The combination of both can lead to automated financial advice, personalized banking services, and efficient risk management.

Cryptocurrency Concept

This theory explores the potential evolution of traditional money into digital forms, such as cryptocurrencies and central bank digital currencies (CBDCs). Cryptocurrencies like Bitcoin have gained attention for their decentralized nature and potential to disrupt traditional financial systems. CBDCs, on the other hand, are digital currencies issued and regulated by central banks, serving as an alternative to physical cash. The theory analyzes the implications of these digital currencies on monetary policy, financial stability, and cross-border transactions (Bank for International Settlements, 2020).

Schumpeter Theory of Innovation

The Schumpeter Theory of Innovation, put forth by economist Joseph Schumpeter in the early 20th century, emphasizes the role of entrepreneurship and technological change in driving economic growth. The theory revolves around the concept of "creative destruction," whereby innovations and entrepreneurial activities disrupt and replace existing industries and technologies. This theory emphasizes the key role of entrepreneurial activity and technological change in driving economic growth and development. It highlights the dynamic nature of the economy, where innovation and creative destruction continually reshape industries and propel economic progress (Gallouj, 1997).

Task-Technology Fit (TTF) Theory

Task-Technology Fit (TTF) theory is a framework that aims to evaluate and understand how well a particular technology aligns with the tasks and goals of its users. It acknowledges that the success of implementing a technology depends not only on its functionality but also on how it meets the specific needs and requirements of the tasks at hand. TTF theory suggests that when there is a good fit between a technology and the tasks it is intended to support, users are more likely to adopt and utilize the technology effectively. This theory emphasizes the importance of considering the context and purpose of technology implementation, ultimately enhancing user satisfaction and productivity (Furneaux, 2012).

2.4. Conceptual Framework

This section provides a conceptual framework for this study based on an empirical literature review. It explains the key variables and the relationships among them. The conceptualization helps answer the study's research questions. Hence, the following conceptual framework will be developed to serve as a road map to analyze the entire analysis in the model below. Variables such as four independent variables

are incorporated in the model, and teachers' job satisfaction is the dependent variable. In the model, three independent variables are incorporated: ATM usage, mobile banking, and internet banking, with profitability as the dependent variable.
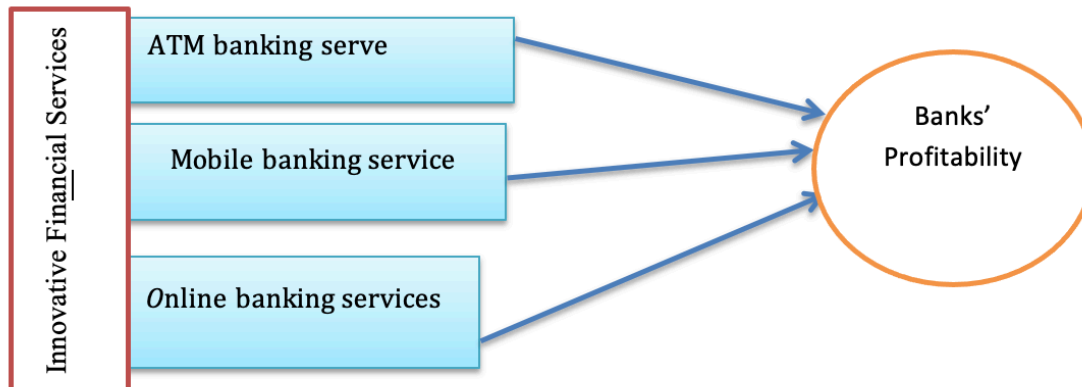

Figure 1. Conceptual framework

2.5. Literature Review Gaps

In reviewing the literature on innovative financial services and profitability in Africa, several notable gaps emerge. Most existing research in this area tends to be cross-sectional, offering a snapshot of the relationship between innovative financial services and profitability at a particular point in time. Longitudinal studies tracking financial institutions' performance over time would provide valuable insights into the sustainability and long-term impact of innovative financial services. The literature often focuses on the impact of innovative financial services on traditional banks while neglecting the use of mixed data, secondary, and primary data. Addressing these gaps in the literature would contribute to a more comprehensive understanding of the relationship between innovative financial services and profitability in Africa. It would also provide insights for policymakers, practitioners, and researchers looking to promote financial inclusion and economic development on the continent.

3. Methods

The objective of this study was to examine the effect of innovative financial services on the financial performance of commercial banks in Africa. Research methodology refers to the systematic approach and techniques used to conduct a research study. It involves the overall design and plan for collecting,

analyzing, and interpreting data to answer research questions or test hypotheses. The research methodology encompasses various components, including the research design, data collection methods, data analysis techniques, and ethical considerations (Gupta & Gupta, 2022). This section includes the area of study, research design and approach, sampling design, method of data collection, and data analysis of the research paper.

3.1. Research Approaches

Research approaches are the techniques used by researchers to collect and analyze data to answer research questions. Several approaches can be used, depending on the nature of the research question and the type of data that needs to be collected. Quantitative research approaches involve the collection and analysis of numerical data, while qualitative approaches involve the collection and analysis of non-numerical data such as text, images, and video. Mixed-methods research approaches combine both quantitative and qualitative methods to get a more comprehensive understanding of the research question. Each approach has its strengths and weaknesses, and the choice of approach will depend on the specific research question and the resources available to conduct the research. The student researchers employed the mix of quantitative and qualitative research approaches.

3.2. Research Design

Research design refers to the overall plan or structure of a research study that outlines how the research questions or objectives will be addressed. It provides a framework for collecting and analyzing data to answer research questions or test hypotheses. The research design is crucial as it determines the validity and reliability of the study's findings. There are several types of research designs, including experimental, quasi-experimental, correlational, descriptive, and exploratory designs. The choice of research design depends on the nature of the research questions, the availability of resources, and ethical considerations. In this study, correlational and descriptive research designs were employed to find the answer to the research questions and hypotheses developed by the researchers.

3.3. Data

Data sources, methods of data collection, and analysis are important components of research. Data sources can include primary sources such as surveys and interviews, as well as secondary sources such as existing datasets and literature reviews. To collect secondary data, a document review was conducted on the 17 oldest commercial banks from 2010 to 2022 (see Table 1). To analyze data, both qualitative data

analysis methods were employed. The primary data was collected through telephone interviews with 17 bank managers in order to have reliable findings on the topic.

3.4. Sampling Design

Sampling design is a critical aspect of any research study that involves collecting data from a sample of the population. It refers to the plan or method used to select individuals or units from the population for inclusion in the study. The sampling design should be carefully chosen to ensure that the sample is representative of the population, meaning that it accurately reflects the characteristics and diversity of the population. Various methods of sampling design, such as random sampling, stratified sampling, and cluster sampling, are available, and the choice of method depends on the research question, the population, and the available resources. A well-designed sampling plan helps to ensure that the study results are generalizable to the population of interest.

Target Population	Sampling Method	Sample size	List of 17 Banks with year of establishment
763 commercial banks operating in Africa, out of which 100 banks were ranked on 27th September 2022 based on assets and capital	Purposive sampling	17 oldest banks with 13 years of audited financial statements from 2010 to 2022 out of the top 100 banks in Africa	Standard Bank Group (1862), First National Bank (1838), Barclays Africa Group Limited (1838), Nedbank Group (1831), Ecobank Transnational Incorporated (1985), United Bank for Africa (1949), First Bank of Nigeria (1894), National Bank of Egypt (1898), Banque Misr (1920), Banque du Caire (1952), Bank of Alexandria (1944), Banque Ouest Africaine de Developpement (1962), Bank of Mauritius (1967), African Banking Corporation of Botswana (1958), Ghana Commercial Bank (1953), Commercial Bank of Ethiopia (1942), and Bank of Uganda (1966)

Table 1. Sampling structure

Source: African Development Bank Group (2023), https://projectsportal.afdb.org/dataportal/ and African Business (2022).

3.5. Data Analysis Methods and Model Specifications

This study used both descriptive and inferential methods of analysis for quantitative data and narrative as well as thematic analysis for qualitative data. Qualitative and quantitative analyses are common methods of data analysis in research. The researchers used both qualitative and quantitative analysis. The Ordinary Least Squares (OLS) model is a statistical method used to estimate the relationship between a dependent variable and one or more independent variables. It works by minimizing the sum of the squared differences between the observed values of the dependent variable and the predicted values based on the independent variables. OLS assumes that the relationship between the variables is linear and that the error terms are normally distributed and have constant variance. This model provides estimates of the coefficients of the independent variables, allowing us to understand their impacts on the dependent variable and make predictions based on the estimated equation. The model equation can be expressed as follows:

$$ROA = \beta 0 + \beta 1 * ATMS + \beta 2 * MBS + \beta 3 * OBS + U - - - - - - \tag{1}$$

Where:

- ROA: Return on asset
- ATMS: Automatic Teller Machine services
- MBS: Mobile banking services
- OBS: Online banking services
- β0 = Constant term
- β1–β3: Coefficients of variables

Test of OLS Assumptions

No presence of serial correlation: Serial correlation refers to the correlation between the error terms across different observations in a time series. In the case of autocorrelation, it means that the errors are correlated with each other over time, violating the assumption of independent errors.

Breusch–Godfrey Serial Correlation LM Test:			p-value
F–statistic	90.67391	Prob. F(201,9)	0.6561
Obs*R-squared	220.8909	Prob. Chi–Square(201)	0.1601

Table 2. Test of Autocorrelation

Source: Audited financial statements from 2010 to 2022.

In the above table, the Breusch–Godfrey Serial Correlation LM Test showed that the F–statistic and observation R^2 were insignificant at a 5% level of significance. The result in the above Table 2 showed that there is no presence of serial correlation. The errors are normally distributed: The OLS model assumes that the errors or residuals (the differences between the predicted values and the actual values) are normally distributed. This assumption is important because it allows for the use of statistical tests and confidence intervals when interpreting the coefficients of the independent variables.
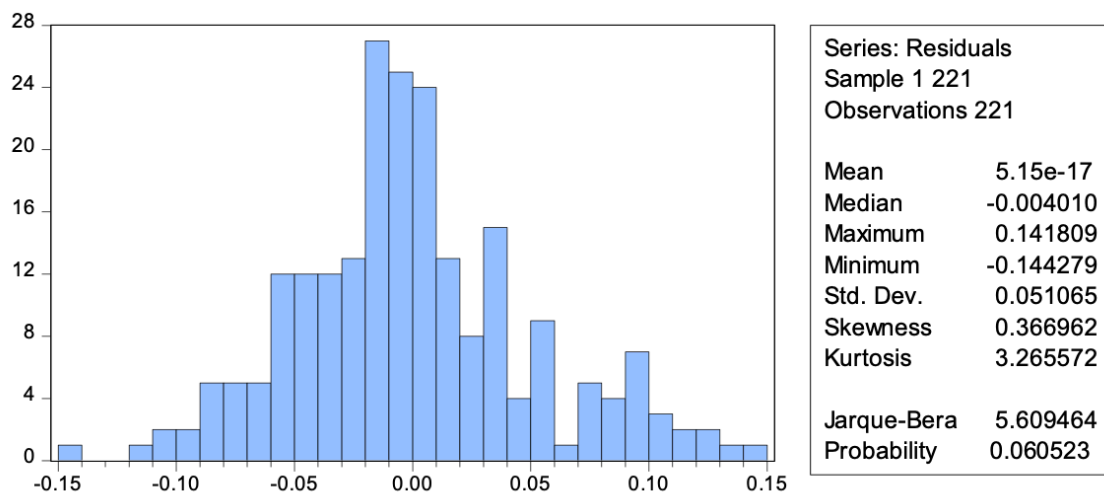

Figure 2. Normality Test

Source: Audited financial statements from 2010 to 2022.

In the above Figure 2, the normality of the model was assured because the probability of Jarque–Bera was insignificant at a 5% level of significance.

There is no perfect multicollinearity among the independent variables: The OLS model assumes that there is no perfect relationship or redundancy between the independent variables. In other words, each independent variable is assumed to contribute unique information to the model and is not perfectly correlated with any other independent variable.

	ATMS	MBS	OBS
ATMS	1	0.682434	0.2910015
MBS	0.682434	1	-0.09967
OBS	0.2910015	-0.09967	1

Table 3. Multicollinearity Test

Source: Audited financial statements from 2010 to 2022.

As a general principle, the correlation among independent variables should not be more than 90%. Hence, the correlation coefficient of explanatory variables in Table 3 is not more than 90%, which is highly acceptable. The error term has constant variance (homoscedasticity): The OLS model assumes that the variance of the errors is constant across all levels of the independent variables. This means that the spread or dispersion of the errors is the same regardless of the values of the independent variables. Homoscedasticity is important because it allows for accurate statistical inference and hypothesis testing.

Heteroskedasticity Test: ARCH			**p–value**
F–statistic	1.321863	Prob. F(30,180)	0.1392
Obs*R-squared	37.93665	Prob. Chi–Square(40)	0.1514

Table 4. Heteroscedasticity Test for ROA

Source: Audited financial statements from 2010 to 2022.

In the above Table 4, the p-values of the F-statistic and observed R^2 are both higher than the 5% level of significance. This implies that there is no Heteroscedasticity problem for ROA.

	Symbol	Variables Description	Scale of Measurement	Expected Sign
		Dependent variable		
	ROA	Return on assets (ROA) is a financial metric used to evaluate the profitability of a bank or financial institution. It measures how efficiently a bank utilizes its assets to generate profits. ROA is calculated by dividing a bank's net income by its average total assets.	Ratio	
		Explanatory variables		
1	ATMs	Automatic teller machine (ATM) services refer to the various financial transactions and services that can be performed using an ATM.	Natural log of revenue generated from ATM service.	+
2	MBS	Mobile banking services are the banking services by which customers easily make financial transactions using mobile	Natural log of revenue generated from ATM service.	+
3	OBS	Online banking service is the type of service offered by banks where customers use their computers.	Natural log of revenue generated from ATM service.	+

Table 5. Measurement and Hypothesis of Variables

The above Table 5 defines the variables of the study.

4. Results

This section presents descriptive, correlation, and regression analysis of the research project.

4.1. Descriptive Statistics Analysis

Descriptive analysis is a statistical method used to summarize and describe the main characteristics of a dataset. It involves organizing, analyzing, and presenting data in a meaningful and easily interpretable way. Descriptive analysis focuses on measures such as central tendency (mean, median, mode), dispersion (range, variance, standard deviation), and frequency distributions. By providing a comprehensive overview of the data, descriptive analysis helps in understanding patterns, trends, and relationships within the dataset, thus laying the foundation for further statistical analysis and decision-making.

Variables	ROA	ATMS	MBS	OBS
Mean	0.62174	4.093136	6.093136	4.114109
Maximum	0.984520	8.293300	9.293300	7.384900
Minimum	0.5300	1.592300	2.592300	1.11111
Std. Dev.	0.250023	2.608876	2.618876	2.755210
Observations	221	221	221	221

Table 6. Summary Descriptive Analysis

Source: Audited financial statements from 2010 to 2022.

The mean value of return on assets was 0.62, implying that, on average, banks in Africa earned 62 cents. The banks in Africa earned a maximum of 98 cents and a minimum of 53 cents from 2010 to 2022. The return earned by banks varied from the actual by up to 25 cents. The mean value of ATM service was $4.09, indicating that, on average, banks in Africa earned $4.09. The banks in Africa earned a maximum of $8.2 and a minimum of $1.6 from 2010 to 2022. The return earned by banks varied from the actual by $2.6. The mean value of mobile banking service was $6.09, implying that, on average, banks in Africa earned $6.09. The banks in Africa earned a maximum of $9.2 and a minimum of $2.6 from 2010 to 2022. The return earned by banks varied from the actual by $2.6. The mean value of online banking service was $4.11, suggesting that, on average, banks in Africa earned $4.11 from online banking. The banks in Africa

earned a maximum of $7.3 and a minimum of $1.1 from 2010 to 2022. The money earned by banks varied from the actual by $2.75 from online banking, respectively (see Table 6).

4.2. Correlation analysis

Correlation analysis in research involves measuring the degree of association or relationship between two or more variables. It is used to examine the strength and direction of the relationship, helping researchers to understand how changes in one variable may be related to changes in another. Correlation analysis calculates a correlation coefficient, which ranges from –1 to 1, indicating the strength and direction of the relationship. Positive values indicate a positive correlation, where variables move in the same direction, while negative values indicate a negative correlation, where variables move in opposite directions. Correlation analysis provides valuable insights into patterns and trends, helping researchers make informed decisions and predictions based on the observed relationships.

Items	ROA	ATM	MBS	OBS
ROA	1			
ATM	0.682434	1		
MBS	0.2910015	0.09967	1	
OBS	0.3344794	0.54931	0.268564	1

Table 7. Correlation Analysis of the Research

Source: Audited financial statements from 2010 to 2022.

As can be easily seen from Table 7, the correlation coefficient of ATM service was 0.68, mobile banking services 0.29, and online banking service 0.33, which were all positive for all variables. This implies that ATM banking services, mobile banking services, and internet banking services move in the same direction as the return on assets of banks in Africa from 2010 to 2022.

4.3. Regression analysis

Regression analysis is a statistical technique widely used in research to examine the relationship between a dependent variable and one or more independent variables. It helps researchers understand how changes in the independent variables impact the dependent variable. By estimating the coefficients of the independent variables, regression analysis allows for the prediction of the dependent variable based on the observed values of the independent variables. This enables researchers to make informed decisions and draw meaningful conclusions about the factors influencing the dependent variable, providing valuable insights for various fields such as economics, social sciences, psychology, and business.

Random versus Fixed Effect Model

The random effects model and the fixed effects model are two commonly used statistical techniques in econometrics for panel data analysis. The key difference between these models lies in how they account for unobserved heterogeneity across individuals or entities. In the random effects model, unobserved heterogeneity is assumed to be random and unrelated to the explanatory variables. It is captured by including a random error term in the model, allowing for variation in the intercepts and slopes across individuals. On the other hand, the fixed effects model assumes that unobserved heterogeneity is fixed and related to the explanatory variables. It introduces individual-specific dummy variables into the model to capture this heterogeneity, effectively estimating the average effect within each individual. Therefore, unlike the random effects model, the fixed effects model controls for all time-invariant characteristics and focuses on within-individual variations. Consequently, the choice between these models largely depends on the research question and the underlying assumptions about the nature of unobserved heterogeneity. The Hausman test is a statistical test used in econometrics to determine whether a particular model is appropriate for estimating a specific relationship. It assesses the consistency of two different estimators, usually a consistent and an efficient estimator, to determine which one is preferable for estimating the relationship of interest. If the p-value is significant at 5%, the random effect model is the best model, but the opposite is true when the p-value is less than 5%. The Hausman test provides a statistical measure to evaluate which estimator is appropriate for the specific research question at hand.

Correlated Random Effects – Hausman Test			
Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	P-value
Cross-section random	32.746015	10	0.22313

Table 8. Hausman Test Result

Source: Audited financial statements from 2010 to 2022.

Table 8 above shows that the p-value of the Hausman Test Result is more than 5 percent. This implies that the random effect model is the appropriate statistical measure to evaluate the estimator for this research paper.

Dependent Variable: ROA				
Method: (Cross–section fixed effects)				
Date: 09/27/23. Time: 06:00				
Sample: 2010 2022				
Periods included: 13 years				
Cross–sections included: 17 banks				
Total panel (balanced) observations: 221				
Variable	Coefficient	Std. Error	t–Statistic	Prob.
ATM banking services	0.6413	0.0027	4.6785	0.000**
Mobile banking services	0.1409	0.0025	7.9637	0.0000**
Internet banking services	0.2643	0.0033	12.925	0.0000**
C	0.2729	0.0650	8.5376	0.0000**
	Effects Specification			
			S.D.	Rho
Cross–section random			0.0127	0.0637
Idiosyncratic random			0.0482	0.9363
	Weighted Statistics			
R-squared	0.9517	Mean dependent var		0.1810
Adjusted R-squared	0.9351	S.D. dependent var		0.1921
S.E. of regression	0.508	Sum squared resid		0.5469
F-statistic	294.861	Durbin–Watson stat		2.3132
Prob(F–statistic)	0.0000			

Table 9. Regression Result

Source: Audited financial statements from 2010 to 2022.

In this research, R^2 was 0.9335, implying that 93.35% of the variations in profitability are caused by ATM banking services, Mobile banking services, and Internet banking services, while only 6.65% of the variations in the dependent variable are due to extraneous variables not incorporated in the model. The F-statistic is a statistical test that assesses the overall significance of the regression model. It compares the variation explained by the model to the unexplained variation and determines if the independent variables, as a group, significantly contribute to the prediction of the dependent variable. In this case, the F-statistic (294.861) was used to test the overall significance of the model. The null hypothesis can be rejected at a 1 percent level of significance since the p-value was (0.0000), which was sufficiently low. This indicates the reliability and validity of the model at a 1 percent level of significance (see table 9).

Model Result

ROA = 0.272789+0.6413*ATM service +0.14029*mobile banking services+0.26643 internet banking services.

The coefficients for each independent variable were expressed in the above equation. These coefficients indicate the magnitude and direction of the relationship between each independent variable and the dependent variable. The regression coefficient for ATM service was 0.64, for mobile service was 0.14, and for internet banking was 0.26. This implies that a 1% increase in ATM service, mobile service, and internet banking services resulted in a 64%, 14%, and 26% increase in the profitability of commercial banks operating in Africa.

5. Discussion

Research is an essential aspect of academia, as it contributes to the expansion of existing knowledge and the generation of new insights. The discussion section in research offers an opportunity for researchers to interpret and analyze their findings in the context of the existing literature. In this research, ATM banking services exhibit a positive regression coefficient (β=0.64) and a p-value of 0.000. This implies that ATM banking services have a positive and statistically significant effect on the profitability of commercial banks in Africa. Therefore, the researchers accept the hypothesis. This finding aligns with the research by Le & Ngo (2020), who suggested that ATM banking services make a positive contribution to bank profitability. It is also consistent with the concepts of blockchain technology theory, financial technology (fintech) theory, Schumpeter's Theory of Innovation, and Task-Technology Fit (TTF) theory,

all of which support the idea that ATM banking services positively impact the financial performance of banks. Similarly, in this research, mobile banking services demonstrate a positive regression coefficient (β=0.14) and a p-value of 0.008, indicating a positive and statistically significant effect on the profitability of commercial banks in Africa. Consequently, the researchers accept the hypothesis. This result is in line with the findings of Medyawati, Yunanto, & Hegarini (2021), who concluded that mobile banking, as a part of financial innovation, contributes positively to bank revenue. It is also supported by the theories of blockchain technology, fintech, Schumpeter's Theory of Innovation, and Task-Technology Fit (TTF), all of which suggest that mobile banking services have a positive impact on the financial performance of banks. Furthermore, in this research, internet banking services exhibit a positive regression coefficient (β=0.26) and a p-value of 0.008, signifying a positive and statistically significant effect on the profitability of commercial banks in Africa. Consequently, the researchers accept the hypothesis. This finding is consistent with the research by Medyawati et al. (2021) and is also supported by the theories of blockchain technology, fintech, Schumpeter's Theory of Innovation, and Task-Technology Fit (TTF), all of which propose that internet banking services positively contribute to the financial performance of banks.

6. Qualitative Analysis

In addition to quantitative data analysis, the researchers conducted interviews with bank managers to explore how ATM, mobile, and internet banking services contributed to customer satisfaction and bank performance. The responses from these interviews are narrated as follows.

According to the interview responses, ATM, mobile, and internet banking services have made significant contributions to customer satisfaction and bank performance. Here are some of the ways in which they have had an impact:

1. Convenience: These banking services have greatly enhanced convenience for customers. ATMs enable customers to withdraw cash or deposit checks at any time and location without the need to visit a physical bank branch. Mobile and internet banking allow customers to carry out various banking transactions through their smartphones or computers, eliminating the necessity of visiting a bank in person. This convenience has substantially improved customer satisfaction, as customers can manage their finances at their own convenience and save time.

2. Accessibility: Through ATMs, mobile, and internet banking services, customers can access their accounts 24/7. This accessibility has enabled banks to reach customers who may not have access to

physical branches or who have busy schedules. Consequently, banks have been able to attract more customers and expand their market presence, resulting in improved bank performance.

3. Enhanced Customer Service: ATM, mobile, and internet banking services have empowered banks to enhance their customer service offerings. Banks can now provide prompt and efficient services, such as real-time balance updates, transaction alerts, and swift fund transfers. This level of service has boosted customer satisfaction by delivering an efficient and dependable banking experience.

4. Cost-effectiveness: The implementation of ATM, mobile, and internet banking services has enabled banks to reduce operational costs, including those associated with physical branches and staff. This cost reduction has allowed banks to allocate resources to other areas, such as improving customer service, developing new products, and expanding their services, ultimately leading to improved bank performance.

5. Advanced Security Features: ATM, mobile, and internet banking services incorporate advanced security features to protect customer accounts and transactions. This ensures that customers' finances are secure and safeguarded from fraud. The increased security measures have significantly contributed to customer satisfaction and trust in the banking services offered, thereby enhancing bank performance. In summary, the introduction and integration of ATM, mobile, and internet banking services have revolutionized the banking industry and resulted in increased customer satisfaction and improved bank performance in Africa.

7. Conclusions

The results of this research paper demonstrate that innovative financial services such as ATM, mobile, and internet banking services have a positive impact on banks' profitability. ATM services, mobile banking, and internet banking have significantly contributed to enhancing the profitability of financial institutions. ATM services provide round-the-clock access to cash withdrawal and deposit facilities, reducing the reliance on physical branches and staff, thereby resulting in cost savings. Furthermore, with the adoption of mobile banking, customers can conveniently manage their accounts, transfer funds, pay bills, and conduct transactions anytime and anywhere. Additionally, internet banking has facilitated efficient online account management, allowing customers to access various financial services without the need for physical documents or in-person visits. This streamlining of processes has led to increased operational efficiency and reduced overhead costs, ultimately enhancing profitability for financial institutions.

8. Future Improvement Implications

This study is solely focused on three innovative service domains: ATM, mobile, and internet banking services of the 17 oldest commercial banks in Africa. Future researchers can enhance this paper by expanding the scope to include a wider range of financial innovative services and a larger number of commercial banks. This expansion will improve the reliability of findings for informed decision-making.

List of Abbreviations

- ATM: Automatic Teller Machine
- MBS: Mobile Banking Services
- OBS: Online Banking Services
- ROA: Return on Asset
- TTF: Task-Technology Fit

Declarations

Availability of Data and Materials

Data is included in the manuscript.

Competing Interests

The authors declare that they have no competing interests.

Funding

The authors thank AIU for the financial support.

Authors' Contributions

The authors contributed equally to the entire work of this paper. They read and approved the final manuscript.

Acknowledgments

References

- Abdulquadri, A., Mogaji, E., Kieu, T. A., & Nguyen, N. P. (2021). Digital transformation in financial services provision: A Nigerian perspective to the adoption of chatbot. Journal of Enterprising Communities: People and Places in the Global Economy, 15(2), 258-281. https://doi.org/10.1108/JEC-06-2020-0126

- Adeiza, A., Abdullahi, M. S., Abdel Fattah, F. A. M., Fawehinmi, O., Ismail, N. A., Arnaut, M., & Ehido, A. (2022). Mediating mechanism of customer satisfaction on customer relationship management implementation and customer loyalty among consolidated banks. Uncertain Supply Chain Management, 10(3), 819-832. https://doi.org/10.5267/j.uscm.2022.3.012

- African Business. (2022). Africa's Top 100 Banks in 2022. Retrieved from https://african.business/

- Agolla, J. E., Makara, T., & Monametsi, G. (2018). Impact of banking innovations on customer attraction, satisfaction, and retention: The case of commercial banks in Botswana. International Journal of Electronic Banking, 1(2), 150-170. https://doi.org/10.1504/IJEBANK.2018.095598

- Bagudu, H. D., Mohd Khan, S. J., & Roslan, A. H. (2017). The effect of mobile banking on the performance of commercial banks in Nigeria. International Research Journal of Management, IT & Social Sciences, 4(2), 71-76. https://doi.org/10.21744/irjmis.v4i2.392

- Bank for International Settlements. (2020). Central Bank Digital Currencies: Foundational Principles and Core Features.

- Chauhan, S., Akhtar, A., & Gupta, A. (2022). Customer experience in digital banking: A review and future research directions. International Journal of Quality and Service Sciences, 14(2), 311-348. https://doi.org/10.1108/IJQSS-02-2021-0027

- Flamini, V., McDonald, C. A., & Schumacher, L. B. (2009). The determinants of commercial bank profitability in Sub-Saharan Africa.

- Furneaux, B. (2012). Task-Technology Fit Theory: A Survey and Synopsis of the Literature. In Y. Dwivedi, M. Wade, & S. Schneberger (Eds.), Information Systems Theory (Vol. 28). Springer, New York, NY. https://doi.org/10.1007/978-1-4419-6108-2_5

- Gallouj, F. (1997). Towards a neo-Schumpeterian theory of innovation in services? Science and Public Policy, 24(6), 405–420.

- Ghose, B., & Maji, S. G. (2022). Internet banking intensity and bank profitability: Evidence from emerging Indian economy. Managerial Finance, 48(11), 1607–1626. https://doi.org/10.1108/MF-09-2021-0434

- Gupta, A., & Gupta, N. (2022). Research methodology. SBPD Publications.

- Jayathilaka, A. K. (2020). Operating profit and net profit: Measurements of profitability. Open Access Library Journal, 7(12), 1–11. https://doi.org/10.4236/oalib.1107011

- Liang, C. J., & Chen, H. J. (2009). How to lengthen, deepen, and broaden customer–firm relationships with online financial services? Journal of Financial Services Marketing, 14, 218–231. https://doi.org/10.1057/fsm.2009.20

- Jayathilaka, A. K. (2020). Operating profit and net profit: Measurements of profitability. Open Access Library Journal, 7(12), 1–11. https://doi.org/10.4236/oalib.1107011

- Linawati, N., Moeljadi, M., Djumahir, & Aisjah, S. (2022). The effect of profitability and bank size on firm value sustainability: The mediating role of capital structure. Investment Management and Financial Innovations, 19(2), 331–343. https://doi.org/10.21511/imfi.19(2).2022.29

- Khalaf, B. A., Awad, A. B., Ahmed, O., & Gharios, R. T. (2023). The Role of FinTech in Determining the Performance of Banks: The Case of Middle East & North Africa (MENA) Region. International Journal of Membrane Science and Technology, 10(3), 1525–1535. https://doi.org/10.15379/ijmst.v10i3.1748

- Kumar, P., Mokha, A. K., & Pattnaik, S. C. (2022). Electronic customer relationship management (E-CRM), customer experience and customer satisfaction: Evidence from the banking industry. Benchmarking: An International Journal, 29(2), 551–572. https://doi.org/10.1108/BIJ-10-2020-0528

- Le, T. D., & Ngo, T. (2020). The determinants of bank profitability: A cross-country analysis. Central Bank Review, 20(2), 65–73. https://doi.org/10.1016/j.cbrev.2020.04.001

- Mutongi, C. S. (2017). Impact of Innovative Financial Services on Customer Satisfaction in South African Commercial Banks. International Journal of Economics, Commerce and Management, 5(9), 229–238.

- Medyawati, H., Yunanto, M., & Hegarini, E. (2021). Financial Technology as Determinants of Bank Profitability. Journal of Economics, Finance and Accounting Studies, 3(2), 91–100. https://doi.org/10.32996/jefas.2021.3.2.10

- Narteh, B. (2018). Service quality and customer satisfaction in Ghanaian retail banks: The moderating role of price. International Journal of Bank Marketing, 36(1), 68-88. https://doi.org/10.1108/IJBM-08-

2016-0118

- Singh, R., Malik, G., & Jain, V. (2021). FinTech effect: Measuring the impact of FinTech adoption on banks' profitability. International Journal of Management Practice, 14(4), 411-427. https://doi.org/10.1504/IJMP.2021.116587

- Musiime, A., & Ramadhan, M. (2011). Internet banking, consumer adoption, and customer satisfaction. African Journal of Marketing Management, 3(10), 261-269.

- Nakamoto, S. (2008). Bitcoin: A Peer-to-Peer Electronic Cash System.

- McKinsey & Company. (2017). Artificial Intelligence in Fintech.

- Varpio, L., Paradis, E., Uijtdehaage, S., & Young, M. (2020). The distinctions between theory, theoretical framework, and conceptual framework. Academic Medicine, 95(7), 989-994.

- World Bank Group. (2019). Innovative Financial Services for Africa's Unbanked Population: Exploring the Relationship with Customer Satisfaction.

- YuSheng, K., & Ibrahim, M. (2019). Service innovation, service delivery and customer satisfaction and loyalty in the banking sector of Ghana. International Journal of Bank Marketing, 37(5), 1215-1233. https://doi.org/10.1108/IJBM-06-2018-0142

Declarations