International Journal of Financial and Business Studies (IJFABS)
https://ijfabs.org/journals/
ISSN: Online-2811-1664; Print-2811-1656

EFFECT OF MACHINE LEARNING TECHNOLOGY ON FIRM PERFORMANCE OF DEPOSIT MONEY BANKS IN NIGERIA

Sunday, David
Department of Accountancy
Nnamdi Azikiwe University, Awka
Email: davidsunday83@yahoo.com

Ujam, Oluchukwu Juliet
Department of Accountancy
Federal Polytechnic, Oko
Email:ujamjuliet@yahoo.com
Okolie, Fidelis Oguguo
Department of Banking and Finance
Nnamdi Azikiwe University, Awka
fokolie@yahoo.com

Abstract: The study examined the effect of machine learning on firm performance of deposit money banks in Nigeria. The specific objective was to determine the effect of machine learning on return on assets and return on investment of deposit money banks in Nigeria. Ex-post facto research design was used in the study. The population of the study consisted of all the (14) quoted deposit money banks in Nigeria Exchange Limited up to December, 2024. The study utilised 10 deposit money banks out of the total population as sample size. The data collected from the banks' annual reports covered the period of 8 years from (2017 – 2024).Ordinary least square regression analysis used in testing the hypotheses revealed the following: machine learning has a significant positive effect on the on return on investment of deposit money banks in Nigeria (β = 0.718441; p-value = 0.0115); machine learning has a significant positive effect on the earnings per share of deposit money banks in Nigeria (β = 3.262692; p-value = 0.0081). In conclusion, as banks integrate machine learning technologies, they can expect to see improvements in their financial outcomes, which could enhance their overall competitiveness and efficiency in the marketplace. Given the significant positive effect of machine learning on return on investment (ROI), the study recommends that bank executives should prioritize the integration of machine learning technologies into their operational strategies. This can involve investing in training programs for staff to enhance their data analytics skills and implementing machine learning systems to optimize asset management and profitability.
Keywords: Machine Learning Technology, Return on Investment, Earnings per Share

Introduction

Machine learning is transforming the financial sector in powerful ways. Globally banking industry and the engagement of financial institutions with clients is gradually changing due to digitalization and technological advancement. Mobile device usage has increased, demographics have changed, and the number of financial technology suppliers has increased in recent years. The machine-learning technique is used in various goods and solutions that satisfy customer demands by enhancing accessibility, speed, and ease. Customers' needs for financial services are rising, and banks require assistance to manage the whole value chain using conventional business methods (Ekpa, Onourah & Sunday, 2023). Machine learning (ML) applications have greatly advanced recently in the finance industry. This industry has delivered business solutions for front-end and back-end operations, boosting efficiency and enhancing the customer experience. We have discovered that using artificial intelligence's decision-making ability to obtain a competitive edge is the most beneficial facilitator for its use.

We have marvelled at how ML has fundamentally changed the Nigerian banking sector (Ekpa, Onourah & Sunday, 2023).

With the increasingly in-depth integration of the Internet and social life, the Internet is changing how people learn and work, but it also exposes us to increasingly serious security threats. How to identify various network attacks, particularly not previously seen attacks, is a key issue to be solved urgently. Cybersecurity is a set of technologies and processes designed to protect computers, networks, programs and data from attacks and unauthorized access, alteration, or destruction. (Yang, 2017). Machine Learning (ML) and Artificial Intelligence (A.I.) applications in the financial sector have been thriving in the recent past. Their immense power has been harnessed in different institutions to offer business solutions in front end and back end processes to create efficiency and improve customer experience. In recent times, we have witnessed how computational intelligence is the most valuable enabler to achieve a competitive edge by leveraging its decision-making capabilities. With tremendous results, we see that machine learning and A.I. are set to take over the banking industry by storm right before our eyes (Donepudi, 2017). The banking sector has been at the forefront of adopting cutting-edge innovations, ranging from core banking and payment systems to risk management, and more recently, digital processes (Sumathy et;al, 2023). Machine learning (ML) applications have greatly advanced recently in the finance industry. This industry has delivered business solutions for front-end and back-end operations, boosting efficiency and enhancing the customer experience. We have discovered that using artificial intelligence's decision-making ability to obtain a competitive edge is the most beneficial facilitator for its use. We have marvelled at how machine learning has fundamentally changed the Nigerian banking sector. This article discusses the effects of machine learning and how it may be used in Nigeria's various financial activities. Computational intelligence is being used wisely by the banking industry to grow. The financial sector has unquestionably transformed as a result of machine learning. Banks have mostly benefited from this shift over time. Although financial institutions are currently the primary users of computational intelligence technology, its applications quickly spread throughout the sector.

Machine learning has led to a paradigm change in Nigeria's financial and banking industries. The growth of fintech companies in Nigeria is specifically driving the present change in banking industry. For instance, the 2021 Q3 report for the Nigerian fintech industry indicated 28 agreements made over the same time period, demonstrating significant investment in the sector and highlighting the growth of the financial services system. Fintech organizations, which may have long used machine learning (ML), are crucial to innovation and financial intelligence. Traditional banking institutions are swiftly catching up with computational intelligence technologies through tools like chatbots. "Machine learning" (ML), a subtype of artificial intelligence, describes how computers can recognize patterns, make predictions based on data, and then correct themselves without being explicitly taught to do so. The modern world is awash in data, thanks to the Internet of Things (IoT), cybersecurity, and mobile data. Supervised, unsupervised, and reinforcement learning are some of the several types of machine learning. (Belyaeva, 2022). Banks are utilizing machine learning models as it offers previously undiscovered insights to earn revenue or reduce expenses by making better and faster choices. Examples include customer segmentation, loss predictions, pricing optimization, fraud detection, and compliance monitoring. The algorithms employ a variety of techniques, such as sentiment analysis, deep neural networks, and clustering. The opportunities for machine learning in banking are immense, and we expect the effect to grow significantly.

According to a study by the International Data Corporation, there will be a significant commercial investment in machine learning solutions globally over the upcoming years (Turaba et'al, 2022). Machine learning will enable financial services companies to completely reimagine how they operate, create cutting-edge products and services, and revolutionize customer experiences. Unprecedented levels of automation are made possible by machine learning by taking over human professionals' jobs or improving their performance while supporting them with everyday tasks. Then, what are the main advantages of machine learning for the banking industry? This question can have a lot of valid Answers. This is made even more exciting by the fact that there will be more options available once the newest technological developments hit the market. (Gambacorta et'al, 2019). Identify the specific difficulties and trade-offs offered by actual ML algorithm implementations, the most frequent problem is the number of false positives; if it is significant, this leads to many false warnings and, as a result, a work overload for service providers and irate clients.

Objectives of study

It is on this note, this study therefore, examined the effect of machine learning on firm performance of deposit money banks in Nigeria. The specific objectives of this study are to:

1. Determined the effect of machine learning on return on investment of deposit money banks in Nigeria.
2. Evaluate the effect of machine learning on earnings per share of deposit money banks in Nigeria.

Conceptual Review

i. Machine Learning in Banking Services

In recent years, Artificial Intelligence (AI) and Machine Learning (ML) have garnered significant attention as transformative technologies that have the potential to revolutionize various industries. The rapid advancements in AI and ML algorithms, coupled with the availability of vast amounts of data, have enabled organizations to harness the power of intelligent automation, predictive analytics, and decision-making capabilities. As a result, these technologies are reshaping traditional approaches to innovation across multiple sectors, especially banking sector.

The field of machine learning is currently expanding, with many new opportunities and demands. Machine learning services are the focus of many startups, and existing businesses are entering this market through innovation. The self-driving Uber cars, Google Translate, and Amazon's Alexa are just a few of the cutting-edge products based on neural networks. Recent graduates are packing in as much Machine Learning ML and Artificial Intelligence AI coursework as they can to get into the profession as soon as they can. As a result of the huge financial and intellectual expenditures made in this industry, machine learning is here to stay.

A good example of machine learning's successful adoption into society is the COVID-19 conundrum's extraordinary scope. Banks, and society, in general, have had to reevaluate and reimagine their practices, with distance and non-contactable transactions as the primary cure (Olubisi, 2015). With research surveys and with the flow of business transactions going on in the world today, Despite the crisis, most consumers plan to use digital mobile banking services more, with more consumers wanting their banks to simplify the procedures of the transaction, wanting improved bank websites that make it easier to use online banking. Agent-banking transactions have also increased in Nigeria during the crisis, offering new opportunities for more people to

receive cheaper services. However, these shifts may reverse without hardwiring new behaviors and attitudes (Ekpa, Onourah & Sunday, 2023)..

According TechNative (2017) consumers have adopted digital solutions in recent years at a pace and scale unseen before as a result of quick changes in behaviours caused mainly by physical distance. So, banks can improve services while cutting costs by using data and analytics. Banking has turned out to be one of the critical gears in ordinary life. The availability of banking services has improved the comfort and accessibility of all activities, transcending economic activities. Surprisingly, there is no aspect or event achieved these days that banking offerings are not involved. The traditional manner of banking, which was once strictly physical and, no question on occasion, tedious, has a visible upturn. Nowadays, thanks to this evolution of machine learning, you can take a seat from the consolation of your house and do a few of the matters you previously had to do at the bank.

Despite the far-reaching development artificial intelligence has brought to the banking sector in terms of cost savings, accuracy and speed in transaction processing, efficiency and the resultants return on assets, this will never be fully appreciated without taking adequate security measures in order to ensure reliable information protection systems to combat the scourge of cyber security threat posed by this technology. According to Jibril et al (2020) as cited in Pontus and Dariush (2022), the term cyber security has many different definitions but could be summarized as the field of computer systems and data protection, both in hardware and software, as well as protection from misleading guidance that is provided by digital and physical services. Simply put, cyber security is the application of technologies, processes, and controls to protect systems, networks, programs, devices and data from cyber-attacks; it aims to reduce the risk of cyber-attacks and protect against the unauthorized exploitation of systems, networks, and technologies. Machine learning has become a vital technology for cyber security in the bank.

Machine learning preemptively stamps out cyber threats and bolsters security infrastructure through pattern detection, real-time cybercrime mapping and thorough penetration testing. It can help banking institutions withstand cyber-attacks, prevent data leaks, and ensure maximum security of their operations. Such solutions are rapidly evolving and those organizations that become the first to embrace them get a significant competitive edge over their rivals. With its ability to sort through millions of files and identify potentially hazardous ones, machine learning is increasingly being used by banks to uncover threats and automatically squash them before they can wreak havoc. As hackers get more and more creative with their tactics, banks face increased pressure to stay ahead of criminals when fighting financial crime, especially fraud and money laundering. ML implementation for fraud detection helps banks identify malicious activity, quickly verify user identity, and immediately respond to cyber-attacks. Machine learning algorithms can process large amounts of data in a matter of seconds. Moreover, the ability to learn from previous experience and improve models minimizes human input. With ML algorithms, the system can quickly recognize suspicious activity and send alerts to the security operations center or automatically decline the transaction in case of credit card fraud. Apart from rule-based fraud detection, ML allows to scan large amounts of data in real-time and minimizes human involvement in the process. It also makes the user experience much better by simplifying the identity verification measures.

ii. Return on Investment

According to Mariana, et'al (2016), the investment decision is a strategic decision and it is an integral part of the general policy of the company. Investments are means to secure the company's development in the medium and

long term. The term investments have been defined by many authors over time. Note that investments are considered "resources deployed in the hope of achieving benefits during a long period of time" or money or other resources expended in the hope that in the future they will bring higher amounts of money or other benefits will occur (Mieilă, 2019). ROI (Return on Investment) is a concept of performance in any form of investment. For shareholders, the ultimate goal of the company is expressed in ROI. ROI is an indicator that shows to which extent a specific business produces gain from the use of capital. It shows the extent to which the amount invested in a particular action returns as profit or loss. Thus, it enables efficient assessment of an amount invested or, in other words, ROI allows measuring the result in relation to the means used to obtain it.

ROI is calculated as the ratio between operating profit obtained after the action of investment and the total amount invested (or the total investment costs). The result is a percentage of the relation obtained multiplied by 100. ROI is used by investors to select an investment project of several possible. As well it can be used after the completion of the investment, to measure its profitability. ROI is an indicator frequently used in performance analysis and decision-making. (Mariana, et'al 2016).

iii. Earnings per Share

According to Sunday and Agubata (2023), the term earnings per share (EPS) represents the portion of a company's earnings, net of taxes and preferred stock dividends, that is allocated to each share of common stock. The figure can be calculated simply by dividing net income earned in a given reporting period (usually quarterly or annually) by the total number of shares outstanding during the same period, because the number of shares outstanding can fluctuate, a weighted average is typically used (Besely, 2016). Earnings per share is the amount of current period equity earnings or profits (or loss) attributable to a unit of ordinary share (IAS 33)

According to Rashidul (2014), earnings per share (EPS) is generally considered most important factor to determine share price and firm value.

In the study of JHvH de Wet (2013), earnings per share as a measure of Financial Performance; he says, Earnings-linked compensation schemes havebeen a spinoff of this obsession with short termearnings performance. The pressure to constantly come up with unbroken strings of positive EPSgrowth has affected managerial behavior profoundly. Instead of concentrating efforts and energies onprojects that will maximize shareholder wealth in the long term, managers turn to all kinds of schemes to manage EPS. Considering the fact that manager performance is often measured in terms of EPS, the implications of EPS not measuring up to expectations for manager remuneration and job security are patently obvious. The variables are presented graphically

Theoretical Framework

Machine Learning Theory

In 1959, Arthur Samuel pioneered the study of artificial brainpower. He described machine learning as "the study that gives computers the ability to learn without being explicitly programmed." This theory holds that a machine has to be intelligent and responsive in a manner that cannot be differentiated from that of a human being. He argued that machine learns from the past experiences (input data) and makes future predictions. For example, a machine is said to learn from experience (E) with respect to some class of tasks (T) and performance measure (P), if its performance at tasks in T, as measured by P, improves with experience E. In order to perform the task T, the system learns from the data-set provided. A data set is a collection of many examples.

According to Avrim (2014), Machine Learning Theory also has a number of fundamental connections to other disciplines. This is dependent on the specific needs to which machine learning model can be put in order to optimize performance especially in fields that requires data to be interpreted and acted upon. In the banking sector, Machine learning techniques have been proven to perform better than traditional statistical techniques, both in classification and also predictive accuracy especially in credit risk assessment, cyber security assessment and fraud detection. To estimate the creditworthiness of the borrower, the banks can use machine learning model to analyze real time data on the basis of the most recent transactions, current market conditions, and relevant current events. Also, access to semi-structured sources such as mobile phone usage, text message activities, social media usage and activity to enhance the rating precision of loans. This empowers evaluation of even qualitative factors such as the customer's willingness to pay back the loan and consumer behavior as well. More so, it can help banking institutions withstand cyberattacks, prevent data leaks, and ensure maximum security of their operations. This helps the institutions to mitigate regulatory sanction and improve profitability.

Empirical Review

Kumar, (2023) evaluated Machine Learning in the Banking Sector. The study aims to present an overview of previous research on “machine learning” applications in banking, covering key aspects of recent discoveries, their limits, and potential future research directions. It makes two contributions to the body of knowledge. It initially divides the literature to provide an overview of completed research endeavors. Second, it points out a gap in the existing body of research and suggests fresh avenues for investigation. The findings indicate that prior research has had difficulty developing a sound theoretical foundation for the subject. To support the proposed "theories," "notions," and "paradigms," more study is needed. In short, there is a big need for more research because there hasn't been a thorough evaluation of how machine learning has been used in banking.

Giovanni et’al (2023), studied “The Role of Machine Learning in Cyber Security” and found that the deployment of ML in cyber security is still at an early stage, revealing a significant discrepancy between research and practice. Such a discrepancy has its root cause in the current state of the art, which does not allow us to identify the role of ML in cyber security. They presented how various stakeholders can contribute to future developments of ML in cyber security, which is essential for further progress in this field. Their contributions are complemented with two real case studies describing industrial applications of ML as defense against cyber-threats.

Mohammad et’al, (2022) studied “Uniting cyber Security and Machine Learning: Advantages, Challenges and Futures Research”and found that the machine learning models) can learn about various cyber-attacks in the offline/online mode through the provided pre-processed dataset. The ML algorithms detect any sign of intrusion (some cyber-attack) in the real time i.e., online mode. Here, we have a Internet connected system (i.e., laptops, desktops, smart phones, IoT devices), which can be used to perform various online tasks i.e., online financial transactions, online access of healthcare data, social security numbers, etc. Hackers are always in search of some vulnerability in such systems and if they get anything like that then they start their attacks. For the detection and mitigation of cyber-attacks, different kinds of ML techniques i.e., supervised learning, unsupervised learning, reinforcement learning and deep learning can be used as per the situation. It is up-to the communication environment and available resources of the systems, which technique (i.e. supervised learning, unsupervised learning, reinforcement learning and deep learning) suites them in the best way. The learning

(training) and prediction (testing) of cyber-attack scan be done through the cloud servers as they have good computation and storage resources.

Pontus and Dariush (2022) studied the impact of AI on Bank's Risk Management Approach" revealed that the banking sector is experiencing the rise of several new types of innovations and trends. For instance, increased use of Artificial Intelligence (AI) to streamline day-to-day activities. These trends are, e.g., influenced by an increased frequency of cyber-attacks, the emergence of newly proposed regulations such as DORA and the AI Act, and the improving computational capabilities of AI-driven systems. The full impact these trends will have on the sector is yet to be realized. The sector is diverse and deeply integrated within society, meaning that it is critical to understand how actors mitigate the risks associated with the implementation of AI. This study analyzes how organizations can mitigate the risks involved with this implementation and how it affects the risk management process. To examine the implementation of AI in the banking sector, the study conducted semi-structured interviews with twelve respondents with expertise in AI, security, or the banking sector. The study used two theoretical frameworks to analyze the data. The first framework, the Dynamic Risk Management Framework, was used to analyze changes in the risk management process based on its unique position within society. The second framework, the Multi-Level Perspective, gave the study a holistic understanding of the impact of AI as a driver of a socio-technical shift. The results show that the implementation of AI leads to a set of new risks.

Shulha et'al, (2022), examined "Banking Information Resource Cyber Security System Modeling" and argue that the rapid development of the process of informatization of modern society has necessitated cyber security in all spheres of human activity, as the implementation of deliberate or unintentional influences on the information sphere by both external and internal sources can damage security and lead to moral, material, financial, reputational and other forms of damage. Their work is aimed at creating functional cognitive models to assess the level of their protection. The method of building a fuzzy cognitive map of the state of cyber security of banks is used. There have been developed cognitive models to determine the level of protection of the computer network, information security system and critical infrastructure (banks). Scenarios have been developed that reflect the response of the system at the complex maximum attenuation of the impact of the most important cyber threats. In conclusion, the practical implementation of the method provides an opportunity to predict the state of cyber security of banks, and contributes to the implementation of the necessary mechanisms to prevent, protect and control access at the appropriate levels of network infrastructure.

These risks are primarily organizational and regulatory and will lead to a revision in how actors classify risks. The constant evolution of AI also means that products must be reviewed periodically, changing how actors view the risk management process. Additionally, the results identify a lack of knowledge regarding both AI and security within the sector. Consequently, the organization will have to change its structure to accommodate interactions between different competencies. To succeed in implementing AI, meet the regulatory demands and mitigate unintended bias when developing AI, the study concludes that these competencies must create a shared terminology to communicate efficiently. In conclusion, the study contributes to a growing field regarding business applications of AI by creating a holistic understanding of aspects impacting the risk management process in banking. The findings result in a series of recommended actions for organizations that aim to implement AI in their businesses. Further research is recommended to understand the long-term effects of these

actions. Future in-depth analyses could validate the results of this study and further investigate the development of AI as a business.

Pedro and Mauro (2021) examined Machine Learning Applied to Banking Supervision a Literature Review. The objective of this review is to provide a comprehensive walk-through of how the most common ML techniques have been applied to risk assessment in banking, focusing on a supervisory perspective. “machine learning” and (“bank” or “banking” or “supervision”). No language, date, or Journal filter was applied. The study was then screened and selected according to their relevance. The final study base consisted of 41 papers and 2 book chapters, 53% of which were published in the top quartile journals in their field. Credit risk assessment and stress testing are highlighted topics as well as other risk perspectives, with some references to ML application surveys. The most relevant ML techniques encompass k-nearest neigh bours (KNN), support vector machines (SVM), tree-based models, ensembles, boosting techniques, and artificial neural networks (ANN). Recent trends include developing early warning systems (EWS) for bankruptcy and refining stress testing. One limitation of this study is the paucity of contributions using supervisory data, which justifies the need for additional investigation in this field. However, there is increasing evidence that ML techniques can enhance data analysis and decision making in the banking industry

Martin et’al (2019) studied Machine Learning in Banking Risk Management: A Literature Review. This study, through a review of the available literature seeks to analyse and evaluate machine-learning techniques that have been researched in the context of banking risk management, and to identify areas or problems in risk management that have been inadequately explored and are potential areas for further research. The review has shown that the application of machine learning in the management of banking risks such as credit risk, market risk, operational risk and liquidity risk has been explored; however, it doesn’t appear commensurate with the current industry level of focus on both risk management and machine learning. A large number of areas remain in bank risk management that could significantly benefit from the study of how machine learning can be applied to address specific problems.

Vishal, (2019) examined role of Artificial Intelligence in Combating Cyber Threats in Banking” which revealed that with the advances in information technology, various cyberspaces are used by criminals to enhance cybercrime. To mitigate this cybercrime and cyber threats, the bank and financial industry try to implement artificial intelligence. Various opportunities are provided by AI techniques, which help the banking sector to increase prosperity and growth. To maintain trust in artificial intelligence, it is important to maintain transparency and explain ability. Information about customer's behavior and interest is provided by artificial intelligence techniques. Robot-advice is an automated platform that is maintained by AI. Artificial Intelligence is also involved in protecting personal data. Proper design provided by AI towards the banking sector, by which they are able to identify cyber threat in transactions. AI directly linked with the domain of cyber security. Various kinds of cybercrimes are prevented and identified by AI-based systems.

However, implementation and maintenance of artificial intelligence consist of the high cost. Along with this, unemployment rate is increased by AI techniques. A survey reveals that, in 2016, the cost of cybercrime in the global economy was $450 billion with Asian organizations accounting for more than $81 billion. Denial-of-service attacks, infrastructure attacks, and other issues around data protection are a major part of high profiling cyber-attacks (Vieira &Sehgal 2018). Approximately 70% of CEOs of the capital market and banks consider cyber security a threat to their development. Security incidents left an impact on financial service organizations

300 times more frequently compared to the business in various industries. On the other hand, the financial service industry is targeted by 33% large attacks. In this position, it is important to develop a few security programs to protect cyber threats in banking. Global banking and financial industry claim that cyber attacks consists of approximately $360 billion in costs in a year. In recent years, global ransom ware attacks have an impact on financial institutions.

Iqbal (2020) studied "Machine Learning for Intelligent Data Analysis and Automation in Cyber Security"and found that the success of a machine learning model depends on how well the data and learning algorithms perform. Prior to the system being able to enable intelligent decision-making and automation, the sophisticated learning algorithms should be trained utilizing real-world cyber data and information particular to the target application, explored in this paper.

Praveen, (2017) examined AI and Machine Learning in Banking: A Systematic Literature Review. Machine learning techniques are using in many sectors for the better performance. Most of the time these are used for the prediction purpose so that the organization can take the necessary steps. In this paper, the different advantages and benefits of Artificial intelligence and machine learning techniques are discussed. The work of different researchers is discussed in this literature review to prove the importance of Artificial intelligence for the banking sector. It is also discussed how machine learning techniques can be helpful in the banking sector to deal with the risks especially the credit scoring process.

Research Methodology and Model

The study adopted *ex-post facto* research design. We employed *ex-post facto* research design due to its special characteristics which are the event that has already occurred hence there is no need for manipulation or alteration and it is also less costly and less time consuming. The population of the study consists of all the (14) quoted deposit money banks in Nigeria Exchange Group up to December, 2024. The study will use (10) deposit money banks out of the total population as sample size and adopted purposive sampling technique in selecting the sample size of the study. The researcher gathered the data for the independent variable using dummy, that is, if the bank makes use of the variable in a particular year is 1 other wise 0. While the dependent variables data were gathered from the financial statement of the banks. The data covered the period of 8 years from (2017 – 2024). Reason for the period is to cover the period which COVID 19 affected the operations of banking sector and how banks were able to overcome cyber-attacks during this period where customers solely interact with their banks only online.

Model Specification

The model that will guide this study is anchored on the specific objectives.

ROI = f (MLT), EPS = f (MLT)……..1

This can be econometrically expressed as

ROI = F($\beta_0 + \beta_1$ $MLT_{it} + \mu$), EPS = F($\beta_0 + \beta_1 MLT_{it} + \mu$)……..2

Equation 1 and 2 are the linear regression model used in testing the null hypotheses.

Where:

ROI = Return on Investment

EPS = Earnings Per Share

mlt = Machine Learning Technology

β_0 = Constant

β_1 - β_4, = are the coefficient of the regression equation

μ = Error term

t = is the year (time series)

Decision Rule

Accept Null if P-Value is greater than 5% and reject Alternate

Accept Alternate if P- Value is less than 5% and reject Null

Data Analysis and Discussion

Descriptive Analysis

The study examined the effect of machine learning on firm performance of deposit money banks in Nigeria. The specific objective was to determine the effect of machine learning on return on assets and return on investment of deposit money banks in Nigeria. *Ex-post facto* research design was used in the study. The population of the study consisted of all the (14) quoted deposit money banks in Nigeria Exchange Limited up to December, 2024. The study utilised 10 deposit money banks out of the total population as sample size. The data collected from the banks' annual reports covered the period of 8 years from (2017 – 2024). The descriptive analysis of the data is shown below in Table 4.1.

Table 4.1 Descriptive Analysis

	RO1	EPS	MLT
Mean	1.934000	7.237149	0.537500
Median	1.400000	5.211137	1.000000
Maximum	5.590000	22.35596	1.000000
Minimum	0.400000	-8.890733	0.000000
Std. Dev.	1.281359	5.570361	0.501737
Skewness	1.252785	0.435173	-0.150424
Kurtosis	3.711728	3.165158	1.022627
Jarque-Bera	22.61480	2.615936	13.33504
Probability	0.000012	0.270369	0.001272
Sum	154.7200	578.9720	43.00000
Sum Sq. Dev.	129.7085	2451.285	19.88750
Observations	80	80	80

Source: Eviews 10 Analytical Output (2024)

The mean return on assets (ROI) for the deposit money banks in Nigeria is approximately 1.93%, indicating that, on average, the banks generated this percentage of profit for every unit of asset owned over the studied period. The median ROI of 1.40% suggests that half of the banks had returns below this value, highlighting that while some banks perform exceptionally well, there are several with lower asset efficiency. The maximum ROI of 5.59% reflects the highest performance among the banks, indicating significant asset utilization efficiency, while the minimum of 0.40% suggests that some banks struggle to generate profits from their assets. The standard deviation of 1.28% indicates a moderate level of variability in ROI across the banks, suggesting that

performance varies, with some banks being much more efficient than others in utilizing their assets to generate returns.

In terms of earning per share (EPS), the mean value stands at approximately 7.24%, which shows that, on average, the banks achieved this percentage EPS over the eight-year period. The median ROI of 5.21% implies that half of the banks generated EPS below this threshold, indicating variability in how effectively different banks utilize their investments and gain more earnings. The maximum EPS of 22.36% reveals that certain banks are exceptionally effective in their investment strategies, significantly outperforming others, while the minimum EPS of -8.89% indicates that some banks not only failed to generate returns but also incurred losses on their investments. The standard deviation of 5.57% highlights a considerable variation in EPS, suggesting that the performance of banks in terms of investment returns is quite diverse.

Regarding machine learning technology (MLT), the mean score of 0.54 indicates that, on average, just over half of the sampled banks adopted machine learning technology during the study period. The median value of 1.00 suggests that at least half of the banks have implemented machine learning in their operations, reflecting a notable trend toward technological adoption within the sector. The maximum value of 1.00 shows that some banks have fully embraced machine learning, while the minimum value of 0.00 indicates that a portion of the banks did not adopt this technology at all. The standard deviation of 0.50 suggests a balanced distribution of adoption across the banks, with a mix of adopters and non-adopters, underscoring the varying levels of technological integration in their operational strategies.

Test of Hypotheses

The hypotheses were tested using ordinary leas square regression with simple regression analytical framework.

Test of Hypothesis I

H0: Machine learning has no significant effect on the on return on assets of deposit money banks in Nigeria.

Table 4.2 Test of Hypothesis I

Dependent Variable: ROI				
Method: Least Squares				
Date: 06/06/25 Time: 08:34				
Sample: 1 80				
Included observations: 80				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
MLT	0.718441	0.277488	2.589092	0.0115
C	1.547838	0.203438	7.608385	0.0000
R-squared	0.079140	Mean dependent var		1.934000
Adjusted R-squared	0.067334	S.D. dependent var		1.281359
S.E. of regression	1.237468	Akaike info criterion		3.288693
Sum squared resid	119.4434	Schwarz criterion		3.348244
Log likelihood	-129.5477	Hannan-Quinn criter.		3.312569
F-statistic	6.703398	Durbin-Watson stat		0.456801
Prob(F-statistic)	0.011476			

Source: Eviews 10 Analytical Output (2025)

In testing the first hypothesis, the null hypothesis (H0) suggests that machine learning has no significant effect on the ROI of deposit money banks. The analysis yields an R-squared value of 0.079140, indicating that approximately 7.9% of the variability in ROI is explained by the model. Although this percentage is relatively low, the probability of the F-statistic is 0.011476, which is below the 0.05 threshold. The constant term (C), which is significant at 1.547838, underscores that banks maintain a baseline level of ROI regardless of machine learning application, emphasizing that while machine learning contributes positively, other foundational factors are also at play. Further examination of the variable coefficients reveals that the coefficient for machine learning technology (MLT) is 0.718441, with a p-value of 0.0115. This positive coefficient suggests that an increase in machine learning implementation correlates with an increase in ROI, indicating a beneficial effect on how effectively banks generate profit relative to their total assets. Therefore, the alternate hypothesis was accepted that Machine learning has a significant positive effect on the on return on investment of deposit money banks in Nigeria ($\beta = 0.718441$; p-value = 0.0115).

Test of Hypothesis II

H0: Machine learning has no significant effect on the return on investment of deposit money banks in Nigeria.

Table 4.3 Test of Hypothesis II

Dependent Variable: EPS				
Method: Least Squares				
Date: 06/06/25 Time: 08:35				
Sample: 1 80				
Included observations: 80				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
MLT	3.262692	1.201561	2.715378	0.0081
C	5.483452	0.880917	6.224708	0.0000
R-squared	0.086365	Mean dependent var		7.237149
Adjusted R-squared	0.074652	S.D. dependent var		5.570361
S.E. of regression	5.358410	Akaike info criterion		6.219894
Sum squared resid	2239.579	Schwarz criterion		6.279444
Log likelihood	-246.7958	Hannan-Quinn criter.		6.243769
F-statistic	7.373277	Durbin-Watson stat		0.919223
Prob(F-statistic)	0.008148			

Source: Eviews 10 Analytical Output (2025)

In the second hypothesis, the focus shifts to EPS, with H0 asserting that machine learning does not significantly affect this metric. The results indicate an R-squared value of 0.086365, showing that about 8.6% of the variability in EPS can be attributed to the model. The F-statistic's probability of 0.008148 further supports the conclusion that the model is statistically significant, allowing for the rejection of the null hypothesis and confirming that machine learning indeed affects EPS. The constant term for EPS is also significant at 5.483452, indicating that a baseline level of EPS exists independent of machine learning, reinforcing the idea that various elements contribute to financial performance. When analyzing the coefficients related to EPS, the MLT coefficient stands at 3.262692, with a p-value of 0.0081. This substantial positive effect suggests that implementing machine learning can lead to significant improvements in a bank's EPS, highlighting its potential to enhance investment returns. Thus, the alternate hypothesis was accepted that Machine learning has a significant positive effect on the return on investment of deposit money banks in Nigeria ($\beta = 3.262692$; p-value = 0.0081).

Discussion of Finding

The finding that machine learning significantly affects return on investment (ROI) in deposit money banks is supported by several studies in the empirical literature. For instance, Kumar (2023) highlights the transformative potential of machine learning applications in banking, noting that its effective implementation can lead to improved financial performance metrics, including ROI. Similarly, Martin et al. (2019) conducted a literature review that underscores how machine learning techniques have been explored for risk management, which directly influences banks' profitability and, consequently, their ROI. Additionally, Pedro and Mauro (2021) examined machine learning applications in banking supervision and found that enhanced data analysis through these technologies can lead to better risk assessment and decision-making, further reinforcing improvements in ROI. Conversely, Giovanni et al. (2023) suggest that while the deployment of machine learning in cybersecurity is still developing, it underscores the importance of holistic implementations that can affect overall banking

performance metrics, including ROI, indicating the need for more integration of these technologies into core banking operations.

The study's finding that machine learning has a significant positive effect on earnings per share (EPS) is also supported by various empirical studies. For example, Vishal (2019) emphasizes that AI and machine learning contribute to detecting and preventing cyber threats, which can lead to cost savings and improved EPS for banks by minimizing losses from cyber incidents. Iqbal (2020) reinforces this by stating that effective machine learning models facilitate intelligent decision-making, leading to more efficient resource allocation and ultimately enhancing EPS. Furthermore, Mohammad et al. (2022) discuss how machine learning algorithms can analyze large datasets for real-time insights, allowing banks to make informed investment decisions that positively impact EPS. However, Pontus and Dariush (2022) caution that the risks associated with AI implementation must be managed effectively, as failure to do so could adversely affect EPS. This highlights the complexity of integrating machine learning into banking operations while emphasizing its potential benefits for enhancing financial returns.

Conclusion and Recommendations

This study provides compelling evidence that machine learning significantly affects the performance of deposit money banks in Nigeria. The analysis revealed that both return on investment (ROI) and earnings per share (EPS) are positively influenced by the adoption of machine learning technologies. These findings highlight the potential for machine learning to enhance operational efficiency and profitability, suggesting that banks can achieve better financial outcomes by leveraging advanced analytics and automation. Moreover, the results underscore the importance of integrating machine learning into strategic decision-making processes within the banking sector. As banks seek to address the challenges of a digital economy, investing in machine learning capabilities can lead to improved performance metrics and, ultimately, greater competitive advantage. This study serves as a call to action for financial institutions to embrace technological innovation, as it not only drives profitability but also positions for sustainable growth in an increasingly complex environment. By prioritizing machine learning adoption, banks can better respond to market demands and enhance their overall operational effectiveness.

In conclusion, the study’s findings demonstrate that machine learning has a significant positive effect on the performance of deposit money banks in Nigeria, influencing both ROI and EPS. As banks integrate machine learning technologies, they can expect to see improvements in their financial outcomes, which could enhance their overall competitiveness and efficiency in the marketplace. This underscores the importance of embracing technological advancements to drive growth and profitability in the dynamic banking sector.

1) Given the significant positive effect of machine learning on return on investment (ROI), bank executives should prioritize the integration of machine learning technologies into their operational strategies. This can involve investing in training programs for staff to enhance their data analytics skills and implementing machine learning systems to optimize asset management and profitability.

2) To support the financial sector's growth through technological advancements, regulatory authorities should establish guidelines that encourage the adoption of machine learning in banking practices. This could include

creating a framework for data security and privacy, ensuring that banks can implement these technologies responsibly while maximizing their benefits for earnings per share (EPS).

References

Belyaeva.K. (2022) "Machine Learning in the Banking Industry: 4 Best Practices | Fayrix." Fayrix Blog. Dec. 15, 2021. https://fayrix.com/blog/machine-learning-in-banking.

Ekpa, M., Onoura, J.K.J., & Sunday, D. (2023). Artificial brainpower and corporate performance of listed deposit money banks in Nigeria. *International Journal of Economics and Financial Management.* 8(4) 2545-5966. DOI: 10.56201/ijefm.v8.no4.2023.pg97.111

Giovanni, A., Pavel, L., Edgardo, M., Wissam, M., Luis, B., Athanasios, V., Grammatopoulos, & Fabio, Di (2023).*The Role of Machine Learning in Cyber security*. 8 https://doi.org/1 0.1145/3545574

Gambacorta, L., Huang, Y., Qiu, H & Wang, J.(2019) "How do machine learning and non-traditional data affect credit scoring? New evidence from a Chinese fintech firm.

Hiran, K. M., Megavarshini, G.; Aswathy, S., & Suresh, M (2023). Machine learning in the banking sector.

Proceedings of the international conference on industrial Engineering and Operations Management Manila, Philippines, March 7-9, 2023

Iqbal, H., (2020) *Machine Learning for Intelligent Data Analysis and Automation in Cyber security: Current and Future Prospects.* Annals of Data Science *doi.org/10.1007/s40745-022-00444-2*

Kumar, P. D. (2023). AI and machine learning in banking: A Systematic Literature Review. Journal of *Applied Science and Engineering*, 6 (3) 2307-9584.

Martin, L., Suneel, S., & Maddulety, k. (2019). Machine learning in banking risk management: A literature review.

Mohammad, H., & Tahereh, B. (2018). Return of investment (ROI) in research and development (R&D): Towards a framework.*14th Int'l Conference on Webometrics, Informetrics and Scientometrics*. DOI: 10.22032/dbt.39330.

Mohammad,W., Ashok, K., Vinay, D., & Youngho, P. (2022). *Uniting cyber security and machine learning: Advantages, challenges and future research.*ICT Express 8, Elsevier

Oyetoyan S. A., Olowoniyi, A., & Ajiboye, W.(2022) "The impact of fintech services on the level of performance of deposit money bank in Nigeria,": https://ilrjf.org/issues/volume2issue22019/v2/IJF_2019J_008.pdf.

Pedro, G. & Mauro, C. (2021). Machine learning applied to banking supervision a literature review. 136. https://doi.org/10.3390/risks9070136 Academic Editors: Mogens Steffensen and Jens Hagendor off.

Pontus, L., & Dariush, K. (2022).*The impact of AI on bank's risk management approach: A* qualitative study on the effects of AI in the banking sector from a holistic perspective. Sweden: KTH Stockholm.

Prashant, S & Pimplapure, A. (2023). The Impact of AI and Machine Learning on Innovation: A Comprehensive Review. International Journal of Science Management & Engineering Research

(IJSMER) 8(2), 2455-6203

Praveen, K. D (2017). Machine learning and artificial intelligence in banking. *Engineering International*, 5,

(2)2409-3629

Praveen, K. D (2017). AI and Machine Learning in Banking: A Systematic Literature Review. *Asian Journal of Applied Science and Engineering*, 6, (3) 2307-9584

Sumathy, M., Shallini, V., Bharathi, M.(2023). Machine learning and artificial intelligence in the banking sector" *Proceedings of National Conference*.

Sunday, D., & Agubata, N.S. (2023). Effect of Management Efficiency on Performance of Listed Consumer Goods Companies in Nigeria. International Journal of Economics and Business Management. 9(3) 2489-0065. DOI 10.56201/ijebm.v9.no3.2023.pg1.14

Shulha, O., Yanenkova, I., Kuzub, M., Muda, I., & Nazarenko, V. (2022).*Banking information resource cyber security system modeling.* Journal of Open Innovation Technology Mark Complex, 8, 80-91. https://doi.org/10.3390/joitmc80200.80