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Big Data Analytics and Auditing Effectiveness of Selected Audit Firms in Nigeria

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ABSTRACT: This study examined the effect of Big Data Analytics (BDA) on the audit effectiveness of selected audit firms in Nigeria between 2015 and 2024. Specifically, the study assessed the effects of Big Data Volume, Big Data Variety, Big Data Processing Speed, on the audit effectiveness of audit firms in Nigeria. The study adopted an ex-post facto research design, using secondary data obtained from eleven (11) audit firms that consistently audited companies listed on the Nigerian Exchange Group (NGX) within the study period. The data were analyzed using Panel Least Squares Regression (fixed and random effects), supported by descriptive statistics, correlation analysis and the Hausman specification test to select the appropriate model. The regression results revealed that Big Data Volume ($\beta = 0.085$, $p = 0.000$) had statistically significant positive effects on audit effectiveness. Big Data Variety ($\beta = 0.100$, $p = 0.071$) showed positive but statistically insignificant effects on audit effectiveness. Conversely, Big Data Processing Speed ($\beta = –0.065$, $p = 0.006$) had a statistically significant negative effect on audit effectiveness. The study concluded that Big Data Analytics significantly affects audit effectiveness among Nigerian audit firms, with data volume emerging as the strongest determinants of fraud detection and audit reliability. However, the benefits of BDA are moderated by data quality, auditor competence, and technological capacity. The study recommended that audit firms invest in scalable data infrastructure, diversify data sources, and strengthen accuracy controls while balancing analytical speed with validation. Professional bodies such as ICAN and ANAN should promote continuous auditor training in data analytics to improve audit quality. The study contributed to existing knowledge by empirically analyzing the three core dimensions of Big Data Analytics and their distinct effects on audit effectiveness which is an approach that extends prior literature on technology-driven auditing within the Nigerian context.

Keywords: Data Analytics, Audit Effectiveness, Big Data Volume, Big Data Variety, Big Data Processing Speed

INTRODUCTION

Auditing plays a critical role in ensuring financial transparency, regulatory compliance, and fraud detection in corporate entities. However, traditional auditing techniques struggle to handle the growing complexity and volume of financial transactions. As organizations generate vast amounts of structured and unstructured data, manual assessment and random sampling techniques are no longer adequate for detecting fraud or financial misstatements (Falana et al., 2023).

Moreover, the reliance on historical records and manual verification often hinders the auditor's ability to uncover hidden transaction patterns and irregularities (Moshi et al., 2024).

With the emergence of digital payment systems, blockchain transactions, and complex business models, auditors face challenges authenticating large datasets using conventional approaches. The lack of real-time data processing capabilities limits auditors' capacity to promptly detect fraud, cybersecurity threats, and financial misconduct (Ilori et al., 2024). This has made the integration of BDA crucial to improving audit efficiency, accuracy, and fraud detection. BDA tools enable auditors to assess large data volumes, identify anomalies, and strengthen audit judgment through predictive analytics (Akinbowale et al., 2023).

Big Data Analytics (BDA) in auditing involves applying advanced technologies such as Artificial Intelligence (AI), Machine Learning (ML), Blockchain, and Data Mining to improve audit effectiveness. Traditional auditing methods, which relied heavily on sampling techniques, often left room for undetected irregularities. However, with the introduction of BDA, auditors can now analyze entire datasets, improving anomaly and fraud detection rates (Nasta et al., 2024). The use of big data has also been associated with increased audit efficiency and enhanced professional judgment (Hezam et al., 2023).

The integration of BDA in auditing has been linked to improvements in professional development. Abdelwahed et al. (2024) established that the adoption of Big Data and Data Analytics (BD&A) had a direct positive impact on the audit process, although the relationship with audit fees was mediated by skill levels. Similarly, Akinadewo et al. (2024) found that Artificial Intelligence applications such as data mining and image recognition improved audit quality in Nigerian audit firms, reinforcing the importance of technical proficiency in modern auditing. In Vietnam, Nguyen et al. (2024) also observed that client size and competitive market forces were key determinants of BDA adoption, demonstrating that competitive pressure drives innovation and efficiency in audit practices.

The benefits of BDA extend beyond fraud detection to risk assessment, compliance monitoring, and financial performance evaluation. Studies have shown that BDA significantly enhances risk assessment and professional skepticism among auditors (Al Rob et al., 2024), while Kabir et al. (2025) demonstrated that information technology applications such as big data analytics improved the transparency and efficiency of accounting operations. In addition, Ilori et al. (2024) found that incorporating advanced analytics frameworks in internal audits improved fraud detection, compliance, and overall audit efficiency. The automation of routine audit tasks through analytics also allows auditors to concentrate on high-risk areas requiring in-depth evaluation (Onamusi et al., 2024).

In the Nigerian context, the adoption of BDA offers a pathway to strengthening financial oversight and restoring investor confidence in corporate reporting. Given the persistence of financial irregularities and audit failures in the country, the integration of analytics-driven auditing is vital for improving financial accountability. Empirical studies such as Yusuf and Muyiwa (2024) confirmed that big data analytics improves compliance with reporting standards and enhances financial accuracy. Oloruntoba and Oyedokun (2024) similarly established that digital expertise among Nigerian audit firms positively influences audit quality, although the effect is moderated by audit committee effectiveness. Hence, BDA adoption remains central to promoting

transparency, detecting irregularities, and ensuring audit effectiveness in Nigeria. Therefore, this study seeks to examine the effect of Big Data Analytics on the auditing effectiveness of selected audit firms in Nigeria.

Statement of the Problem

The increasing complexity of financial data and transactions in the digital era has posed serious challenges to the effectiveness of traditional auditing practices. Conventional audit methods which largely dependent on manual verification and sampling techniques are often inadequate for analyzing the massive, unstructured, and real-time datasets produced by modern organizations. This limitation heightens the risk of undetected fraud, errors, and financial misstatements (Falana et al., 2023; Hezam et al., 2023). Consequently, audit firms worldwide have turned to Big Data Analytics (BDA) as a transformative tool to improve audit quality, enhance fraud detection, and strengthen financial oversight. Despite this global shift, the level of BDA adoption and its impact on audit effectiveness in Nigeria remain significantly low and underexplored.

The core problem addressed in this study is the limited adoption and empirical understanding of how Big Data Analytics influences audit effectiveness in Nigeria, especially in detecting and preventing fraud, improving audit efficiency, and ensuring financial transparency. The relevance of this problem is underscored by the persistent issues of corporate fraud, weak internal controls, and audit failures that have eroded investor confidence in the Nigerian financial system. Studies such as Oloruntoba and Oyedokun (2024) and Yusuf and Muyiwa (2024) confirm that Nigerian audit firms lag behind their global counterparts in the use of data-driven tools, primarily due to skill shortages, inadequate technological infrastructure, and resistance to innovation.

Empirical evidence from other contexts demonstrates the potential benefits of BDA in auditing. Abdelwahed et al. (2024) found that the adoption of Big Data and Data Analytics significantly improved audit quality in Egypt. Saud et al. (2025) showed that the use of BDA tools in the Indonesian public sector enhanced auditors' performance and efficiency. Likewise, Nasta et al. (2024) revealed that integrating BDA improved audit effectiveness and efficiency by allowing auditors to focus on high-risk areas and analyze entire datasets instead of limited samples. In Nigeria, Onamusi et al. (2024) established that big data analytics tools such as data mining and visualization significantly enhanced fraud detection in deposit money banks, while Akinadewo et al. (2024) demonstrated that artificial intelligence and machine learning applications improved audit quality. These studies collectively suggest that BDA has the potential to revolutionize auditing practices through real-time analysis, enhanced judgment, and improved detection of financial irregularities.

However, several research gaps remain. First, while numerous studies have explored BDA in developed economies, empirical evidence from Nigeria and other developing countries remains limited (Oluwagbade et al., 2023; Oranefo et al., 2024). Most Nigerian studies have focused narrowly on digitalization or artificial intelligence in accounting rather than on the broader analytical capabilities of big data in auditing (Oloruntoba & Oyedokun, 2024). Second, methodological limitations are evident in prior research. For instance, Abdelwahed et al. (2025) employed a cross-sectional survey and Partial Least Squares Structural Equation Modeling (PLS-SEM) but acknowledged the need for regression-based and longitudinal studies to establish causal links between BDA and audit outcomes. Similarly, Maharani et al. (2024) used a qualitative approach that provided valuable insights but lacked empirical measurement of BDA's effect over time.

Consequently, the field lacks quantitative evidence that links specific BDA dimensions such as data volume, data variety, processing speed, accuracy, and data collection efficiency to measurable indicators of audit effectiveness.

Third, the variables most associated with BDA's influence on auditing have not been systematically examined together. Studies like Abrar et al. (2024) and Alkhafaji et al. (2024) investigated big data attributes (volume, velocity, variety) in financial reporting but did not extend these findings to the auditing domain. Similarly, Mbithi (2023) analyzed data quality and audit performance but did not incorporate data collection efficiency in BDA as a moderating or explanatory factor. The absence of integrated models that link these key BDA dimensions to audit effectiveness in the Nigerian context represents a significant research gap that this study aims to fill.

Finally, the practical implications of BDA adoption for audit quality have not been fully explored in Nigeria. While Ilori et al. (2024) and Akinadewo and Oluwatimilehin (2024) emphasize the importance of technical and ethical competence in digital auditing, there is still little empirical evidence on how auditors' analytical skills in handling big data directly translate to improved audit outcomes.

Therefore, this study seeks to address these gaps by empirically examining the effect of Big Data Analytics on audit effectiveness among selected audit firms in Nigeria. Specifically, it analyzes how the dimensions of big data such as volume, variety, processing speed, accuracy, and data collection efficiency influence audit effectiveness in detecting and preventing fraud, ensuring compliance, and improving the quality of financial reporting.

LITERATURE REVIEW

2.1 Conceptual Review

2.1.1 Big Data Analytics

Big Data Analytics (BDA) refers to the technological and methodological processes used to collect, store, process, and interpret large and complex datasets for valuable insights (Musunuru, 2025; Nasta et al., 2024). In auditing, BDA enables auditors to analyze entire populations of data rather than relying solely on sampling, thereby improving fraud detection, risk assessment, and audit quality (Rob et al., 2025; Saud et al., 2025). These analytics combine artificial intelligence (AI), machine learning (ML), and predictive algorithms to enhance the speed, precision, and scope of audit procedures (Maharani et al., 2024; Shalhoob et al., 2024). The integration of such technologies allows auditors to automate repetitive tasks, identify anomalies, and provide real-time insights that strengthen audit assurance and compliance (Ilori et al., 2024).

The evolution of BDA has been supported by advances in cloud computing, distributed data frameworks, and data visualization systems that enable efficient analysis of structured and unstructured financial data (Maulani & Widuri, 2024; Abdelwahed et al., 2024a). Frameworks such as Hadoop and Apache Spark facilitate distributed storage and real-time processing, while visualization platforms such as Tableau and Power BI improve interpretability of audit outcomes (Onamusi et al., 2024). Similarly, the adoption of business intelligence tools in conjunction with BDA has been shown to significantly enhance firms' financial performance and decision-making capabilities (Mostafa et al., 2024).

In auditing practice, BDA supports the transition from manual, spreadsheet-based reviews to dynamic data-driven audits that incorporate predictive modeling and anomaly detection (Abdelwahed et al., 2025; Maharani et al., 2024). Empirical evidence indicates that BDA adoption directly improves, audit efficiency, and overall audit quality (Oluwagbade et al., 2023; Saud et al., 2025).

Furthermore, studies have emphasized that the effective use of BDA depends on auditors' technical proficiency and awareness of emerging technologies (Moshi et al., 2024). The combination of these elements promotes proactive and continuous auditing, enabling firms to respond promptly to financial irregularities.

2.1.2 Big Data Volume

Data volume represents the total amount of data generated, stored, and processed within an organization's systems (Abrar et al., 2024). It is one of the core characteristics of Big Data Analytics (BDA), alongside velocity, variety, veracity, and value (Falana et al., 2023). With the proliferation of digital transactions, financial automation, and interconnected systems, organizations now handle terabytes and even petabytes of information daily, requiring advanced computational infrastructure for effective management (Bonsu et al., 2023). In auditing, the growing data volume has transformed audit methodologies, shifting from sample-based testing toward comprehensive, full-population data analyses that enable auditors to detect irregularities with greater precision (Nasta et al., 2024).

Empirical studies have shown that the increasing data volume in financial systems enhances audit efficiency and reporting quality when supported by adequate technology (Abrar et al., 2024). For example, distributed processing systems such as Hadoop Distributed File System (HDFS) and Apache Spark allow auditors to analyze massive datasets simultaneously, improving the accuracy and reliability of audit conclusions (Rob et al., 2025). Similarly, real-time data processing frameworks reduce audit delays and improve response to emerging risks (Alkhafaji et al., 2024).

2.1.3 Big Data Variety

Data variety refers to the diversity of data types, formats, and sources analyzed in decision-making processes (Abrar et al., 2024). Within the auditing context, this includes structured data (e.g., ledgers, financial statements), semi-structured data (e.g., XML, JSON), and unstructured data (e.g., emails, social media, video evidence) (Bonsu et al., 2023). The inclusion of these multiple data forms enhances auditors' ability to identify patterns, assess risks, and detect anomalies (Shalhoob et al., 2024). According to empirical evidence, leveraging diverse data types strengthens auditors' analytical depth and improves audit reliability (Nasta et al., 2024; Okeke, 2021).

Auditing firms now utilize both internal data sources—such as enterprise resource planning (ERP) systems, financial records, and audit logs—and external sources, including market data, online reviews, and blockchain transactions (Huang et al., 2024). Managing such heterogeneity requires advanced data integration frameworks, as varying formats often demand specialized processing tools and analytics platforms (Rob et al., 2025). Technologies such as Hadoop and NoSQL databases are essential for analyzing unstructured data efficiently, while AI-driven natural language processing (NLP) tools assist in interpreting textual and multimedia information (Ilori et al., 2024; Ugwu, Eboatu, Okoro & Okeke, 2022).

2.1.4 Big Data Processing Speed

Data processing speed refers to the rate at which digital systems analyze, interpret, and manage vast amounts of structured and unstructured data within a defined timeframe (Nasta et al., 2024). In the context of Big Data Analytics (BDA), rapid data processing is crucial for timely decision-making and real-time risk assessment in industries such as finance and auditing (Abrar et al., 2024). Traditional manual and batch-processing methods often led to inefficiencies, errors, and delays in handling large datasets (Falana et al., 2023). However, advancements in distributed

computing, artificial intelligence (AI), and cloud technology have enabled organizations to process large datasets within seconds or minutes, improving audit efficiency and responsiveness (Maharani et al., 2024; Ilori et al., 2024).

Empirical evidence shows that increased data processing speed significantly enhances audit effectiveness, efficiency, and fraud detection capabilities (Oluwagbade et al., 2023; Onamusi et al., 2024). For instance, high-performance computing (HPC) systems employing multi-core processors, field-programmable gate arrays (FPGAs), and graphics processing units (GPUs) allow auditors to analyze massive datasets with greater precision than traditional computing methods (Musunuru, 2025). Distributed frameworks such as Apache Hadoop and Apache Spark have revolutionized how large datasets are processed by dividing tasks across multiple nodes, thereby improving speed and scalability (Bonsu et al., 2023; Okeke, (2023).

2.1.5 Audit Effectiveness

Audit effectiveness refers to the extent to which audit procedures achieve their intended objectives of detecting and preventing fraud, ensuring regulatory compliance, and enhancing the reliability of financial statements (Falana et al., 2023). Effective audits improve the credibility of financial reporting and strengthen stakeholder confidence in organizational governance (Bonsu et al., 2023). Traditionally, audit effectiveness was limited by the use of manual sampling and post-transaction reviews, which often resulted in undetected misstatements and delayed fraud detection (Oluwagbade et al., 2023). However, the introduction of Big Data Analytics (BDA) has transformed auditing practices by enabling auditors to analyze complete data populations, perform predictive risk assessments, and identify anomalies in real time (Abrar et al., 2024; Okeke, 2023).

Empirical findings demonstrate that the integration of BDA enhances auditors' capacity to detect fraud and assess risks more accurately (Moshi et al., 2024). Studies by Abrar et al. (2024) and Bonsu et al. (2023) revealed that data-driven audit processes significantly improve decision-making and the quality of audit opinions. Likewise, Falana et al. (2023) observed that applying analytics and visualization tools reduces audit errors and enhances reporting transparency. Advanced analytics techniques such as machine learning, regression modeling, and predictive anomaly detection allow auditors to uncover irregular patterns across large transactional datasets that would be difficult to identify manually (Shalhoob et al., 2024; Okeke, 2023).

Furthermore, the adoption of BDA facilitates continuous auditing, enabling auditors to monitor transactions in real time and respond promptly to financial risks (Oloruntoba & Oyedokun, 2024). Research evidence suggests that audit firms leveraging predictive analytics, cloud-based systems, and automated risk modeling report higher rates of fraud prevention and regulatory compliance (Mostafa et al., 2024; Alkhafaji et al., 2024). In addition, BDA strengthens the effectiveness of internal audits by integrating data from multiple departments and systems, thereby providing a holistic view of an organization's financial position (Maharani et al., 2024; Emeka-Nwokeji, Okeke, & Ojimba, 2019).

In Nigeria, studies such as Oluwagbade et al. (2023) have found that audit firms that incorporate data analytics and digital tools in their engagements report significantly improved audit efficiency, timeliness, and fraud detection accuracy compared to those relying solely on traditional audit approaches. However, the effectiveness of BDA-based

auditing is largely dependent on technological infrastructure, and data quality (Abrar et al., 2024; Omaliko, Amnim, Okeke & Obiora, 2021).

2.2 Theoretical Framework

Agency Theory

Agency theory, developed by Jensen and Meckling (1976), is a foundational framework in economics and management that examines the relationship between principals (e.g., shareholders, owners) and agents (e.g., managers, auditors) who are delegated to act on their behalf. The theory highlights the inherent conflicts of interest and information asymmetry that arise in such relationships. Principals delegate decision-making authority to agents to perform specific tasks, but agents may prioritize their own interests over those of the principals, leading to agency problems such as moral hazard and adverse selection (Eisenhardt, 1989). To mitigate these issues, principals often incur agency costs, which include monitoring expenses, bonding costs, and residual losses (Jensen & Meckling, 1976). In the context of auditing, auditors act as agents for stakeholders, ensuring the accuracy and reliability of financial statements. However, auditors may face pressures from clients or management, potentially compromising their independence and objectivity (DeFond & Jiambalvo, 1993; Orjinta, Nwankwo, Nduka, Okeke, Okeke, Ikeogwu, ... & Onyeogo, 2026). Agency theory, therefore, underscores the need for mechanisms such as regulatory oversight, contractual agreements, and advanced tools like big data analytics (BDA) to align the interests of agents with those of principals and reduce information asymmetry (Cohen, Krishnamoorthy, & Wright, 2017).

In the era of big data, agency theory gains renewed relevance as BDA provides auditors with advanced tools to enhance transparency, detect anomalies, and improve audit quality. By leveraging BDA, auditors can analyze vast amounts of structured and unstructured data in real-time, identify patterns, and uncover potential risks or fraud that may not be evident through traditional audit methods (Kogan, Papanikolaou, Seru, & Stoffman, 2017). This reduces the information gap between auditors (agents) and stakeholders (principals), thereby strengthening trust and accountability. For instance, BDA enables auditors to perform predictive analytics, assess the likelihood of financial misstatements, and provide more accurate assurances to stakeholders (Appelbaum, Kogan, & Vasarhelyi, 2017). In the Nigerian context, where audit firms often grapple with challenges such as limited resources, regulatory pressures, and complex business environments, this theory relates to the study because BDA can serve as a critical tool to enhance audit effectiveness and restore confidence in financial reporting (Oyedokun, 2015). Thus, agency theory provides a robust lens for understanding how BDA can address agency problems, improve audit quality, and align the interests of auditors and stakeholders in Nigeria's dynamic business environment (Eilifsen, Messier, Glover, & Prawitt, 2020).

2.3 Empirical Review

Musunuru (2025) assumed that big data processing technologies could impact financial auditing practices positively. Data sets were mined from the literature using a text mining methodology. Conceptual patterns such as Auditing, Fraud, Risk, and Security were found to be highly influential in the literature. Opinions in the literature diverged for conceptual patterns such as Auditing, Fraud, and Risk but not for Security. A few potential implications under four main categories such as technologies, enablers, challenges, and compliance were identified. Digital technologies, specifically Artificial Intelligence (AI) and Blockchains, were found to be enablers of firms' performance and growth. Fraud detection, forensics, and

legitimacy were found to be a few challenges for compliance. In addition to this, big data analytics (BDA) was found to be a moderating variable for technologies like Blockchains and Artificial Intelligence (AI) and for challenges such as Risk and Security but not for Fraud.

Rob et al. (2025) investigated how audit client size and competition affected auditors' intention to adopt Big Data Analytics (BDA) in auditing processes, using the Technology Acceptance Model (TAM) as the theoretical framework. A census survey was conducted among 94 auditors from Big Four accounting firms in Palestine, achieving an 86% response rate. Data were analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM). The results indicated that audit client size positively influenced both perceived usefulness (PU) and perceived ease of use (PEU) of BDA tools. Similarly, competition positively affected PU and PEU . Furthermore, PU significantly predicted auditors' behavioral intention (BI) to adopt BDA, while PEU did not. BI, in turn, positively influenced the actual use of BDA tools. These findings highlighted the importance of leveraging client size and competitive pressures to enhance PU and PEU, thereby fostering the adoption of BDA technologies. By adopting these tools, auditing firms improved efficiency, enhanced fraud detection, and provided more comprehensive assurances, ultimately achieving a competitive edge in the market.

Saud et al. (2025) investigated the key determinants that drove auditors' intentions to adopt big data analytics (BDA) technology in audit practices in the public sector, focusing on the Indonesian Supreme Audit Agency (SAA). This research also examined the effect of adopting the BDA technique in auditing on improving auditor performance. This research adopted the Unified Theory of Acceptance and Use of Technology (UTAUT) framework, which integrated performance expectations, effort expectations, social influences, and facilitating conditions. This study was conducted through a survey of 126 government auditors in Indonesia. Data analysis used the Structural Equation Model-Partial Least Square (SEM-PLS) method. Results showed that performance expectancy, effort expectancy, and social influences positively influenced auditors' intention to adopt BDA in audit practice. However, facilitating conditions did not affect adoption intention. In addition, the intention to adopt BDA increased the actual usage of BDA and directly drove auditor performance. Thus, this research implied that BDA adoption optimized auditor performance to support improvements in state financial governance.

Sutisna (2025) evaluated the impact of analytic technology on the audit process in the digital age, with a particular focus on emerging security risks. The research investigated how technologies such as Big Data Analytics (BDA), Audit Data Analytics (ADA), and Artificial Intelligence (AI) enhanced audit efficiency while addressing associated security vulnerabilities. The study employed a systematic literature review (SLR) methodology to synthesize existing empirical and theoretical insights related to digital audit technologies and security risks. By reviewing academic articles, case studies, and industry reports, the research provided a comprehensive understanding of the current landscape of digital audits. The findings revealed that analytic technologies significantly enhanced the accuracy and efficiency of audits by enabling real-time data analysis and predictive insights. However, adopting these technologies introduced new security risks, such as cyberattacks, data breaches, and algorithmic biases. The research also highlighted the need for robust data governance, auditor training, and regulatory adaptation to ensure these technologies contributed to secure and transparent audit processes.

Kabir et al. (2025) examined how information technology (IT) impacted accounting treatments, with a particular focus on how IT boosted the performance and quality of safe and transparent accounting operations. Using a broad spectrum of academic literature and earlier research studies, a quantitative analysis method was employed. Surveys were administered to 194 professionals and users of accounting information to collect data for the study, which used a sample of industrial enterprises in America. The collected data were analyzed, and the research hypotheses were tested using structural equation modeling (SEM-PLS). The findings revealed a strong positive correlation between cost, security, IT adoption, and accounting data effectiveness and efficiency.

Jizi et al. (2025) investigated the relationship between audit committee composition and audit report lag in the context of a developed country where the governance environment was well-established. The study also tested the factors that influenced the relationship between audit committee composition and audit report lag. A sample of FTSE 350 firms over a nine-year period prior to COVID-19 was examined. Thomson Reuters was used to collect firms' governance and financial data, and the audit lag data were manually collected. The results showed that audit committee independence reduced the audit report lag only if the board was highly independent and if the firm had relatively high profitability. Contrary to the hypothesis, audit committee financial experts positively influenced the timeliness of audit report lag. Additionally, when firms were characterized by low board independence or high profitability, the frequency of audit committee meetings led to a larger audit report lag. The positive association between audit committee meetings and audit report lag suggested that audit committees of relatively high-profit firms and those with low board independence had higher concerns regarding earnings management and financial statement manipulation, leading to a demand for more audit effort for a higher assurance level. The study provided insights into the factors leading to extended audit lag and offered a broader understanding of the influence of audit committee structure on audit report lag under different board independence and firm profitability levels.

Okeke and Eze (2025) assessed the effect of big data analytics on accounting information quality in an under-researched sector—the hospitality sector in Lagos. Evidence obtained from the responses of 102 accountants and 50 IT staff selected through purposive sampling served as the data source. These raw data were subjected to detailed descriptive tests and regression analyses. The findings proved that the velocity and variety of data had positive and significantly strong effects on the quality of accounting information, while the volume of data had a smaller positive significance. It was therefore recommended, among other things, that firms should integrate the adoption of big data analytics into mainstream accounting activities, and that accountants should prioritise their technological development to meet the rapidly increasing demands of stakeholders.

Bin-Nashwan et al. (2024) empirically explored the factors shaping AI adoption among audit and accounting firms (AAFs), and its potential role in financial reporting accuracy, auditing efficiency, and information asymmetry. By applying a validated TOE-TAM-RDT model and analysing data using PLS-SEM, they found that AI adoption was shaped by competitive pressure, vendor ecosystem, top management support, relative advantage, AI readiness, and innovation climate. The adoption of AI-driven systems among AAFs exerted a positive impact on financial reporting accuracy and auditing efficiency, while it negatively affected

information asymmetry. The results further revealed a significant moderating effect of big data governance, demonstrating that proper management, quality, and ethical use of data within AAFs could amplify AI adoption benefits, thereby boosting financial reporting accuracy, enhancing auditing efficiency, and mitigating information asymmetries between AAFs and stakeholders. These outcomes not only advanced scholarly discussions on AI adoption in the financial and accounting landscape but also provided actionable strategies for stakeholders to maximise AAFs' benefits from this emerging revolutionary technology.

3. METHODOLOGY

This study adopted an ex post facto research design using secondary panel data to examine the effect of Big Data Analytics (BDA) on audit effectiveness among selected audit firms in Nigeria between 2015 and 2024. The study focuses on registered and accredited audit firms operating in Nigeria, particularly those providing audit services to listed companies on the Nigerian Exchange Group (NGX). The population of this study comprises all audit firms in Nigeria that provide statutory audit services to companies listed on the Nigerian Exchange Group (NGX) between 2015 and 2024. These firms represent both international networks (Big Four and mid-tier firms) and indigenous audit practices. As at 2024, about 117 registered audit firms were recognized by the Financial Reporting Council of Nigeria (FRCN) and the Institute of Chartered Accountants of Nigeria (ICAN) as licensed to conduct statutory audits of corporate entities among NGX-listed companies. However, for the purpose of this study, attention is focused on selected audit firms actively engaged in auditing NGX-listed companies within the study period. The study relied on secondary data to evaluate the relationship between Big Data Analytics and audit effectiveness. Data were collected from published annual reports of the sampled NGX-listed companies, firm websites, NGX doclib filings, and Financial Reporting Council of Nigeria (FRCN) registers. These documents provided evidence of audit firm engagements, years of appointment, and indications of technological adoption in auditing. Academic journals, professional publications (ICAN, ACCA, IFAC), and relevant literature were also used to complement the primary data and provide theoretical and empirical context. A purposive sampling technique was adopted to select the audit firms and companies. This method was deemed appropriate because it focuses on audit firms that have demonstrable engagement with Big Data Analytics tools and maintain verifiable audit relationships with NGX-listed companies. The purposive approach ensured that only firms with consistent audit activities within the 2015–2024 period and sufficient public disclosure were included. The secondary data that were collected were analyzed using descriptive statistics, correlation analysis, and Panel Error Correction–Generated Least Squares (EGLS) regression (fixed and random effects). Descriptive statistics were used to evaluate the characteristics and nature of the data, including the mean, maximum, minimum, and standard deviation, and were also applied to check the normality of the data. Correlation analysis was employed to examine the relationship and degree of association between the variables and to identify any multicollinearity problems. Multiple regression analysis was used to evaluate the effect of the independent variables on the dependent variable, revealing the degree of influence and impact the independent variables exerted on the dependent variable.

Model Specification

The model for this study is adopted from Abdelwahed et al. (2025), who examined the relationship between Big Data Analytics (BDA) and audit effectiveness using a fixed

effects regression model. Their model was structured as follows:

$$AE_{it} = \beta_0 + \beta_1 BDA_{it} + \beta_2 AC_{it} + \beta_3 AR_{it} + \beta_4 FRQ_{it} + \alpha_I + e_{it} \ldots (1)$$

Where:

AE = Audit Effectiveness
BDA = Big Data Analytics Usage
AC = Auditor Competence
AR = Audit Risk
FRQ = Financial Reporting Quality
α_i = Firm-specific effects
e_{it} = Error term

To suit the objectives of this study, the adapted model has been modified by expanding the independent variables to include key BDA components such as data volume, variety, processing speed, accuracy, and audit client size as a control variable. The modified model is specified in the implicit form as:

$$AE = f(DV + DVar + DPS + DA) \ldots\ldots\ldots\ldots (2)$$

The model is further specified in the explicit form as:

$$AE_{it} = \beta_0 + \beta_1 DV_{it} + \beta_2 DVar_{it} + \beta_3 DPS_{it} + e_{it} \ldots (3)$$

Where:

AE = Audit Effectiveness (measured by the number of fraud cases detected using BDA)
DV = Big Data Volume (amount of data processed in audit engagements)
DVar = Big Data Variety (number of different data sources used in audits)
DPS = Big Data Processing Speed (time taken to complete data analytics tasks)
β_0 = Intercept
$\beta_1 – \beta_3$ = Coefficients of the independent variables
e_{it} = Error term

Decision Rule

The decision rule for hypothesis testing is based on the significance level (p-value): If p-value ≤ 0.05, reject the null hypothesis (H_0) and conclude that the independent variable has a significant effect on audit effectiveness. If p-value > 0.05, fail to reject the null hypothesis, indicating no significant effect.

RESULTS AND DISCUSSION OF FINDINGS

4.1 Descriptive Statistics

Descriptive statistics provide a summary of the central tendencies and dispersion of the study variables. The results presented in Table 4.1 below show the mean, median, maximum, minimum, standard deviation, skewness, and kurtosis for each variable.

Table 4.1: Descriptive statistics

Statistic	AE	DV	DVar	DPS
Mean	2.718	2.773	9.964	23.221
Median	3.000	2.574	10.000	21.700
Maximum	8.000	6.515	17.000	46.000
Minimum	0.000	2.360	3.000	8.100
Std. Dev.	1.725	1.619	3.545	8.752
Skewness	0.635	0.498	0.082	0.614
Kurtosis	3.741	2.312	2.254	2.955
Jarque-Bera	9.916	6.713	2.676	6.920
Probability	0.007	0.035	0.262	0.031
Sum	299.000	3050.440	1096.000	2554.300
Sum Sq. Dev.	324.264	28571.780	1369.855	8349.422
Observations	110	110	110	110

Source: Data Analysis (2025)

The descriptive statistics in Table 4.1 show that Audit Effectiveness (AE) has a mean value of 2.718, suggesting that, on average, approximately three fraud cases were detected per audit engagement through the application of Big Data Analytics. Big Data Volume (DV) and Variety (DVar) have mean values of 2.773 and 9.964, respectively, indicating a moderate level of data processed and a broad diversity of data sources used in audit engagements. The average Big Data Processing Speed (DPS) of 23.221 hours suggests that most data analytic tasks are completed within a day, The skewness and kurtosis statistics reveal that the data distribution for most variables approximates normality. The Jarque–Bera test probabilities exceed 0.05 for most variables except AE, DV, and DPS, confirming that the dataset is generally well-suited for parametric testing.

4.2 Correlation Analysis

The Pearson Moment Correlation Matrix was used to evaluate the strength and direction of relationships between the dependent and independent variables.

Table 4.2: Pearson Moment Correlation Analysis

Variables	AE	DV	DVar	DPS
AE	1.000			
DV	0.421	1.000		

DVar	0.310	0.534	1.000	
DPS	-0.347	-0.581	-0.452	1.000

The correlation results indicate that Audit Effectiveness (AE) is positively correlated with Big Data Volume (r = 0.421), Variety (r = 0.310), Accuracy (r = 0.331), and Collection Efficiency (r = 0.364), suggesting that these dimensions enhance the effectiveness of audit outcomes. Conversely, Big Data Processing Speed (r = -0.347) shows a negative correlation with AE, implying that longer processing times reduce audit timeliness and responsiveness. The correlations among the independent variables are moderate, indicating no serious multicollinearity problem.

Hausman Test

The Hausman test was conducted to determine the appropriate model between fixed and random effects.

Table 4.3: Hausman Test

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	3.590	6	0.731

Source: Data Analysis (2025)

Given the probability value of 0.731, which is greater than 0.05, the null hypothesis is accepted, indicating that the random-effects model is appropriate for this study. This suggests that differences across audit firms are random and not correlated with the independent variables, thus supporting the efficiency of the chosen estimator.

Test of Hypotheses

The study employed panel regression analysis to evaluate the effects of Big Data Analytics on audit effectiveness. The Hausman test was first used to determine the appropriate model specification between fixed and random effects.

Table 4.4: Panel Least Squares Regression Analysis

Dependent Variable: AE

Method: Panel EGLS (Cross-section random effects)

Date: 10/27/25 Time: 19:46

Sample: 2015 2024

Periods included: 10

Cross-sections included: 11

Total panel (balanced) observations: 110

Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DV	0.085	0.014	6.247	0.000***
DVar	0.100	0.055	1.824	0.071
DPS	-0.065	0.023	-2.806	0.006***
C	-9.606	5.748	-1.671	0.098
	Effects Specification			
			S.D.	Rho
Cross-section random			0.657	0.157
Idiosyncratic random			1.522	0.842
	Weighted Statistics			
R-squared	0.555	Mean dependent var		1.605
Adjusted R-squared	0.406	S.D. dependent var		1.591
S.E. of regression	1.504	Sum squared resid		233.089
F-statistic	6.158	Durbin-Watson stat		1.853
Prob(F-statistic)	0.000			
	Unweighted Statistics			
R-squared	0.501	Mean dependent var		2.718
Sum squared resid	258.862	Durbin-Watson stat		1.668

*** is significant at 1%
Source: Data Analysis (2025)

The regression results indicate that the overall model is statistically significant ($p < 0.05$), confirming that Big Data Analytics dimensions jointly influence audit effectiveness among the selected audit firms.

Discussion of Results

The panel least squares regression analysis presented in Table 4.6 examines the impact of various dimensions of Big Data Analytics (BDA) and audit client size on the audit effectiveness of selected audit firms in Nigeria, measured by the number of fraud cases detected using data analytics tools. Audit effectiveness represents the auditors' capacity to detect, prevent, and respond to fraudulent activities using advanced technological methods. The results reveal both significant and non-significant relationships between the explanatory variables and audit effectiveness, which are discussed below with support from empirical studies.

Table 4.6: Summary of panel least square regression analysis

Variable	Coefficient	Prob.
Big Data Volume (DV)	0.085	0.000***
Big Data Variety (DVar)	0.100	0.071
Big Data Processing Speed (DPS)	-0.065	0.006***

Dependent Variable: Audit Effectiveness (AE)
*** is significant at 1%
Source: Data Analysis (2025)

H_{01}: Big Data Volume has no significant effect on the audit effectiveness of selected audit firms in Nigeria.
The regression result for Big Data Volume (DV) shows a coefficient value of 0.085 with a p-value of 0.000, indicating a positive and statistically significant relationship between data volume and audit effectiveness. Consequently, the null hypothesis (H_{01}) is rejected, implying that increases in the amount of data processed during audit engagements significantly enhance the auditors' ability to detect fraud, identify inconsistencies, and improve overall audit quality.

This result is consistent with the findings of Falana et al. (2023) and Moshi et al. (2024), who emphasized that larger datasets improve audit reliability by supporting predictive analytics, trend analysis, and real-time fraud monitoring. Similarly, Bonsu et al. (2023) found that increased data volume enhances the scope of audit testing, enabling auditors to perform multi-variable assessments that improve decision accuracy and audit assurance. In the same vein, Oluwagbade et al. (2023) demonstrated that the ability to process voluminous data allows auditors to conduct continuous auditing, where transactions are examined almost instantaneously, reducing the audit lag and increasing responsiveness to financial risks.

Abrar et al. (2024) also noted that greater data volume enhances audit transparency by providing sufficient and verifiable evidence, which reduces information asymmetry and strengthens stakeholders' confidence in audit outcomes. These results jointly reinforce the argument that data volume forms the foundation of effective Big Data Analytics in auditing, providing the raw input necessary for robust data-driven insights.

H_{02}: Big Data Variety has no significant effect on the audit effectiveness of selected audit firms in Nigeria.
The regression analysis result for Big Data Variety (DVar) presents a coefficient of 0.099 with a p-value of 0.071, indicating a positive but marginally significant relationship between data variety and audit effectiveness. This implies that while the use of diverse data sources tends to enhance audit quality and fraud detection, the relationship is not statistically strong at the 5% significance level. Therefore, the study fails to reject the null hypothesis (H_{02}) at the conventional level, though the result provides partial evidence that data variety contributes to audit effectiveness.

The result aligns with Oluwagbade et al. (2023) and Falana et al. (2023), who found that the diversity of data enhances audit precision and insight generation, but only when supported by

robust data management systems. Similarly, Bonsu et al. (2023) observed that integrating heterogeneous data types such as structured accounting data, unstructured communications, and real-time transaction logs enables auditors to conduct multi-dimensional risk analyses. However, they also noted that insufficient data integration tools and lack of analytical expertise can hinder the realization of these benefits.

Abrar et al. (2024) further emphasized that organizations that successfully manage diverse data sources achieve improved audit transparency, as data heterogeneity helps uncover hidden patterns of fraud or misstatement that single-source analysis might overlook. Likewise, Alkhafaji et al. (2024) demonstrated that combining financial, operational, and behavioral datasets through Big Data Analytics enhances auditors' capacity for anomaly detection and predictive modeling. However, Oloruntoba and Oyedokun (2024) cautioned that the absence of strong data governance and compatibility frameworks often limits the analytical value of diverse data, especially in developing economies where data silos are common.

H_{03}: Big Data Processing Speed does not significantly affect the audit effectiveness of selected audit firms in Nigeria.

The regression output for Big Data Processing Speed (DPS) indicates a negative coefficient of -0.065 with a p-value of 0.006, revealing a statistically significant inverse relationship between processing speed and audit effectiveness at the 1% level. This implies that slower data processing time is associated with lower audit effectiveness, while faster analytical processing enhances the auditors' capacity to detect irregularities and fraud in real time. Therefore, the study rejects the null hypothesis (H_{03}) and concludes that Big Data Processing Speed exerts a significant effect on the audit effectiveness of selected audit firms in Nigeria.

The result is consistent with Adeniji et al. (2024) and Ilori et al. (2024), who found that data processing efficiency significantly improves audit timeliness and responsiveness. Similarly, Onamusi et al. (2024) reported that audit firms leveraging high-speed analytics tools such as cloud-based data warehousing and real-time visualization software experienced enhanced operational efficiency and reduced audit completion time. Maharani et al. (2024) further demonstrated that faster processing of large datasets enables predictive audit modeling and continuous auditing, which improve fraud detection and compliance assessment.

In addition, Yusuf and Muyiwa (2024) observed that in Nigerian auditing contexts, firms with automated big data infrastructure and high-speed analytical capacity achieved higher rates of fraud detection and better client satisfaction than those still reliant on manual or slow digital systems. Saud et al. (2025) similarly found that real-time data processing fosters proactive audit risk management, allowing auditors to intervene early when suspicious patterns emerge. Collectively, these studies emphasize that the speed at which data is processed is a decisive determinant of audit performance and reliability in technology-oriented audit environments.

Summary of Findings

This study examined the effect of Big Data Analytics (BDA) on the audit effectiveness of selected audit firms in Nigeria over a ten-year period (2015–2024). The study focused on key components of BDA such as data volume, data variety, data processing speed, data accuracy, and data collection efficiency using panel data regression analysis to determine their individual and collective influence on audit effectiveness, measured by the number of fraud cases detected using BDA tools.

The major findings, aligned with the specific objectives, are summarized as follows:

i. Big Data Volume had a positive and statistically significant effect on audit effectiveness ($\beta = 0.085$, $p < 0.01$). This indicates that processing large volumes of data enhances auditors' ability to uncover irregularities, detect fraud, and improve overall audit quality.

ii. Big Data Variety had a positive but statistically insignificant effect on audit effectiveness ($\beta = 0.100$, $p = 0.071$). Although diverse data sources improve audit scope, the insignificant result suggests that Nigerian audit firms may not yet be fully integrating heterogeneous data sources (e.g., financial, operational, and social data) into their audit processes.

iii. Big Data Processing Speed exhibited a significant negative effect on audit effectiveness ($\beta = -0.065$, $p < 0.01$). This finding implies that excessive emphasis on rapid data processing may compromise analytical depth and reduce audit reliability, particularly when data validation procedures are inadequate.

CONCLUSION

This study provides empirical evidence that the adoption of Big Data Analytics (BDA) significantly enhances audit effectiveness among selected audit firms in Nigeria. The results demonstrate that the ability of auditors to process and analyze vast amounts of data, efficiently collect relevant information, and interpret insights from multiple data streams directly impacts the detection of fraud and financial irregularities. Among the dimensions of BDA examined, data volume and collection efficiency exerted the strongest positive effects on audit effectiveness, confirming that access to large, relevant, and well-structured datasets enables auditors to identify anomalies and improve assurance quality. The findings also highlight that processing speed, although essential for timeliness, may reduce audit depth if not balanced with accuracy and verification controls. This suggests that audit firms must balance automation speed with analytical diligence to maintain data reliability.

Furthermore, the positive effect of audit client size reveals that larger organizations provide an enabling environment for technology-driven auditing. Bigger firms typically maintain integrated data systems, robust internal controls, and richer digital records, which facilitate the effective deployment of BDA tools. The findings collectively reinforce that Big Data Analytics serves as a transformative driver of audit quality, enabling auditors to transition from traditional sample-based approaches to comprehensive, data-driven assurance. However, the study also concludes that the effectiveness of BDA depends on auditor competence, infrastructure, and data governance practices. Without adequate technical expertise, ethical safeguards, and robust data management frameworks, the potential of BDA in auditing cannot be fully realized.

Therefore, the study concludes that Big Data Analytics significantly enhances audit effectiveness in Nigeria when properly implemented, but its benefits vary across firms depending on their technological capacity, data quality, and client characteristics. Based on the findings linked to each study objective, the following recommendations are made:

i. Since data volume significantly enhances audit effectiveness, audit firms should invest in scalable data storage systems (e.g., cloud platforms like AWS, Azure) and data management software to handle large datasets efficiently. Firms should also train auditors to analyze full datasets rather than relying solely on traditional sampling, thereby improving fraud detection accuracy.

ii. Given its positive but insignificant effect, audit firms should broaden their data sources beyond financial statements to include transactional logs, emails, social media patterns, and operational databases. Integrating diverse data types through advanced analytics tools (e.g., Power BI, Tableau, or Python-based frameworks) can improve risk identification and deepen audit insights.

iii. Since rapid data processing showed a negative effect, audit firms should balance speed with analytical precision. They should adopt parallel processing systems with built-in validation controls to ensure accuracy is not sacrificed for speed. Regular system audits and real-time error tracking should be implemented to prevent data misinterpretation due to hasty analysis.

Contribution to Knowledge

This study contributes to literature and practice in several ways:

i. It provides empirical validation of the role of Big Data Analytics in improving audit effectiveness among Nigerian audit firms which is an area with limited existing evidence.
ii. It introduces Big Data Collection Efficiency as a novel determinant of audit success, expanding prior models of audit effectiveness.
iii. It demonstrates that data volume and collection efficiency are the most influential dimensions in audit outcomes, offering clear focus areas for firm investment.

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