Big data and efficiency of tax revenue generation in Nigeria

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Abstract
This study investigated the impact of Big Data on the efficiency of tax revenue generation in Nigeria. Using data from field surveys, analyzed via SPSS and SmartPLS, a sample of 391 was drawn from a population of 16,500 using the Taro Yamane formula. Reliability and validity were confirmed through Bartlett's Test of Sphericity and Cronbach's Alpha. Findings showed that Big Data significantly enhances tax efficiency, with regression analysis revealing strong effects across company income tax, value-added tax, personal income tax, and information technology tax models. The study concluded that Big Data plays a crucial role in improving tax revenue generation. It recommended that, given the surge in electronic transactions and the demands of the digital economy, Nigeria must adopt Big Data and other disruptive technologies to strengthen tax administration, enhance efficiency, ensure accuracy, and enable timely revenue collection.

Keywords: big data, company income tax, efficiency of tax revenue, efficiency of information technology tax, revenue generation, efficiency of value-added tax

Introduction

Nigeria's economy has been significantly affected by global uncertainties such as rising commodity prices, inflation, supply chain disruptions, and economic nationalism. These challenges have strained businesses, increasing cases of tax evasion, aggressiveness, and unethical practices. As a result, the government struggles to meet its fiscal responsibilities due to declining tax revenues (Dada et al., 2025). Tax enforcement, a vital tool for financing public infrastructure and services, remains weak due to corruption, institutional failures, and outdated policy frameworks (Adekunle et al., 2025).

The country's tax system, like many in developing nations, suffers from deep structural inefficiencies—ranging from poor digital integration and corruption to excessive reliance on external consultants who prioritize self-interest over

national development (Aladebumoye, 2025). These consultants, often operating without oversight, divert substantial funds from the public purse. There is an urgent need for reform in public financial management to improve transparency and accountability.

Research highlights additional barriers to effective tax revenue generation, including inconsistent policies, excessive tax incentives, the exclusion of informal sectors, and weak technological infrastructure (Yalamati, 2024; Adeusi et al., 2020). Nigeria's tax laws are complex and difficult for citizens and small businesses to understand, leading to low compliance. Overlapping and outdated tax authorities further complicate the system, creating inefficiencies and frustration among taxpayers.

While "third-best" tax policies—those designed with capacity constraints in mind—may offer temporary relief, they are often exploited by corrupt administrators (Knauer et al., 2020; Lin, 2021). Other key issues include poor tax strategy prioritization, weak accounting practices, and outdated administrative techniques (Haleem et al., 2020; Adedokun, 2019).

Globally, countries are leveraging digital tools to track financial flows and reduce tax evasion. In contrast, Nigeria still relies on obsolete systems, resulting in rising defaults and ineffective reforms (Akhila et al., 2024; Ihenyen & Ogbise, 2022). Many policies focus on production efficiency instead of revenue optimization, often serving elite interests. For example, despite VAT collections increasing from ₦1.18 trillion in 2019 to ₦2.07 trillion in 2021, the gains have been eroded by inflation and leakages (Adekunle et al., 2025).

Government negligence has allowed tax defaulters to go unpunished. Many payments fail to reach the Treasury Single Account (TSA), which accrued ₦19 trillion from 2015 to 2020—believed to be below potential due to corruption and poor oversight (Dada et al., 2025). Beyond administrative issues, systemic corruption has enabled networks of fraudulent actors—often in collaboration with state officials—to collect informal taxes at markets, parks, and checkpoints without remittance (Adegbie et al., 2025). The Nigeria Extractive Industries Transparency Initiative (NEITI) found that 77 companies owed a combined $6.8 billion in unpaid taxes (Adegbie & Akinyemi, 2020).

With a tax-to-GDP ratio of just 6% in 2019—far below the African average of 16.6%—Nigeria's tax system remains underperforming. Despite modest increases in subnational internally generated revenue, these gains lack meaningful reform. Programs like the Voluntary Assets and Income Declaration

Scheme (VAIDS) and the whistleblower initiative initially recovered billions but are now largely inactive. Even in Lagos—ranked the fourth-richest city in Africa by Henley & Partners (2022)—many high-net-worth individuals evade taxes.

Historically dependent on oil, Nigeria neglected taxation as a core revenue source. With declining oil income and a debt profile where over 90% of revenue is spent on debt servicing, this model is unsustainable. The country must now embrace transformative approaches.

Globally, tax authorities are turning to big data—using sources like social media, IoT devices, emails, and financial transactions to trace taxpayer behavior and reduce evasion. In Nigeria, such technology could be critical in integrating the informal sector into the formal tax net. Big data tools can help identify tax gaps, profile taxpayers, and reduce reliance on human discretion, thereby minimizing corruption.

Nations like China have adopted centralized platforms, such as the "Golden Three System," which support digital tax administration. For Nigeria, similar centralized inter-agency platforms, improved third-party data access, and enhanced transparency are needed to optimize tax enforcement. Big data enables accurate taxpayer identification, informed decision-making and real-time data processing, making tax collection more efficient, fair, and timely.

Despite several reform attempts, institutional and political inertia has stalled progress. However, digital innovation—especially big data—offers a transformative path. Few studies in Nigeria have explored this approach (Sulman et al., 2019), creating a research gap this study seeks to address.

This study explored the role of big data in enhancing the efficiency of tax revenue generation in Nigeria. It assessed how big data can support real-time data processing, improved taxpayer profiling, and service delivery, while reducing tax leakages and evasion. The study examined the effect of big data on the efficiency of company income tax generation in Nigeria. It investigated the impact of big data on value-added tax (VAT) revenue generation. It also assessed the role of big data in improving personal income tax efficiency and examined its effect on information technology tax revenue generation.

The study formulated four hypotheses to guide the analysis. First, that big data does not significantly affect the efficiency of company income tax revenue generation. Second, that big data has no significant effect on VAT revenue

generation efficiency. Third, that big data does not significantly affect personal income tax efficiency. Fourth, that big data has no significant effect on information technology tax revenue generation.

The remaining sections of this study are structured as follows: Section 2 provides a literature review and theoretical framework. Section 3 outlines the methodology. Section 4 presents the data analysis and measurement models. Section 5 offers conclusions, recommendations, and directions for future research.

Literature Review

Tax revenue generation remains a cornerstone of public finance, particularly in developing nations where resource constraints and enforcement challenges persist. In the domain of public economics, it is widely acknowledged that tax systems should continue to function optimally even in less-than-ideal circumstances. Although taxes on income, wages, and profits are generally accepted, those on intermediate inputs, turnover, and trade are typically discouraged. These theoretical principles have significantly shaped tax policy recommendations for developing countries. However, such recommendations are often rooted in assumptions that do not align with the operational realities of nations with limited tax capacity. For example, they presuppose perfect enforcement mechanisms, no tax evasion, and zero administrative costs, which are rarely achievable in low-capacity environments (Dada et al., 2025; Uhuaba & Aguguom, 2019).

In practice, tax revenue finances essential government functions, including public service delivery. Tax administrations are tasked with interpreting tax laws, collecting various taxes and levies, and enforcing compliance. Nonetheless, many governments have placed budgetary restrictions on these agencies in an attempt to streamline national expenditures. Consequently, improvements in efficiency increasingly rely on how well tax bodies manage internal structures, allocate limited resources, utilize technological tools such as big data, and implement e-government initiatives. According to Hilbert and Lopez (2011), these elements are instrumental in reducing operational costs while enhancing performance.

One key metric for measuring efficiency is the cost of collection ratio, which compares total tax income with administrative expenditures incurred by tax authorities in a given fiscal year. A declining ratio indicates improved operational efficiency and possibly greater compliance among taxpayers. Before the global

financial crisis of 2008, most revenue agencies worldwide recorded declining collection ratios, reflecting either reduced administrative costs or rising revenues due to strong economic conditions. However, in the post-crisis period, particularly around 2009, this trend reversed as revenues declined due to economic contraction.

Focusing on the Nigerian tax system, several specific tax categories demonstrate varying levels of efficiency. The Companies Income Tax (CIT), levied at a rate of 30 percent on corporate profits, applies to resident companies on their global income and to non-resident companies on income generated within Nigeria. However, some categories of income, such as those from cooperative societies not engaged in commercial activities, are exempt. For large companies—defined as those with annual gross revenue exceeding NGN 100 million—the CIT is assessed on prior-year profits. Non-resident digital enterprises with significant economic presence in Nigeria are also subject to taxation, even if they are based in jurisdictions lacking tax treaties with Nigeria (Alade, 2015).

Similarly, the Value-Added Tax (VAT) system has seen recent adjustments, including a rate increase from 5 percent to 7.5 percent effective February 2020. While basic food items, medical and pharmaceutical products, educational materials, and exports are exempt, certain institutional buyers such as banks, telecoms, and government bodies are required to withhold and remit VAT from their suppliers. Other organizations collect VAT from clients and remit it accordingly (Amaefule et al., 2017; Akintoye et al., 2022).

Personal Income Tax (PIT) in Nigeria applies to residents on their global income and to non-residents when employment duties are performed in Nigeria. However, exemptions may apply when duties are performed on behalf of foreign employers without a fixed base in Nigeria, especially where double taxation agreements exist. Foreign individuals who establish a fixed base in Nigeria are taxed under Section 6 of the Personal Income Tax Act (Asaju & Egberi, 2015).

In addition, an Information Technology Tax requires companies with annual turnover above NGN 100 million to pay 1 percent of their pre-CIT profits. This tax applies to banks, insurance firms, pension managers, and telecommunications companies and is deductible for CIT purposes (Adegbie et al., 2020).

The introduction and integration of big data analytics into tax administration have brought transformational improvements in efficiency, decision-making, and policy formulation. The core advantage of big data lies in its ability to collect,

store, and process massive volumes of data in real time. Breur (2016) highlighted that the integration of artificial intelligence into big data frameworks enhances this capability further. Traditionally, data were collected and analyzed retrospectively; however, big data now enables immediate insights that enhance strategic and operational responses (Janvrin & Weidenmier, 2017). Lin (2022) explained that data with more entries improve statistical power, although an increase in data features could raise false discovery rates (Kayser et al., 2018).

Conceptually, big data is understood as a vast and complex dataset that yields valuable insights when processed using advanced analytical techniques. This includes predictive analytics and behavioral analysis, which have become central to understanding taxpayer behavior, minimizing tax evasion, and optimizing compliance strategies (Knauer et al., 2020).

Empirical studies support the assertion that big data enhances operational capability in tax systems. Business intelligence infrastructure is significantly influenced by big data analytics, which subsequently boosts operational and marketing performance. Gusc et al. (2022) and Cappa et al. (2021) established that such infrastructure mediates the relationship between data analytics capabilities and organizational performance, reinforcing the argument for further investment in this area (Liu & Vasarhelyi, 2014; Belahouaoui & Attak, 2024).

Despite the evident benefits, implementation of big data strategies remains complex, particularly in environments with technological and cultural challenges. Rachinger et al. (2018) and Akhila et al. (2024) emphasized that successful implementation depends on leadership support and the development of a data-driven culture. Leaders must recognize the value of transforming data into insights, and subsequently, insights into actionable outcomes. The absence of such foresight renders even the most sophisticated analytics futile (Richin et al., 2017; Adegbie & Akinyemi, 2020).

Analytics operations, by converting raw data into actionable insights, enhance various aspects of tax management. These include identifying taxpayer behavior patterns, improving segmentation, analyzing macroeconomic trends, and refining service delivery approaches. Such activities are vital for achieving operational efficiency (Snijders et al., 2012; Williams et al., 2020; Awofala et al., 2024).

Tax administrations are increasingly leveraging digital technologies to improve compliance and revenue collection. The OECD's Tax Administration Series (2019) reported that more than 35 tax administrations now employ data scientists and utilize behavioral analytics to anticipate taxpayer behavior. Interventions are

increasingly proactive, occurring before tax returns are filed, thereby reducing compliance risks and administrative burdens. Formal cooperative compliance programs targeting large taxpayers are now either implemented or under development in two-thirds of the jurisdictions studied (Zhang et al., 2020; Aladebumoye, 2025).

Accurate and timely reporting remains essential. Proper identification of taxpayers ensures correct liability assessments, prevents both double taxation and unintended non-taxation, and enhances jurisdictional revenue allocation. For direct taxes, accurate identification links individuals and companies to their respective tax obligations. For indirect taxes like VAT, it ensures correct remittance and jurisdictional allocation, thereby minimizing fraud (Sulman et al., 2019; Akintoye & Akinyemi, 2020; Yalamati, 2024; Dada et al., 2025; Ihenye & Ogbise, 2022).

The theoretical foundation of this study is grounded in the Diffusion of Innovations theory, which posits that the adoption of new ideas or technologies follows a pattern influenced by the perceived novelty, usefulness, and ease of implementation of the innovation. In the context of tax administration, big data represents a transformative innovation capable of significantly improving efficiency and compliance. The diffusion process is affected by organizational readiness, leadership, cultural openness to innovation, and the demonstrable advantages of adopting new technologies (Yudkowsky, 2008; Alles, 2015; Liu & Vasarhelyi, 2014).

However, not all studies endorse this theory without reservation. Critics argue that diffusion theory may introduce uncertainty and confusion among potential adopters, especially in environments with low digital literacy. Anindita and Yadav (2018) noted that innovation adoption often suffers from unpredictability, which can hinder effective decision-making. Nonetheless, the theory remains relevant in explaining how innovations such as big data analytics spread through tax institutions, enhancing system performance and managerial effectiveness.

While substantial research exists on the general benefits of big data in business and public sector operations, limited scholarly attention has been paid to how these technologies are integrated into developing countries' tax systems—particularly in the context of Nigeria's diverse and complex tax structure. Much of the existing literature emphasizes either technical capabilities or implementation barriers but rarely explores the measurable effects of big data tools on tax revenue outcomes. Furthermore, studies seldom provide empirical

validation of big data's impact across specific tax types, such as CIT, VAT, and PIT. This gap underscores the need for focused research that evaluates the operational impact of big data technologies on revenue generation within the Nigerian tax administration. The present study aims to fill this gap by examining how big data integration affects tax efficiency and compliance in Nigeria's public sector, thereby contributing to the growing discourse on digital transformation in public finance.

In summary, the review of literature and theory supports the view that the integration of big data into tax administration can significantly improve tax revenue generation, especially when combined with supportive infrastructure and leadership. Digital tools enhance compliance, reduce administrative costs, and offer real-time insights critical for modern tax systems. While theoretical models like diffusion of innovation offer frameworks for understanding adoption, their practical effectiveness is determined by contextual factors such as technological readiness and institutional support.

Methodology

The study adopted a field survey design, utilizing primary data collected through standardized, self-structured questionnaires to examine the impact of big data on tax administration and efficient revenue generation in Nigeria. The target respondents were selected tax administrators and senior managers from the Federal Inland Revenue Service (FIRS) and the Lagos State Internal Revenue Service (LIRS), serving as the study's baseline units.

Questionnaires were distributed both online (via Google Forms) and in person to tax officials with relevant managerial and financial expertise, and a demonstrated familiarity with big data analytics in tax administration. The instrument captured insights into various dimensions, including operational capability (SEBI), strategies for implementation (SSIB), experience in analytical tools (OACB), availability of technology (ATTA), and the need for accurate, timely, and reliable reporting (DATR).

The study population comprised 16,500 senior and managerial staff within FIRS and LIRS who had regular internet access and were presumed to have adequate knowledge of big data tools and applications in the context of tax administration. Using the Yaro Yamane formula for sample size determination, 391 completed and validated questionnaires were retrieved and used for analysis.

Using Taro Yamane formula:

$N = N/1+n(\varrho)^2$
Where
N = sample size, N = Population, ϱ = Level of significance.

$$n = \frac{16{,}500}{1+ 16{,}500\ (0.05)^2}$$

$$n = \frac{16{,}500}{42.25}$$

$n = 390.53 \cong 391$

The dependent variable in this study is the efficiency of tax revenue generation, measured through secondary data on Companies Income Tax (ECIT), Value-Added Tax (EVTR), Personal Income Tax (EPIT), and Information Technology Tax (EFTR). The independent variable is Big Data, measured using structured questionnaires adapted from Al-Dmour et al. (2018). Key constructs include Operational Capability (SEBI), Size and Strategies (SSIB), Analytical Experience (OACB), Availability of New Tools (ATTA), and Desirability of Accurate, Timely, and Trustworthy Reports (DATR). These instruments, previously validated in similar emerging economies, were considered suitable for Nigeria's context (Alade, 2018).

Instrument validity and reliability were confirmed using Bartlett's Test and Cronbach's Alpha, with all constructs showing strong internal consistency (α = 0.795 to 0.962). Table 1 shows that all Bartlett test results were significant at the 5% level, confirming the data's suitability. DATR recorded the highest reliability (α = 0.962), while EVTR had the lowest (α = 0.795), both within acceptable thresholds.

Descriptive and inferential statistical tests—including Hausman, heteroskedasticity, and normality tests—were employed to validate model assumptions. The pre-test and re-test outcomes confirm that the instrument is both valid and reliable for analyzing Big Data's impact on tax revenue efficiency in Nigeria.

Table 1
Results of the Reliability and Validity Tests

Constructs	No. of Items	Bartlett's Test χ^2 (Sig.)	Cronbach's Alpha
Efficiency of Companies Income Tax (ECIT)	5	92.374 (p = .000)	.872
Efficiency of Value-Added Tax Rates (EVTR)	5	90.124 (p = .000)	.795
Efficiency of Personal Income Tax (EPIT)	5	120.324 (p = .000)	.892
Efficiency of Information Technology Tax (EFTR)	5	123.430 (p = .000)	.948
Operational Capability in Big Data Implementation (SEBI)	5	142.120 (p = .000)	.878
Size and Strategies for Implementation of Big Data (SSIB)	5	114.523 (p = .000)	.904
Operating Experience in Analytical Capabilities (OACB)	5	102.317 (p = .000)	.896
Availability of New Tools and Technologies in Tax Administration (ATTA)	5	147.250 (p = .000)	.904
Desirability for Accuracy, Timely, and Trustworthy Reports (DATR)	5	101.512 (p = .000)	.962

Note. All Bartlett's test results were significant at the 5% level.
Source: Pilot Study, 2025.

Model Specification

$$Y_i = \alpha_0 + \beta_1 x_{1i} \ldots + \mu_i \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

Where:
Y_i represents the dependent variable (efficiency of tax revenue generation),
X_{1i} to X_{5i} represent the independent variables
α^0 is the intercept,
β_1 to β_5 are the coefficients of the explanatory variables,
μ_i is the error term.

The specific models for each dependent variable are as follows:

Model 1: Efficiency of Companies Income Tax (ECIT)
$ECIT_i = \alpha_0 + \beta_1 SEBI_i + \beta_2 SSIB_i + \beta_3 QACB_i + \beta_4 AITA_i + \beta_5 DATR_i + \mu_i \ldots (2)$

Model 2: Efficiency of Value-Added Tax Rates (EVTR)
$EVTR_i = \alpha_0 + \beta_1 SEBI_i + \beta_2 SSIB_i + \beta_3 QACB_i + \beta_4 AITA_i + \beta_5 DATR_i + \mu_i$. (3)

Model 3: Efficiency of Personal Income Tax (EPIT)
$EPIT_i = \alpha_0 + \beta_1 SEBI_i + \beta_2 SSIB_i + \beta_3 QACB_i + \beta_4 AITA_i + \beta_5 DATR_i + \mu_i$ …(4)

Model 4: Efficiency of Information Technology Tax (EFTR**)**
$EFTR_i = \alpha_0 + \beta_1 SEBI_i + \beta_2 SSIB_i + \beta_3 QACB_i + \beta_4 AITA_i + \beta_5 DATR_i + \mu_i$ …(5)

Where: ETRG = Efficiency of Tax Revenue Generation; EVTR = Efficiency of Value-Added Tax Revenue; EPIT = Efficiency of Personal Income Tax; EFTR = Efficiency of Information Technology Tax Revenue; SEBI = Operational Capability in Big Data Implementation; SSIB = Size and Strategies for Implementation of Big Data; OACB = Operating Experience in Analytical Capabilities through Big Data; ATTA = Availability of New Tools and Technologies in Tax Administration; DATR = Desirability for Accuracy, Timely, and Trustworthy Reports; α = Constant term; β = Regression coefficients; μ = Error term; i = Cross-sectional unit (e.g., respondent or observation).

Results and Discussion

This section provides a detailed examination of the data through descriptive and inferential analyses. The key findings are discussed in relation to existing literature, with the main objective being to evaluate how big data influences the efficiency of tax revenue generation across various tax categories in Nigeria.

Descriptive Statistics

The demographic profile of respondents (see Table 2) reveals a predominantly youthful workforce, with nearly half (48.7%) aged between 26 and 35 years, while only a small portion (16.9%) are above 45 years old. This suggests that the tax-related sector is staffed mainly by younger professionals. In terms of experience, the majority (56.7%) have between six and nine years of professional exposure, indicating a dominance of mid-level expertise within the sample. Educationally, the respondents are highly qualified, with 65.3% holding advanced degrees such as M.Sc. or M.Phil. Professional qualifications are fairly evenly distributed between traditional certifications like ACA and ACCA, and

other unspecified credentials. Overall, this demographic makeup supports the credibility and reliability of the opinions gathered.

Table 2
Demographic Characteristics of Respondents

Variables	Category	Frequency	Percentage
Age	26–35 years	190	48.7
	36–45 years	135	34.4
	46 years and above	66	16.9
	Total	**391**	**100**
Work Experience	2–5 years	147	37.6
	6–9 years	222	56.7
	10 years and above	22	5.6
	Total	**391**	**100**
Education	HND/BSc	11	2.9
	M.Sc./M.Phil.	255	65.3
	PhD	22	5.6
	Others	103	26.2
	Total	**391**	**100**
Professional Qualification(s)	ACA/ACCA/ACMA/ACTI/COREN/ANAN	190	48.7
	Others	201	51.3
	Total	**391**	**100**

Source: Researcher's Computation (2025).

When examining perceptions of tax revenue generation efficiency across different tax types (Table 3), respondents generally viewed performance positively. The mean scores frequently exceeded 4.0 on a 5-point scale, indicating strong confidence in tax collection improvements. Specifically, the Companies Income Tax (ECIT) category showed consistently high mean scores, reaching up to 4.57, with little variation, suggesting robust perceived gains. Similarly, Value Added Tax (EVTR) also recorded positive assessments, with

means ranging from 3.94 to 4.26. Personal Income Tax (EPIT) displayed slightly more variability, with scores between 3.67 and 4.31, reflecting some uncertainty in efficiency perceptions. The Information Technology Tax (EFTR) category maintained steady positive ratings between 3.74 and 4.20, underscoring growing confidence in digital tax collection mechanisms. Collectively, these results indicate that most respondents consider tax revenue generation to be efficient, though nuances exist depending on the tax type.

Table 3
Efficiency of Tax Revenue Generation

Tax Type / Year Comparison	Very Low	Low	Undecided	High	Very High	Total	Mean (SD)
Companies Income Tax (ECIT)							
2017–2018	0 (0%)	6 (1.5%)	61 (15.5%)	207 (53.1%)	117 (30%)	391 (100%)	4.12 (0.71)
2018–2019	0 (0%)	9 (2.2%)	33 (8.5%)	76 (19.5%)	273 (69.8%)	391 (100%)	4.57 (0.74)
2019–2020	0 (0%)	9 (2.4%)	84 (21.5%)	129 (32.9%)	169 (43.3%)	391 (100%)	4.17 (0.84)
2020–2021	0 (0%)	4 (1.1%)	108 (27.5%)	130 (33.3%)	149 (38.2%)	391 (100%)	4.09 (0.83)
2021–2022	16 (4%)	16 (4.2%)	58 (14.9%)	154 (39.5%)	147 (37.5%)	391 (100%)	4.02 (1.03)
Value Added Tax Rate (EVTR)							
2017–2018	9 (2.2%)	22 (5.6%)	84 (21.5%)	145 (37.1%)	131 (33.6%)	391 (100%)	3.94 (0.99)
2018–2019	6 (1.5%)	18 (4.5%)	57 (14.5%)	98 (25.1%)	212 (54.4%)	391 (100%)	4.26 (0.97)
2019–2020	3 (0.7%)	29 (7.5%)	53 (13.5%)	150 (38.4%)	156 (40%)	391 (100%)	4.09 (0.94)
2020–2021	12 (3.3%)	18 (4.7%)	60 (15.3%)	129 (32.7%)	172 (44%)	391 (100%)	4.09 (1.03)

Tax Type / Year Comparison	Very Low	Low	Undecided	High	Very High	Total	Mean (SD)
2021–2022	4 (1.1%)	11 (2.9%)	71 (18.2%)	117 (29.8%)	188 (48%)	391 (100%)	4.21 (0.91)
Personal Income Tax (EPIT)							
2017–2018	18 (4.7%)	22 (5.5%)	96 (24.5%)	174 (44.4%)	82 (20.9%)	391 (100%)	3.71 (1.01)
2018–2019	0 (0%)	19 (4.9%)	44 (11.3%)	125 (32%)	203 (51.8%)	391 (100%)	4.31 (0.86)
2019–2020	4 (1.1%)	24 (6.2%)	108 (27.5%)	113 (29.1%)	142 (36.2%)	391 (100%)	3.93 (0.99)
2020–2021	39 (10%)	29 (7.3%)	76 (19.5%)	126 (32.2%)	121 (31.1%)	391 (100%)	3.67 (1.26)
2021–2022	21 (5.3%)	42 (10.7%)	75 (19.1%)	85 (21.8%)	168 (43.1%)	391 (100%)	3.87 (1.23)
Information Technology Tax (EFTR)							
2017–2018	11 (2.9%)	36 (9.1%)	100 (25.5%)	140 (35.8%)	104 (26.7%)	391 (100%)	3.74 (1.04)
2018–2019	10 (2.5%)	14 (3.5%)	80 (20.5%)	105 (26.9%)	182 (46.5%)	391 (100%)	4.11 (1.01)
2019–2020	9 (2.2%)	45 (11.5%)	72 (18.4%)	117 (30%)	148 (38%)	391 (100%)	3.90 (1.10)
2020–2021	14 (3.6%)	18 (4.7%)	67 (17.1%)	124 (31.6%)	168 (42.9%)	391 (100%)	4.05 (1.06)
2021–2022	7 (1.8%)	16 (4.2%)	76 (19.5%)	85 (21.6%)	207 (52.9%)	391 (100%)	4.20 (1.01)

Note: Percentages are shown in parentheses.
Source: Researcher's Computation (2025).

Regarding the role of big data in tax administration (Table 4), perceptions were similarly favorable. Respondents demonstrated strong familiarity with big data concepts, reflected by a high average agreement score of 4.53. There was a clear

consensus that big data enhances tax revenue collection efficiency, with a mean of 4.49. However, opinions were more moderate concerning the size and strategic approaches to big data implementation, with average scores between 3.79 and 4.06, suggesting potential areas for improvement. Respondents strongly agreed that deploying new technologies significantly improves compliance and operational efficiency, as indicated by mean scores above 4.2. Furthermore, the importance of accurate and timely reporting was widely acknowledged, with scores ranging from 3.85 to 4.3, emphasizing data integrity as a critical factor in efficient tax administration. Overall, these findings reflect a broad belief in big data's transformative potential, tempered by some concerns regarding execution and strategy.

Table 4

Big Data Implementation in Tax Revenue Generation

Item	SD	D	U	A	SA	Total	Mean (SD)
Operational capability in Big Data implementation							
Familiarity with big data	0 (0%)	6 (1.6%)	29 (7.3%)	108 (27.5%)	248 (63.6%)	391 (100%)	4.53 (0.70)
Not aware of operational capability in big data implementation	2 (0.4%)	22 (5.6%)	58 (14.7%)	119 (30.5%)	190 (48.7%)	391 (100%)	4.22 (0.90)
Big data enhances tax revenue generation	0 (0%)	4 (1.1%)	45 (11.6%)	94 (24.0%)	248 (63.3%)	391 (100%)	4.49 (0.70)
Operational capability improved efficiency of tax revenue generation	0 (0%)	11 (2.9%)	76 (19.3%)	152 (38.9%)	152 (38.9%)	391 (100%)	4.14 (0.80)
Size and strategies for implementation of big data							
Size and strategies	11	43	70	159	108	391	3.79

Item	SD	D	U	A	SA	Total	Mean (SD)
sufficiently affect tax revenue generation	(2.9%)	(10.9%)	(18.0%)	(40.5%)	(27.6%)	(100%)	(1.10)
Tax revenue generation is enhanced by size and strategies	6 (1.6%)	32 (8.4%)	89 (22.7%)	66 (16.5%)	198 (50.7%)	391 (100%)	4.06 (1.10)
Tax revenue generation is greatly affected by size and strategies	13 (3.3%)	16 (4.0%)	60 (15.3%)	182 (46.5%)	120 (30.9%)	391 (100%)	3.98 (1.00)
Size and strategies are available for efficient tax revenue generation	7 (1.8%)	15 (3.8%)	57 (14.5%)	77 (19.6%)	235 (60.2%)	391 (100%)	4.33 (1.00)
Availability of new tools and technologies in tax administration							
New tools and technologies affect efficiency of tax revenue generation	7 (1.8%)	3 (0.7%)	63 (16.0%)	148 (37.8%)	170 (43.6%)	391 (100%)	4.21 (0.90)
Taxpayers comply better with new tools and technologies	6 (1.5%)	10 (2.5%)	63 (16.0%)	120 (30.9%)	192 (49.1%)	391 (100%)	4.24 (0.90)
Tax compliance enhanced with new tools and technologies	0 (0%)	10 (2.5%)	41 (10.4%)	109 (28.0%)	231 (59.1%)	391 (100%)	4.44 (0.80)
Efficiency enhanced with tools and technologies	10 (2.5%)	16 (4.2%)	73 (18.7%)	135 (34.4%)	157 (40.2%)	391 (100%)	4.05 (1.00)
Desirability for accurate, timely, and trustworthy reports							

Item	SD	D	U	A	SA	Total	Mean (SD)
Efficiency impacted by desirability for accurate, timely, trustworthy reports	14 (3.6%)	38 (9.6%)	68 (17.5%)	142 (36.4%)	129 (32.9%)	391 (100%)	3.85 (1.10)
Desirability for accurate, timely reports impacts efficiency	0 (0%)	21 (5.3%)	72 (18.4%)	118 (30.2%)	180 (46.2%)	391 (100%)	4.17 (0.90)
Tax administrators' desirability affects efficiency	0 (0%)	13 (3.3%)	67 (17.1%)	102 (26.2%)	209 (53.5%)	391 (100%)	4.30 (0.90)
Big Data and desirability affect efficiency	0 (0%)	20 (5.1%)	64 (16.4%)	135 (34.5%)	172 (44.0%)	391 (100%)	4.17 (0.90)

Note. SD = Strongly Disagree; D = Disagree; U = Undecided; A = Agree; SA = Strongly Agree; N = 391 respondents. Percentages are presented in parentheses. Source: Researcher's computation (2025).

Regression Results

The impact of various dimensions of big data on tax efficiency was further examined through four regression models (Table 5). The models included four key predictor variables: operational capability in big data implementation (SEBI), size and strategy for implementation (SSIB), availability of tools and technologies (AITA), and desirability for accurate, timely, and trustworthy reports (DATR).

The first model, which focused on Companies Income Tax (ECIT), identified SEBI, SSIB, and AITA as significant positive predictors, with an R^2 of 0.297. This suggests that operational capacity, strategic scale, and technological tools collectively enhance corporate tax efficiency. In the case of Value Added Tax (EVTR), all predictors except DATR were significant, yielding the highest R^2 value of 0.365, indicating that size, strategy, and tools are crucial drivers of efficiency in this tax category. For Personal Income Tax (EPIT), the predictors showed less consistency individually, but collectively explained 34.3% of the variance, pointing to a complex interplay of factors influencing efficiency. The model for Information Technology Tax (EFTR) revealed that size and strategy

(SSIB) were the only significant predictors, with an R^2 of 0.384, underscoring the critical role of strategic scaling in digital tax processes.

A consistent finding across all models was the significance of SSIB, emphasizing the importance of scale and strategic implementation in realizing the benefits of big data. SEBI showed significant influence on ECIT and EVTR, highlighting operational capability as vital in these areas. The availability of tools and technologies (AITA) was a strong contributor to EVTR, EPIT, and EFTR efficiency, affirming the role of modern technological resources. However, the desirability for accurate reporting (DATR) produced mixed results—important in some models (EVTR, EPIT) but less so in others (ECIT, EFTR).

Post-estimation diagnostics identified heteroskedasticity in all models, indicating non-constant variance, which was addressed by employing robust standard errors. Multicollinearity was not a concern, with variance inflation factors below the accepted threshold.

Table 5
Regression Results for the Impact of Big Data Dimensions on Tax Revenue Efficiency

Variable	VIF	ECIT (1)	SE	EVTR (2)	SE	EPIT (3)	SE	EFTR (4)	SE
SEBI (Operational Capability)	1.11	0.1467***	0.050	0.2005***	0.065	-0.0395	0.071	0.1356	0.071
SSIB (Size & Strategy)	1.20	0.2863***	0.037	0.3084***	0.040	0.4166***	0.053	0.3474***	0.047
AITA (Tools & Tech Availability)	1.61	0.1595***	0.051	0.3523***	0.060	0.3604***	0.067	0.5816***	0.063
DATR (Accurate Reporting)	1.58	-0.0084	0.046	0.1155**	0.056	0.1369**	0.069	-0.0843	0.061
Constant	—	1.7579***	0.304	0.0356	0.381	0.2960	0.344	-0.1045	0.391
Observations		391		391		391		391	
R-squared		0.297		0.365		0.343		0.384	

Variable	VIF	ECIT (1)	SE	EVTR (2)	SE	EPIT (3)	SE	EFTR (4)	SE
F-test		28.70		52.89		69.17		62.23	
Prob > F		0.000		0.000		0.000		0.000	
Mean VIF		1.38							
Heteroskedasticity Test		110.21 [0.000]		57.74 [0.000]		16.30 [0.000]		23.55 [0.000]	

Note. ECIT = Efficiency of Companies Income Tax; EVTR = Value Added Tax Rate; EPIT = Efficiency of Personal Income Tax; EFTR = Efficiency of Information Technology Tax.
SEBI = Operational Capability in Big Data Implementation; SSIB = Size and Strategy for Big Data Implementation; AITA = Availability of Tools and Technologies in Tax Administration; DATR = Desirability for Accurate, Timely, and Trustworthy Reports.
VIF = Variance Inflation Factor.
SE = Standard Error.
Significance levels: *p < .01, p < .05, *p < .10. Probabilities in square brackets for heteroskedasticity test.
Source. Researcher's Computation (2025).

Discussion

The results affirm that big data implementation positively influences tax revenue efficiency, particularly in corporate and value-added tax categories, where operational capacity, strategic scale and technological tools are most impactful. The more nuanced results for personal income tax and digital taxes may reflect the complexities inherent in individual taxpayer behavior and the evolving nature of digital tax systems. The mixed effects of accurate reporting suggest that while data quality is generally beneficial, its influence varies by tax type.

These findings align with prior research, such as Ionescu (2019) and Cockroft (2018), who emphasized big data's transformative role in public administration. Similarly, Haleen et al. (2020) identified a strong relationship between big data adoption and tax management efficiency during crises. More recent studies like Rabbani et al. (2023) highlight how AI and technological innovations continue to reshape financial performance and revenue systems.

Conclusion and Recommendations

This study underscores the transformative potential of big data in enhancing the efficiency of tax revenue generation in Nigeria. The findings demonstrate that improvements in operational capability, the strategic scale of implementation, and the availability of modern tools and technologies are significantly associated with increased tax efficiency. Additionally, the desirability for accurate, timely, and trustworthy reporting was found to play an important—though somewhat inconsistent—role across different tax categories.

The study reveals that corporate and value-added taxes are most responsive to big data implementation, reflecting the structured nature of these tax types and their relative ease of digital tracking. In contrast, personal income tax and information technology-related taxes exhibit more nuanced relationships with big data variables. These variations are likely due to the complexities of individual compliance behavior and the evolving nature of digital tax domains. Nonetheless, the research confirms that strategically implemented big data initiatives, when supported by adequate infrastructure and institutional commitment, can substantially enhance tax performance in the Nigerian context.

Based on the findings, several recommendations are proposed to improve tax revenue generation through big data. First, tax authorities in Nigeria should institutionalize the use of big data analytics across all aspects of tax administration, including auditing, risk assessment, and taxpayer profiling. This integration would allow for data-driven decision-making and more effective enforcement strategies.

Second, aligning with global best practices, the adoption of e-taxation platforms and digital solutions should be prioritized to modernize tax systems and accommodate the increasing digitization of business activities. Complementing this effort, financial institutions, telecom companies, and commercial entities should be mandated to report taxpayer data in real time. Real-time data flow is essential for proactive compliance monitoring and early detection of irregularities.

Another critical step is the establishment of a centralized, integrated tax data system. This infrastructure should consolidate information from diverse sources—including banks, telecoms, corporate registries, and digital platforms—to improve taxpayer profiling, reduce evasion, and enhance policy coordination. Investment in big data infrastructure must also be accompanied by targeted capacity building. Tax personnel should receive training in data analytics,

artificial intelligence (AI), cybersecurity, and machine learning to maximize the utility of these technologies.

The study also emphasizes the importance of addressing the informal sector, which remains largely outside the formal tax system. Mobile platforms linked to biometric and transaction data can serve as innovative tools for estimating incomes and assigning tax obligations fairly and efficiently. Furthermore, predictive analytics should be used to identify high-risk taxpayers, streamline audit processes, and detect potential fraud.

To sustain these efforts, legal and institutional reforms are necessary. Laws should support inter-agency data sharing, and a dedicated big data analytics unit should be established within the Federal Inland Revenue Service (FIRS) or equivalent tax bodies. This unit would spearhead the development of tax intelligence and foster innovation. Finally, tax authorities should implement periodic monitoring and evaluation of big data initiatives using clearly defined performance indicators to ensure transparency, promote accountability, and support continuous improvement in tax administration.

Despite the relevance of its findings, the study is not without limitations. The research relied primarily on self-reported perceptions, which may introduce bias due to respondent subjectivity. Additionally, the study focused exclusively on five types of taxes and considered only big data among the spectrum of disruptive technologies.

Future research should therefore incorporate actual tax performance data to validate the present results and reduce reliance on subjective assessments. Longitudinal studies are also recommended to assess the sustained effects of big data implementation over time. Moreover, further research should examine the influence of other disruptive technologies—such as artificial intelligence, cloud-based accounting systems, and the Internet of Things (IoT)—on tax administration performance. Sector-specific studies may also offer deeper insights into compliance behavior and digital adoption patterns, thereby enabling more targeted and effective policy development.

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