

Artificial intelligence, tax revenue and tax compliance in Nigeria

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Abstract

Purpose: This study investigated the transformative impact of artificial intelligence on tax revenue and tax compliance in Nigeria specifically leveraging on the use of Machine Learning (ML), Natural Language Processing (NLP), Blockchain, Big Data Analytics (BDA) and Robotic Process Automation (RPA).

Methodology: The study covered tax professionals from the Chartered Institute of Taxation of Nigeria (CITN) who are staff of the Nigeria Revenue Service (NRS). Data was analysed using ordinary least square regression (OLS) and ordered logistics regression.

Results and conclusion: The result from the findings show that ML, NLP and BDA positively influence tax revenue, while ML, NLP and RPA have significant and positive impact on tax compliance. BDA has a negative impact on tax compliance and blockchain has no significant influence on tax revenue and tax compliance. The study concludes that the Nigerian government and tax authorities should consider investing in artificial intelligence (AI) based infrastructure and training for tax professionals in order to harness the benefits.

Implications of findings: The study recommends the Nigerian government and tax authorities to engage with international organizations and experts who have embraced AI in their tax process to share best practices and experiences in managing the influence of AI on tax administration. This can help Nigeria stay ahead of the curve and ensure that the country is not left behind in the quest for digital revolution.

Keywords: artificial intelligence, machine learning, natural language processing, tax revenue, tax compliance

1. Introduction

Tax revenue is a significant and compulsory component of government finance channeled for government establishments as the proceeds are used to carry out functions which include provision of public goods, maintenance of law and order, trade and business regulation and other needs geared towards the stability of the economy (Adekanmbi *et al.* 2022; Hussain *et al.* 2024). Globally, tax provides a stable flow of revenue to finance economic growth and development, such as strengthening infrastructure and other policy areas (Obaretin & Ohonba, 2018). One of the challenges faced by developing countries such as Nigeria as regards its tax revenue collection is in area of tax evasion, low compliance levels, inadequate enforcement, complexity in the tax system, corruption due to the countries weak administrative capacity, lack of infrastructure, low technological know-how and poor taxpayer education (Besigomwe, 2025; Oyedokun & Ayinde, 2023). Tax compliance remains a significant challenge in Nigeria, characterized by tax evasion, low taxpayer morale, and limited enforcement capacity (Olumoh, 2024).

Despite various reforms such as the move from tax administration 1.0 to 3.0 globally, Nigeria's tax administration system continues to struggle with inefficiencies that limit its effectiveness (Aina, 2024). Several countries have automated parts of their tax administration processes such as Estonia, Singapore, and South Korea with significant improvements in tax compliance, collection efficiency, and revenue growth (Omolore & Onyemечи, 2024). This disparity raises critical questions about the impact of automation on tax revenue and tax compliance in Nigeria.

The Nigerian Tax Administration Act (NTAA, 2025) established a uniform framework for tax administration across federal, state and local governments. The act emphasized on digitalisation to bring about improved taxpayer services as it has the potential to shape tax system in Nigeria if properly implemented by streamlining tax laws and broadening the tax base to increase revenue generation (Pricewaterhouse Coopers, 2025). However, the integration and deployment of these technologies within the tax sector in Nigeria is limited (Olorunfemi & Odewole, 2025).

This research is both timely and economically relevant. First, while developed economies are making significant progress in adopting AI-driven tax systems, empirical evidence on the impact of AI on tax revenue and tax compliance in developing contexts, particularly Nigeria, remains limited (Aina, 2024; Bankole *et al.*, 2025; Titcombe & Micah, 2026). Existing discussions are largely conceptual Folorunso & Nwankwo, (2024), Olabanji *et al.* (2024), with insufficient data-driven evaluation of how AI influences tax revenue and tax compliance.

2. Literature review

Tax Revenue

According to World Bank (2022), tax revenue constitutes a significant portion of total income. Countries like Denmark, Finland, Norway and Sweden had a tax to GDP ratio above 50%. African countries such as Cote d'Ivoire had a tax to GDP ratio of 14.0%, Cameroon 14.4%, Ghana 14.5%, while Nigeria stood at a mere 8.2% and as a result, there should be significant interest in automation to support higher tax revenues (OECD, 2025). It is argued that the major sources of tax revenue which include personal income tax (PIT), corporate income tax (CIT), and indirect taxes such as Value added tax (VAT) and customs duties could potentially be managed in more effective and efficient ways through the adoption of digital technologies (Ideh, 2019; Naik & Nandakumar, 2025). Recent research advocates for comprehensive tax reforms, which include broadening the tax base, simplifying tax codes, technology driven solutions including artificial intelligence in tax administration to increase efficiency and effectiveness (Aggarwal, 2024).

Tax Compliance

Tax compliance refers to the process of adhering to tax laws and regulations and can be defined as the willingness of taxable individuals and organizations to comply with their tax duties without being forced to do so (Ehima & Amede, 2024; Oyedokun & Ayinde, 2023). Oyedokun and Ayinde (2023) research highlights the need for comprehensive strategies to improve tax compliance in Nigeria to include; simplifying taxes, promoting taxpayer rights, improving enforcement techniques and carrying out public awareness campaigns. For better tax compliance, AI solutions can automate tax filings, and other administrative tasks, thereby reducing human error (Opeyemi *et al.*, 2024). However, challenges such as data privacy, digital access, and regulatory concerns must be addressed to ensure equitable implementation of these technologies. Addressing this identified gaps in research and implementing appropriate policy interventions are important steps towards increasing tax compliance and achieving optimum tax revenue, which would invariably aid sustainable economic development (Opeyemi *et al.*, 2024).

Artificial Intelligence

Artificial intelligence involves the use of machine learning to analyze tax data, detect patterns, and make informed decisions (Akinrinola *et al.*, 2024; Olabanji *et al.*, 2024). Artificial intelligence is capable of flagging suspicious activities for further investigation by tax authorities, potentially leading to the recovery of lost revenues and a reduction in tax evasion (Faundez-Ugalde *et al.* 2020). Tax administrators

around the world are increasingly leveraging AI to improve their operations and services such as to reduce lengthy paper work in tax collection process (Aladebumoye, 2025; Ezeife *et al.*, 2021). While AI enhances tax compliance and financial regulation, it requires an expensive implementation process, which includes a robust governance framework and ethical guidelines (Goyal, 2025). This work focused on machine learning, natural language processing, blockchain, big data analytics and robotic process automation as AI tools.

Theoretical Review

The Diffusion of Innovation Theory (DOI) and Technology Acceptance Model (TAM) are the appropriate theories for this study because it addresses the discoveries and adoption of new technologies, and practices, which tallies with the study's central theme of AI and tax management (Aina, 2024). With the low compliance rate and fall in tax collection, DOI explains how these innovations are adopted by tax authorities and taxpayers, starting with early adopters (such as technology-savvy firms) and gradually reaching the broader population. Technology Acceptance Model (TAM) is a foundation model for understanding technology acceptance, with extensive empirical support and adaptability (Conger & Mazey, 2023; Emelumba & Effiong, 2026). Its use extends and adapts to several technological environments such as e-learning, mobile health and social media and is widely applied in sectors like healthcare use for telemedicine adoption, education in e-learning platforms, and marketing for social media usage. The model suggests that if a government sees these technologies as tools to improve efficiency and reduce fraud, they may be more willing to adopt them. In addition, where emerging technologies are easy to use and valuable, there would be adopted explaining why some countries are quick to implement these technologies in their tax systems while others are slow (Cyril *et al.*, 2025).

This research work is based on these two theories; the DOI and TAM reason being that the adoption of these theories spans from the acceptance and perceived use of these technologies by the Nigerian government, its taxpayers and tax officials. DOI explains how innovations spread within a social system, highlighting factors like relative advantage, compatibility, complexity, trialability, and observability that influence adoption (Overbye-Thompson & Hamilton, 2025). While, TAM focuses on perceived usefulness and ease of use, which determine users' acceptance of new technologies (Davis, 1989). These theories help identify barriers and motivators for emerging technology use in the Nigerian tax system.

The DOI, TAM theory and the empirical review informs the research questions for this study.

This paper aims to investigate the impact of AI on tax revenue and tax compliance in Nigeria by focusing on the perceptions of tax professionals. The findings will contribute to understanding the influence of AI in Nigeria's tax process by providing insights for tax officials and government.

Empirical Literature

Titcombe and Micah (2026) researched on AI and tax administration in Nigeria using a structured questionnaire administered to 552 tax administrators across 3 states in Nigeria namely; Delta, Bayelsa and Rivers state. Pearson product moment correlation coefficient and multiple regression analysis was used to analyse the data. The results showed that machine learning ML($r=.521$, $p<0.001$) and natural language processing NLP ($r=.547$, $p<0.001$) both have a positive relationship with tax collection. Their research therefore recommends the use of ML for enhancing data collection process and NLP for analyzing unstructured data.

Research by Bundala and Mjema (2025) researched on the influence of AI in improving tax collection in Zanzibar by employing a quantitative methodology and a cross-sectional design. The questionnaire was the research instrument used for their study and data was analysed using multiple linear regression models. From the results obtained, a positive relationship exists between the role of AI in tax fraud detection and improved tax collection where ($r=0.849$, $p<0.1$). Their analysis also showed a positive relationship occurs between employees perception and improved tax collection ($r=0.827$, $p<0.1$). The values obtained showed that AI has the potential to increase revenue and help taxpayers comply effectively with tax regulations. However, their research opines that for AI to be implemented in tax administration, huge investments need to be made in digital infrastructure and to avoid failure, pilot projects should be integrated for suitable adoption and implementation.

Similar study by Munjeyi and Schutte (2025) carried out a perception analysis on AI adoption in taxation on tax compliance in South Africa employing a qualitative research approach in the form of interviews and analysed using the thematic analysis. It can be suggested from the findings that AI use in tax process has the potential to influence tax compliance positively. However, the use of AI may lead to disruptions in sociocultural cohesion with stakeholders expressing concerns about its broader social impact due to issues raised by the stakeholders during the interview session, which includes data privacy, discrimination, job losses, inequality and information bias. The findings also revealed that stakeholders are prepared to coexist with AI once the government demonstrates its willingness to develop an AI framework for tax administration.

Another research by Bankole et al. (2025) on the effects of AI on tax administration in Lagos state, Nigeria focusing on AI tools such as predictive analytics, blockchain, natural language processing and machine learning. They utilized the use of questionnaire that was distributed to 152 participants in the tax and AI department of Lagos revenue service. From their findings, the use of this AI tools were ranked according to their level of significance with predictive analytics topping the list, followed by NLP, BC and ML. The empirical findings from their study indicates that these technologies address persistent challenges such as tax evasion, high administrative costs, and manual errors. Precisely, the analysis showed that NLP can improve the interpretation of tax regulations, blockchain guarantees secure and transparent transactions, predictive analytics identifies tax evasion patterns, and machine learning automates repetitive tasks, which improves administrative processes.

South Africa is leading in terms of AI use in tax processes in Africa and has spent well over \$200 million (equivalent to R3 billion) on AI and ML investment to enhance tax administration (Munjeyi & Schutte, 2025). The South African revenue service has used AI and ML tools to detect fraud and cases of syndicate that have previously resulted in tax noncompliance and these AI tools has significantly increased tax revenue by 3.2% (R54 billion) in 2023/2024 to R1.74 trillion (Munjeyi & Schutte, 2025; Omolore & Onyemechi, 2024).

The empirical review reveals the advantages and challenges of emerging technologies in tax process. The results are largely positive, while the challenges include tax evasion, lack of infrastructure, corruption and lack of skills and education from tax officials. Hence, the adoption of AI use in tax revenue and tax compliance has the potential to transform tax process in Nigeria. Although challenges exist, they need to be addressed which requires a coordinated effort from government and tax officials which involves capacity building, infrastructural development, legal reforms, and stakeholder engagement.

The research questions for this study are informed by the DOI, TAM theories and the empirical review. Questions 1 to 5 investigates the influence of ML, NLP, BC, BDA and RPA on tax revenue and tax

compliance in Nigeria. The DOI's concept of compatibility, relative advantage, complexity, trialability and observability comes into play as regards the technologies and its effect on tax revenue and tax compliance in Nigeria. The perceived ease of use and perceived usefulness of technology and innovations guides the TAM, which informed the research questions.

This study aims to investigate the impact of AI on tax revenue and tax compliance in Nigeria, focusing on the perceptions of tax specialists. The findings will contribute to understanding the influence of AI on tax process in Nigeria and provide insights for policymakers and practitioners.

Research Questions and Hypotheses

In the light of the above, the following specific questions were asked to guide this study:

1. To what extent does machine learning influence tax revenue and tax compliance in Nigeria?
2. How does natural language processing affect tax revenue and tax compliance in Nigeria?
3. What is the effect of blockchain on tax revenue and tax compliance in Nigeria?
4. To what extent does big data analytics influence tax revenue and tax compliance in Nigeria?
5. How can using robotic process automation influence tax revenue and tax compliance in Nigeria?

The hypotheses stated below align with the research questions to include:

H01: Machine learning has no significant effect on tax revenue and tax compliance in Nigeria.

H02: Natural language processing does not significantly influence tax revenue and tax compliance in Nigeria.

H03: Blockchain has no significant influence on tax revenue and tax compliance in Nigeria.

H04: The utilization of big data analytics does not significantly influence tax revenue and tax compliance in Nigeria.

H05: Robotic process automation does not have any significant influence on tax revenue and tax compliance in Nigeria.

3. Methodology

This study made use of a cross-sectional research design with a survey strategy to investigate the degree to which AI tools such as; machine learning, natural language processing, blockchain, big data analytics and robotic process automation can influence tax revenue and tax compliance in Nigeria. The study's population includes tax professionals who are staff of Nigeria Revenue Service (NRS) and members of the Chartered Institute of Taxation of Nigeria (CITN). This selection comprises a diverse group of knowledgeable professionals across the taxation and technology unit. Several studies have utilized CITN and NRS registry to analyse issues on tax administration and emerging technologies (Aina, 2024; Bankole *et al.* 2025; Titcombe & Micah, 2026). The respondents for this study were carefully chosen using the judgmental and purposive sampling technique as it is based on expert knowledge and relevance to the research questions respectively. Four hundred (400) questionnaires were administered manually by

research assistants and online via google forms sent out on WhatsApp platform, and 396 were retrieved. Therefore, the sample size for this study is three hundred and ninety six (396) professionals as at September 2025.

This method ensured an all-inclusive coverage and convenience for the researcher and participants involved. The decision to use the questionnaire is based on its structured and systematic way it helps researchers collect quantitative and qualitative data efficiently. Using questionnaire allows for standardized and non-biased responses, making it easier to analyse and compare data across different groups or populations (Kuphanga, 2024).

The respondents were required to rate the extent to which they agree or disagree with the questions asked on a five-point Likert scale with 5- strongly agree, 4- agree, 3- not certain, 2- disagree and 1- strongly agree. The questionnaire for this study was constructed based on the review of extant literature (Aina, 2024; Bankole *et al.*, 2025; Falana *et al.*, 2024; Mohammed, 2025; Oyedokun & Ayinde, 2023; Zaqeeba *et al.*, 2025). The questionnaires were divided into two sections; section one formed the demographic part and section two includes the statements that measure the dependent variable, which is tax revenue, and tax compliance and explanatory variables of AI. This research instrument has been pre-tested for its validity and reliability. The research instrument was validated by lecturers in the faculty of management sciences for their objective criticism, corrections and expert knowledge. To test for the reliability of the questionnaire, a pilot test was carried out with thirty (30) respondents using the Cronbach's Alpha test with a result of 0.958.

Data was analysed using the SPSS 22 and the Eviews 10 statistical software to carry out ordinary least square (OLS) and ordered logistics regression.

4. Results and discussion

Table 1: Demographic Analysis

Parameter	Category	Value
Specialisation	Tax Specialist	316
	ICT Specialist	55
	Others	25
	Total	396
Experience	Less than 1 Year	32
	1-5 Years	92
	6-10 Years	104
	11-15 Years	57
	More than 15 Years	111
	Total	396
Knowledge level	Very Low	3
	Low	52
	Not Certain	38
	High	257
	Very High	46
	Total	396

Extract from SPSS result

The table above presents the demographic features of the respondents in this study as regards their area of specialization, level of experience, and depth of knowledge on the subject matter.

From table 1, it is observed that the majority of respondents were tax specialists (79.8%, $n = 316$), followed by ICT specialists (13.9%, $n = 55$), and others (6.3%, $n = 25$). This distribution indicates that the survey primarily captured insights from professionals directly engaged in tax-related functions. Such representation strengthens the validity of the findings, as the perspectives are grounded in the expertise of those most affected by AI adoption in tax administration.

Respondents varied considerably in terms of professional experience to tax administration. A significant proportion reported more than 15 years of experience (28.0%, $n = 111$), while 26.3% ($n = 104$) had between 6–10 years, and 23.2% ($n = 92$) had 1–5 years. Those with less than one year of experience accounted for 8.1% ($n = 32$). This distribution suggests that the sample included both seasoned professionals and relatively new entrants, thereby providing a balanced view of how emerging technology is perceived across different career stages. Furthermore, the majority of respondents rated their knowledge level as high (64.9%, $n = 257$) or very high (11.6%, $n = 46$). Conversely, only 13.1% ($n = 52$) reported low knowledge, and 0.8% ($n = 3$) reported very low knowledge. A small proportion (9.6%, $n = 38$) indicated uncertainty. These findings suggest that most respondents possess substantial knowledge relevant to tax administration, which enhances the reliability of their perspectives on AI technology integration.

Table 2: Perceptions of Tax Revenue and Tax Compliance

Parameter	Category	Value
Tax Revenue	Very Low	21
	Low	148
	Not Certain	27
	High	153
	Very High	47
	Total	396
Rate of Tax Compliance		
Tax Compliance	Very Low	17
	Low	254
	Not Certain	40
	High	66
	Very High	19
	Total	396

Extract from SPSS result

For perceptions of tax revenue, respondents expressed mixed views regarding AI influence on tax revenue. While 38.6% ($n = 153$) rated the impact as high and 11.9% ($n = 47$) as very high, a considerable proportion (37.4%, $n = 148$) rated it low, and 5.3% ($n = 21$) very low. Additionally, 6.8% ($n = 27$) were uncertain. This divergence highlights both optimism and skepticism among professionals, reflecting differing expectations about the potential of AI technologies to enhance revenue generation. Similarly, responses on tax compliance leaned toward lower ratings. More than half of the respondents (64.1%, $n = 254$) rated compliance as low, and 4.3% ($n = 17$) as very low. Only 16.7% ($n = 66$) rated compliance as high, and 4.8% ($n = 19$) as very high, while 10.1% ($n = 40$) were uncertain. This suggests that despite the

perceived potential of AI and other technologies, respondents remain cautious about its effectiveness in improving tax compliance levels.

Table 3: Correlation Analysis with Tax Revenue as Dependent Variable

	TAR	ML	NLP	BC	BDA	RPA	CTS	VIF
TAR	1.000							
ML	0.519	1.000						1.988
NLP	0.497	0.596	1.000					2.063
BC	0.459	0.571	0.648	1.000				2.044
BDA	0.462	0.615	0.548	0.558	1.000			2.209
RPA	0.445	0.558	0.546	0.587	0.654	1.000		2.218

Extract from Eviews result

Table 3 presents the correlation matrix between tax revenue (TAR) and the explanatory variables, alongside variance inflation factor (VIF) values. The results indicate generally positive associations between tax revenue and most AI-related variables. Tax revenue shows a moderate positive correlation with machine learning (ML) ($r = 0.519$), natural language processing (NLP) ($r = 0.497$), blockchain (BC) ($r = 0.459$), big data analytics (BDA) ($r = 0.462$), and robotic process automation (RPA) ($r = 0.445$). These coefficients suggest that increases in the adoption or effectiveness of these technologies are associated with higher tax revenue performance.

The intercorrelations among the independent variables are moderate, with the highest observed correlation occurring between RPA and BDA ($r = 0.654$) and between NLP and BC ($r = 0.648$). Importantly, all VIF values range between 1.988 and 2.218, which are well below the commonly accepted threshold of 10. This confirms the absence of multicollinearity concerns and supports the suitability of the variables for subsequent regression analysis.

Table 4: Correlation Analysis with Tax Compliance as Dependent Variable

	TCR	ML	NLP	BC	BDA	RPA	CTS	VIF
TCR	1.000							
ML	0.518	1.000						1.988
NLP	0.445	0.596	1.000					2.063
BC	0.398	0.571	0.648	1.000				2.044
BDA	0.332	0.615	0.548	0.558	1.000			2.209
RPA	0.422	0.558	0.546	0.587	0.654	1.000		2.218

Extract from Eviews result

Table 4 presents the correlation matrix and variance inflation factors (VIFs) for the study variables. Tax compliance is moderately and positively correlated with machine learning (ML) ($r = 0.518$), natural language processing (NLP) ($r = 0.445$), blockchain (BC) ($r = 0.398$), big data analytics (BDA) ($r = 0.332$), and robotic process automation (RPA) ($r = 0.422$). These coefficients suggest that greater adoption or effectiveness of AI technologies is associated with higher levels of tax compliance.

The intercorrelations among the independent variables are moderate, with the strongest relationships observed between RPA and BDA ($r = 0.654$) and between NLP and BC ($r = 0.648$). Importantly, all VIF

values range from 1.988 to 2.218, which are well below the acceptable threshold, indicating that multicollinearity is not a concern.

Table 5: Linear Estimation Diagnostics for Tax Revenue

Diagnostics Test	Statistics	DF	Prob.
Breusch-Pagan-Godfrey Heteroskedasticity Test.	2.863	F(6,389)	0.001
Breusch-Pagan Serial Correlation LM Test.	1.369	F(2,387)	0.255
RAMSEY RESET	0.838	F(1,388)	0.360

Extract from Eviews result

Table 5 presents the results of the Breusch-Pagan-Godfrey, Breusch Pagan LM, and Ramsey RESET tests. The Breusch-Pagan-Godfrey test reveals the presence of heteroskedasticity, while the Breusch pagan LM test indicates the absence of serial correlation in the residuals. Furthermore, the Ramsey RESET test does not suggest any functional form misspecification. Conclusively, the presence of heteroskedasticity provide evidence that the OLS regression technique will be biased further validating the use of the ordered logistics regression technique.

Table 6: Linear Estimation Diagnostics for Tax Compliance

Diagnostics	Statistics	DF	Prob.
BPG Heteroskedasticity Test	2.593	F(6,389)	0.017
BP Serial Correlation LM Test	0.812	F(2,387)	0.833
RAMSEY RESET	0.228	F(1,388)	0.633

Extract from SPSS result

Table 6 shows the presence of heteroscedasticity, which provides evidence that the OLS regression technique will be biased as seen for tax compliance, hence the use of ordered logistics regression technique.

Table 7: Model Fit (For Tax Revenue)

Model Fitting	-2 Log Likelihood	Chi-Square	Df	Sig.
Intercept Only	454.399			
Final	285.366	169.033	6.000	0.000
Goodness-of-Fit	Chi-Square	Df	Sig.	
Pearson	647.170	333.000	0.000	
Deviance	223.947	333.000	1.000	

Extract from SPSS result

The ordered logistic model predicting tax revenue (TAR) as presented in Table 7 shows a statistically significant improvement over the intercept-only model ($-2LL$ reduced from 454.399 to 285.366; $\chi^2 = 169.033$, $df = 6$, $p < .001$), indicating all the predictor variables add explanatory power to the model.

Table 8: Pseudo R-Square

Pseudo R-Square	Result
Cox and Snell	0.347
Nagelkerke	0.408
McFadden	0.224

Extract from SPSS result

All the pseudo R-squared values indicate good fit (Cox & Snell = .347; Nagelkerke = .408; McFadden = .224).

Table 9: Parameter Estimates (Tax Revenue)

Parameter	Estimate	Std. Error	Wald	Df	Sig.
ML	0.974	0.265	13.541	1.000	0.000
NLP	0.823	0.273	9.119	1.000	0.003
BC	0.418	0.240	3.040	1.000	0.081
BDA	0.641	0.297	4.644	1.000	0.031
RPA	0.345	0.286	1.456	1.000	0.228

Extract from SPSS result

Looking at the individual predictors, machine learning (ML) $\beta = .974$, $SE = .265$, $p < .001$; natural language processing (NLP) $\beta = .823$, $SE = .273$, $p = .003$; and big data analytics (BDA) $\beta = .641$, $SE = .297$, $p = .031$ all have significant positive effects on tax revenue. Blockchain (BC) has a positive but marginal effect ($\beta = .418$, $p = .081$). Robotic process automation (RPA; $\beta = .345$, $p = .228$) is not statistically significant. The overall implication of the findings in table 9 is that ML, NLP, and BDA are positive and significant predictors of higher tax revenue categories, while BC is a marginal predictor, and RPA is not significant.

Table 10: Model Fit (Tax compliance)

Model Fitting	-2 Log Likelihood	Chi-Square	Df	Sig.
Intercept Only	422.006			
Final	267.797	154.209	6.000	0.000
Goodness-of-Fit	Chi-Square	Df	Sig.	
Pearson	2308.847	333.000	0.000	
Deviance	207.912	333.000	1.000	

Extract from SPSS result

The ordered logistic regression results in table 10 indicates that the model predicting tax compliance (TCR) is statistically significant and provides a better fit than the intercept-only model (-2LL reduced from 422.006 to 267.797; $\chi^2 = 154.209$, $df = 6$, $p < .001$).

Table 11: Pseudo R-Square

Pseudo R-Square	Result
Cox and Snell	0.323
Nagelkerke	0.391
McFadden	0.223

Extract from SPSS result

The pseudo R-square values (Cox and Snell = .323; Nagelkerke = .391; McFadden = .223) suggest a moderate explanatory power.

Looking at the individual predictors, machine learning (ML) has a strong, positive, and statistically significant effect on tax compliance ($\beta = 1.744$, $p < .001$). Natural language processing (NLP) also has a positive and significant influence ($\beta = .817$, $p = .004$), indicating that both technologies increase the likelihood of higher tax compliance categories. Robotic process automation (RPA) is similarly positive and significant ($\beta = .965$, $p = .001$), highlighting its role in improving compliance outcomes. In contrast,

big data analytics (BDA) has a negative but significant effect ($\beta = -.851$, $p = .008$), while blockchain (BC) does not have statistically significant effect.

Table 12: Parameter Estimate (Tax Compliance)

Parameter	Estimate	Std. Error	Wald	Df	Sig.
ML	1.744	0.286	37.168	1.000	0.000
NLP	0.817	0.287	8.070	1.000	0.004
BC	0.139	0.246	0.319	1.000	0.572
BDA	-0.851	0.322	7.009	1.000	0.008
RPA	0.965	0.300	10.348	1.000	0.001

Extract from SPSS result

The decision rule is that if the associated p-value of the explanatory variable is less than 5%, then, the null hypothesis will be rejected for the alternate hypothesis. However, if the p-value is greater than 5%, then, we fail to reject the null hypothesis.

H01: Machine learning has no significant effect on tax revenue and tax compliance in Nigeria.

ML has a significant p-value ($p < .01$) in the parameter estimate test for tax revenue. For tax compliance, ML has a significant p-value ($p < .01$) in the parameter test. Therefore, the relative consistent significance in p-values leads to the rejection of the null hypothesis and conclusion that there is a significant positive relationship between machine learning and tax revenue and tax compliance in Nigeria.

H02: Natural language processing does not significantly influence tax revenue and tax compliance in Nigeria

Natural language processing has a significant p-value ($p < .01$) in the parameter estimate for tax revenue and a significant p-value ($p < .01$) for tax compliance. The relative consistent significance in p-values leads to the rejection of the null hypothesis and conclusion that there is a significant positive relationship between natural language processing and tax revenue and tax compliance in Nigeria.

H03: Blockchain has no significant influence on tax revenue and tax compliance in Nigeria.

Blockchain has an insignificant p-value for tax revenue ($p = .081$) in the parameter test, for tax compliance, BC also has an insignificant p-value ($p = .57$). This insignificance in p-values leads to the acceptance of the null hypothesis and conclusion that there is no significant positive relationship between blockchain, tax revenue and tax compliance in Nigeria.

H04: The utilization of big data analytics does not significantly influence tax revenue and tax compliance in Nigeria.

Big data analytics has a significant p-value ($p \leq .031$) in the parameter test for tax revenue and an insignificant p-value ($p = .008$) for tax compliance. Therefore, BDA has a significant p-value with tax revenue and an insignificant relationship with tax compliance in Nigeria.

H05: Robotic process automation does not have any significant influence on tax revenue and tax compliance in Nigeria.

Robotic process automation has an insignificant p-value ($p = .228$) for tax revenue and a significant p-value for tax compliance ($p = .746$). Therefore, RPA has an insignificant p-value with tax revenue and a significant relationship with tax compliance in Nigeria.

Discussion and Findings

For H01, results show consistent and robust statistical support for a positive association between machine learning (ML) and higher tax-revenue and tax compliance outcome. Theoretically, this result is predicted by both DOI and TAM. DOI explains ML's impact via relative advantage and observability being that ML produces observable gains in anomaly detection and forecasting which spur its favoritism among tax specialists. TAM also predicts administrators adopt ML when perceived usefulness (PU) is high. That is, when ML demonstrably improves forecasting and audit targeting leading to operational changes that raise revenue. Contradictions are limited but important because studies show that where ML models are opaque or biased, public trust and legitimacy can be undermined (Faundez-Ugalde & Mellado-Silva, 2023), reducing the compliance dividend. The overriding implication is that ML will produce compliance benefits when coupled with transparency, oversight, and measures to prevent discriminatory outcomes.

Regarding H02, NLP shows a significant positive relationship with tax revenue and tax compliance. Mechanistically, NLP reduces information-processing costs such as automating extraction of entities from unstructured returns, parsing legal texts, and accelerating dispute resolution thereby lowering leakage and administrative delays. This result can be explained using TAM's perceived ease of use (PEOU) and perceived usefulness (PU) for officials processing complex filings. Bankole *et al.* (2025) and Chen *et al.* (2025) document NLP's capacity to extract structured information and improve regulation interpretation. Similarly, NLP is significantly associated with improved tax compliance. The findings connote that NLP enabled services (chatbots, automated clarifications, sentiment/topic analytics) lower taxpayer uncertainty and improve voluntary compliance. Empirical support for this position appears in Bankole *et al.* (2025), who document enhanced communication and regulatory understanding through NLP tools. However, constraints such as limited language coverage and privacy anxieties (Pamisetty, 2021; Aladebumoye, 2025) can dampen the compliance effect unless addressed via inclusive model development and transparent data use policies.

Theoretically, DOI emphasizes through its trialability and relative advantage perspective that early, visible successes in taxpayer service via NLP will accelerate adoption. In addition, TAM highlights that the positive findings may be that NLP increases PEOU for taxpayers interacting with tax systems, which raises behavioural intention to comply.

H03 does not show a clear, uniformly significant positive effect of blockchain on tax revenue and tax compliance. DOI explains that blockchains complexity and need for broad network externalities greatly slow diffusion and blunt near-term revenue effects. In addition, TAM points to the probability of low perceived ease of use and high implementation difficulty as inhibitors of adoption despite perceived usefulness in principle. Empirical literature on the connection between blockchain and tax revenue is ambivalent. While Atadoga *et al.* (2025) and Anomah *et al.* (2024) outline blockchain's VAT and invoice-traceability potential; Judijanto *et al.* (2024) emphasize regulatory, infrastructural and cost barriers in developing contexts. The implication is that blockchains fiscal promise remains conditional; until coordinated ecosystem adoption and legal frameworks are in place, measurable revenue impacts are unlikely. Cyril *et al.* (2025) and Anomah *et al.* (2024) show a positive nexus between blockchain and tax compliance only when the use of blockchain is institutionalized. Consequently, this study finds that

blockchains compliance benefits are theoretical and contingent rather than empirically established in the present Nigeria.

The fourth hypothesis (H04) reveal that BDA has a positive relationship with tax revenue and a negative impact on tax compliance in Nigeria.

Theoretically, BDA's strength lies in integrating diverse datasets to prioritise high-risk taxpayers and to improve forecasting accuracy that are factors that directly bolster revenue mobilisation. DOI frames BDA as offering clear relative advantage for resource optimization while TAM predicts administrators will adopt BDA where PU for forecasting and targeting is high. BDA will function more as an enforcement and forecasting enabler than as an immediate instrument for increasing voluntary compliance.

For the fifth hypotheses (H05), the results shows no statistically significant effect of RPA on revenue outcomes and a significant effect for tax compliance. Theoretically, DOI describes this finding on RPA as an incremental, internally oriented innovation with high compatibility but limited externality for taxpayer behavior. In addition, while a strong perceived usefulness can be argued for RPA using TAM, the seemingly low immediate visibility to taxpayers will result in little direct revenue effect. Furthermore, TAM indicates that unless taxpayers experience PEOU and PU directly from a technology (in this case, RPA), compliance will not shift markedly. Although the empirical literature supports improved processing and reduced errors with RPA (Martinez, 2025a; Zaqeeba *et al.*, 2024), this result has provided consistent evidence of direct compliance effects. Thereby confirming the position of Faundez-Ugalde and Mellado-Silva (2023) that caution about errors, bias and governance risks in automated routines that limit the associated benefits.

5. Conclusion

This study examined the possible adoption of AI tools such as machine learning, natural language processing, blockchain, big data analytics and robotic process automation on tax revenue and tax compliance in Nigeria's tax process using the OLS, and ordered logistics regression technique. The result from the findings show that machine learning, natural language processing and big data analytics positively influence tax revenue, while machine learning, natural language processing, and robotic process automation have significant and positive impact on tax compliance. Big data analytics has a negative impact on tax compliance. Blockchain has no significant influence on tax revenue and tax compliance.

This study concludes that the integration of machine learning and natural language processing in tax administration in Nigeria is recognized as being beneficial as it will increase tax revenue generation and improve taxpayer's compliance. The study found Blockchain not to be beneficial to tax revenue and tax compliance in Nigeria.

This study concludes that the use of emerging technologies in tax administration in Nigeria is not yet established, therefore, this paper recommends the Nigerian government and tax officials to invest in infrastructure, develop clear AI strategies, establish legal and ethical frameworks and carry out digitalization in pilot phases for efficient and effective tax administration process.

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