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# Tax audit on tax revenue of SMEs in Nigeria

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Government expenditure is crucial to the macroeconomic income determination model and taxes constitute a major source of revenue for the government. However, low tax compliance jeopardises the government's capacity to realise its tax revenue potential. Consequently, tax audits are critical to enhancing tax compliance, which then helps to boost tax revenue. Although some empirical studies have examined the relationship between tax compliance and tax revenue scarcely any has investigated the influence of tax audit on tax compliance. To this end, this study sought to examine the influence of tax audits on tax compliance: and tax revenues from SMEs in Nigeria: the study employed a cross-sectional survey design consisting of 205 Owners and managers of SMEs in Nigeria. Convergent and divergent validity and composite reliability tests served as validity and reliability tests of the structured questionnaire designed by the authors. The study used a structured questionnaire to elicit the desired data from the respondents and used structural equation modelling to analyse the data. The results indicate that desk and field tax audits have a significant positive influence on tax compliance. Tax compliance, desk and field tax audits have a significant positive influence on tax revenue. In addition, tax compliance provides a partial linkage for the relationship between tax audits and tax revenues from SMEs. The study contributes significantly to accounting theory by showing that deterrence to tax evasion through tax audit is critical to tax compliance in Nigeria.

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## Introduction

The tax system of any country plays a crucial role in determining the government's ability to generate sufficient revenue to fulfil its obligations, making it integral to macroeconomic policy formulation. The consumer, the firm and the government are the three known economic agents in the literature. The government is critical to the functioning of the other two agents because the policies of the government can constrain the functioning of the other two agents. Government expenditure helps stimulate a country's circular flow of income and its economic activities. Unlike households and firms' incomes, the financing of government expenditure, which contributes to an enabling environment for the firm to thrive, is from tax revenues. Consequently, the equilibrium of national income occurs when government expenditure equals taxes. However, the ability of the government to optimise its tax collection is a function of the degree of tax compliance in the economy (Aladejebi, 2018; Udofot and Etim, 2017). Therefore, statutory mechanisms such as tax audits are required to enable the authorities, like the government agencies in charge of taxation such as the Federal Inland Revenue Service (FIRS) and the State Boards of Internal Revenue Services (SBIRS), to conduct investigations into the affairs of the citizens so that government does not lose tax revenue. The real problem is to find out how tax audits contribute to tax compliance and revenue generation in Nigeria.

Among other reasons, tax audit in Nigeria seeks to determine taxable profits or losses of the taxpayer and consequently, the tax payable and ascertain whether the tax computations submitted to the tax authority by the taxpayer agree with the underlying records (Olaoye et al., 2018). Tax auditing assists the government in collecting appropriate tax revenue necessary for the budget to maintain economic and financial order and stability and ensure that taxpayers submit satisfactory returns (Olaoye and Ogundipeb, 2018). Thus, tax audits help to minimise tax evasion (Oghuma, 2018). Tax audits also examine whether a taxpayer correctly reports his tax obligations. To this end, part of the issues that it seeks to address is tax evasion, which is one of the factors that impedes the capacity of the government to realise its tax revenue potential optimally. Thus, tax evasion is the illegal/refusal of individuals or corporate bodies to fulfil their tax obligations. It is also the failure of the citizenry, either by commission or omission, to accurately declare their income or their refusal to pay tax as and when due. Tax evasion is inversely proportional to tax compliance, which means that if the rate at which the citizens evade tax is high, it will cause their compliance to be low and vice versa. Otekunrin et al. (2021) investigated the e-tax system's effectiveness in reducing tax evasion. This study expects tax audits to make some meaningful contribution to the reduction of tax evasion, and hence contribute to the willingness of people to comply with tax and ultimately lead to the enhancement of tax revenue.

Despite the importance of taxes to the economic well-being of a country, tax compliance is a major problem for tax authorities (Akpubi and Igbekoyi, 2019; Mohammed et al., 2016). Two major constraints to tax payment are cumbersomeness and costliness (Otekunrin et al., 2021; Mongwaketse, 2015). Tax administration as a government source of revenue has been reformed and restructured in Nigeria. The series of amendments and regulations to tax administration in many developed and developing economies, Nigeria inclusive, were to block tax revenue leakages and thus, increase the net tax (Ogunbela et al., 2021). The series of amendments in the tax laws are due to the challenges of tax compliance. Some studies provided evidence that electronic taxation is less cumbersome and less costly than manual tax filing (Otekunrin et al., 2021; Mongwaketse, 2015) and thus, likely to

enhance tax compliance (Night and Bananuka, 2020; Akpubi and Igbekoyi, 2019; Richards and Ekhatior, 2019). Taxpayers' attitude also influences their tax behaviour (Marti, 2010).

An effective tax audit system can also contribute significantly to tax compliance (Kasper and Alm, 2022) and thus, stimulate tax revenue. Many factors may influence tax compliance; they include tax ethics (Al-Asfour and Abu Saleem, 2023), sensitivity to earnings management (Delgado et al., 2023; Kałdoński and Jewartowski, 2020), the influence of international standards on SME tax compliance (Duy and Tran, 2020) and firm valuation (Jacob and Schütt, 2019), among others. Some scholars have examined the likelihood of stimulating tax revenue through tax audits (Oladele et al., 2021; Adelana, 2022; Enofe et al., 2018; Gebreyesus, 2020; Mbotor, 2019; Olaoye and Ekundayo, 2019; Olaoye and Ogundipeb, 2018; Onuoha and Dada, 2016). However, none of the studies examined the influence of tax audits on tax compliance. Based on this statement, the basis for considering tax compliance as the nexus between tax audit and tax revenue becomes appropriate.

In addition, none of these studies explained how tax audit contributes to tax revenues as none provided a theoretical justification for the outcome of their studies. The point of departure of this study from previous studies on tax audit and tax revenue is the unique operationalisation of tax audit and the linkage of tax audit to tax revenue through tax compliance, which is the value/originality of this study. Thus, this study bridged these gaps by investigating the influence of tax audits on tax compliance and the implications for tax revenue. The specific objectives were to ascertain the extent to which desk-tax audit, field tax audit and back duty-tax audit relate to tax compliance of SMEs in Nigeria and the extent to which desk-tax audit, field-tax audit and back duty-tax audit relate to tax revenues from SMEs in Nigeria.

**Conceptual clarification.** Tax compliance means the ability and willingness of a taxpayer to comply with tax laws, to declare accurate income annually and to pay all taxes on time (Trifan et al., 2023; Hassan et al., 2021; Inasius, 2019). The disclosure of all available information about one's earnings by honestly stating all taxable incomes and making payments of all tax liabilities on time without waiting to be chased to fulfil the tax obligations is what tax compliance means (Singh, 2003). Tax revenue or tax income is the monetary value of receipts from all the taxes collected within a particular period. Studies on tax compliance in Nigeria indicate that female SME owners are more tax-compliant than their male counterparts (Aladejebi, 2018). In addition, high tax rates, complex filing procedures, multiple taxation and lack of proper enlightenment are the major constraints to tax compliance among SMEs in Nigeria (Atawodi and Ojeka, 2012). Aladejebi's (2018) investigation of taxpayers' knowledge and the penalties and tax compliance amongst SMEs in Nigeria found tax knowledge significantly influences tax compliance.

Tax revenue: the money generated from tax collection constitutes tax revenue. In other words, tax revenue is the aggregation of the proceeds of taxation in any given period. It is the revenues collected from all taxable sources like income, social security contributions, goods and services, payroll and the ownership and transfer of property. Among other things, tax revenue contributes to the sustenance of all forms of government expenditure including financing of social security and other social programmes as well as investment in infrastructure to create the enabling environment for businesses to thrive and economic development (Ibrahim et al., 2015).

Tax audit (TA) is the independent variable in this research. Tax audits mean the examination of underlying records to determine

the extent to which taxpayers correctly report their tax liabilities. In other words, it concerns the review of the returns of a taxpayer; whether an individual or corporate entity, to ascertain the extent to which there are reports of all income and that deductions or credits accurately reflect reality. Contrary to other types of examinations such as desk examinations, and compliance monitoring/reviews, TA is relatively more detailed and extensive. Federal Inland Revenue Service selects taxpayers for tax audit using a multifaceted approach including risk profiling, intelligence information and requests for refund, among others. It is possible to audit a taxpayer after examination or monitoring based on the desk. There are various types of tax audits; Desk Audit, Field Audit and Back Duty Audit. The Desk Audit is the review of the self-assessment returns filed by a taxpayer to find out its completeness and correctness without necessarily going to the taxpayer's business premises. Given this statement, using tax compliance as a linkage becomes appropriate. Field tax audits require the auditor to go to either the taxpayer's home, place of business or accountant's office to examine the taxpayer's (individual or business) financial records and ensure the filing of tax returns is accurate. This is a comprehensive tax audit. The Back Duty Audit is to tackle doubtful claims of capital allowance related to the previous or current year. It arises due to the desire to verify doubtful claims by taxpayers in a bid to evade tax. When taxpayers submit falsified documents through the doctoring of their taxable incomes or profits or assets, among others, it leads to the imposition of less tax than what the taxpayer should pay. Falsification could be by the reduction of profit in the returns files in the tax office and non-disclosure or non-inclusion in full of any income or earnings made available in the return to the tax office.

**Theoretical review framework.** This section reviews three theories on taxation; the Policeman, classical and regulation theories. This study employs the Policeman theory, the classical theory of tax compliance and the regulatory theory as its framework. The choice of the Policeman theory and classical theory of tax compliance is due to the deterrence of taxpayers from evading tax due to the influence of tax audits. Thus, the capacity of tax audits to expose the evader and cause him to face stringent consequences makes the Policeman and classical theories of tax compliance appropriate. The choice of the regulatory theory is because of the relevance of regulation to the effective function of any system.

*The policeman theory.* Propounded by Awe (2008) on the assumptions of the initiation of monitoring the systems at unspecified times, it is akin to the guarding of a place by a police officer. To this end, using tax auditors at unspecified times in organisations helps to check the propensities for tax evasion and avoidance, thus policing the firms' violation of tax ethics. Consequently, we refer to the theory as the Policeman theory. The theory further asserts; that "auditing is purely on the arithmetical accuracy and on the prevention and detection of fraud. This theory enables the auditor to detect and prevent errors and organisational fraud. It then adds monitoring to the auditing theory" (Mbotor, 2019).

*Classical theory of tax compliance.* The classical theory of tax compliance has its roots in the deterrence theory. From this perspective, the goal of the taxpayer is to maximise the expected utilities associated with the tax evasion bet and he weighs the expected benefits resulting from successful tax evasion against the consequences of the discovery of his tax evasion and prosecution by tax authorities through the imposition of penalties (Sandmo, 2005). The deterrence hypothesis inherent in the classical tax compliance theory relies heavily on tax audits and penalties

(Alabede et al., 2011). In addition, fear and punishment in this theory are what make taxpayers to be tax compliant. The deterrence theories also regard taxpayers to "play the audit lottery;" which means they compute the economic consequences of complying with various options (Trivedi and Shehata, 2005). What the deterrence model of tax compliance does is find out the relationship between the likelihood of detection and the intensity of the consequence of non-compliance.

*Regulation theory.* The primary essence of taxation is to ensure fairness. Taxation is a regulatory framework since it seeks to ensure equitable income distribution in an economy (Rixen and Unger, 2022). However, there is a need to regulate the tax system to ensure the achievement of tax goals, which is the generation of optimum tax revenue. Rixen and Unger (2022) observe that the tax system is regulatory, taxation extends the empirical field of enquiry of regulatory scholars, tax governance exhibits regulatory governance among other institutional changes in contemporary times and tax governance aimed at mitigating tax evasion and avoidance is becoming increasingly politicised. The regulation theory is a body of research and writings that focuses on analysing the power of the state to regulate economic and civil functions of law to facilitate economic efficiency (MacLeod and Holden, 2009). den Hertog (2010) identified two broad categories of the economic theories of regulation. The first assumes that regulators possess adequate information and the powers of enforcement to promote the public interest effectively with the belief that regulators aim to pursue the public interest. The associated theories are 'public interest theories of regulation'. The second economic study of regulation has different assumptions. It regards regulation as deficient in information concerning cost, demand, quality and other dimensions of firm behaviour. Thus, they can only promote public interest imperfectly when controlling firms or societal activities. Within this tradition, the information, monitoring and enforcement costs also apply to other economic agents, and, more importantly, it assumes that all economic agents pursue their interests, which may or may not include elements of the public interest. To this end, we cannot conclude that regulation will promote the public interest. In addition, the variations and costs of interaction between the objectives of economic agents stimulate some of them to pursue their interests, at the expense of the public interest. The economic theories associated with these latter assumptions are 'private interest theories of regulation'.

From the accounting point of view, Gaffikin (2004) examined regulation from the perspectives of positive and normative accounting theories. The economic literature distinguishes between positive and normative economic theories of regulation. The positive variant aims to provide economic explanations for regulation and analyse regulation effectively. The normative variant investigates which type of regulation is the most efficient or optimal. Positive accounting theory is a fallout of positive economics. It examines market failure and regulation, That is, there are analyses of regulation, which are come from positive economics and some from normative assumptions (Gaffikin, 2004; Uche, 2001). Analysts describe these as theories of regulation. We may view all as some type of interest theory – primarily public or private but with "in-between" types. A significant problem characteristic of much of the positive accounting research is the regulation necessitated by information inadequacies leading to information asymmetries The tendencies of either of the two viewpoints (positive and normative accounting) to prioritise their interest is not only unethical but grossly vitiates the goal of regulation.

**Empirical review and hypothesis development.** Tax audits as organisational practice are not deficient in the empirical

literature, as a reasonable number of researchers have explored the area. This section reviews the empirical literature on the research problem.

Oladele et al. (2021) found statistically significant positive relationships between desk tax audit and company income tax and a statistically significant positive relationship between field tax audit and company income tax. Gebreyesus’ (2020) cross-sectional survey indicates that the automation of tax audit to its maximum capacities was significantly constrained and the auditors appear incompetent to tackle tax evasion and avoidance. Mbotor’s (2019) cross-sectional survey, using regression analysis indicated a positive relationship between tax audit strategies and productivity but the relationship is insignificant.

Olaoye and Ekundayo’s (2019) study found that all the categories of tax audits studied (desk, field, back duty and registration) had statistically significant positive relationships with tax compliance and remittance with field audit being the most significantly associated with tax compliance and hence tax revenue.

Enofe et al. (2018) showed that tax audit consisting of desk, field and back-duty has a statistically significant negative relationship with tax evasion, the negative relationship is statistically significant, thus implying that tax audit in any of the specified forms reduces tax evasion. Onuoha and Dada’s (2016) literature review of empirical studies based on content analysis indicates that tax audit is critical to improving the collection of tax revenues in Nigeria and thus, inevitable. Adelana’s (2022) investigation used regression techniques to analyse the data and found that tax audits have positive significant relationships with tax revenue in Nigeria. Using the classical theory of tax compliance, Policemen theory and the empirical review, the study tests the following hypotheses-

- $H_{01}$ : There is a positive relationship between desk-tax audit and SME tax compliance
- $H_{02}$ : There is a positive relationship between field-tax audit and SME tax compliance
- $H_{03}$ : There is a positive relationship between back duty-tax audit and tax compliance from SMEs
- $H_{04}$ : There is a positive relationship between desk-tax audit and the tax revenues from SMEs
- $H_{05}$ : There is a positive relationship between field-tax audit and tax revenues from SMEs
- $H_{06}$ : There is a positive relationship between back duty-tax audit and the tax revenues from SMEs
- $H_{07}$ : Tax compliance has a positive significant linkage on the relationship between tax audit and the tax revenues from SMEs.

**Materials and methods**

This section examines the research strategy. This includes the methods, modalities and sequential steps that the study employed to achieve the set objectives such as the research design, sampling technique, measurement of variables, validity and reliability, as well as, model specification and method of data analysis. The study employs the quantitative research method.

**Research design.** The population consisted of 3677 owners and managers of SMEs from three states in the Niger Delta region of Nigeria. Bayelsa State has 354 SMEs, the number of SMEs in Delta State is 1444 and Edo State has 1879 SMEs (NBS, 2013). The study used convenience sampling to select the area of the study, (Niger Delta region). However, the selection of the three states from the Niger Delta regions is based on the simple random sampling (lottery method) technique. The study employed a structured questionnaire to collect data from 205 respondents who voluntarily participated, out of 361 respondents requested

from the population (See Appendix I). The authors chose the questionnaire as the research instrument because they desired the respondent’s opinion.

**Sampling technique.** Given the population size of 3677, the study used the Taro Yamane formula to determine a sample size of 361 consistent with Inegbedion and Obadiaru (2018) and Ibrahim (2016). Next, the researchers stratified the employees in each of the organisations, under focus into owners and management staff. In addition, the study used simple random sampling (lottery method) to select the desired respondents. Thus, the sampling technique is the stratified random. The staff status formed the basis of stratification while the lottery method was the basis of randomisation.

**Measurement of variables.** The study used three five-point Likert scale items to measure the dependent variable (Tax revenue), In addition, three questions of the 5-Point Likert Scale type measured tax compliance, which served as the nexus between tax audit and tax revenue. Four questions of the 5-Point Likert Scale type measured each of the Independent variables of tax audit (desk, field and back duty), the independent variable.

**Validity and reliability of instrument**

**Validity.** The study employed convergent and discriminant validity techniques to test for the validity of the questionnaire. The authors used 40 respondents to conduct a pilot study to test the validity and reliability of the questionnaire. The responses from the pilot study formed the basis of the validity tests. First, the authors conducted factor analysis using the principal component technique. The results of factor loadings’ Average variance extracted (AVE) served as the decision variable for convergent validity. The cut-off mark for convergent validity = 0.5 (Cheung et al. 2024; Wei et al. 2023; Hair et al., 2006). All the computed AVEs in this study are greater than 0.5, thus establishing convergent validity (Table 1). Subsequently, the study obtained the correlations and comparisons between the correlation coefficients and the square roots of the AVEs. It is required that the AVEs be greater or equal to the squared correlations in each stratum, to establish discriminant validity.

The two validities are critical to the validation of a measuring instrument because the convergent validity helps to indicate how well the measure sufficiently correlates to measures of related constructs while the discriminant or divergent validity measures how well the instrument is unrelated or uncorrelated with measures of dissimilar constructs. The results of the discriminant validity show that all the AVEs in the main diagonal are greater than the corresponding squared correlation coefficients below the diagonals thus, establishing discriminant validity for the instrument (Table 2).

**Reliability.** The study used the composite technique to test the reliability of the instrument. The computation of the composite

Table 1 Convergent validity AVE = $\left(\frac{\sum \lambda_i}{n}\right)^2$ .				
1.	.dta	$\left(\frac{3.006}{4}\right)^2$	=	0.565
2.	.fta	$\left(\frac{2.436}{3}\right)^2$	=	0.6684 (7)
3.	.bda	$\left(\frac{2.204}{3}\right)^2$	=	0.540 (9)
4.	.tc	$\left(\frac{1.485}{2}\right)^2$	=	0.551 (15)
5.	.tr	$\left(\frac{1.92}{2}\right)^2$	=	0.8281 (18)

**Table 2 Discriminant validity.**

	dta	fta	bdtā	tc	tr
.dta	<b>0.752</b>				
.fta	0.345	<b>0.813</b>			
.bdta	0.351	0.223	<b>0.735</b>		
.tc	0.206	0.291	0.181	<b>0.743</b>	
.tr	0.248	0.357	0.239	0.417	<b>0.910</b>

**Table 3 Deviation of factor loadings from the AVEs.**

	e <sub>1</sub>	e <sub>2</sub>	e <sub>3</sub>	e <sub>4</sub>	Σe <sub>i</sub>
.dta	0.798	0.2690	0.124	0.4132	1.6042
.fta	0.2535	0.3061	0.7657	0.4509	1.7762
.bdta	0.6460	0.2115	0.2414	0.5840	1.6829
.tc	0.4239	0.4729	0.7734		1.6702
.tr	0.1972	0.1499	0.7368		1.0839

**Table 4 Composite reliability.**

1.	.dta	$\frac{33.006^2}{3.006+1.6042}$	=	$\frac{9.036}{9.036+1.6042}$	=	0.8492
2.	.fta	$\frac{2.436^2}{2.436^2+1.7762}$	=	$\frac{5.9351}{5.9351+1.7762}$	=	0.7697
3.	.bdta	$\frac{2.2048^2}{2.2048^2+1.6829}$	=	$\frac{4.8611}{4.8611+1.6829}$	=	0.7428
4.	.tc	$\frac{1.485^2}{1.485^2+1.6702}$	=	$\frac{2.2052}{2.2052+1.6702}$	=	0.5693
5.	.tr	$\frac{1.92^2}{1.92^2+1.0839}$	=	$\frac{3.6864}{3.6864+1.0839}$	=	0.773

reliability also employed the results of the AVE. The procedure is as follows:

Composite Reliability:  $\frac{(\sum \lambda_i)^2}{(\sum \lambda_i)^2 + \sum e_i}$

Where:

λ<sub>i</sub> = factor Loadings (Standardised factor loadings)

.e<sub>i</sub> = 1 - λ<sub>i</sub><sup>2</sup>

Composite Reliability:  $\frac{(\sum \lambda_i)^2}{(\sum \lambda_i)^2 + \sum e_i}$

Where:

λ<sub>i</sub> = factor Loadings (Standardised factor loadings)

.e<sub>i</sub> = 1 - λ<sub>i</sub><sup>2</sup>

All the computed values of the composite reliabilities are greater than 0.5 for the indicators of tax audit (desk field and back duty), tax compliance and tax revenue, thus establishing composite reliability for all the indicators and implying that the research instrument is internally consistent and hence, reliable (Tables 3 and 4).

**Data analysis.** The study employed descriptive and inferential statistics but the inferential analysis served as the basis for the research generalisations and conclusions. Frequency tables, percentages, mean and standard deviations served as the descriptive statistics while the path diagram analysis of the structural equation modelling technique served as the inferential analysis.

**Model specification.** The study specifies the models as follows

.tc = f(dta fta, and bdta) (i)

Specifically, (i) is given by:

.tc = β<sub>0</sub> + β<sub>1</sub>dta + β<sub>2</sub>fta + β<sub>3</sub>bdta + e (ii)

Also

tr = f(tc, dta fta, and bdta) (iii)

.tr = λ<sub>0</sub> + λ<sub>1</sub>tc + λ<sub>2</sub>dta + λ<sub>3</sub>fta + λ<sub>4</sub>bdta + e (iv)

Where:

.tc = tax compliance

.tr = tax revenue

.dta = desk tax audit

.fta = field tax audit

.bdta = back duty tax audit

β<sub>0</sub> = Proportion of the fluctuations in tax compliance that the independent variables (dta, fta and bdta) do not explain

β<sub>i</sub> (i = 1–3) = part of the changes in tax compliance that is traceable to the independent variables (dta, fta and bdta) Thus,

β<sub>1</sub> = proportion of the fluctuation in tax compliance that is traceable to the desk tax audit (dta)

β<sub>2</sub> = proportion of the variation in tax compliance that is traceable to the field tax audit (fta)

β<sub>3</sub> = part of the fluctuation in tax compliance that is traceable to the back duty (bdta)

λ<sub>0</sub> = a fraction of the fluctuations in tax revenue that tax compliance and independent variables (tc, dta, fta and bdta) are not responsible for.

λ<sub>i</sub> (i = 1–4) = proportion of the variation in tax revenue that is traceable to the tax compliance and independent variables (dta, fta and bdta). Thus,

λ<sub>1</sub> = proportion of the fluctuation in tax revenue that is traceable to tax compliance (tc)

λ<sub>2</sub> = proportion of the changes in tax revenue that is traceable to the desk tax audit (dta)

λ<sub>3</sub> = proportion of the variability in tax revenue that is traceable to the field tax audit (fta)

λ<sub>4</sub> = proportion of the changes in tax revenue that is traceable to the back duty tax audit (bdta)

.e = Stochastic error term (random error)

**Results**

This section presents the results and interpretations of the descriptive and inferential statistics.

**Descriptive statistics.** The descriptive statistics indicate that the highest mean score was 4.017, which is the respondents' perception of field task audits, while the lowest mean score is 3.733 for respondents' perception of tax revenue. The highest standard deviation is 0.7472 for respondents' perception of tax compliance, while the lowest is 0.5906 for respondents' perception of desk tax audit. Thus, the most dispersed perception is tax compliance, while the least dispersed is for desk tax audits. The findings also show that all the means of the respondents' perception exceed 3, the cut-off mark. In addition, the standard deviations are all less than the means, thus suggesting that the data are normally distributed (Table 5). This normality of the data made it possible for the study to employ the structural equation modelling technique.

**Inferential tests**

**Goodness of fit tests.** The study performed five goodness-of-fit tests. The five goodness of fit tests are the Root Mean Square Error (RMSE), the equation level goodness of fit (ELGF), the Wald test (WT), the Fit statistic (FS) and the stability test (ST). The computed value of the Root Mean Square Error is 0.2234. This value is within a good range being sufficiently close to zero, thus indicating that the model fits the responses adequately. The ELGF test shows that the fitted and predicted values of tc are 0.5556 and 0.3086 respectively. This resulted in a residual value of 0.2469. In addition, the fitted and predicted values of Tax revenues from SMEs are 0.5414 and 0.2816 respectively, resulting in a residual value of 0.2598. These resulted in an overall goodness of fit of 0.6295, thus indicating that desk tax audit, field tax audit and back duty audit explain 62.95% of the variation in tax revenue, with tax compliance as the mediator between tax audit and tax revenue (Table 6).

Based on the p values of the  $\chi^2$  tests, the results of the Wald test suggest statistical significance, thus indicating that the coefficients are significantly different from zero (0). Consequently, the model fits the data well (Table 7).

The goodness of fit statistic shows that the model is not different from the saturated but the baseline is different from the saturated since the p values of the  $\chi^2$  of the model versus saturated and that of the baseline versus saturated are 0.000 (1.00) and 316.7 ( $p < 0.01$ ) respectively (Table 8).

The results of the stability analysis of the simultaneous equations indicate that all the eigenvalues lie inside the unit circle, this means that the model is stable (See Table 9). To this end, all the goodness of fit tests indicate that the model is a good fit for the data

Lastly, Table 10 shows the results of the Breusch Pagan and White's tests for heteroscedasticity. The results indicate the absence of heteroscedasticity, as the tests are not statistically significant, thus indicating homoscedasticity (Table 10).

The direct effects of the structural equation model of tax audit and the tax compliance of SMEs show that all the measures of the explanatory variables, dta, fta and bdta have positive relationships with tax compliance. However, while the bdta has a positive and insignificant relationship with SME tax compliance, the relationships between dta and SME tax compliance as well as, fta and SME tax compliance are statistically significant. The implication is that effective desk tax and field task audits increase tax compliance (Table 11 and Fig. 1). The direct effects of the path diagram analysis of the structural equation model of the

**Table 7 Wald tests for equations.**

	$\chi^2$	P value
Observed		
tc	256.16	0.0000
tr	222.17	0.0000

**Table 8 Fit statistics.**

Fit statistic	Value	Description
Likelihood ratio		
$\chi^2$	0.000	Model vs. saturated
P value	1.00	-
$\chi^2$	316.706	Baseline vs. saturated
P value	0.000	-

**Table 9 Stability analysis of simultaneous equation systems Eigenvalue stability condition.**

Eigenvalue	Modulus
0	0
0	0

SEM satisfies stability condition.

**Table 10 Breusch-Pagan/Cook-Weisberg test for heteroskedasticity.**

Ho: constant variance		
$\chi^2$	=	0.70
P value	=	0.4020
White's test for Heteroskedasticity		
$\chi^2$	=	13.58
P value	=	0.4817

**Table 5 Descriptive statistics.**

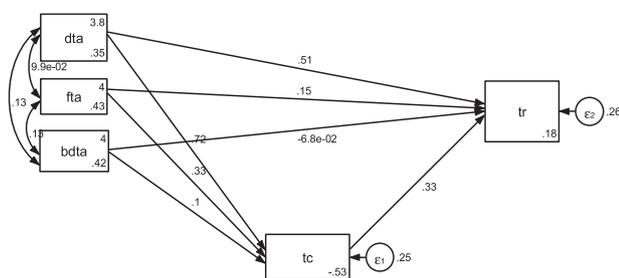
	Mean	Standard deviation
Desk tax audit	3.761	0.5906
Field tax audit	4.017	0.6608
Back duty tax audit	3.960	0.6534
Tax compliance	3.9268	0.7472
Tax revenue	3.7333	0.7376

**Table 6 Equation-level goodness of fit.**

Variance						
depvars	Fitted	Predicted	Residual	R <sup>2</sup>	mc	mc2
Observed						
tc	0.5556217	0.3086291	0.2469925	0.5554663	0.7452961	0.5554663
tr	0.541355	0.2815586	0.2597965	0.5200997	0.7211794	0.5200997
Overall	-	-	0.6295374	RMSE		0.2223

**Table 11 Structural equation model of tax audit and SME tax revenue (direct effects).**

	OIM					
	Coef.	Std.	Err.	z	P >  z	[95% conf. interval]
Structural						
tc <-						
dta	0.7189561	0.063723	11.28	0.000	0.5940614	0.8438508
fta	0.3349027	0.0559657	5.98	0.000	0.2252119	0.4445935
bdta	0.1024702	0.0583395	1.76	0.079	-0.0118731	0.2168134
tr <-						
tc	0.329661	0.0716305	4.60	0.000	0.1892679	0.4700542
dta	0.5141632	0.0832062	6.18	0.000	0.3510819	0.6772444
fta	0.1479594	0.0622094	2.38	0.017	0.0260311	0.2698876
bdta	-0.0677689	0.060281	-1.12	0.261	-0.1859176	0.0503797



**Fig. 1 SEM path diagram of tax audits on tax revenues of SMEs in Nigeria.** The figure presents the paths from the independent variable (tax audits) to the dependent variable (tax revenue from SMEs) and from the independent variable through the mediating variable (tax compliance) to the dependent variable.

relationships between tax audit, tax compliance and Tax revenues from SMEs show that tax compliance (tc) and all the explanatory variables (dta, fta and bdta) have positive relationships with tax revenue. However, while bdta has an insignificant relationship with tax revenue, the relationships between tax compliance and Tax revenues from SMEs, dta and Tax revenues from SMEs as well as that, between fta and tax revenues from SMEs are statistically significant. Thus, effective dta and fta have statistically significant influences on SME tax compliance and Tax revenues from SMEs (Table 11 and Fig. 1).

The structural equation model (indirect effects) of tax audit and Tax revenues from SMEs with tax compliance as the link between tax audit and tax revenue shows that all the explanatory variables (dta, fta and bdta) have positive relationships with tax compliance. However, while the relationship between bdta and Tax revenues from SMEs is not statistically significant, that between dta and Tax revenues from SMEs, as well as, that between fta and tax revenues from SMEs are statistically significant (Table 12).

The results of the hypotheses are summarised in Table 13

Regression coefficients: Transforming the coefficients into the regression formula model yields:

$$tc = 0.71dta + 0.33fta + 0.13bdta + e(\text{Direct Effects}) \quad (v)$$

$$tr = 0.33tc + 0.51dta + 0.15fta - 0.068bdta + e(\text{Effects}) \quad (vi)$$

$$tr = 0.237dta + 0.110fta - 0.02bdta + e(\text{Indirect Effects}) \quad (viii)$$

**Discussion.** The first three hypotheses sought to test the relationships between tax audit (dta, fta and bdta) and SME tax compliance. Based on the p values of the Z statistics ( $p < 0.001$ ,

$p < 0.001$  and 0.079) for dta, fta and bdta the study rejects the third hypothesis but does not reject the first and second hypotheses. Thus, the study’s findings support the first two hypotheses. Consequently, dta and fta have significant influences on SMEs tax compliance. The rejection of the third hypothesis implies that bdta has no statistically significant influence on SME tax compliance. The results support Olaye and Ekundayo (2019), Enofe et al. (2018), as well as, Onuoha and Dada (2016).

The fourth, fifth and sixth null hypotheses were tested to examine the relationships between tax audit (dta, fta and bdta) and Tax revenues from SMEs. Based on the p values, the study does not reject the fourth and fifth hypotheses. The findings show that the study supports the fourth and fifth hypotheses based on the significant probabilities. Thus, dta and fta significantly influence Tax revenues from SMEs. The results are consistent with Olaye and Ekundayo (2019), Enofe et al. (2018), Onuoha and Dada (2016). The findings did not support the sixth hypothesis; the implication is that back-duty audits do not have any significant influence on Tax revenues from SMEs. The study tested the seventh hypothesis to examine the relationship between tax audits (desk tax audit, field tax audit and back duty audit) and Tax revenues from SMEs with tax compliance as the nexus between tax audit and tax revenue. The results indicate that desk tax audit and field tax audit have significant positive influences on Tax revenues from SMEs but back duty tax audit does not have any statistically significant influences on Tax revenues from SMEs. To this end, tax compliance has a partial linkage influence on the relationship between tax audit and SME tax compliance. The results are consistent with Adelana (2022) investigated, Oladele et al. (2021), Olaye and Ekundayo (2019), Enofe et al. (2018) and Onuoha and Dada (2016).

**Practical implication.** The constraint to optimum tax revenue in Nigeria and other sub-Saharan African countries is the poor level of compliance by taxpayers, individuals and corporate entities. Thus, any measure that can enhance tax compliance will stimulate tax revenue. The practical implication of the results of this study is that the policymakers in government and other stakeholders can stimulate tax compliance and boost the taxes from the SMEs through effective regulation, through tax audit since this study’s results indicate that tax audit is critical to the enhancement of Tax revenues from SMEs. Specifically, the results show that desk tax Audits and field tax Audits have statistically significant effects on tax compliance. To this end, the tax authorities and the regulatory bodies, especially the Federal Inland Revenue Service (FIRS) should let the results of tax audits guide them to know the remote causes of the tax behaviours of SMEs so that it will aid policymaking. There is a need to formulate stricter policies on tax audits to make them more effective and thus, elicit the desired level of compliance required to

**Table 12 Structural equation model of tax audit and SME tax revenue (indirect effects).**

	OIM					
	Coef.	Std.	Err.	z	P >  z	[95% Conf. Interval]
Structural	-	-	-	-	-	-
tc <-	-	-	-	-	-	-
dta	0	(no path)	-	-	-	-
fta	0	(no path)	-	-	-	-
bdta	0	(no path)	-	-	-	-
tr <-	-	-	-	-	-	-
tc	0	(no path)	-	-	-	-
dta	0.2370118	0.0556189	4.26	0.000	0.1280009	0.3460228
fta	0.1104044	0.0302634	3.65	0.000	0.0510891	0.1697196
bdta	0.0337804	0.0205853	1.64	0.101	-0.006566	0.0741269

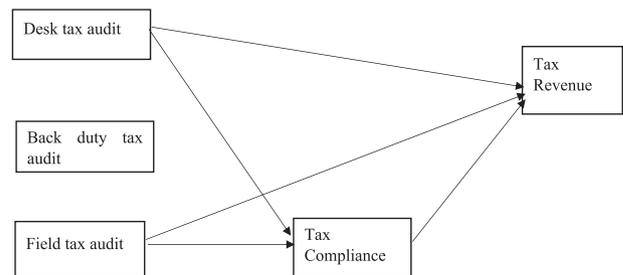
**Table 13 Summary of hypotheses and results.**

Hypothesis		Result
One	There is a positive relationship between desk-tax audit and SME tax compliance	Supported
Two	There is a positive relationship between field-tax audit and SME tax compliance	Supported
Three	There is a positive relationship between back duty-tax audit and tax	Not Supported
Four	Compliance from SMEs	Supported
Five	There is a positive relationship between field-tax audit and tax revenues from SMEs	Supported
Six	There is a positive relationship between back duty-tax audit and the tax	Not Supported
Seven:	Tax compliance has a positive significant linkage on the relationship between Tax audit and the tax revenues from SMEs.	Supported

optimise the tax revenues from the SMEs and enhance the nation’s Gross Domestic Product (GDP). However, it is pertinent to note that the principle of deterrence works well only when the tax policy is appropriate. Taxes should be bearable otherwise; the whole essence will collapse as explained by the Laffer curve theory in Economics (Sanz-Sanz, 2022).

**Theoretical contribution.** The study employed the classical theory of tax compliance, the Policeman theory and the regulation theory. The major thrust of the study is on regulation with a specific focus on the employment of a deterrence mechanism by the classical, regulation and Policeman theories to put a check on the propensities for tax evasion and avoidance, thus policing the firms in respect of the violation of tax ethics to enhance tax compliance. To this end, the study has made a theoretical contribution since the results show that the contribution of dta and fta to tax compliance support hypotheses one and two, thus indicating that dta and fta stimulate tax compliance and ultimately, tax revenue. This is consistent with the regulation and deterrence theories of tax evasion, especially the classical theory of tax compliance and the Policeman theory since the two theories show that deterring people from tax evasion is all that is required to enhance tax compliance and thus, contribute to the enhancement of revenue from tax. The deterrence of desk and field tax audits to tax evasion by SMEs is responsible for their significant influence on tax compliance and the attendant statistically significant effects on tax revenues from SMEs. However, the statistical test for significance indicates that bdta does not have any significant relationship with tax compliance. Thus, bdta does not support the regulation and deterrence theories.

**Proposed model of tax audit and tax revenues from SMEs with tax compliance as the nexus between tax audit and tax revenue.** Consequent to the findings, a model of tax audit and Tax revenues



**Fig. 2 Proposed model of tax audits on tax revenues of SMEs in Nigeria.** The figure shows the proposed relationships between tax audits and taxrevenue from SMEs through the mediation of tax compliance.

from SMEs is proposed. Specifically, the model shows that desk tax audits and field tax audits have significant influence on SME tax compliance; however, bdta does not have a statistically significant effect on SME tax compliance. Similarly, dta and fta significantly influence tax revenues of SMEs. However, bdta does not have any significant influence on tax revenue. This shows that tax administrators have not had any incidences of falsification of tax records to correct or not many of such cases have come to the notice of tax authorities. In addition, tax compliance provides a partial mediation between tax audit and tax revenue (Fig. 2).

**Conclusion**

The study examined the influence of tax audit (dta, fta and bdta) on tax compliance and tax revenue from SMEs in Nigeria. Based on the results, the study’s conclusions are as follows: desk tax audit and field tax audit have statistically significant influences on SME tax compliance. Thus, tax audits have a significant positive influence on tax compliance and this has a significant positive influence on tax

revenue. In addition, desk tax audits and field tax audits significantly influence the tax revenues from SMEs. Furthermore, tax compliance has a significant influence on tax revenue and provides a nexus/mediation for the relationship between tax audits and tax revenue. To this end, policymakers in government and tax authorities can employ tax audits to enhance SMEs' tax compliance in boosting tax revenues from the SMEs and thus, improve the nation's GDP with the tax revenues.

This study has contributed significantly to Accounting, and Management Sciences knowledge. Although there are several studies on tax audits and tax revenues, many have not examined it from the perspective of SMEs. To this end, there is a significant departure from previous studies through the examination of the problem from the perspective of SMEs as well as the integration of the frameworks of the classical theory of tax compliance the Policeman theory and regulatory theory. By so doing, the study supports the use of deterrence in significantly mitigating tax evasion among SMEs and thus enhancing their tax compliance. This new insight will enable the government to increase its capacity to meet up with its financial obligations given the government's current deep involvement in internal and external debt burdens.

The study encountered some constraints, which served as its limitations. The first limitation is the restriction of the constructs of the study's variables as is consistent with quantitative studies. Future studies should endeavour to include open-ended items for the respondents and thus use mixed research methods. Such inclusion of open-ended items will allow the respondents to make suggestions that will enable the study to provide new insights. Secondly, the study employed respondents' opinions to measure tax revenue owing to the scarcity of data on SME tax revenue. Given the increasing sensitisation on the need for electronic taxation, it is likely that very soon; SME tax data will be abundantly available online. This demands that future studies attempt to elicit available data and combine it with respondents' opinions to enable data triangulation. Thirdly, the study relied on online respondents for the research data. However, it is often difficult to achieve randomisation with online data collection bearing in mind that even after attempting to accomplish randomisation, some of the respondents may not respond, thus necessitating the inclusion of additional respondents. The difficulties associated with achieving randomisation constitutes a limitation to this study as randomisation is a prerequisite for a sample to be representative of the population and hence the generalisability of the results. This study suggests that future studies employ field surveys to overcome this limitation and thus enhance the chance of randomisation and the attendant generalisability of the results.

### Data availability

The study employed primary data and the dataset is attached as a supplementary file to this Submission.

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### References

- Adelana OO (2022) Tax audit and tax revenue generation In Nigeria. *Int J Innov Res Adv Stud* 9(7):59–66
- Akpabi MD, Igbekoyi ME (2019) Electronic taxation and tax compliance among selected fast food restaurants in Lagos state, Nigeria (taxpayers perspective). *Eur J Account Auditing Financial Res* 7(7):52–80
- Alabede JO, Ariffin ZZ, Idris KM (2011) Individual taxpayers' attitude and compliance behaviour in Nigeria: the moderating role of financial condition and risk preference. *Eur J Econ Financ Adm Sci* 3(5):91–104
- Aladejebi O (2018) Measuring tax compliance among small and medium enterprises in Nigeria. *Int J Account Tax* 6(2):29–49
- Al-Asfour F, Abu Saleem K (2023) Tax ethics and tax compliance: evidence from emerging markets. *Corp Gov Organ Behav Behav Rev* 7(4):127–136. <https://doi.org/10.22495/cgovbrv7i4p11>
- Atawodi OW, Ojeka S (2012) Factors that affect tax compliance among small and medium enterprises (SMEs) in north central Nigeria. *Int J Bus Manag* 7(12):87–96
- Awe OI (2008) *The Theory and practice of auditing*. Gilgal Publications, Lagos
- Cheung GW, Cooper-Thomas HD, Lau RS et al (2024) Reporting reliability, convergent and discriminant validity with structural equation modelling: A review and best-practice recommendations. *Asia Pac J Manag* 41:745–783. <https://doi.org/10.1007/s10490-023-09871-y>
- Delgado FJ, Rodríguez EF, Fernández RG, Landaja M, Arias AM (2023) Tax avoidance and earnings management: a neural network approach for the largest European economies. *Financial Innov* 9(19):1–25
- den Hertog, J (2010). Review of economic theories of regulation. a discussion paper series nr: 10-18 of Tjalling C. Koopmans Research Institute. [https://www.uu.nl/sites/default/files/rebo\\_use\\_dp\\_2010\\_10-18.pdf](https://www.uu.nl/sites/default/files/rebo_use_dp_2010_10-18.pdf)
- Duy, NV, & Tran, TQ (2020). The influence of international standards on SME tax compliance in Vietnam. *Finance Research Letters*. <https://doi.org/10.1016/j.frl.2020.101750>. As explicitly spelt out, this seeks to ascertain how international standards affect SME tax compliance
- Enofe A, Embele K, Obazee EP (2018) Tax audit, investigation, and tax evasion. *J Account Financial Manag* 5(4):47–66
- Gaffikin, M. (2004). Regulation as Accounting Theory, School of Accounting & Finance, University of Wollongong, Working Paper 9. <https://ro.uow.edu.au/acfinwp/50>
- Gebreyesus SA (2020) Assessment of tax audit practice and its challenges a case study of ethiopian revenue and custom authority large taxpayers. *Int J Innov Sci Res Technol* 5(1):805–812
- Hair, JF, Black, WC, Babin, BJ, Anderson RE and Tatham, RL (2006). *Multivariate data analysis*. New York, NJ, Pearson Prentice Hall
- Hassan, I, Naeem, A, & Gulzar, S (2021). Voluntary tax compliance behavior of individual taxpayers in Pakistan. *J Financial Innov* <https://doi.org/10.1186/s40854-021-00234-4>
- Ibrahim M, Musah A, Abdul-Hanan A (2015) "Beyond enforcement: what drives tax morale in Ghana". *Humanomics* 31(4):399–414
- Ibrahim, S (2016). *Basic research methods in social sciences*. Benin City, UNIBEN Press, University of Benin, Nigeria
- Inasius F (2019) Factors influencing SME tax compliance: Evidence from Indonesia. *Int J Public Adm* 42(5):367–379. <https://doi.org/10.1080/01900692.2018.1464578>
- Inegbedion HE, Obadiaru E (2018) Modelling brand loyalty in the Nigerian telecommunications industry. *J Strateg Mark* 27(7):583–598. <https://doi.org/10.1080/0965254X.2018.1462842>
- Jacob M, Schütt HH (2019) Firm valuation and the uncertainty of future tax avoidance. *Eur Account Rev* 29(3):409–435. <https://doi.org/10.1080/09638180.2019.1642775>. This seeks to find out how firm valuation affects future tax avoidance by firms
- Kaldoński M, Jewartowski T (2020) Do firms using real earnings management care about taxes? Evidence from a high book-tax conformity country. *Fin Res Lett* 35:101351. <https://doi.org/10.1016/j.frl.2019.101351>
- Kasper M, Alm J (2022) Audits, audit effectiveness, and post-audit tax compliance. *J Econ Behav Organ* 195:87–102. <https://doi.org/10.1016/j.jebo.2022.01.003>
- Marti OL (2010) Taxpayers' attitudes and tax compliance behaviour in Kenya. *Afr J Bus Manag* 1(1):112–122
- Mbotor ED (2019) The effect of tax audit on productivity of internal revenue service: Cross-river state experience. *Eur J Account Audit Financ Res* 7(6):1–11
- MacLeod, G and Holden, A (2009). Regulation, rob kitchin and nigel thrift (eds.) *International Encyclopedia of Human Geography*, Elsevier, 309-313, <https://doi.org/10.1016/B978-008044910-4.00802-6>
- Mongwaketse, PB (2015). Perceived effects of an electronic filing system on tax compliance in a district municipality, South Africa. <https://repository.nwu.ac.za/handle/10394/17381>
- Mohammed AU, Derashid C, Ibrahim IB (2016) Income tax noncompliance in Nigeria and the Moderating effect of public Governance Quality: a suggested framework. *Mediterr J Soc Sci* 6(2016):338–349
- NBS (2013). SMEDAN and National Bureau of Statistics collaborative survey selected findings. [https://nigerianstat.gov.ng/pdfuploads/SMEDAN%202013\\_Selected%20Tables.pdf](https://nigerianstat.gov.ng/pdfuploads/SMEDAN%202013_Selected%20Tables.pdf)
- Night S, Bananuka J (2020) The mediating role of adoption of an electronic tax system in the relationship between attitude towards electronic tax system and tax compliance. *J Econ, Financ Adm Sci* 25(No. 49):73–88. <https://doi.org/10.1108/JEFAS-07-2018-0066>
- Ogunbela, GK, Akinboboye, OM Ogunbiyi, TL (2021). Tax regime and challenges of scaling up tax collection in Nigerian informal economy. *J Public Administration, Finance and Law* 10(20):250–266

- Oladele AA, Ndalu TC, Akani EN (2021) The Impact of tax audit practices on revenue generation in Nigeria. *Int J Innov Financ Econ Res* 9(4):42–50. Oct-Dec., 2021
- Olaoye C, Ekundayo A (2019) Effects of tax audit on tax compliance and remittance of tax revenue in ekiti state. *Open J Account* 8:1–17. <https://doi.org/10.4236/ojacct.2019.81001>
- Olaoye CO, Ogundipeb AA (2018) Application of tax audit and investigation on tax evasion control in Nigeria. *J Account, Financ Auditing Stud* 4/1:79–92
- Olaoye CO, Ogunleye SA, Solanke FT (2018) “Tax audit and tax productivity in Lagos state, Nigeria”. *Asian J Account Res* 3(No. 2):202–210. <https://doi.org/10.1108/AJAR-08-2018-0028>
- Oghuma RI (2018) Tax audit, penalty and tax compliance in Nigeria. *Int J Account Financ* 7(2):74–91
- Onuoha LN, Dada SO (2016) Tax audit and investigation as imperatives for efficient Tax Administration in Nigeria. *J Bus Adm Manag Sci Res* 5(5):66–76
- Otekinrin AO, Nwanji TI, Eluyela DF, Inegbedion HEleda T. (2021) E-tax system effectiveness in reducing tax evasion in Nigeria. *Prob Perspect Manag* 19(4):175–185. <https://doi.org/10.21511/ppm>
- Richards, NU and Ekhatior, EO (2019). Electronic taxation in Nigeria: challenges and prospects, *International Company and Commercial Law Review*. <https://www.researchgate.net/publication/330422913>
- Rixen T, Unger B (2022) Taxation: a regulatory multilevel governance perspective. *Regul Gov* 16(3):621–633. <https://doi.org/10.1111/regg.12425>
- Sandmo A (2005) The theory of tax evasion: a retrospective view. *Natl Tax J* 53(4):643–648
- Sanz-Sanz JF (2022) A full-fledged analytical model for the Laffer curve in personal income taxation. *Econ Anal Policy* 73:795–811
- Singh, V. (2003). *Tax Compliance and Ethical Decision Making: Malaysian Perspective*. Longman
- Trifan VA, Szentesi SG, Cuc LD, Pantea MF (2023) Assessing tax compliance behavior among romanian taxpayers: an empirical case study. *Sage Open* 13(3):1–21. <https://doi.org/10.1177/21582440231195676>
- Trivedi A, Shehata C (2005) Attitudes, incentives, and tax compliance. *Br J Soc Psychol* 40:471–499
- Uche CU (2001) The theory of regulation: a review article. *J Financial Regul Compliance* 9(1):67–80
- Udofot PO, Etim EO (2017) The effect of tax revenue components from smes on the economic growth of Nigeria from 1980–2015}. *Res J Financ Account* 8:117–122
- Wei J.Z, Cheung B.K.C, Chu S.L.H (2023) Assessment of reliability and validity of a handheld surface spine scanner for measuring trunk rotation in adolescent idiopathic scoliosis. *Spine Deform* 11:1347–1354. <https://doi.org/10.1007/s43390-023-00737-3>

### Author contributions

The authors contributed to the manuscript as follows”. H.E.: conceptualisation, problem formulation, literature review, methodology, data analysis, interpretation of results, discussion of findings, supervision and conclusion. C.O.: data collection, data analysis, references and manuscript revision

### Ethical approval

The study sought and got ethical approval from the Research Ethical Board of Bowen University, Iwo Nigeria. However, there was no ethical number, as the Ethical committee of the author’s institution is yet to get its license, so it does not currently issue numbers in its Ethical Approvals.

### Informed consent

The author sought and obtained Informed consent before and throughout the data collection process. The authors informed the sampled respondents of the research objective before administering the research instrument to them. The authors ensured the anonymity of the respondents, as there was no indication of personal identifiers on the questionnaire. The administration of the questionnaires began only after the respondents gave their affirmative consent, as participation was solely voluntary

### Competing interests

The authors declare no competing interests.

### Additional information

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