

Forensic Accounting Techniques and Fraud Control in the Nigerian Public Sector: The Moderating Role of Financial Inclusion

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Abstract

Purpose: This study investigated the effect of forensic accounting techniques on fraud control in the Nigerian public sector and examined whether financial inclusion strengthens the relationship between forensic accounting techniques and fraud control. Specifically, the study evaluated the influence of data mining, ratio analysis, trend analysis, and the net worth method on fraud control while assessing the moderating role of financial inclusion.

Methodology: A quantitative survey research design was adopted. Data were collected from 296 respondents drawn from federal and state Ministries, Departments, and Agencies (MDAs) in Calabar, Cross River State. A structured questionnaire was used for data collection, while Structural Equation Modelling (SEM) was employed for data analysis.

Results and Conclusion: The findings revealed that data mining and trend analysis have significant positive effects on fraud control, indicating their effectiveness in identifying irregularities and fraudulent practices in the public sector. Conversely, ratio analysis and the net worth method showed significant negative relationships with fraud control, suggesting possible challenges in their application. The study further found that financial inclusion significantly moderates the relationship between forensic accounting techniques and fraud control by enhancing transparency, accountability, and financial traceability. These findings provide empirical support for the Vulnerable Group Theory of financial inclusion.

Implication of Findings: The study contributes to forensic accounting literature by providing evidence from the Nigerian public sector and highlighting the importance of financial inclusion in strengthening fraud control. It recommends the institutionalization of forensic accounting practices and the expansion of financial inclusion initiatives to improve fraud detection and prevention.

Keywords: Data Mining, Ratio Analysis, Trend Analysis, Net worth Method

1. Introduction

Fraud remains one of the greatest challenges confronting Nigeria's public sector, undermining economic growth, public confidence, and the effective delivery of essential public services. Despite various anti-corruption initiatives introduced since the return to democratic governance in 1999, cases of embezzlement, money laundering, misappropriation of public funds, procurement fraud, and other financial irregularities continue to occur. To address these challenges, the Nigerian government established institutions such as the Independent Corrupt Practices and Other Related Offences Commission (ICPC), the Economic and Financial Crimes Commission (EFCC), the Code of Conduct Bureau (CCB), and the Nigeria Extractive Industries Transparency Initiative (NEITI) to strengthen transparency and accountability in the management of public resources.

Forensic accounting has increasingly become an important tool for detecting, investigating, and preventing fraud by combining accounting, auditing, investigative, and legal skills (Eisenberg, 2018). The evidence generated through forensic accounting investigations is often admissible in judicial proceedings (Singleton & Singleton, 2010). Consequently, scholars have acknowledged forensic accounting as an effective mechanism for combating financial crimes and corruption (Abdallah et al., 2016; Ozili & Mhlanga, 2024; Pourhabibi et al., 2020).

Notwithstanding these institutional and professional efforts, fraud remains pervasive in Nigeria's public sector. Gbegi and Adebisi (2014) and Micah (2022) observed that fraudulent practices have become widespread across different levels of government. Similarly, the Central Bank of Nigeria (2015) introduced enhanced measures to curb illicit financial flows, while the United Nations Conference on Trade and Development (UNCTAD, 2020) estimated that Africa loses about US\$88.6 billion annually through illicit financial flows, with Nigeria accounting for approximately US\$10 billion according to reports by the Independent Corrupt Practices and Other Related Offences Commission (ICPC). According to Igwe (2021), these resources could have been invested in infrastructure, employment creation, and poverty reduction. Fraud also weakens public institutions, reduces government effectiveness, erodes public trust, and threatens sustainable economic development (Usman & Shah, 2013; Eghe-Ikhrhe et al., 2024; Wijerathna & Perera, 2020). Consequently, Abdullahi and Mansor (2018) described financial fraud as one of the most serious economic threats facing modern economies.

The increasing sophistication of financial crimes and corporate scandals such as Enron and WorldCom has strengthened the need for advanced forensic accounting techniques capable of detecting complex fraudulent activities (Popoola et al., 2015). Consequently, forensic accounting now employs several investigative techniques, including data mining, ratio analysis, trend analysis, Benford's Law, financial statement analysis, and the net worth method to identify irregularities and support fraud investigations (Ozuomba et al., 2016; Ojo-Agboodu et al., 2022; Ozili, 2018; Burzinji et al., 2022; Adebisi & Gbegi, 2015; Oyerogba, 2021; Eghe-Ikhrhe et al., 2024).

Although previous studies have established the effectiveness of forensic accounting techniques in fraud detection and prevention, little empirical attention has been given to factors that may strengthen their effectiveness in controlling fraud within the public sector. One such factor is financial inclusion, which refers to the provision of affordable and accessible financial services to all members of society, particularly vulnerable groups (Ozili, 2018; Ozili, 2020). Greater financial inclusion enhances transaction traceability, strengthens audit trails, and improves accountability, thereby supporting forensic investigations. Recent cases involving the diversion of funds meant for vulnerable groups further demonstrate the importance of integrating financial inclusion into public sector fraud control mechanisms.

Against this background, this study investigates the effect of data mining, ratio analysis, trend analysis, and the net worth method on fraud control while examining the moderating role of financial inclusion among selected Ministries, Departments, and Agencies (MDAs) in Cross River State, Nigeria. Unlike previous studies that focused mainly on the direct effects of forensic accounting techniques, this study contributes to the literature by examining whether financial inclusion strengthens the relationship between forensic accounting techniques and fraud control in the Nigerian public sector.

General Objective

To examine the effect of forensic accounting techniques on fraud control in selected Ministries, Departments and Agencies in Cross River State, Nigeria, and determine whether financial inclusion moderates this relationship.

Specific Objectives

The study specifically sought to:

1. determine the effect of data mining on fraud control in selected public sector MDAs in Cross River State;

2. examine the effect of ratio analysis on fraud control in selected public sector MDAs;
3. investigate the effect of trend analysis on fraud control in selected public sector MDAs;
4. assess the effect of the net worth method on fraud control in selected public sector MDAs; and

determine whether financial inclusion significantly moderates the relationship between forensic accounting techniques and fraud control.

2. Literature review

Data mining and fraud control

Data mining, which involves analyzing large datasets to uncover patterns and relationships, has become a powerful tool for detecting and preventing fraud. Techniques like classification, clustering, regression, and association analysis enhance the capacity of public institutions to identify and mitigate fraudulent activities, leading to improved transparency and accountability. Classification techniques, such as decision trees and neural networks, classify transactions as normal or fraudulent based on historical data.

Izedomin and Mgbame (2011) demonstrated that classification models, particularly decision trees, could efficiently differentiate between normal and fraudulent transactions in Nigerian public sector accounts. This work is significant in showing how historical data can inform predictive models that preemptively flag anomalies.

Similarly, Okoye et al. (2019) illustrated that clustering algorithms effectively identify outliers within financial datasets, a crucial step in exposing hidden or previously undetected fraudulent behavior.

Regression-based models also feature prominently. Modugu and Ayaduba (2013) found that regression analysis could predict fraud risk in public procurement with notable precision, providing a quantitative foundation for targeted interventions.

Furthermore, Olukowade and Balogun (2015) employed association analysis to uncover patterns of collusion and overpricing, demonstrating that data mining not only detects fraud but also informs systemic policy responses.

Finally, Ewa et al. (2020) expanded the scope by integrating ratio and trend analysis, confirming that data mining enhances fraud prevention capabilities in the banking sector.

Despite their contributions, the reviewed studies exhibit certain methodological limitations. First, most employ case-specific datasets (primarily Nigerian public sector or financial institutions), which restricts the generalizability of findings to other contexts or countries. The over-reliance on structured financial data also neglects unstructured data sources (e.g., textual reports or social networks) that could provide richer insights. Moreover, few studies provide detailed descriptions of data preprocessing, feature selection, or model validation – critical components that determine the robustness and reproducibility of data mining techniques.

Ratio analysis and fraud control

Ratio analysis is a financial tool used to evaluate relationships between different financial statement items. In Nigeria's public sector, it can help detect and prevent fraud by highlighting discrepancies and unusual patterns in financial data. In the views of Eghe-Ikhrurhe et al.(2024), financial statement analysis can identify inconsistencies or red flags that indicate potential fraud.

Agyei-Mensah (2015) applied the financial ratios (independent variables), as red flags, to predict potential financial statement fraud risk because of its simplicity, flexibility, and popularity among the financial community. The financial ratios examine relationships between two or more different items on the financial statements and identify trends (positive or negative) in these relationships. Multiple ratios can be calculated by relating different items in the financial statements.

Oyadonghan and Ogoun(2017) and Ogbaini et al.(2024) found that ratio analysis in Nigerian local government accounts revealed inflated asset values, leading to the discovery of fraud.

Similarly, Ariyo-Edu, et al. (2024) noted that unusually high profit margins in Nigerian public enterprises often pointed to revenue overstatement and fraudulent reporting.

Saman (2019) demonstrating that entities with abnormal liquidity ratios were more likely to engage in fraudulent cash-handling practices, posited that liquidity ratios, such as the quick ratio and cash ratio, can signal potential fraud, just like the debt-to-equity ratio can uncover fraud related to borrowing.

Ewa et al. (2020) evaluated the application of forensic accounting techniques in preventing/detecting fraudulent practices in commercial banks in Nigeria by specifically assessing the impact of commercial data mining, ratio analysis and trend analysis techniques in fraud detection/prevention. The study revealed the importance of ratio analysis as well as trend analysis techniques in fraud detection/prevention.

Despite its effectiveness, ratio analysis has limitations, such as the accuracy of the data and the need for sector-specific benchmarks, therefore, it may be necessary to combine ratio analysis with other forensic accounting techniques for accurate fraud detection. Despite these challenges, ratio analysis remains a valuable tool for detecting and preventing fraud, enhancing financial transparency in Nigeria's public sector (Akhideme & Uagbale, 2014; Enyi, 2009). By identifying and investigating abnormal ratios, institutions can uncover fraud and safeguard public resources.

Trend analysis and fraud control

Trend analysis is an effective fraud detection method when applied to both financial and operational data over time. It is particularly useful for detecting patterns and anomalies that indicate fraudulent activities, as seen in the Nigerian public sector (Ariyo-Edu & Woli-Jimoh (2024).

Garba (2024) asserted that trend analysis can reveal cases of revenue overstatement, which can be a pointer to fraudulent practices.

Ogbaini et al.(2024) examined the trend analysis of payroll data, and found that the analysis of operational data, such as procurement patterns can uncover anomalies like inflated contract prices, hinting at collusion or kickback schemes.

Ladi-Awofeso et al.(2023, found that trend analysis has uncovered cases of ghost employees and fraudulent salary payments in Nigerian public sectors, resulting in significant cost savings.

A study by Ewa et al. (2020) shows that trend analysis techniques is effective in fraud detection/prevention.

Net worth method and fraud control

Regarding the Net Worth Method, Botha (2009) defines "Net Worth" as the difference between a person's assets and liabilities at a given time – often referred to as "equity" or "capital" (Madinger, 2006). The Net

Worth method is a widely used indirect technique for circumstantially proving income from unknown or illegal sources.

Odoemenam and Ayogoi (2025) examined the effectiveness of lifestyle audits in preventing and detecting fraud in the Bayelsa State Public Service. Using a survey research design, the study found that the comparison of employees' assets, expenditure patterns, and declared income significantly enhances fraud detection and discourages illicit wealth accumulation among public officials. The study concluded that net worth analysis is an effective tool for strengthening accountability and transparency in the public sector.

Similarly, Akinadewo et al. (2024) investigated the determinants of forensic accounting techniques used in fraud investigations in Nigeria. Employing survey data from forensic accounting practitioners and analyzing the responses with multivariate statistical techniques, the study found that asset tracing, wealth verification, and indirect income assessment techniques, including the net worth method, are effective in uncovering concealed fraud and unexplained wealth. The study emphasized the importance of adopting advanced forensic techniques in fraud investigations.

In another study, Obadiah and Ibrahim (2024) examined the role of forensic accounting skills in financial fraud detection among Nigerian Ministries, Departments, and Agencies (MDAs). Using a survey design and responses obtained from accounting and audit personnel, the study revealed that wealth assessment, asset verification, and financial investigation techniques significantly improve fraud detection capabilities. The findings suggest that net worth-related procedures enhance the ability of public institutions to identify financial irregularities.

Furthermore, Onyema et al. (2024) assessed the impact of forensic accounting on fraud management in selected deposit money banks in Nigeria. The study employed a survey research design and analyzed the data using regression techniques. The findings showed that forensic accounting techniques significantly improve fraud management by facilitating the identification of hidden assets, suspicious transactions, and unexplained income sources. The study concluded that asset-based investigative procedures contribute substantially to fraud prevention and control.

More recently, Ojo et al. (2025) investigated the effect of forensic accounting techniques on fraud detection in selected public entities in Nigeria. Using survey data collected from accounting personnel and applying inferential statistical techniques, the study found that forensic accounting practices significantly enhance fraud detection and accountability. Specifically, asset verification and wealth analysis techniques were identified as effective mechanisms for uncovering financial irregularities and strengthening fraud control. Collectively, these studies provide empirical support for the argument that the net worth method is an important forensic accounting technique capable of enhancing fraud detection, accountability, and control across both public and private sector organizations.

Financial Inclusion, forensic accounting techniques and fraud control

Financial inclusion can help to combat financial crime by leaving behind an audit trail. Banks are the most common agents of financial inclusion (Ozili, 2021a; Hannig and Jansen, 2010). They can use their systems to provide an audit trail of financial transactions that are deemed suspicious and hand it over to investigators when investigators request for such information (Singleton and Singleton, 2007). An audit trail is often presented in the account statements linked to suspicious transactions (Power, 2021; Flowerday and Von Solms, 2005). When there is full financial inclusion in society, financial institutions will be able to provide an audit trail for every transaction that takes place in the financial system. This will make it easier for forensic investigators to investigate and detect fraud. The investigators will be able

to use the audit trail to link suspicious transactions to a person or entity and determine whether an actual financial crime has taken place. In contrast, when there is little financial inclusion in a society, financial institutions will not be able to provide an audit trail for every transaction that takes place in the financial ecosystem. If financial institutions are unable to provide audit trail for most transactions, forensic investigators will have difficulties in investigating fraud. The investigators will have to find another way to detect fraud.

Financial inclusion can help to combat financial crime by reducing or shrinking the size of the informal economy – which is the unregulated, untaxed and unmonitored segment of the economy (Rasanayagam, 2011).

Based on the empirical studies reviewed, the following hypotheses were formulated:

H₀₁: Data mining have no significant effect on fraud control in the Nigerian public sector.

H₀₂: Ratio analysis has no significant effect on fraud control in the Nigerian public sector.

H₀₃: Trend analysis does not significantly affect fraud control in the Nigerian public sector.

H₀₄: The Net worth method has no significant effect on fraud control in the Nigerian public sector.

H₀₅: Financial inclusion does not moderate the association between forensic accounting techniques and fraud control in the Nigerian public sector.

Theoretical framework

This study was anchored on the fraud management lifecycle theory and financial inclusion theory.

Fraud Management Lifecycle Theory

The Fraud Management Lifecycle (FML) is a network lifecycle where each node in the network and each stage in the lifecycle, is an aggregated entity comprising interrelated, interdependent, and independent actions, functions, and operations (Wilhelm, 2004). Developed in 2004, by Wilhelm, the effectiveness of the FML depends on an understanding of the stages in the lifecycle. Without an understanding of the stages and processes, conveying the benefits to stakeholders may not be easy. The fraud management lifecycle stages are: deterrence, prevention, detection, mitigation, analysis, policy, investigation, and prosecution (Wilhelm, 2004). Information technology plays a valuable role throughout the Fraud Management Lifecycle. All the stages of the Fraud Management Lifecycle benefit from the effective application of information technology. This reinforces the importance of technology in fraud management.

Financial Inclusion Theory

The financial inclusion theory is not traceable to any particular individual or group and there are conflicting perspectives of the beneficiaries of its outcome (Ozili, 2018; 2020). In the views of Sahay et al. (2015), financial inclusion is the use of, and access to, formal financial services. Financial inclusion has been a major policy objective for the governments of many developing and emerging countries, and there is great promise that financial inclusion will bring the excluded population into the formal financial sector so that they can have access to formal financial products and services (Allen et al, 2016). The literature considers financial inclusion theory from the perspective of four categories of beneficiaries: The Public good theory of financial inclusion, the Dissatisfaction theory of financial inclusion, the Vulnerable group theory of financial inclusion, and the Systems theory of financial inclusion (Ozili, 2020; Kim et al, 2018; Ghosh & Vinod, 2017; Mehrotra & Yetman, 2015; Swamy, 2014; Demircuc-Kunt et al, 2013), but,

the World Bank (2018) and Bhandari (2018) see financial inclusion from the perspective of those it considers are the ultimate beneficiaries – poor households and women. This study rests on the vulnerable group theory of financial inclusion because most of the fraud cases in the public sector concern funds meant for the vulnerable e.g. the pensions fund scandal, the school feeding programmes fraud, the conditional cash transfer scandal, and the most recent corruption case concerning grants meant for vulnerable groups in some parts of the country. Financial inclusion can mitigate the incessant diversion of fund meant for poor citizens.

3. Methodology

This study adopted a quantitative research approach anchored on the positivist research paradigm and employed a cross-sectional correlational survey research design. The quantitative approach was considered appropriate because the study sought to objectively examine the relationships among forensic accounting techniques (data mining, ratio analysis, trend analysis, and net worth method), financial inclusion, and fraud control using numerical data obtained from respondents. Although the data were collected through structured questionnaire items measured on a five-point Likert scale, the responses were coded into numerical values to facilitate statistical analysis.

The positivist paradigm underpinned the study because it assumes that social phenomena can be measured objectively and that relationships among variables can be empirically tested using statistical methods. The cross-sectional correlational survey design was considered appropriate because it enabled the examination of the relationships among the study variables without manipulating them, while data were collected from respondents at a single point in time. Primary data were obtained through a cross-sectional survey of senior staff in the Finance and Accounts, Internal Audit, and Personnel Departments of selected federal and state Ministries, Departments, and Agencies (MDAs) in Cross River State, Nigeria. The collected data were analysed using descriptive statistics, correlation analysis, and Structural Equation Modelling (SEM) to test the hypotheses and examine the moderating role of financial inclusion.

The study covered 52 Ministries, Departments, and Agencies (MDAs) located in Cross River State, Nigeria. The MDAs comprised 29 State Ministries and 23 Departments and Agencies, including the Office of the Accountant-General, Office of the Auditor-General, Cross River State Emergency Maintenance Agency, Cross River State Primary Health Care Development Agency, Cross River State Broadcasting Corporation, Cross River Basin Development Authority, Cross River State Geographical Information Agency, Cross River State Electrification Agency, Cross River State Waste Management Agency, Federal Pay Office, Cross River Urban Development Agency, Nigerian Television Authority (NTA), and several federal ministries operating within the state. These MDAs were selected because they possess finance, accounts, internal audit, and personnel departments that are directly involved in financial management, internal control, and fraud prevention activities, making them appropriate for investigating the effect of forensic accounting techniques on fraud control. Using the Krejcie and Morgan (1970) sample size determination formula for finite populations, a sample size of 300 respondents was obtained. Data were collected through a structured questionnaire consisting of 41 items, see appendix A. The instrument contained demographic questions and measurement items covering fraud control, data mining, ratio analysis, trend analysis, net worth analysis, and financial inclusion, measured on a five-point Likert scale ranging from strongly agree to strongly disagree. The questionnaire items were adapted from validated instruments used in prior studies.

The validity of the instrument was established through expert review to ensure face and content validity, while construct validity was assessed using exploratory factor analysis, with factor loadings of 0.50 and above considered acceptable. Reliability was evaluated through a pilot study involving staff from

selected MDAs, and Cronbach's alpha coefficients were computed using IBM SPSS Statistics version 26. The results indicated satisfactory internal consistency for all constructs, with reliability coefficients exceeding the recommended threshold of 0.70. The collected data were coded and subjected to statistical analysis to test the study hypotheses and address the research objectives.

Model Specification

To enable the testing of the proposed hypotheses the following model shall be relied upon:

MODEL A (Without moderation)

Fraud control = f (Forensic accounting techniques)

FRDCONTR = f (DATMIN, RATANA, TRENDANA, NETWMET)

Where:

FRDCONTR = Fraud control, measured as the effectiveness of fraud prevention, detection, investigation, and response mechanisms in the selected MDAs as perceived by respondents.

DATMIN = Data mining, measured as the extent to which analytical tools are used to identify unusual financial patterns and fraudulent transactions.

RATANA = Ratio analysis, measured as the use of financial ratio analysis to detect irregularities and possible fraudulent activities.

TRENDANA = Trend analysis, measured as the use of trend analysis to identify abnormal changes and suspicious patterns in financial records over time.

NETWMET = Net worth method, measured as the extent to which comparisons between declared income and accumulated assets are used to identify unexplained wealth and possible fraud.

FININCL = Financial inclusion, measured as the extent to which access to and use of formal financial services improve transparency, accountability, and the traceability of financial transactions.

The econometric form of the model is given as:

FRDCONTR = $\alpha_0 + \alpha_1 \text{DATMIN} + \alpha_2 \text{RATANA} + \alpha_3 \text{TRENDANA} + \alpha_4 \text{NETWMET} + \mu$

Where:

FRDCONTR = Fraud control

DATMIN = Data mining

RATANA = Ratios analysis

TRENDANA = Trend analysis

NETWMET = Net worth method

α_0 = slope

α_1 to $\alpha_4 \neq 0$ = the regression coefficients

μ = Stochastic error term

Financial inclusion was introduced as a moderating variable because greater access to and use of formal financial services improve transaction traceability, increase the availability of digital financial records, strengthen audit trails, and enhance transparency. Consequently, financial inclusion is expected to strengthen the effectiveness of forensic accounting techniques in detecting and controlling fraud within public sector institutions. Accordingly, the study examined whether financial inclusion modifies the relationship between forensic accounting techniques and fraud control by incorporating interaction terms between financial inclusion and each forensic accounting technique in the moderated model.

MODEL B (With financial inclusion moderating the relationship)

$$FRDCONTR = f(DATMIN, RATANA, TRENDANA, NETWMET, FININCL)$$

The econometric form of the model is given as:

$$FRDCONTR = \beta_0 + \beta_1 DATMIN + \beta_2 RATANA + \beta_3 TRENDANA + \beta_4 NETWMET + \beta_5 FININCL + \mu$$

$$FRDCONTR = \beta_0 + \beta_1 DATMIN + \beta_2 RATANA + \beta_3 TRENDANA + \beta_4 NETWMET + \beta_5 FININCL + \beta_6 FININCL * DATMIN + \beta_7 FININCL * RATANA + \beta_8 FININCL * TRENDANA + \beta_9 FININCL * NETWMET$$

Where:

FRDCONTR = Fraud control

DATMIN = Data mining

RATANA = Ratios analysis

TRENDANA = Trend analysis

NETWMET = Net worth method

FININCL = Financial inclusion

* = Interaction term

β_0 = slope

β_1 to $\beta_9 \neq 0$ = the regression coefficients

μ = Stochastic error term

4. Results and discussion

Data collected from the completed questionnaires were coded and entered into Microsoft Excel before being exported to the statistical software for analysis. Responses to the questionnaire items were measured on a five-point Likert scale ranging from **Strongly Disagree (1)** to **Strongly Agree (5)**. Each of the 41 questionnaire items was assigned a numerical code corresponding to the respondents' selected option.

The questionnaire items were grouped according to the study constructs: Data Mining (DATMIN), Ratio Analysis (RATANA), Trend Analysis (TRENDANA), Net Worth Method (NETWMET), Financial Inclusion (FININCL), and Fraud Control (FRDCONTR). Responses to the items measuring each construct were aggregated by computing their composite (mean) scores for each respondent. These composite scores served as the observed values used in the descriptive statistics, correlation analysis, and Structural Equation Modelling (SEM).

Descriptive statistics, including the mean and standard deviation, were computed to summarize respondents' perceptions of each construct. Pearson's correlation analysis was performed to examine the degree of association among the variables, while Structural Equation Modelling (SEM) was employed to test the direct and moderating relationships hypothesized in the study.

Table 1: Descriptive Statistics

	FRDCONTR	DATAMIN	RATANAL	TRENDANA	NETWMET	FININCL
Mean	4.45	4.38	4.51	4.38	4.53	4.56
Median	4.50	4.50	4.67	4.50	4.67	4.50
Maximum	5.00	5.00	5.00	5.00	5.00	5.00
Minimum	3.50	4.00	2.67	2.75	3.00	2.25
Std. Dev.	0.33	0.32	0.51	0.37	0.49	0.47
Skewness	-0.19	0.22	-1.18	1.38	-0.68	1.99
Kurtosis	2.38	2.09	4.48	7.23	2.63	8.36
Jarque-Bera	6.42	12.	95.73	314.82	24.71	549.70
Probability	0.04	0.002	0.000	0.000	0.000	0.000
VIF	-	1.03	1.58	1.55	1.28	-
Observations	296	296	296	296	296	296

Source: Researcher's Estimation (2026). **p < 0.001, *p < 0.05

The descriptive statistics in Table 1 show that the mean value for fraud control (FRDCONTR) is 4.45 while the standard deviation is 0.33. The maximum value is 5.00, while the minimum value is 3.50. For the predictor variables, the average values range from 4.38 for data mining (DATAMIN) and trend analysis (TRENDANA) to 4.51 for ratio analysis (RATANAL), 4.53 for net worth method (NETWMET), and 4.56 for financial inclusion (FININCL). The data set for fraud control, ratio analysis and net worth has a greater number of small values as depicted in the values of skewness which are negative, indicating that the distribution is negatively skewed. On the other hand, data set for data mining, trend analysis and financial inclusion has a greater number of large values as depicted in the values of skewness which are positive, indicating that the distribution is positively skewed. As a general guideline, a skewness value between -1 and +1 is considered excellent, but a value between -2 and +2 is generally considered acceptable. As can be seen from the result in the Table, the values of skewness for all the variables (except trend analysis and financial inclusion) are acceptable as the values are less than 1. The values of kurtosis for all the variables are positive and greater than 2 indicating that the distribution is more peaked than normal. Just like the skewness, the general guideline is that if the kurtosis is greater than +2, the distribution is too peaked. Therefore, the study concludes that all the variable in the data set is nonnormally distributed. A key condition for using the ordinary least squares regression for estimation is that the data is normally distributed, implying that the observations follow a normal (Gaussian) distribution. It is assumed that the population from which the samples are collected is normally distributed, and the null hypothesis is that "the sample distribution is normal." If the test of normality is significant, the distribution is non-normal. Using the Jarque-Bera tests to conduct the data normality test, the result shows that the data set is nonnormally distributed since the probabilities are significant at less than 5% level. The test of multicollinearity shows that the variables are not intercorrelated as the variance inflation factors (VIF) are less than 10. The result of skewness, kurtosis and Jarque-Bera tests implies that the estimates from the ordinary least square regression may not be good for drawing valid conclusions.

The Pearson Correlation analysis technique was employed to examine the association between the criterion and predictor variables. The result reported in Table 2 shows that all three of the predictors

(data mining, trend analysis and net worth method) have significant association with the criterion variable, while ratio analysis and financial inclusion are not significantly related. Moreover, the correlation result shows that the association between the predictor and the criterion variables is mixed, thus, while data mining, trend analysis and net worth method are positively correlated with fraud control, ratio analysis and financial inclusion are negatively correlated with fraud control. It should be noted, however, that correlation is not an inferential statistic; therefore, it has no inference value.

Table 2: Correlation analysis

Variable	FRUDCONTR	DATAMIN	RATANA	TRENDANA	NETWMET	FININCL
FRUDCONTR	1					
DATAMIN	0.268** 0.000	1				
RATANA	-0.053 0.366	0.002 0.975	1			
TRENDANA	0.248** 0.000	0.131* 0.024	0.557** 0.000	1		
NETWMET	-0.148* 0.011	0.013 0.825	0.428** 0.000	0.390** 0.000	1	
FININCL	0.021 0.721	0.042 0.474	0.489** 0.000	0.439** 0.000	0.373** 0.000	1

Researcher's compilation (2026). **p < 0.001 level (2-tailed)

Table 3: Results for the test of hypotheses of the constructs and the latent variates

Hypotheses	Constructs	Path	Constructs	Estimates (β)	z-stat	Remark
H_1	Fraud control (FRDCONTR)	<---	Data mining (DATAMIN)	0.222	4.02(***)	significant
H_2	Fraud control (FRDCONTR)	<---	Ratio analysis (RATANA)	-0.119	- 2.84(0.005)*	Significant
H_3	Fraud control (FRDCONTR)	<---	Trend analysis (TRENDANA)	0.368	6.36(***)	Significant
H_4	Fraud control (FRDCONTR)	<---	Net Worth method (NETWMET)	-0.152	-3.85(***)	Significant
<i>Model Fit summary</i>						
	CMIN/DF	χ^2	RMSEA	CFI	NFI	TLI
	25.62	0.000	0.29**	0.000	0.000	0.000

Source: Researcher's computation (2026) from IBM Statistic 26 AMOS. z-stat in parenthesis, *p < 0.05., **p < 0.001

Tests of hypotheses

The tests of hypotheses were based on the coefficients of the variables and the significance of the z-values as depicted in Table 3.

Hypothesis 1

H_{01} : Data mining has no significant effect on fraud control in Nigeria's public sector.

From the result in Table 3, the coefficient of DATAMIN is positive and significant (0.222) with the z-stat and p-value of 4.02 and 0.000 respectively. Thus, the coefficient passed the significance test at less than 1

percent level; dictating the rejection of the null hypothesis. The implication is that data mining technique is a strong predictor of fraud control in the Nigerian public sector.

Hypothesis 2

H₀₂: Ratio analysis does not significantly affect fraud control in Nigeria's public sector. The test of this hypothesis was based on the coefficient of RATANA. The result displayed in Table 3 shows that the coefficient is -0.119; $z = -2.84$ and $p = 0.005$. The p-value is less than the 1 per cent, indicating that the coefficient passed the significance test at less than 1 per cent level. Therefore, the study rejects the null hypothesis, implying that RATANA has a significant effect on fraud control (FRDCONTR).

Hypothesis 3

H₀₃: Trend analysis has no significant relationship with fraud control in Nigeria's public sector The test of this hypothesis was based on the coefficient of TRENDANA in Table 3. The result shows that the coefficient is positive and significant, $c = 0.368$; $z = 6.36$ and $p = 0.000$. The p-value is significant, indicating that the coefficient passed the significance test at the LESS 1 percent level. Therefore, the study rejects the null hypothesis, meaning that TRENDANA has A significant effect on FRDCONTR.

Hypothesis 4

H₀₄: Net worth method has no significant effect on fraud control in Nigeria's public sector.

The test of this hypothesis was based on the coefficient of NETWMET in Table 3. The result shows that the coefficient is negative and significant, $c = -0.152$; $z = -3.85$ and $p = 0.000$. The p-value is significant, indicating that the coefficient passed the significance test at less than 1 percent level. Therefore, the study rejects the null hypothesis, meaning that net worth method has a significant effect on fraud control.

Hypothesis 5

H₀₅: Financial inclusion does not moderate the relationship between forensic accounting techniques and fraud control in Nigeria's public sector

The results displayed in Table 3, all the predictor variables have a significant effect on the criterion variable. Furthermore, the result shows that the coefficients of data mining, ratio analysis, and net worth method were significant when both the moderator variable and the interaction terms (DATAMIN*FININCL), (RATANA*FININCL) and (NETWMET*FININCL) were added to the model. In the moderated model, the coefficient of DATAMIN and TRENDANA were positive and significant, $c = 0.161$; $z = 3.23$ and $p = 0.001$ and $c = 0.295$; $z = 4.46$ and $p = 0.000$ respectively; while the coefficients of RATANA, NETWMET and FININCL were negative and significant: $c = -0.157$; $z = -2.33$ and $p = 0.020$; $c = -0.140$; $z = -2.37$ and $p = 0.018$, and $c = -0.154$; $z = -2.46$ and $p = 0.014$ respectively. The p-value is significant, indicating that the coefficient passed the significance test at less than 1 percent level.

Discussion of Results

Data Mining and Fraud Control in Nigeria's Public Sector

The findings indicate that data mining has a positive and significant effect on fraud control, suggesting that it is an effective forensic accounting technique for detecting unusual patterns, anomalies, and suspicious financial transactions. This finding supports the study's a priori expectation and underscores the importance of technology-driven analytical tools in strengthening fraud detection and prevention within public sector institutions. The result is consistent with the findings of Okoye et al. (2019), Amahalu et al. (2017), Ewa et al. (2020), Olukowade and Balogun (2015), and Hossain (2023), who reported that data mining enhances the identification of hidden fraudulent activities and improves organizational fraud control.

Ratio Analysis and Fraud Control in Nigeria's Public Sector

The study found that ratio analysis has a significant but negative relationship with fraud control, contrary to the study's a priori expectation. This suggests that although ratio analysis can reveal financial irregularities, it may not be sufficiently effective as a standalone forensic accounting technique in the selected MDAs. The negative relationship may be attributed to its broader application in assessing operational and financial performance rather than specifically detecting fraud (Mbanugo et al., 2021). This finding, however, contradicts the studies of Saman (2019) and Ogbaini et al. (2024), who reported that abnormal financial ratios are useful indicators of fraudulent financial reporting.

Trend Analysis and Fraud Control in Nigeria's Public Sector

The positive and significant effect of trend analysis on fraud control demonstrates that continuous examination of financial transactions over time enhances the detection of unusual patterns and potential fraudulent activities. The finding agrees with the study's expectation and highlights the importance of monitoring financial trends in strengthening accountability within the public sector. This result is consistent with the findings of Garba (2024), Ladi-Awofeso et al. (2023), and Ogbaini et al. (2024), who concluded that trend analysis is effective in detecting payroll fraud, contract inflation, and other financial irregularities.

Net Worth Method and Fraud Control in Nigeria's Public Sector

The findings reveal that the net worth method has a significant but negative effect on fraud control, contrary to the expected positive relationship. A possible explanation is the limited availability and reliability of information relating to the assets and liabilities of public officials, which reduces the effectiveness of this investigative technique. Consequently, although the net worth method remains a valuable forensic tool, its application may be constrained by inadequate asset disclosure systems. This finding differs from Eisenberg (2018), who demonstrated the effectiveness of the net worth method in detecting unreported income and financial fraud.

Moderating Role of Financial Inclusion on the Relationship between Forensic Accounting Techniques and Fraud Control

The findings show that financial inclusion significantly moderates the relationship between forensic accounting techniques and fraud control, indicating that increased use of formal financial services enhances the effectiveness of forensic accounting practices. By improving transaction traceability, reducing cash-based transactions, and strengthening audit trails, financial inclusion creates an environment that supports more effective fraud detection and prevention. This finding supports the views of Rasanayagam (2011), Ozili (2021a), and Power (2021) that financial inclusion promotes transparency and accountability in public financial management. Furthermore, the study contributes to the literature by demonstrating the moderating role of financial inclusion in the relationship between forensic accounting techniques and fraud control, an area that has received limited empirical attention.

5. Conclusion

This study concludes that forensic accounting techniques are important instruments for strengthening fraud control in selected Ministries, Departments, and Agencies (MDAs) in Cross River State, Nigeria. The findings demonstrate that data mining and trend analysis significantly enhance fraud control by improving the detection of financial irregularities and fraudulent activities, whereas ratio analysis and the net worth method, although statistically significant, exhibited negative relationships, suggesting that their effectiveness depends largely on the quality of financial records, institutional capacity, and the availability of reliable financial information. The study further establishes that financial inclusion significantly moderates the relationship between forensic accounting techniques and fraud control by

improving transaction traceability, transparency, and accountability. Overall, the study provides empirical evidence that integrating technology-driven forensic accounting techniques with financial inclusion initiatives can substantially strengthen fraud control in the public sector. It therefore underscores the need for sustained investment in digital financial infrastructure, institutional capacity building, and effective implementation of forensic accounting practices to enhance transparency, accountability, and prudent management of public resources.

Recommendations

Based on the findings of this study, the following recommendations are made:

- i. Since data mining significantly enhanced fraud control, management of the selected Ministries, Departments, and Agencies (MDAs) in Cross River State should invest in modern data analytics and forensic accounting software and integrate these tools into their internal audit and financial management systems to facilitate the timely detection of fraudulent transactions and financial irregularities.
- ii. Given the significant but negative relationship between ratio analysis and fraud control, public sector accountants, internal auditors, and forensic accountants in the selected MDAs should receive periodic training on the effective application of ratio analysis as a forensic investigative tool rather than limiting its use to performance evaluation and financial reporting.
- iii. As trend analysis proved to be an effective fraud control technique, the selected MDAs should institutionalize periodic trend analysis of financial transactions, payroll records, procurement activities, and expenditure patterns to facilitate the early detection of anomalies and other indicators of fraudulent activities.
- iv. Considering the significant but negative relationship between the net worth method and fraud control, the selected MDAs should strengthen the documentation, maintenance, and accessibility of relevant financial records required for forensic investigations. This will improve the effectiveness of the net worth method in identifying unexplained wealth and other potential indicators of fraud.
- v. Since financial inclusion significantly strengthened the relationship between forensic accounting techniques and fraud control, the Cross River State Government should promote the use of digital payment platforms and other formal financial services within the selected MDAs to improve transaction traceability, strengthen audit trails, and enhance transparency and accountability in public financial management.

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