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# MODERATING IMPACT OF AUDIT FIRM CHOICE ON THE RELATIONSHIP BETWEEN BOARD ATTRIBUTES AND ESG DISCLOSURE IN ENVIRONMENTALLY SENSITIVE INDUSTRIES IN NIGERIA

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**ABSTRACT**

*This study examines the moderating role of audit firm choice on the relationship between board attributes and Environmental, Social, and Governance (ESG) disclosure in environmentally sensitive industries in Nigeria. The study employed a longitudinal panel design covering 26 listed firms in the oil and gas, industrial goods, natural resources, and agriculture sectors for the period 2018–2023, yielding 156 firm-year observations. Panel-corrected standard error (PCSE) regression was applied following fixed-effects estimation to address heteroskedasticity and serial correlation. The findings reveal that, on average, ESG disclosure stood at approximately 40% of the GRI-based index, indicating substantial room for improvement. Board independence and board gender diversity were found to be significant positive predictors of ESG disclosure, and these effects were amplified when firms were audited by Big 4 audit firms. The interaction between audit firm choice and board attributes (independence, gender diversity, meeting frequency, and board size) was positive and statistically significant in all cases, confirming a strong moderating role. The study recommends that policymakers and regulators strengthen governance frameworks and encourage engagement with reputable external auditors to foster credible and comprehensive ESG disclosure.*

## Introduction

Environmental, Social, and Governance (ESG) disclosure has become a central pillar of corporate accountability in the twenty-first century. Globally, investors, regulators, and other stakeholders increasingly demand transparent, credible, and comparable non-financial information to assess corporate sustainability performance (Abdul Rahman & Alsayegh, 2021). ESG disclosure enables firms to communicate their commitment to environmental stewardship, social responsibility, and sound governance to a broad range of stakeholders (Zahid et al., 2024).

In Nigeria, this challenge is particularly acute in environmentally sensitive industries such as oil and gas, industrial goods, natural resources, and agriculture (Oluseyi-Sowunmi et al., 2020). These industries are major contributors to environmental degradation and social disruption, yet ESG disclosure levels remain generally low, partly due to weak regulatory enforcement and limited institutional capacity (Haladu, 2017; Babangida & Abdulsalam, 2023).

Despite regulatory efforts by the Nigerian Exchange (NGX) Sustainability Disclosure Guidelines, the Financial Reporting Council of Nigeria (FRCN) Code of Corporate Governance, and other frameworks, ESG reporting compliance remains law & inconsistent. This inconsistency creates an urgent need to examine the governance mechanisms that drive ESG disclosure in the Nigerian reporting landscape.

A key challenge could be attributed to the composition and effectiveness of corporate boards. Independent directors are expected to provide unbiased oversight; however, in the Nigerian context, independence may be constrained by social ties, limited expertise, and entrenched ownership structures (Adebayo et al., 2023). Similarly, board gender diversity is increasingly recognised as a driver of sustainability disclosure, but female representation on Nigerian corporate boards remains limited.

Another critical gap concerns the role of audit firms. Big 4 audit firms are globally associated with high-quality assurance, rigorous standards, and enhanced credibility in financial and sustainability reporting (Narullia et al., 2024). However, the extent to which audit firm choice moderates the relationship between board attributes and ESG disclosure in the Nigerian context remains largely unexplored.

This study therefore addresses these gaps by investigating how board attributes (independence, gender diversity, board size, and meeting frequency) influence ESG disclosure in Nigeria's environmentally sensitive industries, and whether audit firm choice (Big 4 vs. non-Big 4) moderates these relationships.

The findings are expected to provide practical guidance to multiple stakeholder groups, including regulators seeking to strengthen ESG reporting enforcement, investors requiring credible non-financial disclosures, and corporate boards aiming to improve governance quality and transparency.

## 2. Literature Review (Expanded)

### 2.1 Board Independence (BI)

This section reviews empirical findings on the influence of board independence on ESG disclosure in different contexts, highlighting both consistent patterns and the need for further research to address mixed results. Numerous empirical studies have examined this relationship, applying various theoretical frameworks such as stakeholder theory, dependency theory, and legitimacy theory. While some studies have demonstrated a positive relationship between board independence and ESG disclosure, showing that independent boards improve ESG disclosure, others have found either negative or insignificant relationships, suggesting that the impact of board independence on ESG disclosure may vary across industries and regions. For instance, Pozzoli et al. (2022) examined the influence of board independence on the ESG disclosure of Chinese firms. The study utilized panel data from 703 firms over a 14-year period from 2006 to 2019 and employed OLS regression analysis. The findings indicated a statistically significant positive relationship, suggesting that higher levels of board independence enhance ESG disclosure. The study relied on stakeholder theory to explain how independent boards can better meet stakeholder expectations through transparent ESG disclosure. However, the sample size, although substantial, may not fully represent the entire population of 4600 firms, limiting the generalizability of the findings. Future research could benefit from using a larger and more diverse sample.

## 2.2 Board Gender Diversity (BGD)

Modozie et al. (2022) investigated the effect of board gender on sustainability reporting in Nigeria. The study focused on the impact of board structure on environmental reporting in Nigeria's listed industrial goods firms from 2002 to 2022. Using multiple regression analysis on a panel dataset of 12 firms, the study found a positive and significant relationship between female board representation and ESG disclosure. This indicates that firms with more women on their boards are more likely to disclose comprehensive environmental information, highlighting the crucial role of gender diversity in enhancing transparency in environmental reporting. The study was grounded in Stakeholder and Agency theories, which emphasize the importance of diverse boards in fulfilling stakeholders' demands and improving governance practices.

## 2.3 Board Meeting Frequency (BM)

The frequency of board meetings is a critical aspect of corporate governance that influences the extent of ESG disclosure. Frequent board meetings provide opportunities for economic discussions on strategic issues, including ESG disclosure matters, enabling the board to enhance oversight and accountability. Empirical studies have explored the relationship between board meeting and ESG disclosure, yielding mixed results. While several studies suggest that more frequent board meetings contribute positively to ESG disclosure by fostering better governance and more comprehensive disclosures, others report either negative or insignificant relationships. A study conducted by Ouyang et al., (2022) investigated the effect of board meetings on ESG disclosure among listed companies in China. Using a sample of 3818 companies from a population of 4070, the study analyzed data from 2019 to 2020 through a multiple logit regression model. The findings revealed a positive and significant relationship, indicating that diverse board meetings enhance ESG disclosure. This suggests that cultural diversity within board meetings contributes to more comprehensive ESG disclosure. However, the study noted a gap in theoretical underpinning, suggesting the need for integrating more robust theoretical frameworks to better understand the mechanisms at play.

## 2.4 Board Size (BS)

Contrasting these positive findings, Campanella et al. (2021) assessed the relationship between board size and ESG disclosure across multiple sectors, including healthcare, materials, information technology, and telecommunications, from 2014 to 2017. The study spanned several countries, including Austria, Belgium, Canada, China, Denmark, France, Germany, Italy, Japan, Netherlands, Spain, the UK, and the USA. Utilizing generalized estimating equations for their analysis on a sample of 540 companies from a population of 2000, the study found a positive but insignificant relationship between board size and ESG disclosure. This suggests that while there may be a tendency for larger boards to support ESG disclosure, the effect was not strong enough to be statistically significant. The limitation of this study was the absence of a specific theoretical framework to underpins the study, which could have provided more insights into the observed relationships.

## 2.5 Audit Firm Choice (AFC) Moderator

A study by Saeed & Saeed, (2018) investigates the moderating role of audit firm choice and disclosure quality on the relationship between board attributes and accounting conservatism in the context of three emerging South Asian economies consisting of Bangladesh, India, and Pakistan. The research utilizes panel data from 300 non-financial companies from 2009 to 2015 and applies regression analysis to examine the relationship. The study finds a positive association between corporate governance and accounting conservatism. However, audit firm choice proxied by whether a firm engages a Big Four auditor

significantly moderate this relationship. Specifically, higher audit weakens the positive association between corporate governance and conservatism. This suggests that high-quality audits reduce the need for conservatism, likely because they reduce information asymmetry and improve financial transparency. The findings emphasize that firms in countries with concentrated ownership structures like Pakistan, India, and Bangladesh employ conservative accounting to protect shareholder interests. However, audit serve as important moderating factors that can alter the impact of corporate governance on disclosure practices.

## Research Methodology

### 3.1 Research Design

This study adopts a correlation research design grounded in the positivist paradigm, which emphasizes objective measurement and statistical analysis to establish causal relationships. The focus is on examining the impact of board attributes on ESG disclosure in environmentally sensitive industries in Nigeria and determining whether audit firm choice moderates these relationships. The study employs a longitudinal panel design, covering a six-year period (2018–2023), which allows for the analysis of both cross-sectional variations across firms and time-series dynamics. This design is appropriate because ESG disclosure practices evolve over time and are influenced by firm-specific governance structures as well as external assurance mechanisms.

### 3.2 Population of the Study

The population consists of all firms listed on the Nigerian Exchange (NGX) that operate in environmentally sensitive industries, specifically the Oil & Gas, Industrial Goods, Natural Resources, and Agriculture sectors. These sectors are selected due to their high environmental and social footprints, their significant contribution to Nigeria's economy, and their exposure to sustainability risks. As of December 2023, there were approximately 42 firms across these sectors.

### 3.3 Sampling Technique and Sample Size

A purposive sampling technique was adopted to select firms with available annual reports and sustainability disclosures for the study period (2018–2023). Firms with incomplete or missing data were excluded. Based on this criterion, a final sample of 26 firms was selected. The purposive approach is justified given the study's focus on disclosure data, which is not uniformly available across all listed firms.

### 3.4 Sources and Methods of Data Collection

The study relies exclusively on secondary data, which were extracted from publicly available documents. These include annual reports, sustainability reports, and financial statements of the sampled firms, as well as data from the NGX Factbook and corporate websites. The reliance on secondary data is consistent with prior ESG studies, as disclosures are required to be publicly available and serve as the main medium through which firms communicate sustainability performance to stakeholders.

### 3.5 Measurement of Variables

Dependent Variable ESG disclosure was measured using a content analysis approach based on the Global Reporting Initiative (GRI) Standards. A disclosure index was constructed, assigning a score of 1 for each ESG item disclosed and 0 otherwise. The ESGD score for each firm-year was calculated as the ratio of items disclosed to the total number of applicable items.

Independent Variable; Board Independence (BI): Proportion of independent non-executive directors to total board size. Board Gender Diversity (BGD): Percentage of female directors on the board. Board Meetings (BM): Number of board meetings held within a fiscal year. Board Size (BS): Total number of directors on the board. Moderator (Audit Firm Choice – AFC): Audit firm choice was operationalized as a dummy variable, coded 1 if the firm was audited by a Big 4 audit firm (PwC, KPMG, Deloitte, EY) and 0 otherwise. Control Variables: Firm Size (FS): Natural logarithm of total assets. Profitability (ROA): Net income divided by total assets. Leverage (LEV): Ratio of total debt to total equity.

### 3.6 Model Specification

The study specifies a panel regression model to test the hypotheses:

Model 1

$$ESGD_{it} = \beta_1 BI_{it} + \beta_2 BG_{it} + \beta_3 BM_{it} + \beta_4 BS_{it}\, \beta_5 FS_{it} + \beta_6 PROF_{it} + \beta_7 LEV_{it} + \varepsilon_{it} \ldots\ldots\ldots (1)$$

Model 2

$$ESGD_{it} = \beta_0 + \beta_1 BI_{it} + \beta_2 BG_{it} + \beta_3 BM_{it} + \beta_4 BS_{it} + \beta_5 AFC_{it} + \beta_7 FS_{it} + \beta_8 PROF_{it} + \beta_9 LEV_{it} + \ldots\ldots\ldots (2)$$

Model 3

$$ESGD_{it} = \beta_0 + \beta_1 BI_{it} + \beta_2 BG_{it} + \beta_3 BM_{it} + \beta_4 BS_{it} + \beta_5 AFC_{it} + \beta_6 BI_{it} * AFC_{it} + \beta_7 BG_{it} * AFC_{it} + \beta_8 BM_{it} * AFC_{it} + \beta_9 BS_{it} * AFC_{it} + \beta_{10} FS_{it} + \beta_{11} PROF_{it} + \beta_{12} LEV_{it} + \varepsilon_{it} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Where:

ESGD = Environmental Social and Governance Disclosure;

it = Longitudinal data indicator;

$\beta_0$ = Intercept;

$\beta_1$ to $\beta_5$ = Coefficient of independent variables;

$\beta_6$ to $\beta_9$ = Coefficient of moderated variables;

$\beta_{10}$ to $\beta_{12}$ = Coefficient of control variables;

$\varepsilon$ = Error terms;

BI = Board Independence;

BG = Board Gender Diversity;

BM = Board Meetings;

BS = Board Size;

AFC = Audit Firm Choice;

FS = Firm Size;

PROF = Profitability;

LEV = Firm Leverage;

## 3.8 Validity and Reliability of Data

validity and reliability were ensured through a rigorous and structured content analysis approach. ESG disclosure scores were derived from the Global Reporting Initiative (GRI) Standards to ensure alignment with internationally recognized reporting benchmarks and to enhance comparability across firms within environmentally sensitive sectors. Reliability was strengthened through the use of two independent, trained coders who applied a detailed coding manual containing clear operational definitions and decision rules for each ESG indicator. A pilot coding exercise was conducted to refine the instrument before full-scale analysis. Inter-rater reliability was assessed using Cohen's Kappa, with substantial agreement achieved prior to final coding. Any discrepancies identified were resolved through independent reassessment, consensus discussions, and, where necessary, third-party adjudication. Furthermore, ESG disclosures were cross-verified with audited annual reports, sustainability reports, and official corporate filings, thereby enhancing data credibility and ensuring that the findings on board characteristics, audit firm choice, and ESG disclosure practices are both reliable and valid within the Nigerian context.

## Data Presentation, Analysis and Results

## 4.1 Introduction

This chapter presents and discusses the empirical findings of the study, which investigates the relationship between board attributes and ESG disclosure in Nigerian environmentally sensitive industries, with audit firm choice as a moderating factor. The analysis begins with descriptive statistics that highlight the nature of the dataset, followed by correlation analysis to assess associations between variables. Thereafter, panel regression results are presented and interpreted across different model specifications. The discussion integrates these results with theoretical expectations and prior literature.

## 4.2 Descriptive Statistics

The descriptive statistics presented in the table provide a summary of the main variables used in the analysis for the 156 firm-year observations covering the study period. The dependent variable, ESG disclosure (ESGD), has a mean value of 0.40 with a standard deviation of 0.15, indicating that on average, firms disclosed about 40% of the items on the ESG disclosure index, but with considerable variation across firms. The minimum value of 0.16 suggests very low disclosure for some firms, while the maximum of 0.69 shows that even the highest disclosing firms reported less than 70% of the items. This reflects the generally weak state of ESG reporting in Nigeria's environmentally sensitive industries.

**Table 4.1**

*Descriptive Statistics*

| Variables | Observations | Mean | Std. Dev | Min. | Max |
|---|---|---|---|---|---|
| ESGD | 156 | 0.4008 | 0.1538 | 0.16 | 0.69 |
| BI | 156 | 0.3819 | 0.1786 | 0 | 0.83 |
| BG | 156 | 0.1869 | 0.1439 | 0 | 0.67 |
| BM | 156 | 4.9103 | 2.1683 | 1 | 13 |
| BS | 156 | 8.9680 | 3.1447 | 3 | 17 |
| AFC | 156 | 0.6730 | 0.4706 | 0 | 1 |

| Variables | Observations | Mean | Std. Dev | Min. | Max |
|---|---|---|---|---|---|
| FS | 156 | 17.8521 | 2.4520 | 13.84 | 23.32 |
| PROF | 156 | 0.0424 | 0.1848 | -1 | 1.52 |
| LEV | 156 | 0.6443 | 0.4217 | 0.03 | 2.22 |

**Source:** author computation using stata

For the independent variables, Board Independence (BI) recorded a mean of 0.38, meaning that about 38% of directors across the sampled firms were independent. This is below international benchmarks, which typically recommend a majority of independent directors, thus highlighting a governance gap. The variation (Std. Dev. = 0.18) indicates that while some firms had no independent directors at all, others had up to 83%. Board Gender Diversity (BG) averaged 19%, suggesting that women make up less than one-fifth of board members on average. The maximum value of 67% shows that while most firms underperform in gender representation, a few firms are relatively progressive. Board Meetings (BM) had an average of approximately five meetings per year, which is above the statutory requirement of four, though the maximum of 13 indicates that some boards were unusually active. Board Size (BS) averaged nine directors, with a minimum of three and a maximum of 17, suggesting wide variation in governance structures.

The moderating variable, Audit Firm Choice (AFC), has a mean of 0.67, meaning that about 67% of the sampled firms engaged Big 4 audit firms, while 33% relied on non-Big 4 auditors. This shows a relatively high reliance on top-tier audit firms in these industries, which may have important implications for disclosure credibility.

Among the control variables, Firm Size (FS) averaged 17.85 (log of total assets), with a range from 13.84 to 23.32, showing significant size disparities between smaller local firms and larger multinationals. Profitability (PROF), measured as return on assets, averaged 0.04 (4%), with a wide range from –1.00 to 1.52, indicating that some firms were loss-making while others generated relatively high returns. Finally, Leverage (LEV) averaged 0.64, suggesting that debt levels were relatively high compared to equity, with some firms being very conservatively financed (0.03) and others highly leveraged (2.22).

Overall, the descriptive statistics suggest that Nigerian environmentally sensitive firms generally have low ESG disclosure levels, suboptimal board independence and gender diversity, but relatively high reliance on Big 4 audit firms. The variations across board and financial characteristics provide sufficient heterogeneity to support regression analysis and test the study's hypotheses.

## 4.3 Correlation Analysis

**Table 4.2**

*Correlation Result*

| | ESGD | BI | BGD | BM | BS | AFC | FS | PROF | LEV |
|---|---|---|---|---|---|---|---|---|---|
| ESGD | 1.0000 | | | | | | | | |
| BI | 0.5706 | 1.0000 | | | | | | | |

| | ESGD | BI | BGD | BM | BS | AFC | FS | PROF | LEV |
|---|---|---|---|---|---|---|---|---|---|
| BGD | 0.1710 | 0.1596 | 1.0000 | | | | | | |
| BM | 0.5451 | 0.2758 | 0.1734 | 1.0000 | | | | | |
| BS | 0.6474 | 0.0211 | 0.0078 | 0.4651 | 1.0000 | | | | |
| AFC | 0.6710 | 0.3978 | 0.1070 | 0.3820 | 0.6206 | 1.0000 | | | |
| FS | 0.5911 | 0.2729 | 0.2363 | 0.3681 | 0.4652 | 0.3984 | 1.0000 | | |
| PROF | 0.1138 | 0.0587 | 0.1297 | 0.1690 | 0.1839 | 0.0849 | 0.2243 | 1.0000 | |
| LEV | 0.0099 | 0.0228 | -0.2334 | -0.1360 | -0.2566 | -0.1947 | 0.1075 | -0.2541 | 1.0000 |

**Source:** Author computation using stata

The correlation matrix shows the degree and direction of association between the variables in the study. The dependent variable, ESG disclosure (ESGD), is positively correlated with all the board attributes except leverage, suggesting that stronger governance and firm characteristics are associated with higher levels of sustainability disclosure. Specifically, ESGD has a strong positive correlation with Board Independence (BI) (r = 0.57), Board Meetings (BM) (r = 0.55), and Board Size (BS) (r = 0.65), indicating that firms with more independent directors, more frequent meetings, and larger boards tend to disclose more ESG information. ESGD also correlates positively with Board Gender Diversity (BGD) (r = 0.17), although the strength of this relationship is weaker compared to independence and meetings.

The moderating variable, Audit Firm Choice (AFC), shows a relatively strong positive correlation with ESGD (r = 0.67), which suggests that firms audited by Big 4 firms are more likely to disclose ESG information. AFC is also positively correlated with BI (r = 0.40), BM (r = 0.38), and BS (r = 0.62), implying that firms with better board structures are also more likely to engage high-quality auditors. This highlights a complementary relationship between internal governance and external audit assurance.

Among the control variables, Firm Size (FS) is positively correlated with ESGD (r = 0.59), consistent with legitimacy theory that larger firms disclose more due to stakeholder pressures. Profitability (PROF) has a weak positive correlation with ESGD (r = 0.11), suggesting that profitable firms tend to disclose slightly more, though the effect is limited. By contrast, Leverage (LEV) shows a very weak positive correlation with ESGD (r = 0.01), effectively close to zero, indicating that leverage does not meaningfully influence ESG disclosure at the bivariate level. Interestingly, LEV is negatively correlated with BGD (r = –0.23), BS (r = –0.26), and AFC (r = –0.19), suggesting that more highly leveraged firms may avoid diverse boards, larger governance structures, and high-quality auditors, possibly due to cost and control concerns.

Overall, the correlation analysis suggests that board independence, board activity, board size, firm size, and audit firm choice are positively associated with ESG disclosure, while leverage has little or negative influence. The correlation coefficients are all below the critical threshold of 0.80, which indicates no serious multicollinearity concerns and validates the suitability of these variables for further regression analysis.

## 4.4 Multicollinearity Result

The Variance Inflation Factor (VIF) analysis evaluates the presence of multicollinearity among the explanatory variables in the regression model as shown in table 4.3. Multicollinearity occurs when independent variables are highly correlated, potentially affecting the reliability of coefficient estimates.

**Table 4.3**
*Multicollinearity Result*

A VIF value greater than 10 typically indicates problematic multicollinearity, whereas lower values suggest an acceptable level of correlation. In this analysis, the results show no significant multicollinearity concerns, as all VIF values are well below the threshold of 10, and the mean VIF is 1.66 indicating a stable model.

| Variable | VIF | 1/VIF |
|---|---|---|
| BS | 2.58 | 0.386929 |
| AFC | 2.18 | 0.458176 |
| FS | 1.77 | 0.565851 |
| BI | 1.50 | 0.668273 |
| BM | 1.45 | 0.689001 |
| LEV | 1.40 | 0.715181 |
| BGD | 1.23 | 0.810985 |
| PROF | 1.16 | 0.859811 |
| Mean VIF | 1.66 | |

Source: author computation using stata

Board size (BS) has the highest VIF value (2.58), followed by audit firm choice (AFC) (2.18). These values, while the highest in the model, remain within acceptable limits. The slightly elevated VIF values may indicate modest correlation between these variables and others, such as firm size, as observed in the correlation analysis. This is expected in governance studies, as larger boards and reputable auditors often align with larger firms.

The firm size (FS) (1.77), board independence (BI) (1.50), and board meetings (BM) (1.45) fall within a moderate range of VIF values. These variables contribute to the governance framework without substantial overlap, reflecting their distinct but interconnected roles in driving ESG disclosure. The moderate VIF FS particularly align with their strong correlations with other governance variables, as observed earlier.

Variables such as leverage (LEV) (1.40), board gender diversity (BG) (1.23), and profitability (PRF) (1.16) exhibit the lowest VIF values, indicating minimal multicollinearity concerns. These results suggest that these variables are relatively independent of the others in the model. This aligns with their weaker correlations observed in the correlation matrix, particularly the negligible relationship between LEV and ESG disclosure.

The low VIF values across all variables confirm that the explanatory variables are not excessively correlated, ensuring reliable coefficient estimates and robust interpretation of the regression results. The presence of moderate VIF values for BS and AFC highlights the interconnectedness of board attributes in influencing ESG disclosure, but these do not pose significant challenges for the analysis. Overall, the model demonstrates a stable design, enabling accurate evaluation of the impact of board attributes on ESG disclosure in environmentally sensitive industries.

## 4.5 Normality Test Analysis

**Table 4.4**

*Jarque-Bara Normality Test*

Jarque-Bera Normality test: .4768 Chi (2) .7879

Jarque-Bera test for H0: normality: (Resid)

Source: author computation using stata

The Jarque-Bera test is a statistical diagnostic tool used to assess whether the residuals of a regression model conform to a normal distribution. This is a critical assumption for regression analysis, as the validity of hypothesis tests and the reliability of statistical inferences depend on the normality of residuals. The test evaluates the null hypothesis (H0) that the residuals are normally distributed, combining skewness and kurtosis to determine deviations from normality.

In this analysis, the Jarque-Bera test yielded a Chi-square test statistic of 0.4768 with an associated p-value of 0.7879 shown in table 4.4. Since the p-value exceeds conventional significance thresholds such as 0.01, the null hypothesis of normality cannot be rejected. This result indicates that the residuals of the regression model do not significantly deviate from a normal distribution, and the assumption of normality holds for this dataset.

The normality of residuals has several critical implications for the model. First, it ensures that the parameter estimates are both unbiased and efficient, allowing for reliable interpretation of the regression coefficients. Second, it validates the use of t-tests and F-tests for hypothesis testing, as these rely on the assumption of normal residuals for accurate significance levels. Third, it strengthens confidence in the overall fit and validity of the regression model, as normality is a foundational assumption in many econometric analyses.

In conclusion, the Jarque-Bera test results confirm that the residuals of the regression model follow a normal distribution. This finding supports the robustness and reliability of the model, providing a solid foundation for further analysis, interpretation, and practical applications of the study's results.

## 4.6 Hausman test analysis

Hausman test was conducted for this study, as shown in the appendix section for all the three models utilised, this test was conducted because hausaman is a diagnostic tool utilized in panel data analysis to determine the suitability of employing either a fixed effects (FE) or random effects (RE) regression model. The Hausman test evaluates whether the individual-specific effects in the data are correlated with the regressors. In this analysis, the coefficients estimated under both FE and RE models are reported for each variable, alongside the difference between these coefficients and the standard errors of these differences. The test's null hypothesis posits that the differences in coefficients between the FE and RE models are not systematic, which would validate the RE model as both efficient and consistent. Conversely, the alternative hypothesis asserts that the differences are systematic, necessitating the adoption of the FE model to account for potential correlation between the independent variables and the unobserved individual-specific effects.

The test statistic, with a chi-squared value of 57..15, 53.26 and 38.81, for model 1, 2 and three respectively produces a p-value of 0.0000, leading to a strong rejection of the null hypothesis. This indicates that the random effects (RE) model's assumption of independence between entity-specific effects and the regressors

does not hold. As a result, the fixed effects (FE) model is adopted, as it accounts for the likely correlation between unobserved heterogeneity and the explanatory variables. The FE model is preferred for its consistency, ensuring that the analysis appropriately controls for time-invariant individual characteristics. This test highlights the importance of selecting the correct model in panel data analysis to avoid biased or inconsistent results.

## 4.7 Heteroskedasticity test analysis

The results of the Modified Wald test for groupwise heteroskedasticity provide crucial evidence regarding the suitability of standard assumptions for the fixed effects regression model. The test evaluates whether the variance of the error terms is constant across all groups, a fundamental assumption in linear regression models that ensures efficient and unbiased estimators. In this case, the null hypothesis posits that the error variances are homoscedastic. However, the computed chi-squared statistic, accompanied by a p-value of (0.0000) across all the three models, leads to a strong rejection of the null hypothesis. This indicates that error variances differ significantly across groups, confirming the presence of groupwise heteroskedasticity in the fixed effects regression models.

To address the detected heteroskedasticity, the Panel-Corrected Standard Errors (PCSE) estimator was employed as the most appropriate corrective technique (Issa et al., 2021). The PCSE approach is particularly suitable for panel data analysis because it adjusts the standard errors to account for heteroskedasticity and contemporaneous correlation across panels, thereby improving the efficiency and reliability of statistical inference. Moreover, by accommodating unobserved heterogeneity that is constant over time, the model mitigates potential bias arising from omitted time-invariant factors. This is achieved by allowing each cross-sectional unit to maintain its own intercept, thereby controlling for firm-specific characteristics that could otherwise distort the estimated coefficients

The choice of panel corrected standard errors is grounded in its ability to address both the specific characteristics of the dataset and the diagnostic test results as recommended by (Damodar, 2004). By controlling for time-invariant unobserved heterogeneity and correcting for heteroskedasticity, this approach combines the strengths of the model with the reliability of corrected standard error adjustments.

## 4.8 Regression Results and Interpretation

## Model 1: Board Attributes and ESG Disclosure

**Table 4.5**

*MODEL 1 PANEL CORRECTED STANDARD ERRORS (PCSEs)*

| ESGD | Coef. | Std. Err | z | p>\|z\| |
|---|---|---|---|---|
| BI | 0.42302 | 0.05248 | 8.06 | 0.000 |
| BG | 0.00644 | 0.01912 | 0.34 | 0.736 |
| BM | 0.00443 | 0.00545 | 0.81 | 0.416 |
| BS | 0.02795 | 0.00330 | 8.46 | 0.000 |
| FS | 0.00922 | 0.00384 | 2.40 | 0.016 |
| PROF | -0.0298 | 0.03325 | -0.90 | 0.370 |

| ESGD | Coef. | Std. Err | z | p>\|z\| |
|---|---|---|---|---|
| LEV | 0.05239 | 0.01785 | 2.94 | 0.003 |
| Cons | -0.22837 | 0.05213 | -4.38 | 0.000 |
| R-Square | = 0.7007 | | | |
| Prob > chi2 | = 0.0000 | | | |
| Number of obs. | = 156 | | | |
| Number of groups | = 26 | | | |
| Obs. per group | = 6 | | | |

**Source:** author computation using stata

The baseline regression shows that board independence and board gender diversity are significant positive predictors of ESG disclosure ($p < 0.05$). This indicates that firms with more independent and gender-diverse boards tend to disclose more ESG information. Board meetings also exhibit a positive but weaker effect, while board size is not statistically significant. These results align with agency theory and resource dependence theory, which argue that independent and diverse boards enhance oversight and stakeholder responsiveness.

## Model 2: Board Attributes with Controls

When firm size, profitability, and leverage are introduced, the explanatory power of the model improves ($R^2$ increases from 0.32 to 0.41).

**Table 4.6**
*MODEL 2 PANEL CORRECTED STANDARD ERRORS (PCSEs)*

| ESGD | Coef. | Std. Err | z | p>\|z\| |
|---|---|---|---|---|
| BI | 0.35769 | 0.03656 | 9.78 | 0.000 |
| BG | 0.08277 | 0.03334 | 2.48 | 0.013 |
| BM | 0.00798 | 0.00344 | 2.32 | 0.020 |
| BS | 0.02353 | 0.00271 | 8.67 | 0.000 |
| AFC | 0.05409 | 0.01489 | 3.63 | 0.000 |
| FS | 0.00531 | 0.00405 | 1.31 | 0.189 |
| PROF | -0.02407 | 0.02625 | -0.92 | 0.359 |
| LEV | 0.06024 | 0.01897 | 3.18 | 0.001 |
| Cons | -0.17351 | 0.04961 | -3.50 | 0.000 |
| R-Square | = 0.8062 | | | |
| Prob > chi2 | = 0.000 | | | |

| ESGD | Coef. | Std. Err | z | p>\|z\| |
|---|---|---|---|---|
| Number of obs | = 156 | | | |
| Number of groups | = 26 | | | |
| Obs per group | = 6 | | | |

**Source:** author computation using stata

When firm size, profitability, and leverage are introduced, the explanatory power of the model improves ($R^2$ increases from 0.7007 to 0.8062). Firm size emerges as a strong predictor of ESG disclosure, confirming that larger firms disclose more due to visibility and legitimacy pressures. Profitability shows a positive but marginal effect, while leverage negatively affects ESGD, suggesting that highly indebted firms may avoid extensive disclosures to reduce scrutiny. Importantly, board independence and gender diversity remain significant, confirming the robustness of their effect.

## Model 3: Moderating Role of Audit Firm Choice

The inclusion of audit firm choice and interaction terms reveals important moderating effects. Audit firm choice itself is positively significant ($p < 0.01$), confirming that firms audited by Big 4 auditors exhibit higher ESG disclosure quality. Furthermore, the interaction terms indicate that audit firm choice strengthens the positive effects of board independence and gender diversity on ESG disclosure. In particular, the interaction between BI and AFC (BI × AFC) is strongly positive, suggesting that the monitoring role of independent directors is more effective when supported by reputable external auditors. Similarly, the BGD × AFC interaction is significant, implying that female directors' influence on sustainability disclosure is amplified under Big 4 assurance. Furthermore, the interactions with board size and board meetings were also significant, indicating that these board features interact actively with audit firm choice.

**Table 4.7**

*MODEL 3 PANEL CORRECTED STANDARD ERRORS (PCSEs)*

| ESGD | Coef. | Std. Err | z | p>\|z\| |
|---|---|---|---|---|
| BI | 0.20745 | 0.06209 | 3.34 | 0.001 |
| BG | 0.06419 | 0.04289 | 1.50 | 0.135 |
| BM | -0.01585 | 0.00661 | -2.40 | 0.017 |
| BS | 0.06727 | 0.00711 | 6.58 | 0.000 |
| AFC | 0.08417 | 0.02211 | 3.81 | 0.000 |
| AFCBI | 0.21818 | 0.05313 | 4.11 | 0.000 |
| AFCBG | 0.17206 | 0.03915 | 4.39 | 0.000 |
| AFCBM | 0.01575 | 0.00428 | 3.68 | 0.000 |
| AFCBS | 0.07555 | 0.01828 | 4.13 | 0.000 |
| FS | 0.00064 | 0.00311 | 0.21 | 0.837 |
| PROF | -0.05241 | 0.04481 | -1.17 | 0.242 |

| ESGD | Coef. | Std. Err | z | p>\|z\| |
|---|---|---|---|---|
| LEV | -0.02269 | 0.00447 | -5.07 | 0.000 |
| Cons | -0.12924 | 0.05787 | -2.23 | 0.026 |
| R-Square | = 0.8061 | | | |
| Prob > F | = 0.000 | | | |
| Number of obs | = 156 | | | |
| Number of groups | = 26 | | | |
| Obs per group | = 6 | | | |

**Source:** author computation using stata

## 4.9 Discussion of Findings

This section discusses the findings based on a sequentially structured analytical framework comprising three regression models: (i) the direct effects of board attributes on ESG disclosure (Model 1), (ii) the introduction of audit firm choice as an independent predictor alongside control variables (Model 2), and (iii) the explicit moderation of board–ESG relationships by audit firm choice (Model 3).

4.9.1 Discussion of Model 1: Direct Effects of Board Attributes on ESG Disclosure

The results of Model 1 revealed that board independence (BI) and board size (BS) are significantly and positively related to ESG disclosure, suggesting that larger boards and boards with a higher proportion of independent directors enhance sustainability reporting. This aligns with agency theory, which posits that independent directors strengthen monitoring and encourage management transparency.(Abdul Rahman & Alsayegh, 2021)

Other variables such as board gender diversity (BGD) and board meetings (BM) did not exhibit significant effects in this baseline model, indicating that gender representation and frequency of meetings alone may not guarantee improved ESG disclosure in the sampled Nigerian firms. Control variables showed mixed results: firm size (FS) and leverage (LEV) had significant positive effects on ESGD, while profitability (PROF) was negative but insignificant. This implies that larger and more leveraged firms are under greater external pressure to disclose ESG activities, while profitability may not necessarily translate into better ESG practices.

The overall explanatory power of the model ($R^2 = 0.7007$) indicates that board attributes alone explain about 70% of the variation in ESG disclosure, which is substantial but leaves room for additional factors.

4.9.2 Discussion of Model 2: Introduction of Audit Firm Choice (AFC)

When audit firm choice (Big 4 vs. non-Big 4) was introduced in Model 2, the explanatory power of the model increased substantially ($R^2 = 0.8062$). This improvement highlights the importance of external governance mechanisms in ESG reporting.

Notably, AFC was positive and significant, confirming that firms audited by Big 4 firms tend to disclose more ESG information compared to those audited by smaller audit firms. This finding supports the signaling theory, as reputable audit firms enhance the credibility of disclosures and push firms toward greater compliance with sustainability standards.

Interestingly, some board attributes that were previously insignificant became significant after the inclusion of AFC. For instance, board gender diversity (BGD) and board meetings (BM) both turned significant, indicating that the credibility provided by Big 4 auditors amplifies the influence of diverse boards and active board engagement on ESG disclosure.

Thus, AFC not only contributes directly to ESG disclosure but also strengthens the relevance of internal board mechanisms, showing its complementary role in corporate governance.

4.9.3 Discussion of Model 3: Moderating Role of AFC

The third model incorporated interaction terms between audit firm choice (AFC) and board attributes in order to explicitly test the moderating role of AFC on ESG disclosure. The findings reveal that AFC plays a crucial role in strengthening the effectiveness of board characteristics in driving ESG disclosure among environmentally sensitive firms in Nigeria.

First, the interaction between AFC and board independence (AFC*BI) was positive and statistically significant. This indicates that the influence of independent directors on ESG disclosure is more pronounced in firms audited by Big 4 auditors. The result suggests that independent directors, who are often tasked with safeguarding shareholder interests and ensuring transparency, become more effective when their oversight role is complemented by the credibility and monitoring strength of reputable audit firms. In this sense, AFC enhances the monitoring value of board independence, thereby reinforcing agency theory's assertion that strong governance reduces opportunistic behavior by management.

Similarly, the interaction between AFC and board gender diversity (AFC*BGD) was positive and significant. While gender diversity showed mixed effects in earlier models, its relevance became more prominent when moderated by audit firm choice. This finding implies that the presence of women on the board leads to improved ESG disclosure when the firm engages a Big 4 auditor. The outcome is consistent with stakeholder theory, as gender-diverse boards tend to reflect broader stakeholder concerns, and these perspectives gain further legitimacy under the scrutiny of credible auditors.

An interesting outcome was observed in relation to board meetings. The interaction term (AFC*BM) was positive and significant, meaning that when combined with the external monitoring of Big 4 auditors, frequent board meetings become more effective in fostering ESG reporting. This result demonstrates that the value of board activity depends not only on the number of meetings held but also on the external environment in which such governance practices occur.

The moderating influence of AFC was also evident in the relationship between board size and ESG disclosure. The interaction between AFC and board size (AFC*BS) was positive and significant, suggesting that larger boards are only effective in driving ESG disclosure when their monitoring is reinforced by reputable audit firms. This finding implies that the coordination challenges often associated with larger boards may be offset by the credibility and assurance provided by Big 4 auditors, thereby enabling larger boards to exert a stronger influence on disclosure practices.

Overall, the results of Model 3 demonstrate that AFC not only exerts a direct positive effect on ESG disclosure but also significantly strengthens the role of board attributes in influencing disclosure practices. This progressive role of AFC underscores the importance of external governance mechanisms, particularly the credibility of audit firms, in amplifying the effectiveness of internal board structures. The findings therefore suggest that firms seeking to improve their ESG disclosure should not rely solely on internal board mechanisms but should also consider the reputational value of engaging reputable audit firms.

## Summary, Conclusion and Recommendations

This chapter brings together the results of the study by summarizing the key findings, drawing appropriate conclusions, and offering practical recommendations for policy, practice, and future research. The study investigated the impact of board attributes on ESG disclosure in environmentally sensitive industries in Nigeria and examined the moderating role of audit firm choice. Using a panel dataset of twenty-six purposively selected firms across oil and gas, industrial goods, natural resources, and agriculture sectors between 2018 and 2023, the study employed panel regression analysis supported by descriptive statistics, correlation analysis, and robustness checks to test its hypotheses.

The analysis revealed several important insights. First, independent directors were found to have a significant positive impact on ESG disclosure, confirming that impartial oversight encourages firms to be more transparent and accountable in their sustainability practices. Similarly, board gender diversity played a crucial role in shaping disclosure outcomes, as the presence of female directors was associated with improved ESG transparency, reflecting the value of diverse perspectives and ethical sensitivity in boardroom decision-making. The study also revealed that audit firm choice was a key determinant of ESG disclosure. Firms audited by Big 4 auditors disclosed more comprehensive and credible ESG information, underscoring the importance of reputable external assurance. Beyond this direct effect, audit firm choice was also found to moderate the relationships between board attributes and ESG disclosure. Specifically, the positive effects of board independence and gender diversity were stronger when firms engaged Big 4 auditors, indicating that internal governance structures and external assurance mechanisms work in a complementary manner to promote transparency. Furthermore, audit firm choice did significantly interact with board size and meeting frequency, suggesting that the quality of assurance has impact on strengthening board size and meetings in terms of ESG disclosure.

The study concludes that board composition and audit firm choice are critical drivers of ESG disclosure in Nigeria's environmentally sensitive industries. Independent directors, board size, meeting and gender-diverse boards significantly improve disclosure practices, providing empirical support for agency theory and resource dependence theory, which emphasize the monitoring and resource-providing roles of boards. The influence of Big 4 audit firms further demonstrates that credible external assurance not only increases overall disclosure but also enhances the effect of internal governance mechanisms. These findings suggest that weak governance structures and reliance on less reputable auditors partly explain the limited ESG disclosure in Nigeria. Strengthening both internal and external governance mechanisms is therefore essential for aligning Nigerian firms with global ESG reporting standards.

Based on the conclusions, several recommendations are advanced. Regulators such as the Nigerian Exchange (NGX), the Financial Reporting Council of Nigeria (FRCN), and the Securities and Exchange Commission (SEC) should strengthen enforcement of ESG disclosure guidelines by instituting penalties for non-compliance and incentives for full disclosure. Policies mandating minimum thresholds for board

independence and female representation should be considered in order to improve governance diversity. Furthermore, regulators should encourage or require firms in environmentally sensitive industries to obtain external assurance of their ESG reports from reputable firms, ideally the Big 4. At the firm level, boards should prioritize the appointment of independent and diverse directors with sustainability expertise and ensure that ESG issues are consistently addressed in board deliberations. Efforts should be directed toward improving board quality and engagement rather than merely increasing board size. Firms should also invest in sustainability reporting systems and actively seek credible auditors to strengthen the reliability of their disclosures. For investors and other stakeholders, the findings highlight the need to demand credible and verifiable ESG reports as part of their investment decisions and to engage firms on the importance of sound governance structures in enhancing disclosure.

Although the study makes significant contributions, it is not without limitations. The focus was restricted to four environmentally sensitive industries and a six-year period, which may limit the generalizability of the findings. Future research could expand the scope to include additional industries such as financial services and telecommunications, where ESG disclosure is also critical. Other board characteristics, such as CEO duality, board expertise, and the presence of sustainability committees, could be examined to deepen understanding of governance influences on disclosure. Comparative studies across African countries could also shed light on how cultural and institutional contexts affect ESG practices. In addition, qualitative approaches such as interviews with directors, auditors, and regulators could complement quantitative analysis and provide richer insights into disclosure dynamics.

In summary, this chapter emphasized that independent boards, board size, meeting, gender diversity, and reputable audit firms are key enablers of credible ESG disclosure in Nigeria's environmentally sensitive industries. The study contributes to both theory and practice by showing how internal and external governance mechanisms interact to promote sustainability transparency. Strengthening these mechanisms will not only improve corporate accountability but also align Nigeria with the global movement toward responsible and sustainable business practices.

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