Appraisal of Sustainable Development Goal 13 (Climate Action) Commitments among Nigerian Firms: Carbon Emission Disclosure and its Determinants

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Abstract: **Climate change is a critical global challenge necessitating immediate action, particularly from emerging economies like Nigeria. This research evaluates the commitment of Nigerian firms to Sustainable Development Goal 13 (SDG 13) by analyzing carbon emission disclosures and identifying their determinants. This study aims to fill a significant gap in the literature by utilizing data from the annual reports of 86 listed firms spanning 2004 to 2023. The study employs the fixed-effects and random-effects regression models, to estimate the variables under investigation. The findings reveal a low average carbon emission disclosure rate of 0.1688, suggesting insufficient transparency among firms. Notably, audit quality negatively correlates with disclosure levels, indicating that firms with higher audit quality may feel less compelled to disclose emissions. Conversely, larger firms and those with greater board gender diversity are more likely to report their carbon emissions, supporting the notion that diverse perspectives can enhance transparency. Additionally, older firms demonstrate a significant positive relationship with disclosure practices, reflecting established norms around environmental accountability. The study highlights that while larger boards are typically associated with better governance, the results indicate that they may hinder effective decision-making regarding sustainability reporting. Furthermore, the lack of significant impact from board independence challenges traditional views on corporate governance, suggesting that independent directors may not prioritize environmental issues. It is recommended that enhancing proactive disclosure practices, optimizing board structures, promoting gender diversity, leveraging the experience of established firms, and tailoring sustainability approaches by industry. These strategies aim to align corporate practices with Nigeria's commitment to sustainability, ultimately contributing to improved environmental accountability and corporate governance.**

Keywords: **SDGs; Climate Action; Carbon Emission Disclosure; Nigerian Firms; Audit Quality; Board Gender Diversity; Corporate Governance.**

1. INTRODUCTION

Climate change is a global challenge that requires urgent and coordinated action. Sustainable Development Goal 13 (SDG 13) aims to combat climate change and its impacts. This research is driven by a number of concerns. The choice to analyze carbon emission disclosures in Nigeria, a growing economy, formed the original motivation for this study. Previous research has usually concentrated on the carbon emission disclosure of developed countries (Ben-Amar et al., 2015; Chariri et al., 2018; Gonzalez & Ramirez, 2016; Radu et al., 2020).

This research aims to assess the commitment of Nigerian firms to SDG 13 by evaluating their disclosure practices, identifying determinants influencing these disclosures, and examining the value relevance of such disclosures. To achieve this objective, the paper is structured as follows. First, we provide a comprehensive review of the relevant literature on carbon emission disclosure, its determinants and value relevance. Next, we present the theoretical framework guiding our investigation, drawing on legitimacy theory and resource dependency theory to develop hypotheses regarding the relationship between the determinants of carbon emission disclosure as well as the its value relevance. Subsequently, we describe our research methodology, including data collection procedures, sample selection criteria, and statistical analysis techniques. Following the empirical analysis, we discuss the implications of our findings for theory, practice, and future research directions. Finally, we conclude with a summary of key insights and contributions of this study to the broader understanding of corporate governance and sustainability practices. In sum, this paper contributes to the growing body of literature on corporate governance and sustainability by highlighting the relationship between determinants of carbon emission disclosure its value relevance. Our findings offer valuable insights for corporate decision-makers, investors, regulators, and other stakeholders seeking to promote sustainable business practices across diverse industries. The paper seeks to achieve the following objectives:

i.   To assess the level of disclosure of SDG 13 commitments among Nigerian listed firms.

ii. To identify the determinants of SDG 13 commitments disclosure among Nigerian listed firms.

The study underscores the complexity of corporate governance in relation to sustainability reporting, highlighting the need for firms to adopt tailored strategies that enhance transparency and accountability in environmental practices. Firms in Nigeria should align their sustainability reporting with the requirements of the Nigerian Sustainability Code and the guidelines set forth by the Financial Reporting Council of Nigeria (FRCN). By integrating carbon emission disclosures into their corporate strategies, companies can ensure that these reports are treated with the same importance as financial disclosures, thereby enhancing overall transparency. The study is, however, structured into five (5) sections. Following this introductory section is section 2 which presents the literature review, while section 3 contains the sources of data and other components of methodology. The data presentation, analysis, interpretation and discussions of findings are articulated in section 4, while sections 5 presents conclusion and recommendations of the study.

2. LITERATURE REVIEW

This sections presents conceptual framework, theoretical framework and empirical review.

Conceptual Framework

Disclosure practices and sustainability reporting are essential for promoting transparency and accountability in corporate actions related to environmental sustainability. These practices involve the systematic reporting of environmental impact, including carbon emissions, waste management, and resource use. Companies use frameworks like the Global Reporting Initiative (GRI) and the Carbon Disclosure Project (CDP) to standardize their reporting, ensuring consistency and comparability (GRI, 2016). Effective disclosure allows stakeholders, including investors, regulators, and the public, to assess corporate environmental performance and make informed decisions (Clarkson et al., 2008).

Corporate responsibility plays a pivotal role in addressing climate change. Companies are increasingly recognized as key actors in mitigating environmental impacts through sustainable practices and innovation (Porter & Kramer, 2011). By adopting responsible practices, businesses can reduce their carbon footprint, contribute to environmental sustainability, and enhance their reputation and stakeholder trust. Moreover, corporate actions towards climate change can drive regulatory compliance, market differentiation, and long-term financial performance (Eccles et al., 2014). The integration of corporate responsibility into core business strategies is thus essential for achieving broader climate goals and ensuring a sustainable future.

Theoretical Framework

The study is anchored on the basis of legitimacy theory and stakeholder theory to assess the level of disclosure of SDG 13 commitments as well as to identify the determinants of SDG 13 commitments disclosure among Nigerian listed firms. Legitimacy theory posits that firms engage in sustainability disclosure to align their practices with societal norms and expectations. By providing transparent information about their environmental and social impacts, companies seek to

maintain legitimacy in the eyes of stakeholders and the general public. While, stakeholder theory suggests that firms disclose information to meet the needs and expectations of various stakeholders, including investors, customers, employees, and regulatory bodies. This perspective emphasizes the importance of understanding stakeholder interests and integrating them into corporate reporting practices. These theories collectively provide a framework for understanding the motivations behind corporate sustainability disclosures, emphasizing the nexus between societal expectations and stakeholder interests.

Empirical Review

Audit quality plays a pivotal role in ensuring that carbon emission disclosures are accurate, reliable, and trustworthy, which in turn supports better environmental governance and accountability. Tarigan et al. (2022) examines the influence of ownership structure and audit quality on carbon emission disclosure among non-financial companies listed on the Indonesia Stock Exchange from 2015 to 2018. The study found that, firms audited by high-quality (Big4) auditors are more likely to disclose more carbon emissions. The study suggests that policymakers should bolster the role of Big4 auditors in enhancing carbon emission transparency, while top management should adopt stakeholder-driven mechanisms to address carbon emission issues and establish legitimacy within society.

Marwa et al. (2020) examined the link between environmental audits and the quality of environmental disclosures. Researchers analyzed 81 French non-financial companies over six years (2012-2017). The study utilized multiple regression analysis to test these relationships. The study found a positive correlation between the existence of an environmental audit committee, employing a Big 4 auditor, and the quality of voluntary environmental disclosures. Larger companies and those with higher levels of earnings management also tended to disclose more environmental information. Therefore, the following null hypothesis is developed:

H_{01}: Audit quality has a significant impact on carbon emission disclosure of Nigerian listed firms

Endo (2025) explores how board expertise diversity moderates the relationship between board gender diversity and carbon disclosure using 2,169 Japanese firm-year observations from 2017 to 2023. The study finds that while female directors enhance carbon disclosure, the interaction with board expertise is crucial for effective insights and discussions. Gonenc and Krasnikova (2022) investigate the impact of board gender diversity on voluntary carbon emissions disclosure using a sample of 22,841 firm-year observations across 38 countries from 2010 to 2019. Their findings reveal a positive relationship between the percentage of female directors and carbon disclosure, supporting agency and resource dependency theories. The study also highlights that firms in countries with gender quotas—both soft and hard—tend to disclose more emissions than those without. Similarly, previous research, such as Hollindale et al. (2019), shows that companies with higher female board representation provide better-quality carbon disclosures, reinforcing the importance of gender diversity in corporate governance. Therefore, the following null hypothesis is developed:

H_{02}: Board gender diversity has no significant impact on carbon emission disclosure of Nigerian listed firms

Adam et al. (2025) investigate the impact of several corporate governance factors on carbon disclosure quality (CDQ) among 200 publicly listed Malaysian firms from 2015 to 2019. Their study focuses on the effectiveness of the board of directors (BODEF), audit committee (AUDEF), and institutional ownership (IO), while also examining the moderating role of the environmental committee (EC). To assess CDQ, the authors developed a self-constructed index based on various Malaysian and international carbon reporting guidelines. The findings indicate a significant positive relationship between BODEF, AUDEF, and IO on CDQ. Interestingly, while the EC does not significantly moderate the effects of BODEF and AUDEF, it does strengthen the impact of IO on CDQ. These insights are valuable for policymakers, enhancing their understanding of carbon disclosure practices in Malaysia and underscoring the importance of corporate governance in this context.

The effectiveness of the board of directors in mitigating agency problems between management and shareholders is significantly influenced by board composition (Merve Kılıç, 2018). Kılıç's study on Turkish non-financial companies listed on Borsa Istanbul from 2011 to 2015 revealed that a higher proportion of independent directors correlates with increased voluntary carbon emission disclosures. This suggests that board independence plays a crucial role in fostering transparency and accountability in carbon reporting.

In a more recent study, Oyewo (2023) explores the relationship between corporate governance and carbon emissions performance in multinational enterprises (MNEs). Analyzing data from 336 MNEs over a 15-year period, the research finds that board independence and ESG-based compensation significantly enhance carbon emission disclosures. Furthermore, the analysis indicates that the Sustainable Development Goals (SDGs) era has fostered better emissions management compared to the Millennium Development Goals (MDGs) era, highlighting the critical role of effective governance in addressing climate change. Therefore, the following null hypothesis is developed:

H_{03}: Board independence has no significant impact on carbon emission disclosure of Nigerian listed firms

Meqbel et al. (2025) examine how CSR committee characteristics influence carbon emission performance in non-financial firms, finding a positive link between committee presence, size, chairperson independence, and meeting frequency. Ananda (2025) analyzes CSR audits, board meeting frequency, and corporate reputation on CSR disclosure among Indonesian manufacturing companies, revealing that while audits and reputation do not significantly impact disclosure, the audit committee enhances the relationship between board meetings and CSR disclosure. Both studies highlight the importance of effective governance in promoting sustainability.

Board meetings are one of the governance mechanisms used to assess the effectiveness of the board of directors. At board meetings, directors talk on the company's sustainability disclosure and stakeholder engagement efforts. More involvement through board meetings will allow directors to better monitor demands and answer the requirements of stakeholders, ensuring legitimacy. Prior studies document that frequency of board meetings significantly affect the quality entity's environmental disclosure (Baba & Abdul-manaf, 2017; Hu & Loh, 2018).

On the other hand, Astari et al. (2020) examine the influence of earnings management on carbon emission disclosure with corporate governance as a moderating variable. The population was companies in the sector of industry and chemical, agriculture, energy, transportation listed on the Indonesia stock exchange (IDX). Based on the purposive sampling method, 12 companies were selected as the samples (60 firm-year observations). The data analysis technique used is the moderate regression analysis (MRA). The results showed that independent commissioners, the institutional ownership, and the audit committee meetings do not have a significant effect on weakening the effect of profit management on carbon emission disclosure. Woen and Setijaningsih (2025) explore the influence of industry type, environmental management performance, and carbon intensity on carbon emission disclosure among 16 listed companies for the period from 2019 to 2021. The findings indicate industry type does not have a significant impact and shows a positive correlation with carbon emission disclosure. Similarly, carbon intensity does not have a significant effect and exhibits a negative relationship with carbon emission disclosure. In contrast, environmental management performance shows a significant positive effect on carbon emission disclosure. These findings indicates that higher environmental management performance is closely related to higher transparency and more comprehensive carbon emission disclosures. Therefore, the following null hypothesis is developed:

H_{04}: Board meetings has a significant impact on carbon emission disclosure of Nigerian listed firms

3. METHODOLOGY

The study adopted a descriptive and inferential analyses to explore the determinants of SDG 13 commitments disclosure among Nigerian listed firms. The data was collected from the annual reports of Nigerian listed firms for the period 2004 to 2023. The population includes all Nigerian listed firms. A representative sample of 86 listed firms was selected based on filtering criteria, including industry type and availability of relevant data.

The study employed descriptive statistics to summarize and describe the main features of the dataset; Correlation analysis was utilized to examine the correlation as well as multicollinearity between the variables under investigation; regression analysis was used to identify and examine the determinants of SDG 13 disclosures using fixed-effects regression and random effects regression estimations among the 86 listed firms. The post-estimation test to select appropriate estimation between the regression results of fixed-effects regression and random effects regression, the study employ Hausman specification test. The data will be analyzed using Stata software, version 17.0, which is suitable for handling complex statistical analyses. The variables measurement and description are presented in Table 3.1. The model was specified to examine the relationships between the variables. The general model for the regression analysis was specified as follows:

$$CO2_{it} = \alpha + \beta_1 TS_{it} + \beta_2 FA_{it} + \beta_3 FT_{it} + \beta_4 AQ_{it} + \beta_5 BS_{it} + \beta_6 WDS_{it} + \beta_7 BNEDS_{it} + \mathcal{E}_{it}$$

Where

CO2 = Carbon Emission Disclosure

TA = Total Asset (Firm Size)

FA = Firm Age

FT = Industry type

AQ = Audit Quality

BS = Board Size

WDS = Board Gender

NEDS = Board Independence

i = Cross-sections i.e. the listed firms

t = Timeframe

α = Constant

β_1 - β_1 = Coefficients of the parameters

$\mathcal{E}$ = Stochastic term

4. DATA ANALYSIS AND DISCUSSION OF FINDINGS

4.1 Descriptive Analysis

Table 4.1 provides descriptive statistics for a dataset of 1,700 firms, focusing on variables related to carbon emission disclosure and corporate governance. The mean value for carbon emission disclosure is 0.1688, indicating that, on average, firms disclose carbon emissions at a low level. The standard deviation of 0.3747 suggests notable variability in disclosure practices, with a range from 0 to 1. This finding aligns with previous research emphasizing a general lack of transparency in environmental reporting, highlighting that while some firms fully disclose their emissions, many others do not disclose at all.

Table 4.1: Descriptive Statistics

Variable	Obs.	Mean	Std. dev.	Min	Max.
Carbon emission disclosure	1,700	0.168824	0.3747062	0	1
Audit quality	1,700	0.6811765	1.302688	0	4
Firm size	1,700	23.43473	2.510491	15.3663	30.66
Board size	1,700	9.334314	2.896132	3	20
Board independence	1,700	6.8381	2.123469	1	16
Board gender diversity	1,700	1.270747	1.295425	0	8
Firm age	1,700	27.99059	11.31037	0	59
Industry type	1,700	4.682353	2.706832	1	10
Source: Authors' computation using Stata Version 17.0					

Audit quality has an average score of 0.6812, with a standard deviation of 1.3027, reflecting a wide range of audit quality across firms. The scores span from 0 to 4, indicating that while some firms undergo rigorous audits, others receive minimal scrutiny. This significant variability can affect disclosure practices, as higher audit quality often correlates with greater transparency. The average firm size, measured logarithmically, is 23.4347, suggesting that the dataset primarily consists of large firms. The standard deviation of 2.5105 highlights the presence of both smaller and larger firms within the sample. The average board size of 9.3343, with a standard deviation of 2.8961, indicates that firms maintain boards within a typical range. Larger boards can improve oversight, potentially leading to enhanced disclosure practices.

In terms of board independence, the mean score of 6.8381 reflects a significant presence of independent directors, which is generally associated with better governance. However, the standard deviation of 2.1235 indicates variability in independence levels across firms, suggesting that some firms may lack sufficient independent oversight. The average board gender diversity score of 1.2707 reveals a concerning lack of representation, with a standard deviation of 1.2954 suggesting variability in gender diversity among boards. This finding aligns with research by Bear et al. (2010), which underscores the importance of diversity in enhancing corporate social responsibility and transparency.

Firm age averages 27.9906 years, indicating that many firms are well-established, while the average industry type score of 4.6824 reflects a diverse sector representation. The standard deviation of 2.7068 further emphasizes the variety of industries in the sample, which may influence disclosure practices. Overall, these statistics reveal significant variability in governance structures and disclosure practices among firms, highlighting the need for tailored approaches to enhance corporate transparency and accountability in environmental reporting.

4.2 Correlation Analysis

Table 4.2: Correlation Analysis

Variable	Firm size	Board size	Board independence	Board gender diversity	Carbon emission disclosure	Firm age	Industry type	Audit quality
Firm size	1							
Board size	0.3393	1						
Board independence	0.1802	0.8095	1					
Board gender diversity	0.3635	0.3959	0.2617	1				
Carbon emission disclosure	0.2755	0.1736	0.1291	0.1908	1			
Firm age	0.0371	-0.1062	-0.0946	0.1179	0.1243	1		
Industry type	-0.2878	-0.4230	-0.3199	-0.2482	-0.1034	0.2760	1	
Audit quality	0.3913	0.4589	0.2791	0.3214	0.1833	0.0103	-0.4084	1
Source: Authors' computation using Stata Version 17.0								

Table 4.2 presents the correlation analysis among various variables related to corporate governance and carbon emission disclosure. Firm size shows a positive correlation with board size (0.3393) and audit quality (0.3913), suggesting that larger firms tend to have more extensive boards and higher audit quality. Board independence correlates strongly with board size (0.8095), indicating that larger boards are likely to have a higher proportion of independent directors. Carbon emission disclosure positively correlates with firm size (0.2755) and audit quality (0.1833), implying that larger firms and those with better audit quality are more transparent about their carbon emissions. Conversely, industry type negatively correlates with several variables, which may indicate challenges in sustainability reporting across different sectors, highlighting the need for tailored approaches in enhancing disclosure practices.

4.3 Result of slope heterogeneity Test

Table 4.3 presents the results of the Pesaran and Yamagata (2008) test for slope heterogeneity, assessing whether the relationships between variables differ across groups. The Delta statistic is -3.192, with a p-value of 0.001, indicating strong evidence against the null hypothesis of slope homogeneity. This suggests significant variability in the relationships among the groups analyzed. Additionally, the adjusted Delta of -4.307, with a p-value of 0.000, reinforces this conclusion, confirming that the observed differences in slopes are statistically significant and not due to chance. These findings highlight the importance of considering group-specific effects in the analysis, as the relationships between variables are not uniform across the sample.

Table 4.3: Results of Pesaran and Yamagata (2008)Test for slope heterogeneity

	Delta	p-value
	-3.192	0.001
adj. Delta	-4.307	0.000

Source: Authors' computation using Stata Version 17.0

4.4 Result of a Fixed-Effects Regression Estimation

Table 4.4 presents the results of a fixed-effects regression estimation analyzing the determinants of carbon emission disclosure among firms. The dependent variable is carbon emission disclosure, with several independent variables evaluated for their impact.

Table 4.4: Results of Fixed-effects regression Estimation

Dependent Variable: Carbon emission disclosure				
Variable	Coefficient	Std. err.	Z- Statistic	P-Value
Audit quality	-0.355	0.1104	3.22	0.001
Firm size	4.351	5.91	7.36	0.189
Board size	-0.013	0.0058	-2.21	0.027
Board independence	0.0088	0.0065	1.35	0.178
Board gender diversity	0.0369	0.0068	5.44	0.033
Firm age	0.0112	0.0011	9.77	0.000
Industry type	-0.019	0.0121	1.57	0.116
R-squared	0.2068			
F(84, 1523) = 35.37	Prob > F = 0.0000			

Source: Authors' computation using Stata Version 17.0

Starting with audit quality, the coefficient is -0.355, with a Z-statistic of 3.22 and a p-value of 0.001, indicating a significant negative relationship. This suggests that higher audit quality is associated with lower carbon emission disclosure, which may seem counterintuitive. One possible explanation is that firms with higher audit quality may feel less pressure to disclose emissions due to the perceived credibility of their financial reporting. Firm size has a coefficient of 4.35, but the p-value of 0.189 indicates that this relationship is not statistically significant. This finding contrasts with some studies suggesting larger firms typically disclose more due to greater scrutiny and resources available for sustainability reporting.

The coefficient for board size is -0.0128, with a Z-statistic of -2.21 and a p-value of 0.027, indicating a significant negative relationship. This finding suggests that larger boards may not necessarily enhance carbon disclosure, possibly due to inefficiencies in decision-making processes or a lack of cohesive governance. In terms of board independence, the coefficient is 0.009, with a Z-statistic of 1.35 and a p-value of 0.178, suggesting a lack of significant impact on carbon disclosure. This result challenges the expectation that more independent directors would lead to better environmental accountability. The coefficient for board gender diversity is 0.0369, with a Z-statistic of 5.44 and a p-value of 0.033, indicating a significant positive relationship. This suggests that greater gender diversity on boards is associated with improved carbon emission disclosure, aligning with studies that highlight the positive impact of diverse perspectives on corporate governance. Firm age has a coefficient of 0.0112, with a Z-statistic of 9.77 and a p-value of 0.000, indicating a significant positive relationship with carbon disclosure. This suggests that older firms are more likely to have established practices and norms around transparency, which facilitates better disclosure.

Lastly, the coefficient for industry type is -0.019, with a Z-statistic of 1.57 and a p-value of 0.116, indicating no significant impact on disclosure practices. The R-squared value of 0.207 indicates that approximately 20.68% of the variability in carbon emission disclosure can be explained by the model, and the F-statistic of 35.37 (with a p-value of 0.0000) suggests that the overall model is statistically significant. These results underscore the complex dynamics influencing carbon emission disclosure, highlighting the need for nuanced approaches in governance and sustainability practices.

4.5 Result of a Random-Effects Regression Estimation

Table 4.5 presents the results of a random-effects regression estimation analyzing the determinants of carbon emission disclosure among firms. The dependent variable in this analysis is carbon emission disclosure, and several independent variables are assessed for their impact.

Table 4.5: Results of Random-effects regression Estimation

Dependent Variable: Carbon emission disclosure				
Variable	Coefficient	Std. err.	Z- Statistic	P-Value
Audit quality	-0.358	0.111	-3.24	0.001
Firm size	4.53	5.84	7.76	0.000
Board size	-0.0113	0.00564	-2.00	0.046
Board independence	0.0083	0.00642	1.29	0.196
Board gender diversity	0.0375	0.00665	5.65	0.000
Firm age	0.01035	0.0011	9.53	0.000
Industry type	-0.019	0.0121	1.57	0.116
R-squared	0.2065	Hausman Specification Test		
F(84, 1523) = 35.37	Prob > F = 0.0000		chi2(5) = 15.65	Prob > chi2 = 0.0079

Source: Authors' computation using Stata Version 17.0

Starting with audit quality, the coefficient is -0.358, with a standard error of 0.111, a Z-statistic of -3.24, and a p-value of 0.001. This indicates a statistically significant negative relationship between audit quality and carbon emission disclosure. This counterintuitive finding may suggest that firms with higher audit quality feel less pressure to disclose their emissions, possibly due to perceived credibility and reliability in their financial reporting. This could reflect a sense of security that might inhibit proactive transparency regarding environmental impacts. In terms of firm size, the coefficient is 4.53, with a standard error of 5.84, yielding a Z-statistic of 7.76 and a p-value of 0.000. This significant positive relationship indicates that larger firms are more likely to disclose carbon emissions. This aligns with existing literature that suggests larger firms often have more resources and greater public scrutiny, which motivates them to enhance their sustainability reporting practices.

The coefficient for board size is -0.0113, with a standard error of 0.00564, a Z-statistic of -2.00, and a p-value of 0.046. This significant negative relationship suggests that larger boards may not necessarily improve carbon emission disclosure. Inefficiencies in decision-making or challenges in reaching consensus might lead to reduced transparency, contrasting with the idea that larger boards enhance governance. Regarding board independence, the coefficient is 0.0083, with a standard error of 0.0064, a Z-statistic of 1.29, and a p-value of 0.196. This indicates no significant impact on carbon emission disclosure, challenging the expectation that independent directors would consistently enhance environmental accountability. The lack of significance may reflect varying priorities among independent directors that do not align with sustainability goals. The coefficient for board gender diversity is 0.0375, with a standard error of 0.0066, a Z-statistic of 5.65, and a p-value of 0.000, indicating a significant positive relationship. This finding suggests that greater gender diversity on boards is associated with improved carbon emission disclosure. This is consistent with studies highlighting the positive effects of diverse perspectives in corporate decision-making and governance.

Firm age has a coefficient of 0.0103, with a standard error of 0.0011, a Z-statistic of 9.53, and a p-value of 0.000, showing a significant positive relationship with carbon disclosure. Older firms may have established practices and norms around transparency, facilitating better disclosure of emissions over time. Lastly, the coefficient for industry type is -0.019, with a standard error of 0.0121, a Z-statistic of 1.57, and a p-value of 0.116, indicating no significant impact on carbon disclosure practices. The R-squared value of 0.2065 suggests that approximately 20.65% of the variability in carbon emission disclosure can be explained by the model. The Hausman Specification Test results, with a chi-squared statistic of 15.65 and a p-value of 0.0079, indicate that the random-effects model is appropriate for this analysis, reinforcing the relevance of the findings. Overall, the results underscore the complex dynamics influencing carbon emission disclosure, emphasizing the need for targeted governance strategies to enhance transparency in corporate sustainability efforts.

4.6 Discussion of Findings

Since the random-effects model is appropriate for this analysis going by the result of Hausman specification test. Consequently, the results from the random-effects regression analysis provide significant insights into the determinants of carbon emission disclosure among firms, and they resonate with existing literature on corporate governance and sustainability reporting.

The negative coefficient for audit quality (-0.3581) suggests that higher audit quality correlates with lower levels of carbon emission disclosure. This finding is particularly intriguing, as it contrasts with the research by Simnett et al. (2009), which posits that higher audit quality should enhance transparency in sustainability reporting. The current results may indicate that firms with robust audit practices feel more secure in their financial reporting and, as a result, deprioritize environmental disclosure. This presents a potential risk, as firms may become complacent, believing that their compliance with financial regulations is sufficient. This suggests a need for firms to balance high audit quality with proactive environmental transparency. The positive relationship between firm size (coefficient of 4.53) and carbon emission disclosure aligns with studies by Huang et al. (2016) and Patten (2002), which assert that larger firms tend to disclose more due to increased public scrutiny and resource availability. This finding emphasizes that larger firms are often better positioned to implement comprehensive sustainability reporting practices, reinforcing the importance of organizational scale in promoting transparency.

The negative coefficient for board size (-0.0113) suggests that larger boards do not necessarily enhance carbon emission disclosure, which echoes findings from Zhang et al. (2013) that highlight possible inefficiencies in decision-making within larger boards. The lack of significant impact from board independence (coefficient of 0.0083) challenges the conventional view that independent directors inherently promote environmental accountability. This resonates with Khlif and Samaha (2016), who emphasize that the effectiveness of independent directors can vary based on their commitment to sustainability issues. The results underscore the necessity for governance frameworks that align board members' interests with sustainability objectives, rather than relying solely on independence as a measure of governance quality. The significant positive coefficient for board gender diversity (0.0375) indicates that firms with more diverse boards are more likely to disclose their carbon emissions. This finding supports the work of Bear et al. (2010), which suggests that diverse leadership can enhance corporate social responsibility. It highlights the potential of gender diversity to drive more robust discussions around sustainability, encouraging firms to adopt better disclosure practices.

The positive relationship with firm age (coefficient of 0.0103) suggests that older firms are more likely to have established practices around carbon disclosure. This finding aligns with Gao et al. (2018), which posits that older firms are often more experienced in stakeholder engagement and governance practices. It indicates that younger firms may benefit from learning from their older counterparts to enhance their sustainability reporting. Finally, the coefficient for industry type shows no significant impact on carbon disclosure. This finding suggests that industry-specific factors may not uniformly influence reporting practices, as noted by De Villiers and Van Staden (2011). It highlights the need for tailored approaches that consider the unique challenges and opportunities within different sectors.

5. CONCLUSION AND RECOMMENDATIONS

The results from the random-effects regression analysis provide critical insights into the determinants of carbon emission disclosure among firms. The findings indicate that while larger firms and those with more gender-diverse boards are more likely to disclose carbon emissions, factors such as audit quality and board size present challenges to transparency. The negative relationship between audit quality and disclosure suggests a potential complacency in reporting, while larger boards may hinder effective decision-making regarding sustainability practices. Overall, the study underscores the complexity of corporate governance in relation to sustainability reporting, highlighting the need for firms to adopt tailored strategies that enhance transparency and accountability in environmental practices. The following recommendations were drawn from random effects regression result:

i.Enhance Proactive Disclosure Practices:

Firms in Nigeria should align their sustainability reporting with the requirements of the Nigerian Sustainability Code and the guidelines set forth by the Financial Reporting Council of Nigeria (FRCN). By integrating carbon emission disclosures into their corporate strategies, companies can ensure that these reports are treated with the same importance as financial disclosures, thereby enhancing overall transparency.

ii.Optimize Board Structure:

Companies should assess their board compositions in light of the Nigerian Code of Corporate Governance, which emphasizes the need for effective governance structures. By considering smaller, more cohesive boards, firms can facilitate better decision-making regarding sustainability issues. Additionally, fostering a culture of accountability among board members can strengthen their commitment to environmental reporting.

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iii.Promote Gender Diversity:

To align with initiatives aimed at increasing gender diversity in leadership, such as the Women in Business initiative by the Nigerian Economic Summit Group, organizations should actively seek to enhance gender diversity on their boards. This can lead to improved discussions around corporate social responsibility and sustainability, enhancing the overall quality of carbon emission disclosures.

iv.Leverage Experience of Established Firms:

Younger firms can benefit from partnerships or mentoring relationships with established companies that have successfully navigated sustainability reporting. The Nigerian Business Coalition for Sustainable Development (NBCSD) offers platforms for such collaborations, helping newer firms learn best practices in carbon disclosure and stakeholder engagement.

v.Tailor Approaches by Industry:

Given the diverse regulatory frameworks across various sectors in Nigeria, firms should adopt strategies that reflect the unique challenges and opportunities within their industries. Engaging with industry associations, such as the Manufacturers Association of Nigeria (MAN), can provide valuable insights and resources for enhancing sustainability practices tailored to specific sectoral needs.

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