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# ANALYSIS OF THE IMPACT OF AUDIT QUALITY AND BOARD GENDER DIVERSITY ON CARBON EMISSION DISCLOSURE AMONG LISTED FIRMS IN NIGERIA

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**ABSTRACT**

*Climate change poses a significant global challenge, urging immediate action from businesses, particularly in emerging markets like Nigeria. This study investigates the commitments of Nigerian firms to Sustainable Development Goal 13 (SDG 13) by analyzing carbon emission disclosures as a proxy for climate action. The data from the annual reports of 86 listed firms from 2016 to 2023 were collected and analyzed. The study aims to assess the impact of audit quality and board gender diversity on carbon emission disclosures. The findings reveal that the average carbon emission disclosure rate among firms is low, suggesting insufficient transparency regarding environmental accountability. Descriptive statistics indicate a significant variance in disclosure practices, with some firms providing complete information while others disclose none. Correlation analysis shows positive relationships between carbon emission disclosure and variables such as firm size and audit quality, highlighting that larger firms and those with higher audit quality tend to be more transparent. The findings from System GMM estimation include a statistically significant positive impact of audit quality and board size on disclosure practices, while board independence and gender diversity show unexpected negative relationships. The results suggest that independent directors may not prioritize environmental issues, and gender-diverse boards do not automatically enhance sustainability practices. Moreover, older firms demonstrate a stronger commitment to transparency, indicating that established practices and stakeholder engagement promote better disclosure. The recommendations drawn include enhancing audit practices, optimizing board composition, fostering purposeful gender diversity, leveraging the experience of established firms, engaging with industry-specific guidelines, and cultivating a culture of transparency.*

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

## 1. INTRODUCTION

Climate change is a pressing global challenge demanding urgent action from businesses. The Sustainable Development Goal 13 (SDG 13) underscores the imperative to combat climate change and its impacts. While the role of developed economies in addressing this issue is well-documented, the commitment of emerging markets like Nigeria remains relatively unexplored. This research aims to bridge this gap by examining the climate action disclosures (using carbon emission disclosure as proxy) of Nigerian listed firms, identifying the factors influencing these disclosures, and evaluating their impact on firm value.

To achieve these objectives, a quantitative research design will be employed. Data will be collected from the annual reports of Nigerian listed firms covering the period from 2004 to 2023. The data will undergo rigorous analysis using statistical techniques, including descriptive statistics to summarize key features, correlation analysis to examine relationships between

variables, regression analysis to identify determinants of SDG 13 disclosures and assess value relevance, and post-estimation tests to validate the regression models. The statistical software Stata will be utilized for these analyses. The findings of this study will provide critical insights into the level of SDG 13 disclosure among Nigerian firms, the factors driving these disclosures, and their implications for firm valuation. This knowledge will be invaluable for policymakers, investors, and businesses in developing strategies to mitigate climate risks and enhance sustainability performance.

The study aims to assess the impact of audit quality on carbon emission disclosure among listed firms in Nigeria. And to examine the impact board gender diversity on carbon emission disclosure among listed firms in Nigeria.

Firms in Nigeria should prioritize enhancing audit quality to align with the requirements of the Nigerian Sustainability and the guidelines established by the Financial Reporting Council of Nigeria (FRCN). Engaging reputable audit firms that specialize in sustainability and environmental accountability can ensure rigorous scrutiny of both financial and environmental reporting. By fostering a culture of transparency through strong audit practices, firms can encourage more comprehensive carbon emission disclosures, thereby building stakeholder trust and aligning with best practices in sustainability reporting.

Companies should evaluate their board structures in accordance with the Nigerian Code of Corporate Governance, which emphasizes the importance of effective governance. Maintaining an optimal board size that facilitates open dialogue while encouraging diverse perspectives is essential. Firms should focus on cultivating board members who not only possess independence but also demonstrate a commitment to environmental accountability. Providing training on sustainability issues can enhance their understanding and engagement in promoting carbon disclosure. The study is, however, structured into six (6) sections. Following this introductory section is section 2 which presents the literature review and theoretical framework, while section 3 contains the sources of data and other components of research methodology. The data presentation, analysis, interpretation and discussions of findings are articulated in section 4, while sections 5 and 6 present summary of major findings as well as conclusion and recommendations of the study.

## 2. LITERATURE REVIEW

Sustainable Development Goal 13 (SDG 13) aims to take urgent action to combat climate change and its impacts. It emphasizes the necessity for a coordinated international response to mitigate climate change and adapt to its effects (United Nations, 2015). SDG 13 is crucial as climate change poses significant risks to the environment, economies, and societies globally, potentially reversing decades of development progress (IPCC, 2018). 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

This study adopted Stakeholder Theory and Resource-Based View (RBV) theory to underpin the impact of audit quality and board gender diversity on carbon emission disclosure among the listed firms in Nigeria. 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. While, Resource-Based View (RBV) asserts that firms with more substantial resources-such as financial capital, human expertise, and technological capabilities-are better equipped to implement and disclose sustainability initiatives. This view highlights how resource availability can enhance a firm's capacity to engage in effective sustainability practices and communication. These theories provide a complete framework for understanding the motivations behind corporate sustainability disclosures, emphasizing the interplay between societal expectations, stakeholder interests, and resource capabilities.

**Empirical Review**

Implementing and disclosing social and environmental performance requires significant funding and expertise. Large companies are assumed to comply more with carbon emission disclosure requirements. Prior studies found that firm size has a significant impact on carbon emission. Hermawan et al., (2018) examined the determinants of carbon emission disclosure in manufacturing companies in Indonesia. The study found that company size influences carbon emission disclosure. Boshnak (2022) investigates the determinants of corporate social and environmental voluntary disclosure (CSEVD) among Saudi listed firms. The study spans the period from 2016 to 2018 and uses content and regression analyses based on data from the annual reports of non-financial firms in Saudi Arabia. The findings indicate that firm size positively influence CSEVD. On contrary Zayol et al. (2021) examined the factors influencing environmental disclosure among less environmentally sensitive Nigerian companies for the period of 10 years (2009-2018). The study employed an ex-post facto research design and panel regression analysis, the study found insignificant relationship between firm size and auditor size on environmental disclosure levels. Therefore, the following hypothesis is developed:

$H_{01}$: Firm size has a significant impact on carbon emission disclosure of Nigerian listed firms

Bedi and Singh (2024) investigate the impact of carbon emission disclosure on firm financial performance on 100 Indian firms for the period of 2018–2019 to 2020–2021. The study established significant negative relationship between carbon emission disclosure and firm financial performance. Lina and Adelia (2024) provide empirical evidence on the effect of carbon emission disclosure on financial performance. This study reveals that carbon emission disclosure has a positive effect on accounting-based performance measures. Aini and Aryati (2024) examine the effect of Greengas House Emission Disclosure, Carbon Performance, and Company Age on Firm Value across 86 energy sector companies listed in Indonesia over the period 2021-2023.

Zayol et al. (2021) examined the factors influencing environmental disclosure among less environmentally sensitive Nigerian companies for the period of 10 years (2009-2018). The study employed an ex-post facto research design and panel regression analysis, the study found a positive relationship between firm age and leverage, and environmental disclosure. Solikhah et al. (2021) investigated the factors influencing carbon emission disclosure among Indonesian listed manufacturing companies, for the period of 4years (2012 – 2015). Using panel data regression analysis on a sample of 40 companies, the researchers found that older companies with higher institutional ownership and more independent commissioners tend to disclose carbon emissions more frequently. Conversely, Boshnak (2022) investigates the determinants of corporate social and environmental voluntary disclosure (CSEVD) among Saudi listed firms. The study spans the period from 2016 to 2018 and uses content and regression analyses based on data from the annual reports of non-financial firms in Saudi Arabia. The findings indicate that firm age, and institutional ownership do not significantly affect CSEVD levels.

Prasetya and Yulianto (2018) investigates the influence of proper rating, industrial type, profitability, leverage, and company age on carbon emission disclosure among non-financial companies listed on the Indonesia Stock Exchange from 2013 to 2016. The sample consists of 32 companies, totaling 126 units of analysis, selected using purposive sampling. The Carbon Emission Disclosure Checklist (CED) is used to measure carbon emissions disclosure. The research employs descriptive statistical analysis and multiple linear regression analysis, processed through IBM SPSS 21. The findings reveal that company age do not significantly affect carbon emission disclosure. Therefore, the following hypothesis is developed:

$H_{02}$: Firm age has a significant impact on carbon emission disclosure of Nigerian listed firms

Carbon emissions are the release of carbon gas into the atmosphere, which can arise as a result of a company's operational activities. Disclosure of carbon emissions is a form of responsible practice for environmental aspects carried out by companies. However, there are still companies that do not disclose carbon emission disclosure items. Ruhiyat (2025) examines the influence of Media Publications, Environmental Performance, Leverage and industry type on Carbon Emission Disclosure in 20 energy sector companies listed in Indonesia for the 2019 - 2023 Period. The results show that Media Publications, Environmental Performance and Leverage influence Carbon Emission Disclosure, while Industry Type has no influence on Carbon Emission Disclosure. Woen & 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 indicates that higher environmental management performance is closely related to higher transparency and more comprehensive carbon emission disclosures.

The relationship between industry type and sustainability reporting has received significant attention in corporate governance and sustainability research, often framed within legitimacy and stakeholder theories.

These theories suggest that certain industries face heightened societal pressure to disclose their social and environmental impacts. Empirical evidence from various global and regional contexts supports this association. For instance, Burgwal and Vieira (2014) found a significant positive link between firm size, industry membership, and environmental disclosure in Dutch-listed companies. Similarly, Aman et al. (2015) identified industry type as a crucial factor influencing corporate sustainability reporting among Malaysian public companies. Ashfaq and Rui (2019) also noted a significant impact of industry type on corporate social and environmental disclosure practices in Pakistan.

Prasetya and Yulianto (2018) further investigate how PROPER ratings, industry type, profitability, leverage, and company age affect carbon emission disclosure among non-financial companies listed on the Indonesia Stock Exchange from 2013 to 2016. Their study, which analyzes a sample of 32 companies (totaling 126 units of analysis) selected through purposive sampling, employs the Carbon Emission Disclosure Checklist (CED) for measurement. Using descriptive statistical analysis and multiple linear regression via IBM SPSS 21, the findings indicate that industry type is a critical determinant of carbon emission disclosure. Therefore, the following hypothesis is developed:

$H_{03}$: Industry type has a significant impact on carbon emission disclosure of Nigerian listed firms

Mansour, Abu-Allan, and Alshdaifat (2025) explore the impact of corporate board governance attributes on carbon emission disclosure across ASEAN-5 countries (Indonesia, Malaysia, the Philippines, Singapore, and Thailand) from 2015 to 2022. Their findings indicate that gender diversity and the presence of an environmental committee significantly enhance carbon disclosure, while board size and meeting frequency show inconsistent effects. Notably, board independence negatively impacts disclosure. In a related study, Alamanda, Azis, and Djajuli (2025) assess the effects of leverage, firm size, and environmental performance on carbon disclosure among energy and industrial sector firms listed on the Indonesia Stock Exchange from 2021 to 2024. They find that environmental performance, measured through the PROPER rating, positively influences disclosure, while leverage and firm size do not significantly affect transparency.

The relationship between board size and transparency regarding greenhouse gas emissions and climate change impacts is complex. Generally, larger boards facilitate more comprehensive carbon disclosure, but this dynamic is influenced by various board characteristics. Uwuigbe et al. (2011) examined the link between board characteristics-specifically size and composition-and environmental disclosure among Nigerian listed companies. Analyzing annual reports from 40 firms between 2006 and 2010 using the Kinder Lydenberg Domini (KLD) rating scheme, their regression analysis revealed that, counterintuitively, larger boards were associated with lower levels of environmental disclosure. This finding highlights the nuanced role of board structure in promoting transparency. Therefore, the following hypothesis is developed:

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

Dewi (2025) examines the direct and indirect effects of carbon emission disclosure and environmental performance on firm value, using financial performance as a mediating variable. Analyzing panel data from 15 firms in the raw materials and industrial sectors listed on the Indonesia Stock Exchange from 2017 to 2023, the study finds that carbon emission disclosure positively impacts firm value, while environmental performance does not. Financial performance significantly affects firm value but does not mediate the relationship between carbon disclosure and firm value, indicating the need for further exploration of sustainability's impact on financial outcomes. Abdullah, Syariati, Muchlis, Fajrin, and Hanafie (2025) investigate how green accounting, financial performance, and environmental performance affect firm value, across 16 mining companies listed in Indonesia during 2019-2023, with 16 companies selected through purposive sampling, yielding 80 total observations. The analytical approach combines multiple linear regression with Moderated Regression Analysis (MRA) or interaction testing to examine the proposed relationships.

Hardiyansah et al. (2021) examine the impact of carbon emission disclosure on firm value, with environmental performance and industrial type as moderating variables. Using 82 companies listed on the Indonesia Stock Exchange and awarded by the Indonesian Sustainability Reporting Award from 2014-2018, the study employs multiple linear regression analysis. Findings indicate that carbon emission disclosure positively and significantly affects firm value, with the market responding favorably to companies' environmental concerns. Kurnia et al. (2020) explore the relationships among carbon emission disclosure, good corporate governance, financial performance, and firm value in Indonesian firms. Covering 43 firms from the mining, agriculture, and manufacturing sectors listed on the Indonesia Stock Exchange between 2015 and 2017, the study uses structural equation modeling for data analysis.

The findings reveal that while carbon emission disclosure and good corporate governance do not directly impact firm value, their effects are significant when mediated by financial performance. Kurnia, et al. (2021) investigates the effect of carbon emission

disclosure on firm value, focusing on manufacturing firms in Indonesia and Australia. The study employs a sample of 39 Indonesian and 25 Australian manufacturing firms, with firm value measured by Tobin's Q and carbon emission disclosure by a specific Conversely, Kurnia et al. (2021) investigates the effect of carbon emission disclosure on firm value, focusing on manufacturing firms in Indonesia and Australia. The study employs a sample of 39 Indonesian and 25 Australian manufacturing firms, with firm value measured by Tobin's Q and carbon emission disclosure by a specific index. The findings reveal that in Australia, no significant effect was found; indicating that the high costs associated with carbon emission disclosures may outweigh the benefits, leading to lower cash flow and not significantly affecting firm value. Therefore, the following hypothesis is developed:

$H_{05}$: Carbon emission disclosure has a significant impact on firm value of Nigerian listed firms.

## 3. METHODOLOGY

The study adopted a descriptive and inferential analyses to examine the impact of audit quality and board gender diversity on carbon emission disclosure among the listed firms in Nigeria. 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. Although 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 also utilized to examine the correlation as well as multicollinearity between the variables under investigation; regression analysis was also used to identify and examine the impact of audit quality and board gender diversity on carbon emission disclosure using System Generalized Method of Moments (SGMM) estimations. 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:

$$CED_{it} = \alpha + \beta_1 FSIZ_{it} + \beta_2 FAGE_{it} + \beta_3 INDT_{it} + \beta_4 AUDQ_{it} + \beta_5 BSIZ_{it} + \beta_6 BGEN_{it} + \beta_7 BIND_{it} + \beta_8 BMEE_{it} + \varepsilon_{it}$$

Where

i = Cross-sections i.e. the listed firms
t = Timeframe
$\alpha$ = Constant
$\beta_1$ - $\beta_1$ = Coefficients of the parameters
$\varepsilon$ = Stochastic term
CED = Carbon Emission Disclosure
FSIZ = Firm Size
FAGE = Firm Age
INDT = Industry type
AUDQ = Audit Quality
BSIZ = Board Size
BGEN = Board Gender
BIND = Board Independence

**Table 3.1:**
**Variables Description and Measurement**

| Variables | Definition | Measurement | Source |
|---|---|---|---|
| **Independent Variables** | | | |
| Firm size | The scale or magnitude of a firm, typically measured by the total assets or revenue of the firm. | Natural log of total assets | Hermawan et al., (2018) |
| Firm age | The number of years a firm has been in operation since its establishment. | Years since establishment | Amna Noor et al., (2020) |
| Audit quality | The level of assurance provided by the auditor, often associated with the reputation and rigor of the audit firm | Big Four (1) or non-Big Four (0) | Salaudeen & Abdulwahab, (2022) |
| Industry type | The sector or industry in which the firm operates, which may influence its approach to sustainability reporting. | Industry type (categorical variable) | Ong & Djajadikerta, (2020) |
| Board size | The total number of members on the firm's board of directors. | Number of directors | Merve Kılıç, (2018) |
| Board gender diversity | The proportion of female directors on the board relative to the total number of board members. | Percentage of female directors | Hollindale et al., (2019) |
| Board independence | The proportion of board members who are independent directors, meaning they are not involved in the day-to-day operations or have no financial ties to the firm. | Percentage of independent directors | Merve Kılıç, (2018) |
| **Dependent Variables:** | | | |
| Carbon emission disclosure | The extent to which a firm reports its carbon emissions and climate-related impacts in its sustainability or annual reports. | Measured using the Global Reporting Initiative (GRI) standards | Jibril et al. (2021) |

Source: Authors' Compilation

## 4. DATA ANALYSIS AND DISCUSSION OF RESULTS

### 4.1 Descriptive Analysis

The descriptive statistics presented in Table 4.1 provide a detailed overview of various corporate governance and carbon emission disclosure characteristics across a sample of 1,700 firms. The average carbon emission disclosure rate is 0.1688, indicating that firms generally exhibit low levels of transparency regarding their emissions. This suggests that many organizations may not prioritize environmental accountability, potentially due to a lack of regulatory pressure or stakeholder demand. The high standard deviation of 0.3747 further underscores the variability in disclosure practices, with some firms fully disclosing their emissions while others report none at all.

**Table 4.1: Descriptive Statistics**

| Variable | Obs. | Mean | Std. dev. | Min. | Max. |
|---|---|---|---|---|---|
| Carbon emission disclosure | 1,700 | 0.169 | 0.375 | 0 | 1 |
| Audit quality | 1,700 | 0.6812 | 1.303 | 0 | 4 |
| Firm size | 1,700 | 23.434 | 2.511 | 15.366 | 30.659 |
| Board size | 1,700 | 9.334 | 2.896 | 3 | 20 |
| Board independence | 1,700 | 6.838 | 2.124 | 1 | 16 |
| Board gender diversity | 1,700 | 1.271 | 1.295 | 0 | 8 |
| Firm age | 1,700 | 27.991 | 11.310 | 0 | 59 |
| Industry type | 1,700 | 4.682 | 2.709 | 1 | 10 |

*Source: Authors' computation using Stata Version 17.0*

In terms of audit quality, the average score stands at 0.6812, which is relatively low and implies that a significant number of firms may not be receiving high-quality audits. The standard deviation of 1.3027 highlights the extensive range of audit quality across the firms, with scores varying from 0 to 4. This variability may reflect differing levels of oversight and governance practices among firms, potentially impacting their operational effectiveness. When examining firm size, the average logarithmic value of 23.4347 indicates that the firms in the dataset are predominantly large. However,

the considerable standard deviation of 2.5105 reflects a mix of smaller and larger firms within the sample, suggesting that the dataset encompasses a broad spectrum of organizational scales. The average board size is 9.3343 members, which is typical for corporate boards. Nevertheless, the variability in board size, indicated by a standard deviation of 2.8961, suggests differences in governance structures that may influence decision-making processes.

Board independence is another critical measure, with an average score of 6.8381, reflecting a significant presence of independent directors. The standard deviation of 2.1235 indicates variability among firms, which may affect governance quality. Moreover, the average board gender diversity score is low at 1.2707, highlighting a concerning lack of gender representation in corporate leadership. Firm age averages 27.9906 years, suggesting that many firms are well-established within their industries. The notable standard deviation of 11.3104 points to a mix of younger and older firms, indicating a diverse range of operational histories. Lastly, the average industry type score of 4.6824 reflects a diversity of sectors represented in the dataset, with a standard deviation of 2.7068 emphasizing significant operational variety. Overall, these statistics reveal considerable variability among firms, which may influence the relationships explored in subsequent analyses, highlighting the need for tailored approaches in understanding corporate governance and sustainability practices.

**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 Results of Slope Heterogeneity Test**

Table 4.3 displays the results of the Pesaran and Yamagata (2008) test for slope heterogeneity, crucial for assessing whether the relationships between variables differ across groups. The Delta statistic of -3.192, accompanied by a p-value of 0.001, provides strong evidence against the null hypothesis of slope homogeneity, indicating that the slopes significantly vary among the analyzed groups. This suggests that the impact of the independent variables may not be uniform, reflecting distinct underlying dynamics. Furthermore, the adjusted Delta of -4.307, with a p-value of 0.000, further supports this conclusion, reinforcing the notion that the observed variability in slopes is statistically significant and unlikely to result from random variation. These findings underscore the importance of considering group-specific effects in the analysis.

**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* | | |

**4.3 Results of System GMM Estimation**

Table 4.3 presents the results of the System Generalized Method of Moments (GMM) estimation, focusing on various determinants of carbon emission disclosure among firms. The dependent variable in this analysis is carbon emission disclosure, and several independent variables are examined, each with its respective coefficient, standard error, Z-statistic, and p-value. The findings provide valuable insights into how governance structures, firm characteristics, and industry contexts influence transparency in environmental reporting.

**Table 4.3: Results of System GMM estimation**

| Dependent Variable: Carbon emission disclosure | | | | |
|---|---|---|---|---|
| Variable | Coefficient | Std. err. | Z- Statistic | P-Value |
| Audit quality | 0.221 | 1.41 | 15.62 | 0.000 |
| Firm size | 0.481 | 3.66 | 1.31 | 0.189 |
| Board size | 0.621 | 2.97 | 20.94 | 0.000 |
| Board independence | -0.781 | 3.38 | -23.12 | 0.000 |
| Board gender diversity | -0.855 | 4.00 | -2.14 | 0.033 |
| Firm age | 0.242 | 7.58 | 31.99 | 0.000 |
| Industry type | 0.201 | 1.23 | 16.28 | 0.000 |
| *Source: Authors' computation using Stata Version 17.0* | | | | |

Starting with audit quality, the coefficient is 0.221, indicating a positive relationship with carbon emission disclosure. The Z-statistic of 15.62 and a p-value of 0.000 suggest that this relationship is statistically significant. This finding aligns with previous research, such as that by Simnett et al. (2009), which found that higher audit quality leads to better sustainability reporting due to increased scrutiny and accountability. The positive impact of audit quality may stem from the auditor's role in ensuring compliance with disclosure regulations, thus encouraging firms to be more transparent about their carbon emissions. Next, the variable of firm size has a coefficient of 0.481, but the p-value of 0.189 indicates that this relationship is not statistically significant. Despite the positive coefficient, this suggests that larger firms may not necessarily disclose more information on carbon emissions. This finding contrasts with studies such as those by Patten (2002) and Huang et al. (2016), which argue that larger firms tend to disclose more due to greater public scrutiny and resource availability. The lack of significance in this analysis may reflect industry-specific factors or organizational culture that inhibit transparency, regardless of firm size.

The coefficient for board size is 0.621, with a Z-statistic of 20.94 and a p-value of 0.000, indicating a significant positive impact on carbon emission disclosure. This result supports the findings of previous studies, such as those by Zhang et al. (2013), which suggest that larger boards may enhance governance and oversight, leading to greater transparency in emissions reporting. Larger boards often provide a diverse array of perspectives, which can foster comprehensive discussions about sustainability practices and encourage firms to adopt more robust disclosure practices. Conversely, board independence has a negative coefficient of -0.781, accompanied by a Z-statistic of -23.12 and a p-value of 0.000. This significant negative relationship indicates that greater board independence is associated with lower levels of carbon emission disclosure. This finding challenges the conventional view that independent directors enhance corporate governance. Research by Khlif and Samaha (2016) suggests that independent directors may not prioritize environmental issues, possibly due to their shorter tenure and less commitment to the firm's long-term sustainability goals. This complexity reflects the need to consider the motivations and dynamics of independent directors in governance structures.

The coefficient for board gender diversity is -0.855, with a Z-statistic of -2.14 and a p-value of 0.033, suggesting a significant negative impact on carbon emission disclosure. This finding is particularly intriguing, as it contrasts with the notion that gender-diverse boards enhance corporate social responsibility. Previous studies, such as those by Bear et al. (2010), have highlighted the positive correlation between gender diversity and improved sustainability practices. The negative relationship observed here may indicate that while gender diversity is important, it does not automatically translate to enhanced environmental accountability, potentially due to differing priorities among board members. Regarding firm age, the coefficient is 0.242, with a Z-statistic of 31.99 and a p-value of 0.000, indicating a significant positive relationship with carbon emission disclosure. This suggests that older firms may have more established

practices and norms around transparency in emissions reporting. This finding aligns with research by Gao et al. (2018), which posits that older firms are more likely to have mature governance structures and a longer history of stakeholder engagement, promoting better disclosure practices.

Finally, the coefficient for industry type is 0.201, with a Z-statistic of 16.28 and a p-value of 0.000, indicating that the industry context plays a critical role in determining the level of carbon emission disclosure. This finding is consistent with studies such as those by De Villiers and Van Staden (2011), which emphasize that firms in industries with stricter regulations or heightened public scrutiny are more likely to disclose their environmental impacts. This suggests that industry characteristics significantly influence corporate behavior concerning sustainability reporting. Overall, these results underscore the complex interplay of governance structures, firm characteristics, and industry contexts in influencing carbon emission disclosure practices. The findings highlight the need for tailored approaches to enhance transparency in corporate sustainability efforts, suggesting that simply increasing board independence or size may not suffice. Instead, firms must foster a culture of transparency that prioritizes environmental accountability while considering the diverse perspectives brought by board members, regardless of their independence or gender.

## 5. CONCLUSION AND RECOMMENDATION

**Conclusion**

The results of the System Generalized Method of Moments (GMM) estimation provide significant insights into the determinants of carbon emission disclosure among firms, revealing the intricacies of corporate governance and environmental accountability. The analysis demonstrates that various factors-such as audit quality, board size, board independence, board gender diversity, firm age, and industry context-play critical roles in shaping transparency in environmental reporting. The positive relationship between audit quality and carbon emission disclosure aligns with previous research, reinforcing the notion that rigorous audits promote accountability and transparency. Firms with higher audit quality are more likely to be scrutinized, which encourages them to be more forthcoming about their environmental impacts. This finding emphasizes the importance of not just compliance but proactive engagement in sustainability practices. Conversely, the findings regarding firm size indicate that larger firms do not necessarily disclose more information about their carbon emissions, challenging the assumption that size alone drives transparency. This suggests that factors such as organizational culture and industry-specific dynamics may hinder larger firms from maximizing their disclosure potential.

The significant positive impact of board size on disclosure practices indicates that larger boards can facilitate diverse perspectives and discussions that enhance sustainability practices. This supports the view that a variety of viewpoints can lead to more comprehensive decision-making regarding corporate social responsibility. However, the unexpected negative relationships with board independence and board gender diversity indicate a need to reconsider how these factors contribute to corporate governance and environmental accountability. Specifically, independent directors and gender-diverse boards may not inherently align with sustainability goals, as their motivations and priorities can vary significantly.

The significant positive relationship between firm age and disclosure practices suggests that older firms benefit from established norms and practices that enhance their commitment to transparency. This aligns with the idea that firms with a longer history of stakeholder engagement are more likely to adopt comprehensive sustainability reporting. Additionally, the influence of industry type highlights the importance of regulatory environments and public scrutiny in driving disclosure practices. Firms operating in industries with stricter regulations are more likely to be transparent about their environmental impacts, indicating that external pressures can significantly influence corporate behavior. Overall, these findings underscore the complex nexus between governance structures, firm characteristics, and external contexts in influencing carbon emission disclosure. They suggest that a one-size-fits-all approach may be inadequate; instead, firms must adopt tailored strategies that align with their unique circumstances and industry dynamics.

**Recommendations**

The following recommendations are drawn from the major findings:

i. Strengthen Audit Practices

Firms in Nigeria should prioritize enhancing audit quality to align with the requirements of the Nigerian Sustainability Code and the guidelines established by the Financial Reporting Council of Nigeria (FRCN). Engaging reputable audit firms that specialize in sustainability and environmental accountability can ensure rigorous scrutiny of both financial and environmental reporting. By fostering a culture of transparency through strong audit practices, firms can encourage more comprehensive carbon emission disclosures, thereby building stakeholder trust and aligning with best practices in sustainability reporting.

ii. Optimize Board Composition:

Companies should evaluate their board structures in accordance with the Nigerian Code of Corporate Governance, which emphasizes the importance of effective governance. Maintaining an optimal board size that facilitates open dialogue while encouraging diverse perspectives is essential. Firms should focus on cultivating board members who not only possess independence but also demonstrate a commitment to environmental accountability. Providing training on sustainability issues can enhance their understanding and engagement in promoting carbon disclosure.

iii.Foster Gender Diversity with Purpose:
In line 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 promote gender diversity on their boards. However, it is crucial that this diversity translates into meaningful engagement with sustainability issues. Implementing training and development programs focused on corporate social responsibility can help align board members' understanding with the firm's sustainability objectives. Recruiting board members with a demonstrated commitment to sustainability can further ensure that diverse perspectives contribute effectively to environmental accountability.

iv. Leverage the Experience of Established Firms:
Younger firms should seek mentorship and collaboration opportunities with established companies that have successfully navigated sustainability reporting. The Nigerian Business Coalition for Sustainable Development (NBCSD) provides platforms for such collaborations, enabling younger firms to learn best practices in carbon disclosure and stakeholder engagement. By leveraging the experiences of established firms, younger organizations can develop effective strategies to enhance their sustainability efforts.

v. Engage with Industry-Specific Guidelines:
Given the diverse regulatory frameworks across various sectors in Nigeria, firms should tailor their sustainability reporting practices to 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 to enhance environmental accountability. By participating in industry-specific initiatives, firms can improve their sustainability practices and contribute to the establishment of higher standards within their sectors.

vi. Cultivate a Culture of Transparency:
Firms must foster a corporate culture that prioritizes transparency and environmental accountability, aligning with Nigeria's commitment to sustainable development as outlined in the National Environmental Policy. This involves integrating sustainability into the core values of the organization and ensuring that all employees understand their role in promoting carbon emission disclosure and environmental stewardship. Training programs, internal communications, and leadership commitment to sustainability can help embed these values into the organizational culture, fostering a sense of collective responsibility toward environmental issues.

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