



Carbon Accounting and Financial Performance of the Energy Sector in Nigeria

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ABSTRACT

Energy firms in developing countries, such as those in Nigeria, are concerned about the long-term impacts of their actions to reduce greenhouse gas emissions, meet stakeholder demands and combat the effects of climate change. Consequently, there is an increasing concern about how these efforts will affect their bottom line. This paper examined the relationship between carbon reporting practices and the financial performance of quoted Nigerian oil and gas firms (listed on the Nigerian Exchange Group), using stakeholder theory as the foundation of the research methodology. Data for this study consisted of secondary data, specifically all available data collected from 10 publicly traded oil and gas firms from 2014 to 2023, obtained through the review of Annual Reports and Sustainability Reports issued by the Nigerian Exchange Group. Descriptive statistics and Panel Ordinary Least Squares Regression were used to evaluate the data and determine whether a relationship existed. The results indicate a statistically significant, positive relationship between carbon emissions and both earnings per share and stock price. These findings indicate that investors are not environmentally conscious and will be attracted to investments in companies that produce high levels of carbon-based performance. However, the results also demonstrate that the relationship between carbon emissions and return on capital employed is positive but statistically insignificant. Moreover, the findings demonstrate the strategic importance of carbon accounting for firms operating in carbon-intensive industries and conclude that firms should invest in transparent, sustainability-based reporting to ensure that environmental responsibility (climate action) aligns with long-term financial performance.

Keywords: Carbon Accounting, Financial Performance, Energy Sector, Sustainability, SDG 13, Nigeria

JEL Classifications: Q400, Q420, Q430

1. INTRODUCTION

The main problem for businesses is balancing maximising profits with ensuring sustainability, despite both objectives affecting and altering the business's surroundings (Huy and Dinh, 2025). The pursuit of sustainability has been successful, motivating many countries to adopt environmental protection and sustainable development goals (SDGs), particularly since the adoption of the Kyoto Protocol. As an example of this, in Sub-Saharan Africa, two major economies – Nigeria and South Africa (both with significant economic potential and a wealth of natural resources)

utilise energy to promote economic development and growth (Shao et al., 2025).

Energy remains one of the primary drivers of greenhouse gas emissions (including carbon dioxide (CO₂)) in resource-dependent economies facing environmental challenges (e.g. land degradation, oil spills, air pollution, etc.) (Banjo et al. 2024). Furthermore, as emerging markets continue to grow and face environmental challenges, stakeholders are becoming increasingly environmentally conscious and are demanding corporate sustainable reporting (Sharma, 2025). While some

companies are taking proactive climate-related actions, other companies are either nonresponsive or merely symbolic in responding to stakeholder demands for sustainability and environmental reporting.

As a significant challenge, climate change continues to disrupt long-standing business practices, making adaptation an urgent priority for nations and corporations alike (Odeyemi et al. 2024). Our study is vital due to voluntary initiatives aimed at increasing environmental accountability, transparency, and provide guidance through integrating carbon accounting into corporate financial reporting including, these initiatives stem from bodied such as the task force on climate related financial disclosures (TCFD), carbon disclosure project (CDP), global reporting initiative (GRI), and most recently, the International Financial Reporting Standards (IFRS), IFRS S1 (sustainability), and IFRS S2 (climate-related disclosures).

Furthermore, there is growing interest in the connection between environmental sustainability and corporate financial performance in developing economies (Gidage and Bhide, 2025; Akinsola, 2025). Since CO₂ emissions are largely unregulated, the question is, what percentage of companies voluntarily report their carbon data, and how does it impact their bottom line? This research identifies a critical knowledge gap: The effect of carbon accounting on the financial performance of the energy sector in Nigeria, specifically in terms of stock performance, profitability and market value, has not yet been fully explored.

Furthermore, the empirical literature globally provides mixed evidence, suggesting positive, no association or negative relationships (Orazalin et al., 2025; Serem et al., 2024; Khan et al., 2023), thus emphasising the need for country-specific research. Conceptually, stakeholder theory suggests that carbon reporting will address various stakeholder expectations and provide social approval and access to capital (Mahajan et al., 2023). Legitimacy Theory extends this view, arguing that such reporting integrates corporate activity with societal norms and regulatory compliance, thereby reducing the level of scrutiny applicable to organisations operating under conditions of high environmental impact (Obafemi and Oyedepo, 2024; Maharani et al., 2024; Martens and Bui, 2023). Also, these theories suggest that carbon accounting impacts financial performance through information, legitimacy and capability channels, and the outcome depends on firm-specific and contextual characteristics.

Nevertheless, past studies have not focused on the specific mechanisms linking carbon accounting to the financial indicators of profitability and market valuation (Triasma and Sari, 2025; Aswani et al., 2024; Maharani et al., 2024; Adu et al., 2023). Methodologically, the focus on the ROA and ROE as metrics has limited the scope of insights regarding moderating variables and mechanisms. As a result, this study examines the relationship between carbon emissions and the financial performance of quoted Nigerian oil and gas companies. It also aims to help alleviate an important research gap by analysing the complex dynamic and moderating influences using return on capital employed (ROCE)

and earnings per share (EPS) as performance indicators for a more detailed analysis.

The findings of this study aim to support companies in adopting sustainable practices that harmonise environmental accountability with long-term financial stability in emerging markets. Additionally, although, in theory, carbon accounting should lead to a reduction in costs, an improved competitive position (as well as a better image) and therefore positively influence profitability, the actual relationship between these variables remains to be proven (Nwokeogu et al., 2024). Furthermore, even though the benefits of carbon accounting are widely recognised, its impact on financial performance in Nigeria's energy sector remains largely unexplored (Nwokeogu et al., 2024).

Therefore, the purpose of this research is to investigate the relationship between carbon emissions and the financial performance of listed Nigerian oil and gas companies. This study contributes to the literature in the following ways. First, it extends contemporary research on carbon disclosure and corporate performance. Second, the use of carbon emissions to proxy carbon accounting is innovative compared to previous studies that adopt proxies such as waste and toxic chemicals emissions. Third, the study examines the complex dynamics and ensured robustness using multiple proxy for performance indicators (return on capital employed [ROCE], earnings per share [EPS] and stock price [SP]) to provide a more detailed investigation of the relationship.

2. LITERATURE REVIEW

2.1. Conceptual Review

Climate change has an impact on how companies operate and financially perform, and studies have shown both a positive and negative association with stock performance (Antoniuk and Leirvik, 2024). A low-carbon economy is important to enhance environmental sustainability, reduce greenhouse gases and fight climate change. The recent initiatives of the 26th United Nations Climate Change Conference (COP26), the Paris Climate Change Agreement, and the Energy Code demonstrate the importance of reducing carbon dioxide (CO₂) emissions (Gupta and Jose, 2024). Furthermore, in terms of reporting, corporations need to adopt new sustainability reporting methods to incorporate social and environmental factors into decision-making. This allows organisations to identify their environment and stakeholder groups, and to transition from less socially responsible entities in their operational communities to more socially responsible entities (Hristov and Searcy, 2025).

To achieve this, voluntary carbon information disclosure and increased environmental investments are the two initial steps to advance sustainable reporting (Moussa and Elmarzouky, 2024). For organisations, disclosing information about environmental sustainability increases a company's value. Nevertheless, studies yield mixed findings, such as a positive relationship (Khan et al., 2023), a negative relationship (Orazalin et al., 2024), and no relationship (Serem et al., 2024) between environmental sustainability and business value. Furthermore, a comprehensive approach to assessing business performance goes beyond just

the financial component and incorporates environmental factors, such as carbon accounting. In the banking industry, corporate performance is usually assessed by combining both financial and non-financial metrics, including return on assets (ROA) and return on equity (ROE).

Nevertheless, recent perspectives suggest that incorporating carbon accounting into a corporation's performance measurement framework provides a more complete view of its overall performance (Hristov and Searcy, 2025). Therefore, this study will utilise return on capital employed (ROCE), earnings per share (EPS) and stock price to evaluate the corporate performance of banks. ROCE is a financial metric that measures how well a company performs relative to its investment in capital and the resulting income. EPS is a market metric used to evaluate a company's performance based on comparing the returns of a financial instrument to a specific benchmark index.

2.2. Theoretical Review

The stakeholder theory provides a lens through which we understand how the interest of various stakeholders interacts with carbon accounting practices (Di Vaio et al., 2024). The actions of these stakeholders can greatly impact the company's performance, as the company also affects them. Therefore, stakeholders are vital to a company's survival and success, serving as its lifeline. Edward Freeman founded the stakeholder theory in 1984. Stakeholders include parties like employees, customers, suppliers, the government, and shareholders. With respect to environmental sustainability, information disclosure helps the relevant stakeholders understand how the firm's operations affect them (Ul Abideen and Fuling, 2024).

A large body of evidence shows that how companies manage their carbon footprint is a key element in shaping stakeholder perceptions and expectations about a company's environmental policy (Awa et al., 2024). Sustainability strategies such as carbon accounting enable companies to meet the expectations of various stakeholder groups and build trust with them (Di Vaio et al., 2024). This level of transparency can help mitigate risks associated with climate change, ensure compliance with environmental regulations and avoid reputational damage (Sari and Muslim, 2024).

By providing information about a company's environmental performance, carbon accounting enables companies to meet their obligations under environmental regulations, reduce the risk of incurring fines or penalties, and minimise non-compliance costs (Yang et al., 2025). Additionally, companies that implement carbon accounting systems to identify opportunities to reduce emissions and improve energy efficiency can lower operating expenses and therefore enhance their financial performance (Lubis et al., 2023). Furthermore, carbon accounting provides companies with a strategic tool to enhance their reputation and foster customer loyalty. Therefore, companies that have implemented carbon accounting systems and taken steps to reduce their environmental footprint often appeal to environmentally conscious consumers, thereby increasing sales and market share (Onat et al., 2025).

2.3. Empirical Review

There is a significant amount of literature investigating the relationship between environmental responsibility and company performance. However, such evidence found is somewhat inconsistent. For instance, Ejoh and Omoile (2023) sought to assess CSR activities and innovation among Nigerian companies. Using a qualitative methodology, he found a positive relationship between CSR and employee motivation, which brings about innovation. Also, Okonkwo (2023) investigated environmental responsibility and market value using a combination of quantitative and qualitative methodologies. His results showed that decreased carbon emissions were associated with lower capital costs for companies.

Furthermore, Emmanuel et al. (2023) assessed the relationship between carbon emissions and financial returns in Nigerian companies. They found a positive relationship between emissions and profitability. Jum'a et al. (2021) evaluated environmental sustainability and financial performance using supply chain analysis and environmental evaluation. He found a positive relationship between sustainability practices and financial performance among Jordanian companies.

Also, Dharma et al. (2024) assessed the relationship between carbon emissions and profitability. Using a panel regression methodology, results showed that carbon emissions improved profitability. Cesarone et al. (2022) used portfolio analysis to assess ESG investments and financial returns. His results suggested that companies with strong sustainability practices do not enjoy significantly better financial performance than those without. Additionally, Sari et al. (2025) used regression analysis and content analysis to assess the relationship between ESG disclosure and market value. Their results showed that transparent ESG disclosure enhanced market value. Likewise, Wisdom et al. (2024) assessed the relationship between CSR and employee retention using a panel research design. He found that CSR positively and significantly improved the employee retention rate.

Similarly, Adomako and Tran (2022) assessed the relationship between sustainable environmental strategy and firm competitiveness within the mining industry. The results showed that environmental disclosures enhanced corporate competitiveness. Le and Nguyen-Phung (2024) evaluated the relationship between environmental performance and corporate performance. They found that GHG emission intensity led to reduced profitability. Also, Abubakar and Abdullahi (2022) assessed the relationship between carbon emissions and economic growth in Nigeria. From the ARDL analysis, they found a negative relationship between carbon emissions and GDP. This research builds on prior empirical research by examining the relationship between carbon emissions and financial performance in the Nigerian energy sector.

3. METHODOLOGY

The study utilised an Ex post facto research design, which involves examining existing data to determine relationships between variables. In this study, data on carbon emissions (Scope 1 and

Scope 2 in metric tons) were collected from the annual reports and corporate disclosures of the selected oil and gas firms. The study's population consists of all 10 oil and gas firms listed on the Nigerian stock exchange, and it cuts across 10 years (2014-2023). The study's total population also serves as the study's sample. To achieve the research objectives, the study used descriptive and inferential statistics, employing the panel ordinary least squares regression to evaluate the relationship between carbon accounting and financial performance.

3.1. Model Specification

$$EPS_{it} = \beta_0 + \beta_1 CAREM_{it} + \beta_2 FRMSIZE_{it} + \beta_3 LEV_{it} + \mu \quad (i)$$

$$ROCE_{it} = \beta_0 + \beta_1 CAREM_{it} + \beta_2 FRMSIZE_{it} + \beta_3 LEV_{it} + \mu \quad (ii)$$

$$SP_{it} = \beta_0 + \beta_1 CAREM_{it} + \beta_2 FRMSIZE_{it} + \beta_3 LEV_{it} + \mu \quad (iii)$$

Where:

EPS = Earnings per share (dependent variable)

$ROCE$ = Return on capital employed (dependent variable)

SP = Stock price (dependent variable)

$CAREM$ = Carbon emission (independent variable)

$FRMSIZE$ = Firm size

LEV = Leverage

β_0 = Serves as the intercept or constant term

$\beta_1, \beta_2, \beta_3$ = Parameter estimate of the variables

μ = Stochastic error term

3.2. Definition and Measurement of Variables

Variables used and their definitions are presented in Table 1.

4. ANALYSIS AND DISCUSSION

4.1. Descriptive Statistics

Table 2 presents the descriptive statistics of the dependent and independent variables utilised in the model estimated in this study.

The mean EPS (Earnings per Share) is #2.59, indicating that on average, firms generate #2.59 per share. The median value of #2.53, close to the mean, suggests a fairly symmetrical distribution around the central value. The standard deviation of 0.66 indicates moderate EPS variation. The skewness of 0.34 indicates a slight rightward skew, meaning a few firms report higher-than-average EPS. The kurtosis value of 2.42 is near the normal distribution (3), suggesting the distribution is not significantly leptokurtic or platykurtic. The Jarque-Bera value for EPS ($P = 0.19$) shows no significant departure from normality.

The mean ROCE, a measure of capital efficiency, stands at 0.045, indicating a modest return relative to capital. The median, 0.063, is higher than the mean, hinting at a leftward skew in the data. The standard deviation is quite high at 0.22, reflecting a significant variation in profitability across firms. The skewness of -7.96 and kurtosis of 73.58 indicate an extreme left skew and highly leptokurtic distribution, with a few firms experiencing very poor returns. The Jarque-Bera probability is 0, confirming the extreme non-normality of the ROCE data.

The average stock price is #4.66, with a median of #4.65, indicating that most firms' stock prices are clustered around this value. A standard deviation of 0.82 further supports this, implying relatively low volatility in stock prices. The skewness is slightly negative (-0.063), indicating a very mild leftward skew in stock prices, while the kurtosis of 2.15 suggests the distribution is fairly close to normal. The Jarque-Bera probability of 0.22 indicates that stock prices follow a normal distribution, with no significant outliers.

The average CO₂ emissions (CO₂E) among the firms is 12.39 units, with a median of 12.33, suggesting a well-balanced distribution around the mean. The standard deviation of 0.63 indicates relatively low variation in emissions. Skewness is 0.27, indicating a slight right skew, meaning a few firms emit slightly more CO₂ than others. With a kurtosis of 1.54, the distribution appears somewhat platykurtic, with thinner tails than a normal distribution. The Jarque-Bera probability of 0.0065 indicates a significant deviation from normality, likely due to the slight skew.

Firm size, as measured by this dataset, has an average of 7.85 and a median of 8.60, suggesting a slight right skew, with larger firms dominating the upper range. The standard deviation of 1.40 suggests moderate variability in firm size. A Skewness of -0.34 indicates a slight left skew, meaning smaller firms are more frequent than larger ones. The kurtosis of 1.32 suggests a platykurtic distribution with relatively fewer extreme values. The Jarque-Bera test statistic of 0.001 confirms that firm size deviates significantly from normality.

Leverage (LEV), which measures the extent to which firms use debt, has a mean of 78.17 and a median of 84.77, suggesting that firms generally have high debt levels. The standard deviation is 17.71, reflecting a wide dispersion in leverage. Skewness is -1.42, indicating left skew: most firms have higher debt levels, while a few have low or moderate leverage. The kurtosis of 5.04 shows a leptokurtic distribution with fat tails, meaning extreme leverage values are more common than in a normal distribution. The Jarque-Bera probability of 0 indicates significant non-normality in the dataset.

4.2. Diagnostic Tests

4.2.1. Correlation analysis

Table 3 presents the correlation analysis, showing the relationship among the variables in the dataset.

The correlation analysis in Table 3 examines the interdependence among the variables simultaneously with a focus on the independent variables. EPS shows a strong positive correlation with stock price (0.86), indicating that firms with higher EPS generally have higher stock prices. It has a weak positive correlation with CO₂ emissions (0.17), suggesting slightly higher emissions in more profitable firms, but weak negative correlations with firm size (-0.16) and LEV (-0.07). The relationship with ROCE is almost negligible (-0.04). Also, ROCE is minimally correlated with other variables, with a weak positive correlation with firm size (0.1038) and a slight negative correlation with leverage (-0.0357). It shows little

Table 1: Measurement of variables

Variable	Definition	Source
Return on capital employed (ROCE)	Profit before tax×100 capital employed	Iliemena et al. (2023)
Earnings per share (EPS)	Net income – Preferred dividends end of the period common share	Ristiya et al. (2024)
Carbon dioxide emission (CO ₂)	This is denoted by the total amount of CO ₂ per metric ton emitted over the full life cycle of a product, service, or activity.	Dong et al. (2023)
Stock price (SP)	The closing price of firms in the Nigerian exchange group.	Adebanjo and Wisdom (2024)
Firm size (FRMSIZE)	Denoted as the natural logarithm of total assets.	Okere et al. (2025)
Leverage (LEV)	Denoted as the total liabilities to total assets.	Okeke et al. (2025)

Source: Author's computation (2026)

to no significant relationship with stock price (0.0055) or CO₂ emissions (−0.0749).

Stock price correlates strongly with EPS (0.8567) but weakly with other variables, including CO₂ emissions (0.0318) and leverage (−0.1494). CO₂ emissions have a moderate positive correlation with firm size (0.2667) but a weak correlation with other variables. Firm size also shows weak correlations with EPS (−0.1604) and leverage (−0.0346). Leverage generally has weak negative correlations with all variables, suggesting that higher debt levels have a limited impact on earnings, stock prices, and other financial metrics.

4.2.2. Hausman test analysis

Table 4 presents the Hausman test results, which determine which model effect to apply in the regression.

The Hausman test is used to determine whether a random-effects or a fixed-effects model is more appropriate for panel data analysis. From the analysis, the P-value (0.0000) is <5% significance level for all the models, so the alternative hypothesis is accepted and the null hypothesis is rejected, indicating a random-effect model.

4.2.3. Multicollinearity analysis

Table 5 presents the VIF test results to assess multicollinearity in the dataset.

A variance inflation factor (VIF) was employed to detect multicollinearity among the independent variables in a regression model. High VIF values suggest that multicollinearity is present, while low VIF values indicate that multicollinearity is not a concern. Since all the VIF values are close to 1, there is no significant multicollinearity among the independent variables (CO₂E, firm size, and leverage) for the three models. This means that each variable provides unique information in the regression model, and its coefficient estimate is reliable and not distorted by collinearity.

4.3. Regression Analysis

Examining the results from Panel Regression Model I: the dependent variable is earnings per share (EPS) (Table 6). Additionally, CO₂ emissions had a coefficient of 3.38 and a P = 0.00. Therefore, the results demonstrate a positive, statistically significant relationship between CO₂ emissions and EPS; a one-unit increase in CO₂ emissions is expected to increase EPS by 3.38 units, holding all else constant. The coefficient of firm size was 2.31, and the P = 0.00. Thus, a

Table 2: Descriptive statistics

Information	EPS	ROCE	SP	CO ₂ E	FRMSIZE	LEV
Mean	2.59	0.04	4.66	12.38	7.85	78.16
Median	2.52	0.06	4.65	12.33	8.60	84.76
Std. Dev.	0.66	0.22	0.81	0.63	1.39	17.70
Skewness	0.33	−7.95	−0.06	0.27	−0.34	−1.42
Kurtosis	2.41	73.57	2.15	1.54	1.31	5.03
Jarque-Bera	3.34	21811.6	3.05	10.07	13.75	51.09
Probability	0.18	0.00	0.21	0.01	0.00	0.00
Obs	100	100	100	100	100	100

Source: Author's computation (2026)

Table 3: Correlation matrix

Information	EPS	ROCE	SP	CO ₂ E	FRMSIZE	LEV
EPS	1.00					
ROCE	−0.04	1.00				
SP	0.86	0.0	1.00			
CO ₂ E	0.17	−0.08	0.03	1.0		
FRMSIZE	−0.16	0.10	0.0	0.27	1.00	
LEV	−0.07	−0.04	−0.1	−0.15	−0.04	1.00

Source: Author's computation (2026)

Table 4: Hausman test

Correlated random effects - Hausman test			
Test summary	Chi-sq. Statistic	Chi-sq. d.f.	Prob.
Cross-section random (EPS)	56.891164	3	0.0000
Cross-section random (ROCE)	20.399229	3	0.0001
Cross-section random (Stockprice)	88.244996	3	0.0000

Source: Author's computation (2026)

positive and significant relationship exists between firm size and EPS; a one-unit increase in firm size results in an approximate one-unit increase in EPS. The extremely low P-value supports the notion that the relationship between firm size and EPS is statistically significant and, therefore, firm size plays a pivotal role in increasing EPS.

A positive, statistically significant coefficient of 0.01 (P = 0.03) was found for leverage. The positive, statistically significant coefficient indicates a small, yet positive relationship between leverage and EPS. A one-unit increase in leverage is expected to correspond to a 1% unit increase in EPS. While leverage affects EPS, the relationship is smaller than that of CO₂ emissions and firm size. Furthermore, the R-squared value of 0.73 indicates that the regression model used to estimate the relationship between the

Table 5: Variance inflation factor (VIF) test

Variable	Model i: EPS		Model ii: ROCE		Model iii: STOCKPRICE	
	Coefficient	Uncentered	Coefficient	Uncentered	Coefficient	Uncentered
Variable	Variance	VIF	Variance	VIF	Variance	VIF
CO ₂ E	1.237374	1.013597	0.116727	1.013597	2.172602	1.013597
FRMSIZE	0.521243	1.053699	0.049171	1.053699	0.915208	1.053699
LEV	2.42E-05	1.050650	2.28E-06	1.050650	4.24E-05	1.050650

Source: Author's computation (2026)

Table 6: PANEL OLS regression

Variable	EPS				ROCE				STOCKPRICE			
	Coeff	Std Error	T-Stat	Prob	Coeff	Std Error	T-Stat	Prob	Coeff	Std Error	T-Stat	Prob
CO ₂ E	3.38	0.80	4.20	0.00	0.17	0.13	1.28	0.20	5.67	1.26	4.49	0.00
FRMSIZE	2.31	0.33	6.90	0.00	0.02	0.07	0.36	0.71	4.66	0.51	9.09	0.00
LEV	0.01	0.00	2.11	0.03	-0.00	0.01	-4.78	0.00	0.01	0.00	1.28	0.20
R-Squared	0.73				0.59				0.64			
Adjusted R ²	0.69				0.53				0.60			
S.E. of regression	0.38				0.17				0.55			
F-stat (Prob)		20.2 (0.00)				10.53 (0.00)				13.40 (0.00)		
Durbin Watson		0.68				2.03				0.79		
Observation		100				100				100		

Source: Author's computation (2026)

independent variables and EPS demonstrates strong explanatory power, accounting for approximately 73.6% of the variance in EPS. The F-statistic of 20.21 and its P = 0.00 affirm the model's significance. However, the Durbin-Watson statistic of 0.68, which is significantly lower than 2, suggests that there is likely positive autocorrelation in the residuals. Nevertheless, autocorrelation is usually present in time series data of this nature.

Furthermore, based on the return on capital employed (ROCE), there is a positive (0.17) but insignificant (0.20) relationship between CO₂ emissions and ROCE. Also, firm size has a positive (0.02) and insignificant (0.71) impact on ROCE. Additionally, Leverage has a negative and significant effect on ROCE. Therefore, an increase in Leverage will decrease ROCE. The R-squared value of 0.59 indicates that the regression model used to estimate the relationship between the independent variables and ROCE has moderate explanatory power, accounting for approximately 59.2% of the variance in ROCE. The F-statistic of 10.5291 and its P-value of 0.00 also support the model's overall significance since the independent variables collectively explain a significant portion of the variance in ROCE. The Durbin-Watson statistic of 2.0, which is close to 2, also suggests that the residuals are independent over time, and therefore, there is little to no autocorrelation in the residuals.

The third model presents the relationship between carbon accounting and stock prices (SP). The analysis revealed that CO₂ emissions had a positive (5.67) and statistically significant (0.00) effect on stock price, specifically an increase of 5.67 units per additional CO₂ Emission unit. Also, a positive (4.67) and significant (0.00) result was found for firm size and SP. An increase in firm size by one unit is expected to correspond to an increase in SP of approximately 4.67 units. However, leverage (LEV) had a positive (0.01) but insignificant (0.20) impact on stock price (SP), suggesting that an increase in leverage is associated with a small increase in SP. Importantly, the adjusted R-squared value

of 60% was found for the model used to estimate the relationship between the independent variables and SP. Therefore, the model demonstrates strong explanatory power since. The Durbin-Watson statistic of 0.7857 suggests positive autocorrelation in the residuals, which is typical of many time series datasets.

4.4. Discussion of Findings

The analysis reveals several important implications of carbon accounting on the financial performance of listed energy firms in Nigeria. First, the regression results provide strong evidence that CO₂ emissions are positively and statistically significantly related to earnings per share (EPS). Therefore, an increase in CO₂ disclosures or emissions is associated with a corresponding increase in EPS for listed firms in Nigeria. This finding supports previous literature indicating that larger firms derive benefits from economies of scale and that higher emissions may indicate more intense business activity (Su et al., 2023).

Secondly, the regression results provide additional perceptions into the association between the independent variables and return on capital employed (ROCE). The results indicate that a positive relationship exists between CO₂ emissions and ROCE. However, the relationship is not statistically significant. The results indicate that the relationship between CO₂ emissions and capital efficiency remains uncertain despite the observed positive correlation. This is in line with the findings of Busch et al. (2022), who found a positive relationship between carbon emission and long-term performance.

Finally, the regression results indicate that a positive, statistically significant relationship exists between CO₂ emissions and SP. Therefore, an increase in CO₂ emissions will correspondingly increase SP, and the relationship is statistically significant. Therefore, these findings indicate that productive firms that disregard environmental considerations (CO₂ emissions) are viewed as being more profitable because there are no established systems to penalise them for their harmful environmental interactions. These

findings contradict global practices that are subject to sanctions and taxed for excessive CO₂ emissions. Nigeria represents a unique environmental scenario typically found in developing countries with no formalised carbon tax structure. Furthermore, these findings suggest that investors who focus primarily on profit will continue to invest in Nigerian firms. Also, the lack of mandatory climate-related disclosure practices will further exacerbate sustainability issues. Nigeria's energy division is heavily dependent on fossil fuels. Therefore, investors may prioritise profitability over long-term ESG risks and environmental sustainability.

Nonetheless, in the future, these types of companies may experience significant external economic consequences, such as carbon taxes. Additionally, as stakeholders' interest in ESG and sustainability grows, foreign direct investment (FDI) into Nigeria by institutional investors that practice ESG will likely decline. These findings contradict those of Daud et al (2023), who reported a positive outcome in terms of reduced CO₂ emissions leading to improved financial performance.

4.5. Managerial and Policy Implications

The findings of this research also illustrate the use of carbon accounting as a strategic tool to enhance a firm's outcomes. These findings suggest that managers of firms that benefit from increased CO₂ emissions will be motivated to maintain current CO₂ levels rather than reduce them. However, firms must consider the long-term impacts of this strategy, including, but not limited to, international sanctions and penalties. Additionally, this research highlights the importance of preparation for regulatory changes and/or shifts in consumer preferences toward green investments. Also, it clearly illustrates the necessity for environmental regulations and policies, incentives for green finance, and investor education and awareness of ESG risks and alignment with global climate objectives to promote a more sustainable business environment.

5. CONCLUSION AND RECOMMENDATION

This study examines the impact of carbon accounting on the financial performance of listed oil and gas firms in Nigeria. Carbon accounting was found to positively, but insignificantly, affect the EPS and STOCKPRICE of quoted firms in Nigeria. Also, carbon accounting was found to positively, but insignificantly, affect the ROCE by quoted firms in Nigeria. Therefore, CO₂ and financial metrics are two important factors that investors consider when making decisions, as well as indicators for long-term sustainability. While sustainability is well structured globally, achieving this practically in emerging economies is difficult. To achieve sustainability, we must continue to rebrand and redefine accounting as a framework for resolving global issues.

Furthermore, it can be inferred that entities with significant CO₂ emissions and sizes are probable to produce higher EPS. Also, the leverage effect on EPS was smaller than expected, although it remained statistically significant in some cases; it would appear to be less impactful than CO₂ emissions and firm size. On the other hand, ROCE presented a different view. This finding mirrors the existing literature, which indicates that environmental factors often indirectly affect capital efficiency (Li et al., 2024). Leverage

negatively affected ROCE across all models examined, supporting theoretical concepts that too much debt reduces capital efficiency and profitability (Saif-Alyousfi et al., 2025).

Additionally, the study highlighted the low explanatory power of ROCE, suggesting that many other factors influence capital efficiency. Future research could identify additional determinants and consider industry-specific factors to improve our understanding of how capital efficiency works in emerging markets. The study's outcomes demonstrate the significance of sound debt management and the varied influences that carbon accounting and firm size have on financial performance.

The suppositions of the study provide the subsequent recommendations;

- i. The report suggests that regulatory agencies establish a legislative framework and uniform standards to support the practice of carbon accounting.
- ii. Laws should be enacted to ensure that policies and rules related to carbon accounting are adhered to by organisations.
- iii. This study recommends that quoted firms should make provisions for their carbon emission disclosure in their annual reports.

6. FUNDING

This study received no specific financial support.

7. TRANSPARENCY

The authors state that the manuscript is honest, truthful, and transparent, that no key aspects of the investigation have been omitted, and that any differences from the study as planned have been clarified. This study followed all writing ethics.

8. DATA AVAILABILITY STATEMENT

Upon a reasonable request, the supporting data of this study can be provided by the corresponding author.

9. COMPETING INTERESTS

The authors declare that they have no competing interests.

10. AI DECLARATION

Grammarly and Quillbot were used for language editing and grammar improvement.

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