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Carbon Accounting and Corporate Performance of Listed Oil and Gas Firms in Nigeria

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Abstract: *This study was carried out to investigate the relationship between carbon accounting, energy accounting, and environmental compliance information disclosure and corporate performance of listed oil and gas companies in Nigeria. Anchored on the Legitimacy Theory, the study adopted the quantitative research design. Population of the study consisted of all 10 oil and companies on the Nigeria Exchange Group (NGX) as at 31 December 2024. Annual reports of oil and gas firms for the years 2014 to 2023 were used as the source of data. Findings of the study show that carbon accounting information disclosure has a significant negative relationship with corporate performance of listed oil and gas companies in Nigeria. The study also establishes a positive and significant relationship with energy accounting information disclosures, environmental accounting information disclosure and corporate financial performance. The study concludes carbon accounting dimensions have a bearing on corporate performance of listed oil and gas companies in Nigeria and recommends amongst others that that listed oil and gas firms should improve on their carbon accounting management and disclosure by formulating and implementing disclosure and reporting strategies that will enhance optimum level of profitability.*

Keywords: carbon accounting, energy accounting, environmental compliance, return on assets, oil and gas firms.

INTRODOCTION

There has been an increased awareness of the interaction between firms and the environment in which they operate. Oceans, atmosphere, drinking water, land and habitat for threatened and endangered species, air, water, and subterranean pollution are just a few of the ways that corporate operations affect the environment. There are national and worldwide efforts to lessen the overall economic, social, and health effects of industrial pollution, deforestation, oil spills, and gas flaring, all of which are greatly influenced by organizational processes (Orajekwe & Ogbodo, 2023; Zhang

et al., 2022). The increasing concern about environmental degradation, resources depletion, and the activities of the firms that lead to the depletion of the ozone layer and thereby causing an imbalance in the environmental system has made the development of environmental accounting, green accounting, social responsibility accounting, sustainability reporting, and recently carbon accounting an area of significant interest.

The idea of carbon accounting or carbon emission disclosures focusses on meeting the information needs of stakeholders regarding social responsibility and the environmental protection efforts of companies, ensuring that this information is provided in sufficient quality and quantity (Oyerogba et al, 2024). Nevertheless, these issues can be mitigated through the company's sustainability efforts and by providing reliable carbon emission data in the financial reports (Faisal et al., 2018; Oluwagbemiga, 2021). The examination of carbon emission disclosures holds significant importance in the Nigerian context, especially within the oil and gas sector, due to pressing environmental management and pollution challenges, including oil spills, rising greenhouse gas emissions, and environmental degradation (Moses et al., 2019; Mohammed, 2019).

In the corporate landscape, carbon accounting has surfaced as a tool for organizations to formulate strategic responses to climate change challenges and transition towards lower-carbon business models (Damieibi, 2023). The carbon footprint model was established to quantify the impact (expressed in CO_2-equivalent) that a product, service, or organization exerts on climate change (Oyerogba et al., 2024). Carbon accounting offers a structured approach for quantifying and revealing carbon expenses, while also allowing organizations to recognize climate-related risks and opportunities (Alrazi et al., 2016; Chinanu & Folajimi, 2024; Xie et al., 2022). Therefore, carbon accounting serves as a strategic approach to addressing Green House Gas (GHG) emissions adaptation by integrating the assets and liabilities related to GHG emissions into conventional accounting frameworks (Mondal et al., 2023).

A variety of initiatives have been established to tackle carbon emissions and environmental challenges. The initial global reaction to environmental challenges and climate change occurred in 1992, at the Rio Earth Summit, as numerous nations came together to participate in the United Nations Framework Convention on Climate Change. The conference established the framework for global collaboration in addressing climate change and managing its effects. Several years later, the Kyoto Protocol was adopted, with over 150 countries committing to efforts aimed at reducing carbon dioxide (CO_2) emissions (Agbo & Egbunike, 2024; Zhang et al., 2022).

The Nigerian government has undertaken a number of initiatives aimed at enacting laws to promote environmental sustainability in the country. The relevant legislation comprises the Environmental Impact Assessment Act of 2004, the Environmental Guidelines and Standards for the Petroleum Industry Act of 2002, and the National Environmental Standards and Regulations Enforcement Agency Act of 2004, Climate Change Act 2021, and the Petroleum Industry Act of 2021. In terms of general corporate reporting requirements, the Companies and Allied Matters Act (CAMA), International Accounting Standards (IAS), International Financial Reporting Standards (IFRS), the Securities and Exchange Commission (SEC) 2018, and the Nigeria Codes of Corporate

Governance (NCCG) 2018 provide essential guidelines for the preparation and presentation of financial statements in Nigeria. Despite the abundance of Acts and guidelines, there remains no obligatory requirement for the quantitative or qualitative disclosure of social, environmental, or sustainability accounting information in annual reports. Given this context, it has been observed that environmental compliance in Nigeria is lacking, and there are ongoing concerns regarding the corporate commitment to invest sufficiently in mitigating the impacts of environmental pollution. The prevalence of inadequate environmental accounting practices in the Nigerian oil and gas sector has persisted for an extended period (Akeem et al., 2016; Chinanu & Folajimi, 2024; Oyerogba et al., 2024). A major issue facing the oil and gas sector in Nigeria is the ongoing contamination of the Niger Delta's shorelines or waterways and the destruction of mangrove, forest and agricultural areas resulting from oil spills that occur during petroleum exploration. This is exacerbated by the country's failure to refine oil domestically and meet the production quotas set by the Organization of Petroleum Exporting Countries (OPEC). In light of widespread global and local concern, the Nigerian government has mandated the prompt execution of the United Nations Environmental Programme (UNEP) report regarding the environmental restoration of Ogoniland in the Niger Delta region (UNEP, 2020). The Niger Delta region has persistently experienced environmental degradation, characterized by what the UNEP report identifies as the most severe environmental pollution in Nigeria's history, stemming from hydrocarbon exploration and production activities. The Nigerian government initiated a remediation programme, in part as a response to this situation, to be executed by the Hydrocarbon Pollution Remediation Project (HYPREP), a specialized unit or a special purpose vehicle within the Ministry of Environment that was established after the UNEP Report was submitted.

However, empirical research regarding the influence of green innovation, encompassing carbon accounting, energy accounting, environmental compliance accounting, sustainability reporting and social responsibility accounting, on company performance has not achieved a consensus. Essentially, a critical consideration is whether the economic returns from carbon or greenhouse gas accounting can compensate for the costs while enhancing environmental advantages. To this end, this study seeks to investigate the relationship between carbon accounting, energy accounting, and environmental compliance accounting on corporate performance of listed oil and gas companies in Nigeria.

LITERATURE REVIEW

Concept of Corporate Performance

A firm's performance is a quantitative indicator that represents the economic worth of the firm (Marimuthu & Maama, 2021). The knowledge and measurement of corporate performance hold significant importance in the realm of accounting and finance research, as it elucidates the disparities in firm success and wealth creation. The measurement of corporate performance has posed a significant challenge for both scholars and practitioners, as noted by Simerly and Li (2000). The primary emphasis has been placed on four factors that drive value. The initial three perspectives encompass the financial perspective, which involves monitoring financial performance, the customer perspective that entails tracking customer satisfaction, attitudes, and

market share goals, and the internal process perspective that involves monitoring internal operational goals necessary to fulfill customer objectives. The final perspective is the learning and growth or innovation perspective, which involves monitoring intangible factors that contribute to future success, such as human capital, organizational capital, training, and informational systems (Jabbour et al., 2019). According to Das and Goswami (2019), the financial performance perspective serves as the definitive measure for evaluating the success of a company and is regarded as the most important aspect of firm value. The assessment of a company's financial performance has been employed as a means to evaluate its capacity in attaining its economic objectives. Several proxies have been employed to calculate the financial dimension of a company's performance. The literature has classified these proxies into two main categories: the accounting-based proxies and the market-based proxies (Assidi et al., 2016). The accounting-based measures focus on evaluating a company's present financial performance, while market-based measures concentrate on assessing investor perceptions regarding the future potential performance of the company.

Consistent with empirical research findings in contemporary literature pertaining to firm performance, this study employed Return on Assets (ROA) as measures to assess the performance of the firm. The adoption of ROA is justified because the use of the ROA as a firm performance metric is highly valuable for determining corporate performance.

Carbon Accounting

An organization's greenhouse gas emissions can be determined using carbon accounting. Carbon accounting, which records climate impact rather than financial impact, measures the impact of an organization's operations in a similar way to financial accounting (Hills, 2022). Carbon accounting, also known as "greenhouse gas accounting," is a method used by governments, businesses, and even private individuals to determine their carbon footprints. It was not until the early 2000s that carbon accounting took on its current shape, but its roots may be found in Renaissance Italy (Mooney, 2022).

According to Mueller et al. (2021), carbon accounting, often known as greenhouse gas accounting, is a set of techniques for calculating and monitoring an organization's greenhouse gas (GHG) emissions. Additionally, it can be used to monitor initiatives or activities aimed at cutting emissions in industries like renewable energy or forestry. These strategies are used by cities, corporations, and other organizations to help slow down climate change. Gurney et al. (2021) state that companies frequently establish an emissions baseline, develop goals for lowering emissions, and monitor their progress. They are able to accomplish this in a more open and consistent way thanks to the accounting techniques.

Energy Accounting

Both renewable and non-renewable energy sources, such as solar, wind, hydro, geothermal, natural gas, coal, oil, and uranium, can be found in a clean environment. Growing the use of fossil fuels without acting to reduce greenhouse gas emissions would have a negative effect on the climate throughout the world (Almagtome & Abdlazez, 2021). According to Amuakwa-Mensah and Adom

(2017), energy accounting is a system that is used to regularly monitor, analyze, and report on the energy consumption of various activities. This is done to increase energy efficiency and track how energy use affects the environment. Energy accounting is a technique for monitoring and quantifying the cost and use of energy in a specific system or organization, according to Davis (2000). This entails keeping an eye on energy use, identifying inefficient areas, and putting plans in place to lower expenses and utilization. Businesses can find areas of energy waste and implement actions to reduce consumption by monitoring and measuring energy usage (Dargahi & Khameneh, 2019). Organizations can identify inefficient locations, comprehend trends of energy consumption, and put measures into place to increase overall energy efficiency with the aid of energy accounting.

Environmental Compliance Accounting

Presley et al. (2024) define environmental compliance as following environmental laws, rules, and standards as well as additional requirements, like operating site permits. In order to reduce the influence on the environment, this idea entails making sure that organizations comprehend and abide by these rules. According to Keen (2022), environmental compliance is crucial for safeguarding natural resources, human health, and ecosystems. Additionally, it guarantees sustained growth and lowers the possibility of fines and harm to a company's reputation. Toxic release inventory, storm water permits, waste management, fume release into the environment, safe drinking water, clean air requirements, wildlife and plants, and forest resources are a few examples of environmental elements that organizations must adhere to, according to Ou and Jiang (2023). It may be advantageous to put in place an Environmental Management System to demonstrate that a business is adhering to environmental regulations. This system will assist in monitoring all the actions that an organization does. An organization can lessen its effects on the environment and boost its operational efficiency by using an Environmental Management System (EMS).

Theoretical Framework

Stakeholder theory, signaling theory, stewardship theory, and environmental information disclosure theory serve as some of underpinning theories that support and reinforce carbon accounting and reporting procedures. The legitimacy theory is still the most important theoretical lens, even though researchers can use a variety of theories to explain concepts like sustainability, environmental accounting, social responsibility reporting, or green innovation (Ascui, 2014; Etale & Otuya, 2018; Velte et al., 2020). Historically, companies report their sustainability and environmental measures on a voluntary basis when stakeholder pressure is high (Deegan, 2002).

Furthermore, improved company financial performance in the future could result from higher-quality green innovation accounting (Qian & Schaltegger, 2017), suggesting a dynamic and reciprocal relationship between the two proxies. However, without the management putting in place a good environmental management system, stakeholder expectations may also encourage greenwashing practices to create a favourable corporate environmental image and acquire legitimacy (Mahoney et al., 2013). Therefore, there could be a positive (substantial use) or negative (symbolic use) relationship between environmental performance and environmental disclosure.

Hence, all these provide an appropriate ground to embrace the legitimacy theory as the fundamental theory for this study.

Empirical Review

A number of studies have been conducted on the link between carbon accounting and corporate financial performance with divergent results. For instance, Agbo and Egbunike (2024) in a study aims to contribute to the body of knowledge regarding the effects of disclosures related to climate change on the financial performance of Nigerian oil and gas businesses. Eight oil and gas businesses listed on the NGX for the years 2012–2021 made up the final sample of the study, which used an ex post facto research approach. A balanced panel of 80 firm-year observations made up the final sample. CCRD and ROA were shown to be positively correlated, and this association was also deemed significant at the 5% significance level. In a related study, Aniefor et al. (2024) looked at how carbon emissions affected the financial performance of Nigerian companies that manufacture oil and gas. The study used an ex post facto research design. Purposive sampling was used to choose a sample of seven (7) oil and gas companies for the study. The hypothesis was tested using regression analysis. Based on the data, the study found that returns on equity (ROE) for Nigerian oil and gas companies are statistically significantly impacted by emissions disclosure.

A five-year study on the effect of environmental accounting disclosure on corporate profitability in Nigeria was carried out by Obiora et al. (2022) between 2017 and 2021. Their investigation, which used an ex post facto approach and secondary data from the financial statements of five chosen companies, revealed that investments were positively impacted by environmental accounting transparency. It did, however, also have a very minor adverse effect on the capital used. Similarly, over a ten-year period from 2010 to 2019, Emmanuel and Ifeanyichukwu (2021) investigated the connection between the financial success of Nigerian manufacturing companies and the disclosure of environmental accounting information. Disclosure improved market capitalization and share price, according to their research of secondary data from 40 chosen companies.

A study by Aremu and Adegbie (2024) looked at the connection between publicly traded Nigerian oil and gas firms' sustainable corporate growth and the expenses of energy and environmental conservation. The empirical data analysis indicates that community development costs and gross margin returns on investment have a positive and statistically significant relationship. This suggests that there is a significant relationship between sustainable business growth and gross margin returns on investment. In a similar vein, the study shows a positive and statistically significant correlation between GMRI and pollution cost. The study by Bamishe and Adegbie (2024) examined how Nigerian oil and gas companies managed the expenses of energy and environmental conservation and the effects it had on their financial results. Twenty of the 66 oil and gas companies in the population were chosen at random for the 22-year period between 2001 and 2022. The study discovered that the long-term sustainability of the working capital turnover

of publicly traded oil and gas firms is significantly impacted favourably by the expenses related to environmental preservation.

The association between environmental compliance and corporate financial performance has also been a subject of empirical research in recent times. For example, Presley et al. (2024) assess the circumstances in which adherence to environmental regulations may facilitate or impede corporate performance using data from Chinese companies and fixed effects regression. They discover that environmental compliance simultaneously enhances financial performance and decreases corporate market performance. The study also discovered that large and privately held businesses experience the opposite fall in market performance, underscoring the significance of ownership and firm size in corporate performance. When separating market performance from financial performance, the research indicates that when an enterprise's carbon intensity level is low, environmental compliance will probably increase market performance; when it is high, it will likely improve financial performance.

Gap in Literature

Even with the backdrop of the energy revolution and the rapid expansion of renewable energy sources, oil and gas will continue to be crucial components of energy systems in the foreseeable future. Thus, efforts to lower environmental emissions from the oil and gas sector will have a significant effect on the environment and are essential to helping the world meet its climate change targets. Although there are many research on environmental and triple bottom line accounting in Nigerian oil and gas companies, a review of the literature brings up a few questions considered as likely gaps to research on carbon accounting and corporate performance in Nigeria. Firstly, available empirical evidence regarding the relationship between various dimensions of carbon accounting and corporate performance provides an unclear picture. Some studies (Damieibi, 2023; Mdasha et al., 2024; Ironkwe & Ordu, 2016; Oti & Mbu-Ogar, 2018; Gatimbu & Wabwire, 2016 Shehu, 2014) have confirmed a positive connection between corporate sustainability or environmental accounting measures such as carbon accounting, environmental accounting information disclosure, water and environmental compliance disclosures, energy accounting information disclosures, and green innovation. However, other studies have recognized corporate environmental firm specific measures such as wastes management, community development costs, and social responsibility accounting to have a negative association with corporate financial performance (Iliemena, 2020; Leung & Snell, 2019; Jimoh et al., 2023; Kurawa & Shuaibu, 2022). To close the gap and add to the body of existing research, it is necessary to examine the topic in the context of Nigerian oil and gas companies.

MATERIALS AND METHODS

The objective of this study is to examine carbon accounting at its other dimensions and their impact on corporate financial performance of listed oil and gas firms in Nigeria. To accomplish the specified objectives, the study employs a quantitative research design. The population of the study consists of all the ten (10) listed Oil and Gas firms in the Nigerian Exchange Group as at 31st December, 2024. A census sample approach was used because of the small population. The study's

data set included yearly reports from the eight (8) oil and gas firms that were selected after filtering which will provide data for the years 2014 through 2023.

Model Specification

Based on the theoretical literature and earlier empirical studies on carbon accounting and corporate financial performance, the model used by Chinanu and Folajimi (2024) was modified for the purpose of establishing the relationship between the dependent variable and the linear combinations of several independent variables captured in this study. Succinctly, the model expresses a functional relationship between carbon accounting and financial performance of the form:

$PFM_t = f(CACC)$ ---------- (1)

Equation (I) was modified to suit our objective as follows:

ROA = *f*(CACC, ENGY, ENVC)..... (2)

Articulating equation (2) in econometric model and bearing in mind the panel nature of the regression data, equation (3) is converted as:

$ROA_{it} = \beta_0 + \beta_1 CACC_{it} + \beta_2 ENGY_{it} + \beta_3 ENVC_{it} + \mu_{it}$ ---------- (3)

Operationalization Definition of Variables

Table 1: Summary of variables and their operational definitions

Variables	Proxy	Definition	References
Financial Performance	ROA	Return on Assets: Proft after tax scaled by total assets	Otuya and Omoye (2021) Omesi and Berembo (2020)
Carbon Accounting Information Disclosure	CACC	0 = No information in any subsection about the carbon accounting disclosure index (Co_2). 1 = Only data related to sustainability, environmental accounting information disclosure, environmental protection policies, and GRI Index Statements that are relevant to the carbon accounting disclosure index. 2 = An explanation detailing the events and their notable effects. 3 = An explanation including actual figures that details the events and their noteworthy effects	Chinanu and Folajimi (2024) Odunayo et al. (2023)
	ENGY	0 indicates there is no information on the energy accounting disclosure index in this subsection. 1 = Exclusive data regarding sustainability, environmental accounting information	

Energy Accounting Information Disclosure		disclosure, environmental protection policy, and the GRI index A declaration on the energy accounting disclosure index. 2 = A description of the events and their noteworthy effects. 3 = A detailed explanation of the events and their major effects, accompanied by a recorded real number.	Agbo and Egbunike (2024) Dagar et al. (2022)
Environmental Compliance Information Disclosure	ENVC	0 indicates there is no information in any subsection regarding the accounting index for environmental compliance. 1. Information solely regarding sustainability, environmental accounting information disclosure, environmental protection policy, and the GRI index A statement regarding the accounting index for environmental compliance and water consumption 2 = A description of the events and their noteworthy effects. 3 = A detailed explanation with actual numbers that illustrate what occurs and its major effects	Chinanu and Folajimi (2024) Ofurum and Mmadubuobi (2023)

Source: Researcher's compilation 2025

Data Analysis and Results Discussion

Table 2: Descriptive Statistics of the Variables

The results are presented and analyzed thus:

	ROA	ENVC	QMGT	SIZE
Mean	0.061788	1.600000	0.412500	2100.063
Median	0.029500	2.000000	0.000000	607.0000
Maximum	0.727000	3.000000	1.000000	26761.00
Minimum	-0.380000	1.000000	0.000000	4.000000
Std. Dev.	0.167473	0.648269	0.495390	4283.738
Jarque-Bera	203.3038	6.169845	13.38656	732.8459
Probability	0.000000	0.045734	0.001239	0.000000
Observations	**80**	**80**	**80**	**80**

The table displays the descriptive statistics for the data. As observed, return on assets (ROA) has a mean value of 0.617 for the time examined. The maximum and minimum values for ROA for the ten-year period are 0.727 and -0.380 respectively. The standard deviation measuring the spread of distribution stood at 0.167 indicating a considerable variation in the data series Further, the descriptive statistics result from the table on carbon accounting (CACC) and energy accounting

disclosure information (ENGY) point to the fact that while the companies had an average of about 1.56 disclosure index for carbon accounting in the period under consideration (2014-2023); the disclosure index of energy accounting disclosure information within the same period under consideration stood at an average of about 1.487. The descriptive statistics also shows that during the period the maximum proportion for carbon accounting diclosure was 3 with the lowest being 0. The ENGY also recorded the maximum value of 2 and minimum value of 0.00 during the period. The standard deviation of 0.6333 for the carbon accounting disclosure index and 0.527 for environmental disclosure information shows that there is no much dispersion in the distribution among sampled firms.

In addition, the descriptive statistics result from the table on environmental compliance disclosure information (ENVC) point to the fact that while the companies had an average of about 1.60 disclosure index for environmental compliance accounting in the period under consideration (2014-2023). The descriptive statistics also shows that during the period the maximum proportion for environmental accounting disclosure information was 3 with the lowest being 1. The standard deviation of 0.648 for the environmental disclosure index shows that there is no much dispersion in the distribution among sampled firms.

Correlation Analysis

Table 3: Pearson's Correlation Matrix of the Independent Variables

	CACC	ENGY	ENVC
CACC	1.000000		
ENGY	0.381219	1.000000	
ENVC	0.431633	0.244279	1.000000
VIF	6.440433	7.11506	6.171041
C. VIF	1.102757	2.554368	1.232555

Table 3 shows the relationship among the independent variables. CACC is observed to correlate positively with ENGY (r=0.38119), ENVC (r=0.04316). Further, the table also indicates that ENGY is positively correlated with ENVC (r= 0. .24427). As shown in the table, none of the variables is strongly correlated with each other (r>0.8). Thus, a model of predictor variables (carbon accounting, energy disclosure information, environmental compliance disclosure) could be used in forecasting the financial performance of listed oil and gas firms in Nigeria.

Further, the results of the multicollinearity test using the variance inflation factor (VIF) measure are reported in lower part of the table show that each of the independent variables has a VIF value of less than 10, which suggests the absence of multicollinearity among the independent variables. Therefore, the results of the VIF test indicate that the regression model does not have the problem of multicollinearity.

Regression Analyses

The Hausman test is used to determine whether fixed effects or random effects estimation is appropriate for panel data models. The null hypothesis of the Hausman test is that the random effects estimator is consistent and efficient. For the ROA models, the Hausman test statistics (X^2 = 217, df 9, (0.775)) are insignificant ($p > 0.05$), indicating that the random effects estimator is appropriate.

Table 4: Regression Results

	MODEL 1 (RANDOM EFFECTS)	
Variable	**Coefficient**	**Prob.**
C	0.347560	0.0000
CACC	-0.069650	0.0000
ENGY	0.032756	0.0216
ENVC	0.047752	0.0010
R^2	0.188015	
ADJ R^2	0.178765	
F-Stat	20.32499	
P(f-stat)	0.000000	

Source: Author's Compilation, 2025

Table 4 shows the result for the model. As observed, the regression estimation model shows an R^2 value of 0.188 which suggests a 18.8% explanatory ability of the model for the systematic variations in the dependent variable with an adjusted value of 0.178. The F-stat (20.324) and p-value (0.0000) indicates that the hypothesis of a significant linear relationship between the dependent and independent variables cannot be rejected at 5% level. For an evaluation of the effects of the explanatory variables on return on, we examine their slope coefficients. As observed, the coefficients of carbon accounting, appeared negative and significant while energy accounting, environmental compliance disclosure appeared positive and significant at 5% ($p<0.00$).

DISCUSSION OF FINDINGS

The findings of this study contribute to the understanding of the carbon accounting practices and financial performance of listed oil and gas firms. First, the negative relationships observed between carbon accounting practices and financial performance ROA suggest that excessive focus on carbon related matters may constrain a firm's ability to invest in other profitable and sustainable ventures, potentially hampering financial performance. This finding is consistent with the studies of Saka and Oshika (2014), Obiora et al. (2022), Yunus et al. (2014), and Imo and Ikegwuru's (2024). This suggests that the more expenses paid or divestment on carbon related matters, the lower the performance of the company. However, this study contradicts the findings from Agbo and Egbunike (2024), Aniefor et al. (2024), Oyerogba et al. (2024), Shahzad et al. (2023), Shahzad et al. (2023), Dubisz and Golinska-Dawson (2021), Chukwukadiba and Nnamani (2023),

Mohammad et al. (2023), Emmanuel and Ifeanyichukwu (2021), and Obara and Nangih (2017) who found a positive and significant relationship between carbon accounting information disclosure and financial performance, measured by return on assets (ROA) and return on equity (ROE).

Secondly, significant relationship between energy accounting information disclosure and financial performance implies that an increase in energy accounting information disclosure is associated with an increase in the financial performance of oil and gas firms. The positive relationships observed between energy accounting information disclosure, and financial performance measures ROA suggest that the more attention and disclosure about information relating to energy consumption, management and usage of the firm may improve a firm's social responsibility and sustainability which in turn positively influences its relations with stakeholders and regulatory bodies potentially enhancing financial performance. This finding aligns with the notion that energy management saves the future and can positively influence financial performance by enabling companies to fund strategic energy saving and green initiatives, enhance operational efficiency, and pursue growth opportunities. This finding is consistent with the studies of Mukhopadhyay and Nayak (2024), Aremu and Adegbie (2024), Xu et al. (2022), Agyemang et al. (2024), Kujoro and Adegbie (2024), and Nwaiwu and Oluka (2018) that found energy accounting information reporting to positively influence corporate performance of firms. However, this study contradicts the findings from Bamishe and Adegbie (2024), Emovon and Izedonmi (2023), and Kaupke and Dodo (2022) who found a no significant relationship between energy accounting information disclosure and financial performance.

Third, the relationship between environmental compliance information disclosure and financial performance measured by ROA showed a positive and significant association. The implication of this finding is that the more an oil and gas firm is compliant with environmental regulations the higher the legitimacy and better the stakeholder's satisfaction. The result meet our appriori expectation and is consistent with prior studies such as Mdasha et al. (2024), Khatib et al. (2023), Damieibi (2023), Abidemi (2023), Wang and Liang (2021), Ezeokafor and Amahalu (2019), Daferighe and Offiong (2019), and Nwaiwu and Oluka (2018). The finding does not however, agree with Udeh and Ezejiofor (2018), Omesi and Berembo (2020), and Egbunike and Emudainohwo (2017) who in the various individual studies reported a non-significant effect of environmental compliance information disclosure on financial performance of firms using return on assets (ROA), Tobin Q (TBQ), return on equity (ROE), and net profit margin (NPM).

CONCLUSION AND RECOMMENDATIONS

Empirical evidence regarding the relationship between different measures of carbon accounting, energy accounting, environmental compliance and corporate performance provides an unclear picture with some studies showing different patterns of information disclosure structure as having a positive effect on performance while others provide divergent and conflicting results. Against this backdrop, this study extends the existing literature on the relationship between carbon

accounting information disclosure, energy accounting information disclosure, environmental compliance information disclosure and corporate performance using listed oil and gas companies in Nigeria.

Using results of the financial statement statistics and exploratory variables in a panel regression model show that carbon accounting information disclosure have a significant negative relationship with corporate performance of listed oil and gas companies in Nigeria. The study also establishes a positive and significant relationship with energy accounting information disclosures, environmental accounting information disclosure and corporate financial performance. In line with the findings of this study, the following recommendations are proffered:

First, listed oil and gas firms should improve on their carbon accounting management and disclosure by formulating and implementing disclosure and reporting strategies that will enhance optimum level of profitability. Second, it is recommended that listed oil and gas firms should invest in energy saving and green innovations to enhance corporate performance. Third, the study has shown that environmental accounting compliance information disclosures enhances corporate financial performance. It is therefore recommended that more attention should be devoted to reporting environmental compliance issues so as to improve legitimacy, satisfy stakeholders and enhance corporate performance of the firm.

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