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ENVIRONMENTAL DEGRADATION COST AND FINANCIAL PERFORMANCE OF LISTED OIL AND GAS FIRMS IN NIGERIA

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Abstract:

Oil spills, gas flaring, and poor waste management have resulted in severe environmental damage, leading to increased operational expenses for companies as they struggle to comply with environmental regulations, this study examined the effect of environmental degradation cost and financial performance of listed oil and gas firms in Nigeria. Environmental degradation cost is the independent variable proxied by oil spill cost, environmental fines and penalties cost, carbon emission cost, waste management cost and environmental restoration cost and financial performance is the dependent variable proxied by return on assets. Ex-post facto research design was used and panel data covering ten (10) years (2015-2024) across nine (9) listed oil and gas firms in Nigeria. The data were analyzed using descriptive statistics and multiple linear regression analysis via E-views 10.0 statistical package. The study findings revealed that oil spill cost has a significant positive effect {Coeff = 6.6475 (0.0028)} on the return on assets of listed oil and gas firms in Nigeria, environmental fines and penalties have non-significant negative effect {Coeff = -0.5802 (0.6408)} on the return on assets of listed oil and gas firms in Nigeria while carbon emissions cost has a significant negative effect {Coeff = -174.4241 (0.0000)} on the return on assets of listed oil and gas firms on Nigeria. It also revealed that waste management cost has non-significant negative effect {Coeff = -1.4233 (0.7954)} on the return on assets of listed oil and gas firms in Nigeria while environmental restoration cost has a non-significant positive effect {Coeff = 1.3290 (0.0853)} on the return on assets of listed oil and gas firms on Nigeria. It was thus concluded that environmental degradation cost has a significant effect on financial performance of listed oil and gas firms in Nigeria. The recommendations made included that policymakers and regulators should strengthen environmental regulations and enforcement mechanisms to ensure that oil and gas firms comply with environmental standards, thereby reducing environmental fines and penalties

Keywords:

Environmental degradation cost, financial performance, oil spill, return on assets.

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1.0 INTRODUCTION

Environmental degradation has become a critical concern globally, particularly in industries with significant ecological footprints, such as the oil and gas sector. In Nigeria, the oil and gas industry are a cornerstone of the economy, contributing substantially to the nation's GDP and export earnings. However, the environmental costs associated with oil and gas operations have raised serious concerns. These costs, often overlooked in financial reporting, have begun to influence the financial performance of listed oil and gas firms. This study is motivated by the need to understand how environmental degradation costs, such as oil spill clean-ups, environmental fines, and penalties, carbon emissions, environmental waste management and environmental restoration cost, impact the financial health of these firms. Recent studies have highlighted the growing pressure on corporations to adopt sustainable practices, yet the financial implications of environmental degradation remain underexplored in the Nigerian context (Adegbite et al., 2019).

Environmental degradation costs refer to the economic burdens incurred due to the negative impact of industrial activities on the environment. These costs arise from the depletion of natural resources, pollution, and the destruction of ecosystems. According to Okonkwo and Eze (2021), these costs can be direct, such as expenses for cleaning up oil spills, or indirect, such as reputational damage and regulatory fines. The variables of environmental degradation costs in the oil and gas industry include oil spill costs, environmental fines and penalties, environmental restoration, waste management cost and carbon emissions costs. Oil spill costs encompass the expenses related to cleaning up spills, compensating affected communities, and restoring damaged ecosystems. These costs can be substantial, as seen in the case of the 2011 Bonga oil spill in Nigeria, which cost Shell Nigeria millions of dollars in clean-up and compensation (Udoh & Ekpo, 2020). Environmental fines and penalties are imposed by regulatory bodies for non-compliance with environmental laws and standards. These fines not only affect a firm's financial statements but also its reputation and stakeholder relationships. Carbon emissions costs, on the other hand, are associated with the release of greenhouse gases during oil and gas extraction and processing (Okafor & Adeleye, 2022). Waste management cost

Financial performance in the context of listed oil and gas firms in Nigeria refers to the ability of these firms to generate profits and create value for shareholders. It is commonly measured using metrics such as return on assets (ROA), which indicates how efficiently a firm utilizes its assets to generate earnings. ROA is a critical indicator of financial health, as it reflects both operational efficiency and profitability. For oil and gas firms, financial performance is influenced by various factors, including oil prices, production levels, and operational costs. However, environmental degradation costs have emerged as a significant factor that can erode profitability. For instance, firms with high environmental liabilities may experience reduced ROA due to increased operational expenses and potential legal liabilities (Lu & Guo (2024). Understanding the impact of these costs on financial performance is essential for stakeholders seeking to assess the long-term viability of oil and gas investments in Nigeria.

The link between environmental degradation costs and the financial performance of listed oil and gas firms in Nigeria is increasingly evident. As global awareness of environmental issues grows, firms are facing greater scrutiny and higher costs associated with environmental compliance and remediation. These costs can directly affect profitability by increasing operational expenses and reducing net income. Additionally, environmental incidents such as oil spills can lead to reputational damage, resulting in lost revenue and reduced investor confidence. Studies have shown that firms with poor environmental performance often experience lower financial returns, as investors and stakeholders increasingly prioritize sustainability (Okafor et al., 2021).

1.2 Statement of the problem

The current situation in Nigeria's oil and gas industry is characterized by escalating environmental degradation costs that significantly impact the financial performance of listed firms. Oil spills, gas flaring, and poor waste management have resulted in severe environmental damage, leading to increased operational expenses for companies as they struggle to comply with environmental regulations. Despite the existence of regulatory frameworks, enforcement remains weak, allowing firms to prioritize short-term financial gains over long-term sustainability. As a result, many oil and gas companies face frequent legal penalties, fines, and compensation claims from affected communities, which erode their profitability. Additionally, the rising costs associated with carbon emissions management and environmental remediation efforts have placed further financial burdens on these firms.

The persistent financial burden caused by environmental degradation costs diminishes corporate profitability, reducing returns to shareholders and discouraging new investments in the sector. The reputational damage suffered by oil and gas companies due to environmental infractions further limits their ability to attract international partnerships and funding opportunities, placing them at a competitive disadvantage in the global energy market. If these issues remain unresolved, the long-term financial viability of many listed oil and gas firms in Nigeria will be threatened, potentially leading to business closures, job losses, and reduced contributions to national revenue.

1.3 Objectives of the study

The main objective of this study was to examine the effect of environmental degradation cost and financial performance of listed oil and gas firms in Nigeria. The specific objectives of this study were to:

1. Assess the effect of oil spill cost on the return on assets of listed oil and gas firms in Nigeria.
2. Ascertain the impact of environmental fines and penalties on the return on assets of listed oil and gas firms in Nigeria.
3. Investigate the effect of carbon emissions cost on the return on assets of listed oil and gas firms in Nigeria.
4. Examine the effect of waste management cost on the return on assets of listed oil and gas firms in Nigeria.
5. Determine the effect of environmental restoration cost on the return on assets of listed oil and gas firms in Nigeria.

1.4 Research questions

In order to give answer to the research problems, the following questions was formulated for the study;

1. What effect does oil spill cost has on the return on assets of listed oil and gas firms in Nigeria?
2. What effect does environmental fines and penalties cost have on the return on assets of listed oil and gas firms in Nigeria?
3. To what extent does carbon emissions cost affect return on assets of listed oil and gas firms in Nigeria?
4. To what extent does waste management cost affect return on assets of listed oil and gas firms in Nigeria?
5. What effect does environmental restoration cost has on the return on assets of listed oil and gas firms in Nigeria?

2.0 LITERATURE REVIEW

2.1 Conceptual framework

The conceptual review covers the concept of environmental degradation cost with five dimensions as it relates to financial performance as depicted in the diagram below.

Independent variable — Environmental Degradation Cost

Dependent variable — Financial performance

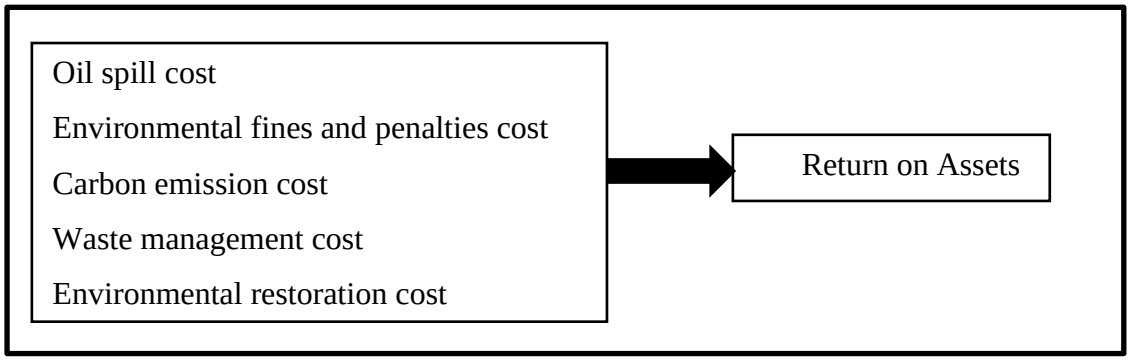

Fig 2.1: Conceptual framework of variables
Source: Researcher's compilation (2025

2.1.2 Environmental degradation costs

Al-Mawali, H. (2021) Environmental cost accounting is the process of calculating and measuring the cost of environmental goods and services as well as the information utilized to guide decisions about environmental management. Environmental expenditures, in their opinion, are expenses related to the incidence, identification, mitigation, and prevention of environmental harm. According to Bucior and Szadziewska (2021), environmental cost refers to the environmental accounting principles of an organization that aims to achieve sustainable growth, maintain positive relationships with the community, and pursue successful environmental conservation projects. The researcher claims that this type of accounting provides the best tools for quantitative measurement and results communication, helps a company determine the benefits and gains from these activities, and calculates the cost of environmental protection while conducting routine business operations. According to Al-Mawali, H. (2021), environmental accounting is a comprehensive topic in environmental fines and penalties associated with oil spills, accounting for carbon emissions, waste management, environmental restoration, and return on assets. The financial community and the general public may find environmental data interesting and useful in deciding on capital budgeting, pricing, and overhead control, they add, adding that environmental accounting offers reports for both internal and external usage. Al-Mawali, H. (2021) define environmental costs as the costs associated with causing, comprehending, treating, and preventing environmental damage.

Bucior and Szadziewska (2021) described environmental costs as having been expanded to include factors such as worker training, research and development, recycling, and product design for sustainability. The authors go on to say that environmental management systems (EMS) have developed as a way to systematically apply business management to environmental costs in order to improve a firm's long-term financial performance by creating procedures and goods that boost both competitive and environmental performance. Effiong, and Inyang, (2022) described environmental expenses as environmental measurements and environmental losses, such as clean-up expenses, costs associated with resource recycling or energy conservation, closure costs, capital expenditures, and development expenditures.

According to Gola et al (2022), environmental accounting is also referred to as "green accounting," which has to do with the present generation's capacity to meet its demands without necessarily compromising or impeding the ability of future generations to do the same. He continued by stating that it is an art or science to assess organizational performance in relation to the objective, disclose it to internal and external stakeholders, and be responsible for its sustainable development.

According to Effiong, and Inyang (2022), environmental accounting can help communities preserve their relationships with one another while also achieving sustainable growth and development. They go on to say that it is an essential component of accounting that is growing and developing because societal forms are becoming more environmentally conscious, which raises the bar for monitoring the environment. They continued by pointing out that the International Organization for Standardization (IOS) had introduced the IOS 14,000 series of standards, which cover a variety of environmental management-related topics. This gave businesses useful tools to improve their environmental performance, which in turn increased productivity and success.

2.1.3 Oil spill cost

Ahmed et al. (2019) defined oil spill cost as the financial burden incurred in the containment, cleanup, and remediation of oil spills, as well as the economic losses suffered by affected communities and ecosystems. They stated that oil spill costs include direct expenses such as emergency response efforts, fines, and legal fees, along with indirect costs like loss of biodiversity and damage to fisheries. Eze (2020) referred to oil spill cost as an economic consequence of environmental pollution that affects both corporate entities and society, emphasizing that it involves compensation for affected individuals, restoration of damaged ecosystems, and loss of revenue in industries dependent on marine and land resources.

El Moussaoui and Idelhakkar (2023) described oil spill cost as an essential aspect of environmental management that provides financial insights into the short- and long-term impacts of oil spills. They noted that these costs are categorized into regulatory compliance expenses, compensation claims, and mitigation expenditures aimed at restoring the affected environment. The authors further asserted that oil spill cost analysis is crucial in formulating policies that promote sustainable oil exploration and production, ensuring that financial and environmental risks are adequately managed. Emenyi and Okpo (2023) stated that the costs associated with oil spills include expenditures on emergency response, remediation technologies, and liability settlements disclosure. They highlighted that oil spill costs often extend beyond immediate cleanup efforts, affecting local economies by disrupting agricultural activities, contaminating water sources, and leading to long-term health consequences for exposed populations.

Agbadiba and Patricks (2024) investigated oil spill costs have expanded to include socio-economic damages such as displacement of communities, loss of employment, and degradation of natural resources essential for economic activities. They emphasized that environmental impact assessments (EIA) have become crucial tools in evaluating the financial implications of oil spills and developing strategies to minimize future occurrences. Olatunji and Emeka (2019) described oil spill costs as comprising legal penalties, operational disruptions, and reputational damage that negatively impact companies and investors. They argued that the rising financial burden associated with oil spills has led to increased corporate social responsibility (CSR) initiatives, with firms investing in preventive measures such as spill containment technologies and improved safety protocols.

According to Abubakar (2021), oil spill cost analysis is a growing aspect of environmental accounting, driven by rising global awareness of ecological degradation and

the need for sustainable business practices. The author noted that oil companies are increasingly required to disclose spill-related expenditures in their financial reports, enhancing transparency and accountability in the energy sector. He further highlighted those international regulations, such as the International Convention on Oil Pollution Preparedness, Response, and Cooperation (OPRC), have been instrumental in guiding corporate responses to oil spills, ensuring that financial and environmental risks are effectively mitigated. Hassan et al. (2022) stated that the financial burden of oil spills extends beyond immediate cleanup costs, impacting national economies through declining tourism revenues, reduced agricultural output, and increased healthcare expenditures due to pollution-related illnesses. They pointed out that a robust environmental management framework is essential to minimizing oil spill costs, as well as ensuring that oil companies adopt sustainable practices that protect both economic and environmental interests.

2.1.3 Environmental fines and penalties

Johnson et al. (2021) defined environmental fines and penalties as monetary charges imposed on individuals, businesses, or organizations for violating environmental laws and regulations. They stated that these fines serve as a deterrent against harmful environmental practices and are often imposed by government agencies to ensure compliance with environmental standards. Furthermore, they noted that environmental fines are structured to encourage organizations to adopt environmentally sustainable practices while penalizing those that contribute to pollution, habitat destruction, and other forms of environmental degradation. Okonkwo (2022) referred to environmental fines and penalties as regulatory enforcement mechanisms designed to hold corporations accountable for environmental misconduct. The researcher further explained that these penalties are essential in reinforcing environmental policies, promoting corporate social responsibility, and encouraging industries to invest in eco-friendly technologies to mitigate regulatory risks. Adeyemi et al. (2020) described environmental fines and penalties as essential legal tools used to safeguard natural ecosystems and public health. They noted that these costs arise from regulatory breaches such as illegal waste disposal, excessive emissions, deforestation, and failure to comply with environmental impact assessments. The authors further asserted that the severity of fines depends on the extent of environmental damage caused, the duration of non-compliance, and the responsible entity’s willingness to rectify the violation. Uchenna and Bello (2019) stated that environmental fines and penalties include direct financial charges, mandatory remediation costs, and reputational damages that affect a company's market value. They highlighted that industries with poor environmental compliance records often experience reduced investor confidence, increased operational costs, and long-term economic instability due to recurring fines and legal battles.

According to Gola et al (2022), explained that environmental fines and penalties have expanded to include both monetary sanctions and legal restrictions on business activities, such as license revocations and operational suspensions. They emphasized that strict enforcement of environmental regulations compels organizations to prioritize compliance in their strategic planning and risk management frameworks. The authors further noted that firms operating in highly regulated industries, such as oil and gas, manufacturing, and mining, face significant financial consequences if they fail to adhere to environmental standards. Olagunju amd Nweke (2023) described environmental fines and penalties as encompassing legal liabilities that can lead to substantial financial losses, including compensatory damages to affected communities and restoration expenses. They argued that corporations that fail to implement sustainable environmental management practices are likely to incur higher regulatory costs and litigation risks.

According to Ibrahim (2023), environmental fines and penalties are increasingly being used as revenue-generating tools by governments while simultaneously promoting environmental conservation. The author noted that many countries have strengthened their regulatory frameworks by increasing the financial penalties for non-compliance, making it more costly for businesses to disregard environmental laws. He further highlighted that the integration of technology, such as remote sensing and artificial intelligence, has improved environmental monitoring, leading to a higher detection rate of regulatory violations and an increase in imposed fines.

Hassan et al. (2021) stated that environmental fines and penalties not only affect individual businesses but also have macroeconomic implications, influencing national investment climates, industrial competitiveness, and long-term sustainability goals. They pointed out that regulatory agencies must balance the enforcement of environmental laws with economic growth objectives, ensuring that penalties do not disproportionately burden businesses while still achieving environmental protection goals.

2.1.4 Carbon emissions cost

Williams et al. (2020) defined carbon emissions cost as the financial burden associated with the release of greenhouse gases, particularly carbon dioxide, into the atmosphere due to industrial activities, transportation, and energy production. They stated that these costs include regulatory penalties, carbon taxes, and expenditures related to emissions reduction strategies. Okonkwo (2021) referred to carbon emissions cost as the economic impact of carbon pollution on businesses and governments, which involves direct compliance costs, mitigation investments, and the social costs of climate change. The researcher further explained that carbon emissions accounting allows firms to assess their financial obligations under environmental regulations, estimate the long-term impact of emissions on economic performance, and integrate sustainable practices into their business models.

Adeyemi et al. (2019) described carbon emissions cost as an essential element of environmental sustainability that influences both corporate strategies and national economic policies. They noted that these costs arise from emissions trading schemes, carbon offset programs, and investments in cleaner energy technologies. The authors further asserted that carbon pricing mechanisms, such as carbon taxes and cap-and-trade systems, are designed to internalize the environmental externalities of industrial activities, ensuring that businesses take responsibility for their contributions to climate change. Zhang and Zhang (2025) stated that carbon emissions costs include expenditures on regulatory compliance, technological upgrades, and sustainability reporting. They highlighted that these costs are not only borne by corporations but also impact economies through inflationary pressures, reduced industrial output, and shifts in consumer demand towards eco-friendly alternatives.

Wang et al (2020) evaluated the industry's emission reduction effects across 30 provinces of China. Then, the emission reduction paths of “lagging regions,” which fail to meet the 2030 industrial carbon emission reduction target, are optimized based on the two-dimensional perspective of carbon emission efficiency and emission reduction cost. This study found that China has exceeded its 2020 industrial carbon emission reduction target. Olagunju and Nweke (2022) described carbon emissions costs as comprising financial penalties, operational adjustments, and reputational risks associated with excessive carbon footprints. They argued that as environmental regulations tighten, companies are increasingly investing in renewable energy sources and carbon capture technologies to minimize their exposure to emissions-related costs.

According to Ibrahim (2023), carbon emissions cost analysis has become a fundamental aspect of environmental economics, driven by global efforts to combat climate

change and achieve carbon neutrality. The author noted that businesses are now required to disclose their carbon emissions-related expenditures in financial reports, improving transparency and accountability in corporate sustainability practices. He further highlighted those international agreements, such as the Paris Agreement, have played a significant role in shaping policies that encourage firms to adopt cost-effective carbon reduction strategies. Hassan et al. (2022) stated that the financial burden of carbon emissions extends beyond corporate expenses, impacting national economies through increased energy costs, disruptions in global trade, and heightened financial risks associated with extreme weather events. They pointed out that a well-structured carbon pricing system is essential to mitigating carbon emissions costs while ensuring that economic growth and environmental sustainability remain aligned.

2.1.5 Waste management cost

Waste management cost refers to all the expenses a company incurs to handle waste throughout its lifecycle, from generation to final disposal or recycling. It is the practice of disclosing information related to the management, handling, and disposal of waste generated by an organization or industry. It involves providing detailed information on waste reduction initiatives, recycling efforts, waste disposal methods, and overall waste management practices. Waste management disclosure can take various forms, including narrative descriptions in corporate social responsibility reports or sustainability reports, quantitative metrics showing waste reduction targets and achievements. Adopting standardized reporting frameworks like the Global Reporting Initiative (GRI) or the Sustainability Accounting Standards Board (SASB) ensures consistency and comparability in waste management disclosure practices (Osuagwu & Okoyeuzu, 2020). Both the owner of the facility where hazardous substances are discharged and the generator of those pollutants are subject to environmental liability.

2.1.6 Environmental restoration cost

Environmental restoration cost plays a crucial role in shaping stakeholder perceptions and influencing investment decisions. Shareholders, customers, regulators, and the broader community are increasingly demanding greater transparency from companies regarding their environmental performance and restoration efforts. By disclosing information on environmental projects, expenditures, outcomes, and long-term sustainability goals, firms can enhance their reputation, build trust with stakeholders, and differentiate themselves in the marketplace. However, the effectiveness of environmental restoration cost depends on the quality of data provided, the accuracy of reporting methodologies, and the comparability of information across different companies and industries. Without clear guidelines and benchmarks for assessing the credibility of environmental restoration disclosures, there is a risk of inconsistency, misinterpretation, and manipulation of information that could undermine the trust and confidence of stakeholders as stated by Johnson and Jumoke (2022).

2.1.7 Financial performance

Anderson et al. (2022) defined financial performance as the measure of a firm’s overall financial health over a specified period, evaluated through key indicators such as profitability, liquidity, efficiency, and solvency. They stated that financial performance reflects an organization’s ability to generate revenue, manage costs, and achieve financial stability while maintaining operational efficiency. Additionally, they noted that financial performance serves as a critical benchmark for investors, stakeholders, and regulatory bodies in assessing a firm’s sustainability and long-term viability. Okonkwo (2021) described financial performance as the evaluation of a company's financial position using financial

statements, return on assets (ROA), return on equity (ROE), and earnings per share (EPS). The researcher further explained that strong financial performance enables firms to expand their operations, attract investments, and maintain competitiveness in dynamic business environments. Adeyemi et al. (2020) described financial performance as a multidimensional concept encompassing profitability, revenue generation, and cost management efficiency. They emphasized that an organization's financial health is influenced by internal management strategies and external macroeconomic factors, such as inflation, interest rates, and market competition. The authors further asserted that companies with sound financial performance exhibit higher resilience to economic downturns and maintain a stable capital structure that supports growth. Uchenna and Bello (2019) stated that financial performance is assessed using financial ratios, cash flow analysis, and profitability metrics. They highlighted that firms with strong financial performance attract higher investor confidence and have greater access to financing, allowing them to sustain growth and innovation.

Chukwuemeka et al. (2018) explained that financial performance has evolved to include both traditional accounting measures and modern performance metrics, such as economic value added (EVA) and market value added (MVA). They emphasized that financial performance is not solely dependent on revenue generation but also on effective risk management and corporate governance. The authors further noted that firms that integrate sustainable financial practices achieve long-term profitability and mitigate financial distress. Olagunju and Nweke (2023) described financial performance as a determinant of corporate success, influenced by both internal operational efficiencies and external economic conditions. They argued that companies that effectively manage their financial resources achieve superior performance outcomes, resulting in higher shareholder value and sustainable business growth. According to Ibrahim (2023), financial performance is a key driver of corporate decision-making, influencing investment strategies, resource allocation, and business expansion.. Hassan et al. (2021) stated that financial performance plays a crucial role in determining an organization's ability to meet its short-term and long-term obligations. They pointed out that maintaining financial stability enhances a firm's reputation, fosters stakeholder trust, and supports sustainable development objectives.

2.1.8 Return on assets

Johnson et al. (2022) defined return on assets (ROA) as a financial performance metric that measures the profitability of an organization relative to its total assets. They explained that ROA provides insight into how effectively a company utilizes its assets to generate earnings and is widely used by investors and financial analysts to assess operational efficiency. The authors further noted that a higher ROA indicates a firm's ability to convert investments in assets into profits, reflecting strong management efficiency and financial sustainability. Olatunji (2021) described ROA as a key profitability ratio that evaluates how well a company leverages its assets to generate net income. He stated that firms with high ROA ratios tend to have effective asset management strategies, leading to improved financial stability and long-term growth. Adegbite et al. (2020) explained that ROA is a critical measure of corporate profitability, as it quantifies the relationship between net earnings and total assets employed. They emphasized that ROA is influenced by factors such as capital structure, operational efficiency, and industry-specific dynamics. The authors argued that organizations with optimal asset utilization strategies tend to achieve higher returns, positioning them for sustainable financial performance. Nwosu and Ahmed (2019) stated that ROA serves as a fundamental indicator of financial health, providing valuable insights into a firm's ability to generate profits from its asset base. They highlighted that an increasing ROA suggests improved financial management, while a declining ROA may indicate inefficiencies in asset utilization or excessive financial leverage.

Eze et al. (2018) noted that ROA has evolved as an essential metric for evaluating business performance across industries. They explained that ROA is particularly useful for comparing firms within the same sector, as it eliminates size-related disparities and focuses solely on profitability relative to asset deployment. The authors also pointed out that firms with higher ROA tend to attract more investors due to their demonstrated ability to generate earnings from invested resources. Bello and Usman (2023) described ROA as a profitability ratio that reflects management's efficiency in utilizing assets to generate earnings. They argued that maintaining a consistent and high ROA is crucial for businesses aiming to maximize shareholder value and sustain competitive advantage. According to Ibrahim (2023), ROA plays a vital role in corporate decision-making, influencing investment strategies, asset allocation, and financial planning. He emphasized that businesses must continuously assess and optimize their ROA to ensure profitability and operational effectiveness. Hassan et al. (2021) stated that ROA is a key determinant of a firm's overall financial stability, as it directly impacts growth potential, investor confidence, and long-term sustainability. They concluded that businesses must adopt sound financial strategies to maintain a favorable ROA and enhance their financial resilience.

2.1.9 Effect of Environmental degradation cost on financial performance

According to Saputra et al (2025), environmental accounting can help communities preserve their relationships with one another while also achieving sustainable growth and development. They go on to say that it is an essential component of accounting that is growing and developing because societal forms are becoming more environmentally conscious, which raises the bar for monitoring the environment. They continued by pointing out that the International Organization for Standardization (IOS) had introduced the IOS 14,000 series of standards, which cover a variety of environmental management-related topics. This gave businesses useful tools to improve their environmental performance, which in turn increased productivity and success.

According to Ibrahim (2023), financial performance is a key driver of corporate decision-making, influencing investment strategies, resource allocation, and business expansion.. Hassan et al. (2021) stated that financial performance plays a crucial role in determining an organization's ability to meet its short-term and long-term obligations. They pointed out that maintaining financial stability enhances a firm's reputation, fosters stakeholder trust, and supports sustainable development objectives.

Environmental degradation costs are **not merely liabilities,** when managed properly, with investment, transparency, and community engagement, they can become strategic assets that enhance financial performance for oil and gas companies in Nigeria.

2.2 Theoretical framework

2.2.1 Stakeholder theory by Edward Freeman (1984)

Stakeholder theory was introduced by R. Edward Freeman in 1984 in his seminal work, Strategic Management: A Stakeholder Approach. Freeman argued that businesses should not focus solely on maximizing shareholder value but must also consider the interests of all stakeholders, including employees, customers, suppliers, communities, and the environment. The theory posits that firms that address the needs and concerns of their stakeholders are more likely to achieve long-term success and sustainability. In the context of environmental degradation costs, stakeholder theory suggests that firms must proactively manage their environmental impact to maintain the trust and support of stakeholders such as regulators, local communities, and investors. For instance, oil and gas firms that fail to address oil spills or carbon emissions risk alienating these groups, leading to financial penalties, reputational damage, and reduced profitability (Freeman, 1984). In Nigeria, where

oil and gas operations often lead to significant environmental harm, stakeholder theory provides a framework for understanding how firms can balance environmental responsibility with financial performance.

Despite its widespread acceptance, stakeholder theory has faced criticism from various scholars. Some argue that the theory is too broad and lacks clear guidelines for prioritizing competing stakeholder interests (Jensen, 2001). For example, while addressing environmental concerns may benefit communities and regulators, it may increase operational costs, potentially reducing shareholder returns. Others contend that stakeholder theory is difficult to operationalize, as it does not provide specific metrics for measuring stakeholder satisfaction or environmental performance (Donaldson and Preston, 1995). Additionally, critics argue that stakeholder theory may encourage firms to engage in superficial or symbolic environmental initiatives rather than implementing substantive changes (Adegbite et al., 2019).

This study is anchored on stakeholder theory because it provides a comprehensive framework for understanding how environmental degradation costs impact the financial performance of listed oil and gas firms in Nigeria. The theory emphasizes the importance of addressing the concerns of diverse stakeholders, including regulators, communities, and investors, all of whom are directly affected by environmental issues in the oil and gas sector. By adopting a stakeholder perspective, the study can explore how firms that fail to manage environmental degradation costs risk losing stakeholder support, leading to financial penalties, reputational damage, and reduced profitability.

2.2.2 The Resource-based view (RBV) by Birger Wernerfelt (1984)

The Resource-based view (RBV) is a theory that says a business can perform better than others if it owns special resources that others don't have. These resources can be physical things like machines, or non-physical things like a strong brand, skilled workers, or good relationships with customers. When we talk about environmental degradation, RBV helps us understand that how a company manages its environmental problems like pollution or waste can also be a resource. If a company has good systems to reduce pollution or use less energy, it can save money, avoid fines, and protect its reputation, which all help its financial performance (Nguyen & Tran, 2021). Companies that train their workers to understand and manage environmental risks are building another valuable resource: environmental knowledge and skills. This can help reduce environmental degradation, like oil spills or emissions, because trained workers know how to avoid or handle such issues better. This kind of human resource becomes an asset that other companies may not have, giving the company an edge in both environmental and financial performance (Abbas & Saeed, 2023). RBV sees these skills and practices as important parts of what makes a company special and successful in the long term.

Many companies today try to reduce the cost of environmental damage by using green technologies or eco-friendly methods. These green efforts can become a strong resource if done well. For example, companies that reduce waste or recycle more can attract customers who care about the environment. These practices can also make the company stand out from competitors. According to Ali et al. (2022), firms with strong environmental management practices tend to perform better financially because they avoid risks and build trust with customers and investors. The RBV theory tells us that if a company treats its environmental practices as valuable resources, it can reduce the cost of environmental degradation and improve its financial results. This means that taking care of the environment is not just good for nature but can also be good for business. Firms that see green practices as part of their business strengths are more likely to survive and grow in the long run (Mekpor et al., 2023).

Another important idea from the Resource-Based View is that a company's ability to create and use green innovations like eco-friendly products or clean energy can give it an advantage.

These innovations help reduce the costs linked to environmental harm, such as cleanup costs or government penalties. When a company invests in research and development to produce cleaner products or better waste systems, these become part of its unique resources. As Suganthi (2023) points out, firms that develop green innovations tend to have lower environmental costs and better financial returns because they spend less on damage control and gain more from environmentally conscious customers. Strong relationships with environmental stakeholders like government agencies, local communities, or green organizations can also be seen as strategic resources. If a company has a good reputation for environmental care, it may face fewer protests, enjoy tax benefits, or even get government support. These kinds of relationships reduce environmental costs and improve financial outcomes (Chen et al., 2022). So, from the RBV view, managing environmental degradation is not just about reducing harm; it is also about building resources that help the business succeed.

2.2.3 Signalling theory by Michael Spence, (1973)

Michael Signalling theory was initially developed by Spence (1973) and eventually developed by Connelly et al. (2011). Signalling theory helped explain the behaviour of two parties when they have access to different information; so, it is safe to say that this theory tends to address information asymmetries. In his formulation of signaling theory, Spence (1973) utilized the labour market to model the signaling function of education. The signaling theory has four components; the signaler, signal, receiver and feedback. The fundamental tenet of the signalling theory is that signalers are insiders (such as executives or managers) who possess knowledge about a person, product, or organization that is unavailable to outsiders (e.g., Spence, 1973; Amahalu, 2020). On the whole, insiders get knowledge that outsiders would find beneficial, some of it positive and some of it unfavourable. Examples of this information would be specifics regarding the organization's goods or services, environmental penalties disclosure practices, financial reporting techniques, risks and risk management. This information if passed, is the signal. Insiders obtain both positive and negative private information, and they must decide whether to communicate this information to outsiders. The third component of the signalling timeline is the signal receiver. Receivers are outsiders who don't know much about the organization in question but would wish to learn more, according to signalling models as postulated by (Nkanga et al., 2023).

This theory is the anchor theory for this work and is relevant because it explains that there exists information asymmetry between the firm and the outside stakeholders. In the context of this study, information regarding the impact of the firm's activities on the environment is possessed by the firm or insiders (executives and other relevant staffs). The signalling theory states that the release of this information has implications for both the signaller (the firm insiders) and the receiver (the outsiders; general public, investors, regulators, etc.); Managerial "information signals" should be beneficial to all participants in the socially responsible firm model (Ezeagba et al., 2017). Here, the feedback is what matters. For signalling to take place, the signaller should benefit by some action from the receiver that the receiver would not otherwise have done (i.e., signalling should have a strategic effect); this usually involves selection of the signaller in favour of some alternatives (in other words, potential investors choosing firms who disclose over those who don't). This means that disclosures of environmental penalties should have influence on the firm's value as documented (Gunawan & Lina, (2015).

2.3 Empirical Review

Iqbal et al. (2025) investigated the impact of sustainable finance, green technologies, and environmental policies on environmental degradation. Environmental degradation is a problem, and the consequences, in terms of emission of pollutants into different ecosystems, human health, and sustainable development are disastrous. This study explains the complex interactions that exist among sustainable finance, green technology innovation, green energy adoption, the climate change financial policy, green growth index, government spending, and financial globalization across the globe. This research applies to an extensive dataset that ranges to 23 years in 50 countries by enforcing robust dynamic econometric methods such as unit root tests, cointegration analysis, and generalized method of moments (GMM) estimations for the analysis of these complicated issues. The results show that Sustainable finance (SF) has a negative coefficient of −0.033, suggesting that increased sustainable financial practices contribute to reducing environmental degradation. Similarly, technology innovation (TI) and green energy (GE) both show significant negative impacts on environmental degradation, with coefficients of −0.132 and −0.075, respectively. The green growth index (GGI) has the most substantial negative effect, with a coefficient of −0.686, highlighting its critical role in mitigating environmental degradation. Lastly, the climate-related financial policy index (CRFPI) exhibits a positive coefficient of 0.029, indicating that advancements in financial policies targeting climate issues slightly offset environmental degradation. These results collectively emphasize the importance of financial, technological, and policy interventions in reducing environmental degradation. It also becomes clear that government spending and financial globalization both influence the efficacy of the government actions in reducing environmental pollution, while government efforts are affected by the second factor negatively. Those perceptions reveal why green finance that is advanced technologically along with renewable energy initiatives and governmental policy backing are the need of the hour in view of these very environmental challenges.

Kelly and Nembot (2025) research on understanding the nexus: Economic complexity and environmental degradation in Sub-Saharan Africa. In Sub-Saharan Africa (SSA), where economic development is gaining momentum, the intricate connection between economic complexity and ecological footprint emerges as a pivotal challenge. The region's burgeoning economic activities raise concerns about escalating environmental degradation, making the delicate balance between economic progress and ecological sustainability in SSA increasingly crucial. In this light, the present study aims to examine the effect of economic complexity on environmental degradation in the SSA context, shedding light on the nuanced dynamics and contributing insights for sustainable development in the region. Using a sample of 22 SSA Countries spanning the period from 1998 to 2017, and employing both the Discroll and Kraay Fixed Effect and the System Generalized Method of Moments estimators, the empirical results reveal that economic complexity exacerbates ecological footprint intensity. Introduction of control variables demonstrated that GDP per capita, population density, trade, and FDI all exacerbate environmental degradation while access to electricity mitigates the ecological footprint intensity. The findings withstand scrutiny when an alternative measure of ecological footprint and economic complexity is applied. The study concludes by proposing policy implications such as sustainably enhancing energy infrastructure, focusing on eco-friendly urban planning policies, and prioritizing resource-efficient industrial development so as to help curbing the escalating ecological footprint and foster sustainable development in the region.

Ashraf et al. (2025) examined the impact of environmental sustainability on financial performance of organizations: A study of Malaysia. The debate on the economic benefits of adopting environmentally friendly practices continues. This study does not aim to resolve the

argument; instead, it alleviates it by enhancing the notion of "when it is advantageous to be environmentally conscious". This research study focusses on the shortcomings of current literature review by focusing the influence of environmental sustainability on financial performance of Malaysian firms for the period of 2014-2023. The data is collected from Thomson Reuter DataStream. In general, environmental sustainability and financial performance holds an optimistic relationship. The empirical result shows that the outcome of environmental sustainability on financial performance is positive. Institutional and legitimacy criteria serve as an effective foundation for establishing environmental sustainability. Policymakers and investors must consider these results when formulating economic policies and investment strategies, while enterprises in emerging nations such as Malaysia should recognize the potential implications of these elements and seek appropriate management strategies.

Nsair and Alzubi (2025) examined on globalization, financial risk, and environmental degradation in China: The role of human capital and renewable energy use. Amid rising climate concerns, understanding how renewable energy adoption, human capital, fossil fuel efficiency, and globalization collectively shape CO2 emissions is crucial for unlocking pathways to a cleaner, resilient, and globally connected low-carbon future. Using China as a case study, this research investigates the drivers of CO2 emissions, focusing on fossil fuel efficiency, renewable energy adoption, and globalization, utilizing quarterly data from 1984Q1 to 2023Q4. To ensure robust and nuanced insights, the study integrates advanced machine learning techniques alongside Quantile-on-Quantile Kernel Regularized Least Squares (QQ-KRLS) and a Modified Quantile Regression as robustness checks, capturing complex distributional dynamics often overlooked in conventional analyses. To the authors' knowledge, this is the first empirical study examining such relationships for the case of China. The results reveal that globalization, fossil fuel efficiency, renewable energy, human capital, and financial risk all contribute to increasing CO2 emissions. The study proposes precise policies based on the findings obtained.

Ntui (2024) examined how corporate governance frameworks influence the relationship between firm internal characteristics and environmental disclosure in Tanzania's extractive industry. Drawing from institutional theory, the research used content analysis and panel data from annual reports from 18 companies, spanning the years 2004 to 2018. The study classified its variables into two primary categories: the first category comprises firm internal characteristics (such as age, size, profitability, kind, structure of ownership, and structure of capital of the organization) that directly impact environmental disclosure. The second group examines corporate governance structures, such as the board's independence, size, gender diversity among board members, and board committees, as factors that reduce or enhance the impacts. The research findings are important because they showed that gender diversity has a moderating effect on the relationship between business size and environmental disclosure. Conversely, the autonomy of the board diminishes the correlation between the company's dimensions, longevity, ownership composition, financial framework, and nature, as well as its disclosure of environmental information.

Ogunmodede et al. (2024) investigated how firm attributes influence sustainability disclosure, focusing on a comparative analysis within the less environmentally sensitive sector in Nigeria. The specific aims included determining the variance in the impact of Leverage on sustainability disclosure and exploring the distinction in the effect of profitability on sustainability disclosure within this sector. Employing a longitudinal and ex-post facto research design, the study targets a population of 150 listed firms in Nigeria, selecting a sample of 20 firms from both financial and non-financial sectors through judgmental sampling. Data spanning from 2012 to 2021 were gathered from the annual

reports and accounts of the chosen firms, along with information from the Nigeria Exchange Group (NGX) fact book. Hypotheses were tested using panel regression and t-test techniques. The primary findings revealed a significant difference in the influence of firm size on sustainability disclosure in more environmentally sensitive industries (P= 0.0002). In summary, the adoption of sustainable development strategies by companies reflects management's acknowledgment of stakeholder perceptions. The study suggested that regulators prioritize environmental and social concerns to encourage sustainable practices, including enhanced disclosure on environmental, social, and governance fronts.

Sari and Adi (2024) examined the impact of firm characteristics on the environmental disclosures of listed oil and gas marketing companies in Nigeria. Specifically, it investigated the significance of leverage and foreign affiliation on environmental disclosures. The study utilized longitudinal data from 10 oil and gas marketing companies listed on the Nigerian Exchange Group over a 10-year period, from 2011 to 2020. Content analysis was employed to extract environmental disclosure data as specified by the Global Reporting Initiative (GRI) 11 of 2021, and panel regression techniques were applied. The findings revealed a significant relationship between leverage, foreign affiliation, and environmental disclosures among the listed oil and gas marketing companies, with p-values of 0.031 and 0.009, respectively. The paper recommended that creditors of these companies should continue to monitor the compliance level of management regarding environmental disclosures.

Egedegu et al. (2024) investigated the relationship between environmental accounting and financial performance of Conoil. The ex-post facto research design was employed in this case study of the sampled oil gas giant in Nigeria due to its comprehensive disclosure of environmental expenditures in its annual reports. The study utilized secondary data obtained from annual reports and accounts, downloads from Nigerian Exchange Group (NXG), and the company websites covering the period 2008 to 2022. The study employed descriptive statistics, correlation analysis, and Ordinary Least Squares (OLS) regression using Eview9 econometric software for data analysis. The correlation analysis result indicates that environmental restoration costs (ERC) are negatively correlated with profit after tax (PAT) and return on assets (ROA), while a positive correlation exists between PAT and ROA, providing insights into Conoil Plc's financial and environmental performance dynamics. The regression analyses reveal that while environmental restoration costs have a significant negative impact on return on assets (ROA), neither ERC nor health, safety, and environmental expenses (HSE) significantly influence profit after tax (PAT), indicating the nuanced relationship between environmental accounting metrics and financial performance in Conoil Plc's operations. The research additionally recommended that the corporation should regularly carry out environmental audits to evaluate adherence to environmental rules and pinpoint opportunities for enhancing environmental performance. The company should allocate resources towards renewable energy projects to reduce reliance on fossil fuels, mitigate environmental impact, and enhance long-term financial sustainability.

Majekobaje (2024) investigated the relationship between environmental liability and financial performance of listed oil and gas companies in Nigeria. The study made use of ex-post facto research design. The data used for this study was obtained from the annual reports published by the selected oil and gas firms listed on the Nigerian stock exchange. This research work adopted the panel least square (PLS) regression analysis with longitudinal (panel) regression using E-Views 10.0 statistical software. The findings of the study show that using the dimensions of Compensation obligation and profitability, and the dimensions of Remediation Obligation and Market Value, Environmental liability has a positive and significant relationship with financial performance of oil and gas companies in Nigeria. While environmental liability dimension of Remediation has no significant relationship with profitability of oil and gas firms in Nigeria, and Environmental liability dimension of

Compensation Obligation has no significant relationship with market value of oil and gas companies in Nigeria. Based on this, this study recommends that oil and gas companies in Nigeria should spend significant amount on remediation to measure up to the damages caused to the environment and to individuals affected by the activities of their operation.

Chen et al., (2024) researched on environmental penalties and financing punishment: Evidence from incremental bank loans. This study examines the impact of environmental penalties on corporate incremental bank loans. The results show that both the frequency and degree of environmental penalties significantly reduce corporate incremental bank loans, indicating that corporate environmental penalties lead to "financing punishment" by damaging corporate reputation and increasing risks. This financing punishment can be alleviated by good CSR performance and CSR assurance, indicating that exemplary CSR performance and assurance can provide an "insurance" effect to influence bank loans when a firm has a negative event. We also find that this financing punishment has intra-industry peer effects, suggesting that the environmental penalties incurred by one firm can influence the broader credit decisions of commercial banks within the same industry.

Wu and Xu (2024) examined environmental regulation, agency costs, and financial performance: Based on the release of "The New Environmental Protection Law." The urgency of protecting our planet cannot be overstated. This paper employs Agency Cost Theory, utilizing "the new EPA" as a case study and the difference-in-difference (DID) model to analyze A-share-listed companies in heavily polluting sectors (2012–2018). The research demonstrates that the implementation of the new EPA leads to a sustained enhancement in the financial performance (UnEBIT) of heavily polluting enterprises. Furthermore, the analysis of the mediating effect from a principal-agent perspective reveals that agency costs play a partially mediating role in the relationship between the new EPA and financial performance. The adoption of the new EPA reduces information asymmetry between shareholders and executives, thereby contributing to the improvement in financial performance. Additionally, when examining the diversity among economic regions and the nature of property rights, it is observed that agency costs have a partially mediating role in the three major economic regions. Notably, heavily polluting state-owned enterprises display heightened sensitivity to the implications of the new EPA, indicating a proactive leadership role. These findings have significant implications for enhancing the financial performance of listed companies operating in heavily polluting industries, as well as for contributing to the attainment of carbon peaking and carbon neutrality objectives while advancing the development of China's legal framework.

Guedhami (2024) carried out a research on do environmental penalties matter to corporate innovation? Environmental penalties play a crucial role in enforcing corporate environmental compliance and performance. In this paper, we examine whether and how government environmental violation penalties influence corporate innovation. Using a large sample of Chinese-listed firms, we find that firms subjected to environmental penalties tend to reduce their investment in R&D, resulting in a reduction in both patent applications and granted patents. These adverse effects intensify with the severity of the penalties and contribute to raising the cost of capital for penalized firms. However, our analysis also reveals that the number of green patent applications tends to increase post-penalty imposition. These results indicate that companies that are subject to environmental penalties may shift their long-term investment strategy from general innovation towards environmental initiatives.

Chen et al., (2024) assessed environmental penalties and analyst recommendations: Based on the perspective of negative environmental governance performance. This paper

aims to test the influence of environmental penalties on analyst recommendations from the perspective of negative environmental governance performance, and further tests the influence of environmental penalties on corporate environmental governance. We subdivide environmental penalties into two dimensions: environmental penalty frequency and environmental penalty intensity based on the breadth and depth of environmental penalties. Then we take listed firms in heavy pollution industries in China from 2015 to 2021 as research samples, and use OLS regression analysis to test the impact of environmental penalty frequency and environmental penalty intensity on analyst recommendations. We find that both environmental penalty frequency and environmental penalty degree are significantly and negatively correlated with analyst recommendations. The heterogeneity analysis finds that the negative impacts of corporate environmental penalties on analyst recommendations are mainly reflected in the group with larger firm size and the group with greater industry competition degree. Further analysis shows that both environmental penalty frequency and environmental penalty degree can promote corporate environmental governance. The results show that environmental penalties bring lower analyst recommendations and reputation loss to enterprises. Under the deterrent effect of environmental penalties and the negative impact of analyst recommendations, enterprises have the motivation to improve environmental governance. This paper finds that corporate negative environmental governance performance is truthfully embedded in analyst recommendation decisions, providing evidence for the mechanism and path for China's environmental governance system to play its role. These findings are conducive to providing new evidence for analysts to play the role of capital market information intermediary. This study expands the literature on the economic consequences of corporate environmental penalties and enriches the literature on the factors affecting analyst recommendations from the new perspective of corporate negative environmental performance.

Zhou et al., (2024) carried out an investigation on environmental administrative penalties and corporate greenwashing. We develop a method that identifies corporate greenwashing adopting a deep learning algorithm and find a robust positive association between environmental administrative penalties and corporate greenwashing. We also find that opportunistic management tendencies and heightened external pressures motivate firms to greenwash after such penalties. Additionally, firms with weak internal control quality, operating within fiercely competitive industries, or located in regions of severe environmental pollution are more inclined to greenwash to mitigate losses stemming from administrative penalties. Our work provides theoretical insights into the effectiveness of environmental penalties and contributes to the ongoing regulation and disclosure debate.

Li and Ramanathan (2024) examined the interactive effect of environmental penalties and environmental subsidies on corporate environmental innovation: Is more better or worse? Most previous studies fail to investigate the interactive effects of different environmental instruments. Whether adopting more environmental instruments is better or worse for corporate environmental innovation (CEI) remains unclear. In this study, we distinguish between regulatory pressures as punitive pressures (environmental penalties, EP) and incentive pressures (environmental subsidies, ES) and focus on investigating whether EP and ES act as complements or substitutes on CEI. The results reveal that the interactive effect of EP and ES can act as substitutes rather than complements in promoting CEI. The results remain unchanged after a series of robustness tests. Further heterogeneity analysis reveals that the substitutive effect of EP and ES on CEI is more pronounced for state-owned firms and for firms operating in regions characterized by higher environmental quality and greater marketization. Our results provide valuable insights for the government on achieving an optimal outcome by mixing environmental instruments to promote CEI.

Zhao et al., (2024) carried out an investigation on analysis of the moderating effects of environmental regulations on green accounting information disclosure and financial performance of heavily polluting enterprises. This study focuses on the heavy pollution industry of A-share listed companies in China, spanning the period from 2012 to 2022. It meticulously examines the current state of green accounting information disclosure within this sector and delves into the implications of such disclosure on the financial performance of these enterprises. The findings reveal a compelling correlation: the more extensive and transparent the green accounting information disclosed by a company, the more favorable its financial performance tends to be. Furthermore, the study identifies green innovation as a pivotal moderating factor, positively influencing the relationship between disclosure and financial outcomes.

3.0 METHODOLOGY

3.1 Research design

This study adopted ex-post facto research design. This design was suitable because the data for the analysis had already existed, leaving no room for the researcher to manipulate the variables under study.

3.2 Population of the study

The population of this study was made up of all the nine (9) oil and gas firms that are listed on the floor of the Nigerian Exchange Group (NGX) for the period between 2015 and 2024.

3.3 Sample size determination and sampling procedure

The nine (9) oil and gas firms which constitute the entire population was used as the sample size. The sample size for this study was nine publicly listed oil and gas firms which are RAK Unity, Capital Oil Plc, Conoil Plc, Eterna Plc, Japaul Gold & Ventures Plc, Mrs. Oil Nigeria Plc, Oando Plc, Seplat Energy Plc, and Totalenergies Marketing Nigeria Plc. Data was gathered from the published financial statements of the nine NGX listed oil and gas over a ten-year period from 2015 to 2024.

3.4 Sampling Technique

Census sampling method was used to determine the sample size because the entire population of nine (9) oil and gas firms was used.

3.5 Sources and method of data collection

The data for the dependent and independent variables were extracted from the financial report. The panel data methodology was suitable for the study.

3.6 Method of data analysis

The study adopted panel least squares regression in analyzing the data via E-views 10.0. The data conformed to the standardized regression assumptions, that is, linearity, homoscedasticity, normality and independence of data.

3.7 Model specification

To achieve the stated objectives of the study, as well as testing the study hypotheses, the researcher adopted and modified the model of Enekwe, et al., (2023) and modified thus;

$$ROA_{it} = \beta 0 + \beta_1 OSC_{it} + \beta_2 EFP_{it} + \beta_3 CEC_{it} + \beta_4 WMC_{it} + \beta_5 ERC_{it} + \mu_{it}.$$

Where;

ROA_{it} = Return on Assets
OSC_{it} = Oil Spill Cost
EFP_{it} = Environmental Fines and Penalties
CEC_{it} = Carbon Emissions Cost
WMC_{it} = Waste Management Cost
ERC_{it} = Environmental restoration Cost
β_0 = Intercept or regression constant
$\beta_1 - \beta_3$ = Regression coefficients to be estimated for firm i in period t
μ = Stochastic error term.

3.8 Measurement/operationalization of variables

Table 3.1 Operationalization of variables

S/N	Variable	Measurement	Sources	Apriori sign
1	Return on Assets	Profit after tax/Total Assets	Enekwe, et al., (2023)	
2	Oil spill cost	Log of Oil spill cost	Orajekwe and Ogbodo (2023)	+
3	Environmental fines and penalties	Log of Environmental fines and penalties	Sari and Adi (2024)	+
4	Carbon emissions cost	Log of Carbon emissions cost	Ogunmodede et al. (2024)	+
5	Waste Mgt Cost	Log of Waste Mgt cost	Ogunmodede et at (2024)	+
6	Environmental Restoration cost	Log of Environmental Restoration cost	Ogunmodede et at (2024)	+

Source: Researchers operationalization (2025)

3.9 Decision rule

The decision was based on 5% level of significance. Accept null hypothesis (Ho) if probability value (i.e. P-value or Sig.) is greater than or equals to (≥) stated 5% level of significance (α); otherwise, reject and accept alternate hypothesis (H_1), if p-value or sig. calculated is less than 5% level of significance.

4.0 DATA PRESENTATION, ANALYSIS AND DISCUSSION OF FINDINGS

4.1 Data presentation

The data for this study is presented in table 4.1 in Appendix I. The data comprise a panel data of ninety (90) pooled observations across nine (9) listed oil and gas firms in Nigeria for ten (10)-year period (2015-2024). The data include the independent variable being environmental degradation cost were proxied by oil spill cost, environmental fines and penalties, carbon emissions cost, waste management cost and environmental restoration cost and the dependent variable (financial performance) proxied by return on assets.

4.2 Data analysis

Various statistical techniques were utilized in the analysis of data presented in table 4.1 (see Appendix II). These include descriptive statistics, regression assumption tests and panel multiple regression analysis. The results from the panel multiple regression analysis were used in the testing of the research hypotheses which had been stated in the first section of this work.

4.2.1 Descriptive statistics

This was conducted to understand the behaviour of the data using various statistics including mean, standard deviation, skewness, and kurtosis. The result for the descriptive statistics analysis is as presented in table 4.2 below;

Table 4.2 Descriptive statistics results

	ROA	OSC	EFP	CEC	WMC	ERC
Mean	12.84083	2.831798	2.049971	2.602806	2.914854	2.833036
Median	0.025712	3.510587	2.360387	3.489556	3.667591	3.645735
Maximum	722.1271	6.691056	7.406070	5.729501	6.848059	5.920122
Minimum	-0.471715	-4.871743	-2.615599	-4.242774	-4.714740	-4.052153
Std. Dev.	79.11538	2.581134	2.366880	2.218322	2.633932	2.121424
Skewness	8.242561	-0.886294	0.096585	-1.266829	-0.797986	-1.177786
Kurtosis	73.56876	3.011574	1.861866	3.847714	2.738613	3.600384
Jarque-Bera	19693.91	11.78327	4.997489	26.76764	9.807945	22.15942
Probability	0.000000	0.002762	0.082188	0.000002	0.007417	0.000015
Sum	1155.674	254.8619	184.4974	234.2526	262.3368	254.9732
Sum Sq. Dev.	557072.7	592.9405	498.5888	437.9647	617.4463	400.5393
Observations	90	90	90	90	90	90

Source: Researcher's computation (2025) using E-views 10.0

The results in table 4.2 above indicates that the dependent variable- return on assets and the independent variables which were oil spill cost, environmental fines and penalties, carbon emissions cost, waste management cost and environmental restoration cost of listed oil and gas firms in Nigeria had mean scores of approximately 12.8408, 2.8317, 2.0499, 2.6028, 2.9148 and 2.8330 respectively. The median values obtained for these variables were approximately 0.0257, 3.5105, 2.3604, 3.4895, 3.6675 and 3.6457 respectively. These constitute the middle values for the distributions of these variables under the period covered in this study (2015-2024).

In terms of the level of variability and dispersion in the distribution of these variables, the standard deviations obtained for return on asset, oil spill cost, environmental fines and penalties, carbon emissions cost, waste management cost and environmental restoration cost of listed oil and gas firms in Nigeria were approximately 79.115, 2.5811, 2.3668, 2.2183, 2.6339 and 2.1214 respectively. This indicates varying levels of variability in the distribution with oil spill cost indicating high variations over the years under study.

4.2.2 Model evaluation

Residual and coefficient diagnostics were however conducted to assess the suitability of the model as stated in the previous section. These include normality test, multicollinearity test, heteroscedasticity test and autocorrelation assessment.

4.2.2.1 Normality test

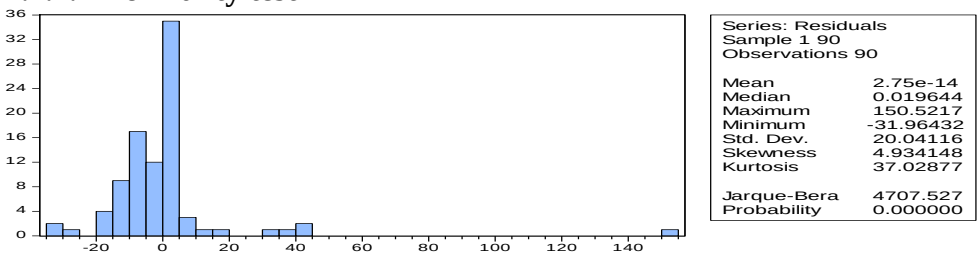

Fig. 4.1 Jarque-Bera Normality test results
Source: E-views 10.0 Output (2025)

The essence of a normality test is to determine if a dataset or sample follows a normal distribution. This is important because many statistical models assume normality, and deviations from normality can affect the validity of statistical inference. The Jarque-Bera test was employed in this case. As applied, if the p-value associated with the Jarque-Bera test is below a predetermined significance level ($p<0.05$), then we reject the null hypothesis and conclude that the data do not follow a normal distribution. With a p-value of 0.000000, there is sufficient evidence to conclude that the data were not normally distributed.

4.2.2.2 Multicollinearity test

In examining the association among the variables, the study employed the Spearman Rank Correlation Coefficient (correlation matrix), and the results are as presented in table 4.3 below**.**

Table 4.3 Correlation matrix of the effect of environmental degradation cost on financial performance

	ROA	OSC	EFP	CEC	WMC	ERC
ROA	1.000000	0.011368	-0.028556	-0.089198	0.014710	-0.081255
OSC	0.011368	1.000000	0.152325	0.513712	0.199193	0.520534
EFP	-0.028556	0.152325	1.000000	0.590651	0.150244	0.590092
CEC	-0.089198	0.513712	0.590651	1.000000	0.513951	0.297880
WMC	0.014710	0.199193	0.150244	0.513951	1.000000	0.520757
ERC	-0.081255	0.520534	0.590092	0.297880	0.520757	1.000000

Source: Researcher's computation (2025) using E-views 10.0

Table 4.3 above shows the association between two pairs of the variables of the study. Of particular interest is the relationship existing between each pair of the independent variables. As highlighted, no pair of the independent variables have correlation coefficient greater than 0.80 suggesting the absence of multicollinearity issues in the series.

4.2.2.3 Heteroscedasticity test

Table 4.4 Heteroscedasticity test

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.622451	Prob. F(5,84)	0.6830
Obs*R-squared	3.215427	Prob. Chi-Square(5)	0.6668

Source: Researcher's computation (2025) using E-views 10.0

The statistics and probability value associated with the Breusch-Pagan LM test otherwise known as the Breusch-Pagan Godfrey test help determine whether there is evidence of heteroscedasticity in the regression model. A low p-value ($p<0.05$) suggests evidence against the null hypothesis in favour of the alternate hypothesis which indicates the presence of heteroscedasticity in the regression model. With a p-value of 0.6830 ($p>0.05$), there is sufficient evidence to accept the null hypothesis, thus, conclude that the predictor variables in the regression model were homoscedastic.

4.2.2.4 Autocorrelation

Autocorrelation, also known as serial correlation, occurs when there is a correlation between the residual errors of a time series or panel data over time. Autocorrelation tests examine whether the residuals are independently distributed or if there is a systematic pattern of dependence. The Durbin-Watson statistic is commonly used to test for autocorrelation, with values close to 2 indicating no significant autocorrelation. The Durbin-Watson statistic as obtained from the panel regression results (see Appendix II) was utilized in this case. The Durbin-Watson statistic value of 1.3539 suggests that there is no evidence of autocorrelation in the residuals of the model.

4.3 Test of hypotheses

Each of the hypotheses in this study was tested based on the result obtained from the panel multiple regression analysis. The result that relates to these hypotheses is summarized in table 4.5 below;

Table 4.5 Panel multiple regression results of the effect of environmental degradation cost on financial performance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-19.48838	4.048850	-4.813313	0.0000
OSC	6.647595	5.651152	3.176326	0.0028
EFP	-0.580181	1.238939	-0.468289	0.6408
CEC	-174.4241	5.501478	-31.70495	0.0000
WMC	-1.423376	5.470741	-0.260180	0.7954
ERC	1.329004	5.974171	1.093700	0.0853

R-squared	0.935831	Mean dependent var	12.84083
Adjusted R-squared	0.932012	S.D. dependent var	79.11538
S.E. of regression	20.62900	Akaike info criterion	8.955614
Sum squared resid	35746.69	Schwarz criterion	9.122268
Log likelihood	-397.0026	Hannan-Quinn criter.	9.022818
F-statistic	245.0095	Durbin-Watson stat	1.353927
Prob(F-statistic)	0.000000		

Source: Researcher's computation (2025) using E-views 10.0

The multiple regression line is as written below:

$$ROA = -19.4883829504 + 6.64759485813*OSC - 0.580181405109*EFP - 174.424083827*CEC - 1.42337553099*WMC + 1.3290042694*ERC + \mu$$

The regression line represents the relationship between Return on Assets (ROA) and various environmental degradation costs in the Nigerian oil and gas industry. According to

the equation, ROA is negatively related to environmental fines and penalties (EFP), carbon emissions cost (CEC), and waste management cost (WMC), indicating that increases in these costs are associated with decreases in ROA. In contrast, ROA is positively related to oil spill cost (OSC) and environmental restoration cost (ERC), suggesting that increases in these costs are associated with increases in ROA.

4.3.1 Hypothesis one

Ho: Oil spill cost has no significant effect on return on assets of listed oil and gas firms on Nigeria.

H_1: Oil spill cost has significant effect on return on assets of listed oil and gas firms on Nigeria.

By way of testing whether the variations in return on assets of listed oil and gas firms on Nigeria caused by oil spillage cost is significant. The T test was carried out at .05 significance level and T_{cal} = 3.1763, compared with T_{tab} of 2.262, given at $_{T0.05,9,}$ So far, the T_{cal} is greater than T_{tab}. Hence, the null hypothesis which states that Oil spill cost has no significant effect on return on assets of listed oil and gas firms on Nigeria fails to hold, thus rejected, and the alternative hypothesis accepted. The null hypothesis is further accepted given that its probability value (p-value = 0.0028) is less than 0.05 ($p<0.05$).

4.3.2 Hypothesis two

Ho: Environmental fines and penalties have no significant effect on the return on assets of listed oil and gas firms on Nigeria.

H_1: Environmental fines and penalties have significant effect on the return on assets of listed oil and gas firms on Nigeria.

For Environmental fines and penalties, the T test was carried out at .05 significance level and T_{cal} = 0.4682, compared with T_{tab} of 2.262, given at $_{T0.05,9,}$ So far, the T_{cal} is less than T_{tab}. Hence, the null hypothesis which states that environmental fines and penalties has no significant effect on return on assets of listed oil and gas firms on Nigeria holds, thus accepted, and the alternative hypothesis rejected. The null hypothesis is further accepted given that its probability value (p-value = 0.6408) is greater than 0.05 ($p>0.05$).

4.3.3 Hypothesis three

Ho: Carbon emissions cost has no significant effect on the return on assets of listed oil and gas firms in Nigeria.

H_1: Carbon emissions cost has significant effect on the return on assets of listed oil and gas firms in Nigeria.

For Carbon emissions cost, the T test was carried out at .05 significance level and T_{cal} = -31.7049, compared with T_{tab} of 2.262, given at $_{T0.05,9,}$ So far, the T_{cal} is less than T_{tab}. Hence, the null hypothesis which states that Carbon emissions cost has no significant effect on return on assets of listed oil and gas firms in Nigeria fails to hold, thus rejected, and the alternative hypothesis accepted. The null hypothesis is further rejected given that its probability value (p-value = 0.0000) is less than 0.05 ($p<0.05$).

4.3.4 Hypothesis four

Ho: Waste management cost has no significant effect on the return on assets of listed oil and gas firms on Nigeria.

H_1: Waste management cost has significant effect on the return on assets of listed oil and gas firms on Nigeria.

For waste management cost, the T test was carried out at .05 significance level and T_{cal} = 0.2601, compared with T_{tab} of 2.262, given at $_{T0.05,9,}$ So far, the T_{cal} is less than T_{tab}.

Hence, the null hypothesis which states that Waste management cost has no significant effect on return on assets of listed oil and gas firms in Nigeria holds, thus accepted, and the alternative hypothesis rejected. The null hypothesis is further accepted given that its probability value (p-value = 0.7954) is greater than 0.05 (p>0.05).

4.3.5 Hypothesis five

Ho: Environmental restoration cost has no significant effect on the return on assets of listed oil and gas firms in Nigeria.

H_1: Environmental restoration cost has significant effect on the return on assets of listed oil and gas firms in Nigeria.

For environmental restoration cost, the T test was carried out at .05 significance level and T_{cal} = 1.093, compared with T_{tab} of 2.262, given at $_{T0.05, 9,}$ So far, the T_{cal} is less than T_{tab}. Hence, the null hypothesis which states that environmental restoration cost has no significant effect on return on assets of listed oil and gas firms in Nigeria fail to holds, thus rejected, and the alternative hypothesis accepted. The null hypothesis is further accepted given that its probability value (p-value = 0.0853) is greater than 0.05 (p>0.05).

4.4 Discussion of findings

4.4.1 Oil spill cost and return on assets

The study's finding shows that oil spill cost has a significant positive effect on the return on assets of listed oil and gas firms in Nigeria is intriguing. This result suggests that an increase in oil spill cost is associated with an increase in financial performance, as measured by return on assets. One possible explanation for this finding is that oil spill costs might be accounted for as part of operational expenses, and companies that incur higher oil spill costs might be more likely to invest in measures to mitigate future spills, leading to improved operational efficiency and financial performance. However, this finding contradicts the conventional wisdom that environmental degradation costs, such as oil spills, would have a negative impact on financial performance. This result is consistent with the findings of Okezie et al. (2019), who found a positive but insignificant relationship between environmental costs and financial performance of listed companies in Nigeria. Similarly, Okafor (2018) found that environmental remediation and pollution control have a positive but negligible impact on the return on assets of Nigeria's listed oil and gas companies. These studies suggest that environmental costs, including oil spill costs, may have a positive impact on financial performance, possibly due to increased investment in safety measures or reputational benefits.

4.4.2 Environmental fines and penalties and return on assets

The study's finding shows that environmental fines and penalties have a non-significant negative effect on the return on assets of listed oil and gas firms in Nigeria suggests that these costs do not have a substantial impact on financial performance. The negative coefficient of -0.5802 indicates that an increase in environmental fines and penalties is associated with a decrease in return on assets, but the relationship is not statistically significant. This finding might be attributed to the fact that environmental fines and penalties are typically accounted for as exceptional items or one-time expenses, which might not have a significant impact on overall financial performance.

The non-significant relationship between environmental fines and penalties and financial performance highlights the need for companies to prioritize environmental sustainability and compliance with regulations to avoid reputational damage and potential financial losses. Companies should focus on implementing effective environmental management systems to minimize the risk of incurring fines and penalties. This result is

consistent with the findings of Nwaimo (2020), who found that environmental costs, including waste management and community development costs, have a negative impact on financial performance in some African countries. Similarly, Falack et al. (2020) found that environmental protection, development, and safety costs have a negative but significant relationship with return on assets. These studies suggest that environmental fines and penalties can have a negative impact on financial performance, possibly due to the additional costs imposed on firms.

4.4.3 Carbon emissions cost and penalties and return on assets

The study's finding shows that carbon emissions cost has a significant negative effect on the return on assets of listed oil and gas firms in Nigeria is consistent with expectations. The negative coefficient of -174.4241 indicates that an increase in carbon emissions cost is associated with a substantial decrease in return on assets. This finding suggests that companies that incur higher carbon emissions costs might experience reduced financial performance due to the increased costs associated with greenhouse gas emissions.

The significant negative impact of carbon emissions cost on financial performance highlights the need for companies to prioritize sustainability and reduce their carbon footprint. This result is consistent with the findings of Orajekwe and Ogbodo (2023), who found that firm size and profitability are significant factors that influence environmental disclosure, but carbon emissions cost is not. Similarly, Dorathy et al (2024) examined the effect of environmental disclosure on the cost of equity of listed consumer goods firms in Nigeria. The study findings revealed environmental risk disclosure and waste management disclosure have significant negative relationships on cost of equity (COE) of listed consumer goods firms in Nigeria while greenhouse gas emission disclosure (GGED) has an insignificant negative effect on cost of equity (COE) of listed consumer goods firms in Nigeria. It was thus concluded that environmental accounting disclosure plays a crucial and significant role in shaping the cost of equity of listed consumer goods firms in Nigeria.

4.4.4 Waste management cost and return on assets

The study's finding that waste management cost has a non-significant negative effect on the return on assets of listed oil and gas firms in Nigeria suggests that these costs do not have a substantial impact on financial performance. The negative coefficient of -1.4233 indicates that an increase in waste management cost is associated with a decrease in return on assets, but the relationship is not statistically significant. This finding might be attributed to the fact that waste management costs are typically accounted for as part of operational expenses, and companies might be able to absorb these costs without significant impacts on financial performance. The non-significant relationship between waste management cost and financial performance highlights the need for companies to prioritize effective waste management practices to minimize environmental impacts and potential financial losses. Similarly, Okpo et al. (2024) investigated the relationship between environmental policies information disclosure and investors' confidence. The results of analysis indicate that the environmental replenishment policy disclosure, waste management policy disclosure and carbon emission management policy disclosure exhibited significant positive relationship with the market capitalisation of the firms. The study therefore concludes that the disclosure of information on environmental policies enhances investor's confidence on firms in the capital market.

The studies by Chen et al. (2024) and Guedhami (2024) both examined the impact of environmental penalties on corporate outcomes. Chen et al. (2024) investigated how environmental penalties affect corporate incremental bank loans, finding that both the frequency and degree of environmental penalties significantly reduce corporate incremental

bank loans. Guedhami (2024) explored the relationship between environmental penalties and corporate innovation, finding that firms subjected to environmental penalties tend to reduce their investment in R&D. Both studies highlight the significant consequences of environmental penalties on corporate financial and innovation outcomes. These studies align with the theme of environmental penalties and corporate outcomes, providing insights into the impact of environmental regulations on corporate behavior and performance.

4.4.5 Environmental restoration cost and return on assets

The study's finding that environmental restoration cost has a non-significant positive effect on the return on assets of listed oil and gas firms in Nigeria suggests that these costs do not have a substantial impact on financial performance. The positive coefficient of 1.3290 indicates that an increase in environmental restoration cost is associated with an increase in return on assets, but the relationship is not statistically significant. This finding might be attributed to the fact that environmental restoration costs might be accounted for as part of long-term investment in environmental sustainability, which could lead to improved financial performance in the long run.

The non-significant relationship between environmental restoration cost and financial performance highlights the need for companies to prioritize environmental sustainability and invest in restoration activities to minimize environmental impacts and potential financial losses. Companies should focus on implementing effective environmental management systems and investing in restoration activities to improve sustainability and financial performance.

The studies by Ashraf et al. (2025), Egedegu et al. (2024), and Majekobaje (2024) all examined the relationship between environmental sustainability and financial performance. Ashraf et al. (2025) find a positive relationship between environmental sustainability and financial performance in Malaysian firms. Egedegu et al. (2024) investigate the relationship between environmental accounting and financial performance in Conoil, finding that environmental restoration costs have a significant negative impact on return on assets. These studies contribute to the ongoing debate on the relationship between environmental sustainability and financial performance, highlighting the complex and nuanced nature of this relationship.

5.0 SUMMARY, CONCLUSION AND RECOMMENDATION

5.1 Summary of findings

This present study examined the effect of environmental degradation cost on the financial performance of listed oil and gas firms on Nigeria. The independent variable being environmental degradation cost was proxied by oil spill cost, environmental fines and penalties, carbon emissions cost, Waste management cost and environmental restoration cost while the dependent variable being financial performance was proxied by return on assets. The study relied on a panel least squares regression analysis and the results of empirical findings were as follows.

1. Oil spill cost has a significant positive effect {Coeff = 6.6475 (0.0028)} on the return on assets of listed oil and gas firms on Nigeria.
2. Environmental fines and penalties have a non-significant negative effect {Coeff = -0.5802 (0.6408)} on the return on assets of listed oil and gas firms on Nigeria.
3. Carbon emissions cost has a significant negative effect {Coeff = -174.4241 (0.0000)} on the return on assets of listed oil and gas firms on Nigeria.
4. Waste management cost has a non-significant negative effect {Coeff = -1.4233 (0.7954)} on the return on assets of listed oil and gas firms on Nigeria.

5. Environmental restoration cost has a non-significant positive effect {Coeff = 1.3290 (0.0853)} on the return on assets of listed oil and gas firms on Nigeria.

5.2 Conclusion

This study examined the effect of environmental degradation costs on financial performance in the Nigerian oil and gas industry. The findings suggest that environmental degradation costs have varying effects on the financial performance of listed oil and gas firms in Nigeria. The study's results have implications for policymakers, regulators, and industry stakeholders, highlighting the need for effective environmental management practices and sustainable development strategies in the oil and gas sector. The study's findings underscore the importance of balancing economic growth with environmental sustainability in the oil and gas industry. As the Nigerian economy continues to rely heavily on the oil and gas sector, it is crucial for industry stakeholders to prioritize environmental sustainability and adopt best practices in environmental management. By doing so, oil and gas firms can minimize the negative impacts of environmental degradation on their financial performance while contributing to the country's sustainable development goals.

5.3 Recommendations

Taking cognizance of the findings of this present study, the following recommendations have been put forward for consideration.

1. Oil and gas firms in Nigeria should prioritize investments in safety measures and environmental protection to minimize oil spill costs, which can have a positive impact on their financial performance.
2. Policymakers and regulators should strengthen environmental regulations and enforcement mechanisms to ensure that oil and gas firms comply with environmental standards, thereby reducing environmental fines and penalties.
3. Oil and gas firms in Nigeria should adopt sustainable practices and invest in carbon reduction technologies to minimize their carbon footprint and mitigate the potential negative impacts of carbon emissions costs on their financial performance.
4. Firms should prioritize effective waste management practices to minimize waste disposal costs and potential environmental liabilities. This can be achieved by implementing waste reduction and recycling strategies, investing in waste management infrastructure, and adopting best practices in waste handling and disposal.
5. Firms should prioritize environmental restoration activities as part of their sustainability strategies. Investing in environmental restoration can help to mitigate the negative impacts of oil and gas operations on the environment, enhance corporate reputation, and potentially lead to long-term financial benefits.

5.4 Suggestions for further studies

1. Future studies could investigate the effect of environmental degradation costs on other financial performance metrics, such as return on equity (ROE), return on sales (ROS), or Tobin's Q, to provide a more comprehensive understanding of the relationship between environmental costs and financial performance.
2. Further research could examine the moderating effects of variables such as firm size, industry type, or regulatory environment on the relationship between environmental degradation costs and financial performance.

3. A comparative study could be conducted to examine the effect of environmental degradation costs on financial performance across different industries, such as oil and gas, manufacturing, or mining, to identify industry-specific differences.
4. A longitudinal study could be conducted to examine the trend of environmental degradation costs and financial performance over a longer period, providing insights into the dynamic relationship between these variables.
5. A case study approach could be used to investigate the environmental degradation costs and financial performance of specific oil and gas firms in Nigeria, providing in-depth insights into the practices and strategies employed by these firms.

5.5 Contributions to knowledge

1. This study provides empirical evidence on the relationship between environmental degradation costs and financial performance in the Nigerian oil and gas industry, contributing to the existing body of knowledge on environmental accounting and financial performance.
2. The study provides insights into the impact of specific environmental costs, such as oil spill cost, carbon emissions cost, and environmental restoration cost, on financial performance, highlighting the varying effects of different environmental costs.
3. The study contributes to the understanding of environmental degradation costs in the Nigerian context, highlighting the unique challenges and opportunities faced by oil and gas firms in the country.
4. The study demonstrates the use of panel least squares regression analysis in examining the relationship between environmental degradation costs and financial performance, providing a methodological framework for future studies.
5. The study's findings have implications for policymakers, regulators, and industry stakeholders, highlighting the need for effective environmental management practices and sustainable development strategies in the oil and gas sector.

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APPENDICES: DATASET EMPLOYED

Table 4.1 Dataset employed

COMPANIES	YEARS	ROA	OSC(N'B)	EFP(N'B)	CEC(N'B)	WMC(N'B)	ERC(N'B)
TOTAL OIL PLC	2015	0.0672	62.0261	56.1231	79.4036	72.5705	96.0783
TOTAL OIL PLC	2016	0.0463	76.6036	70.3336	95.5124	89.6262	115.5700
TOTAL OIL PLC	2017	0.0484	63.9499	56.1264	83.6536	74.8214	101.2208
TOTAL OIL PLC	2018	0.1081	113.1129	106.7707	136.9282	132.3420	165.6831
TOTAL OIL PLC	2019	0.0743	76.9389	722.1271	107.9819	90.0185	130.6581
TOTAL OIL PLC	2020	0.0601	95.9841	89.9124	132.5208	112.3013	160.3501
TOTAL OIL PLC	2021	0.0169	101.1394	88.0085	135.0309	118.3330	163.3874
TOTAL OIL PLC	2022	0.0144	109.8183	96.3127	143.6129	128.4874	173.7716
TOTAL OIL PLC	2023	0.0808	159.4408	159.1787	118.6230	186.5458	143.5338
TOTAL OIL PLC	2024	0.0524	247.9603	255.8337	307.8157	290.1136	372.4570
JAPAUL OIL PLC	2015	0.0062	6.4853	10.2738	38.7766	7.5878	46.9197
JAPAUL OIL PLC	2016	-0.0682	9.0045	0.0000	38.6864	10.5352	46.8106
JAPAUL OIL PLC	2017	-0.2372	8.1052	0.0000	33.8896	9.4831	41.0064
JAPAUL OIL PLC	2018	-0.2638	10.8355	0.0000	29.9482	12.6776	36.2373
JAPAUL OIL PLC	2019	-0.4717	11.6765	0.0000	28.0016	13.6615	33.8819

JAPAUL OIL PLC	2020	-0.2743	13.3572	2.5360	24.0384	15.6279	31.4620
JAPAUL OIL PLC	2021	0.1762	12.6417	10.9264	23.3721	14.7908	28.2802
JAPAUL OIL PLC	2022	-0.0639	7.1737	4.9303	15.6064	0.0000	18.8837
JAPAUL OIL PLC	2023	-0.2373	8.7640	3.8474	13.0892	0.0000	15.8380
JAPAUL OIL PLC	2024	0.0118	7.7159	4.4099	13.1971	0.0000	14.4526
CAPITAL OIL PLC	2015	-0.2556	256.6146	557.0011	36.5815	300.2391	32.6256
CAPITAL OIL PLC	2016	-0.0772	161.6232	463.2445	14.1099	189.0991	17.0730
CAPITAL OIL PLC	2017	-0.0376	154.7233	1645.9447	20.4634	181.0262	24.7607
CAPITAL OIL PLC	2018	-0.2604	152.4186	0.0000	31.6338	178.3298	38.2769
CAPITAL OIL PLC	2019	0.0746	141.2008	0.0000	39.3002	165.2049	47.5533
CAPITAL OIL PLC	2020	0.0670	161.2693	16.0351	40.0683	188.6850	48.4827
CAPITAL OIL PLC	2021	722.1271	208.7290	20.8250	0.0169	244.2129	0.0000
CAPITAL OIL PLC	2022	89.9124	307.8157	21.6604	0.0144	360.1444	0.0174
CAPITAL OIL PLC	2023	88.0085	38.7766	24.7101	0.0808	45.3686	0.0977
CAPITAL OIL PLC	2024	96.3127	38.6864	0.1027	0.0524	45.2631	0.0634
ETERNAL OIL PLC	2015	159.1787	33.8896	0.0000	18.2531	39.6509	22.0863
ETERNAL OIL PLC	2016	0.0695	29.9482	0.0000	18.5669	35.0393	22.4659
ETERNAL OIL PLC	2017	0.0447	17.7747	22.1596	28.5654	20.7964	34.5641
ETERNAL OIL PLC	2018	0.0466	18.3043	25.0579	31.6901	21.4160	38.3450
ETERNAL OIL PLC	2019	0.0417	33.6770	39.7642	48.0457	39.4021	58.1353
ETERNAL OIL PLC	2020	0.0190	36.5815	43.3190	53.1365	42.8004	64.2951
ETERNAL OIL PLC	2021	-0.0051	14.1099	0.0000	28.5334	16.5086	34.5254
ETERNAL OIL PLC	2022	0.0263	20.4634	21.6773	35.7676	23.9422	43.2787
ETERNAL OIL PLC	2023	-0.0239	31.6338	30.9261	46.0823	37.0116	55.7596
ETERNAL OIL PLC	2024	0.0187	39.3002	39.3489	53.9910	45.9813	65.3291
MRS OIL PLC	2015	0.0097	40.0683	0.0000	65.6946	46.8799	79.4905
MRS OIL PLC	2016	0.0129	32.0903	37.2778	57.8466	37.5456	69.9944
MRS OIL PLC	2017	0.0140	40.5917	47.4834	66.8937	47.4923	80.9414
MRS OIL PLC	2018	0.0180	54.0702	62.0064	81.3648	63.2621	98.4514

MRS OIL PLC	2019	0.0237	33.2601	0.0000	58.5363	38.9143	70.8289
MRS OIL PLC	2020	-0.0233	32.2331	36.7157	54.2832	37.7128	65.6827
MRS OIL PLC	2021	-0.0365	23.6843	26.8518	44.2096	27.7107	53.4937
MRS OIL PLC	2022	-0.0618	18.8723	0.0000	36.6591	22.0806	44.3575
MRS OIL PLC	2023	0.0091	19.8624	21.6604	37.2053	23.2390	45.0184
MRS OIL PLC	2024	0.0325	21.2092	24.7101	40.5261	24.8147	49.0366
SEPLAT ENERGY	2015	0.4216	0.0658	0.1027	0.2026	0.0770	0.2452
SEPLAT ENERGY	2016	0.0968	0.1368	0.0000	0.4183	0.1601	0.5061
SEPLAT ENERGY	2017	0.0238	0.1278	0.3482	0.5452	0.1495	0.6597
SEPLAT ENERGY	2018	-0.0683	0.1531	0.4043	0.6647	0.1791	0.8043
SEPLAT ENERGY	2019	0.1014	0.2178	0.4748	0.7996	0.2549	0.9675
SEPLAT ENERGY	2020	0.0578	0.1434	0.5141	0.7757	0.1678	0.9385
SEPLAT ENERGY	2021	0.0847	0.2469	0.5394	1.0042	0.2888	1.2151
SEPLAT ENERGY	2022	-0.0234	0.2011	0.0731	1.3108	0.2352	1.5861
SEPLAT ENERGY	2023	0.0360	0.7760	0.5989	1.3031	0.9080	1.5767
SEPLAT ENERGY	2024	0.0281	1.0321	0.7917	1.5816	1.2075	1.9138
CONOIL PLC	2015	0.0373	63.4576	0.0000	82.3730	74.2454	99.6714
CONOIL PLC	2016	0.0096	69.9666	0.0000	86.5935	81.8609	104.7781
CONOIL PLC	2017	0.0333	50.4443	0.0000	69.3874	59.0198	83.9587
CONOIL PLC	2018	0.0406	50.3841	64.0708	69.8335	58.9494	84.4985
CONOIL PLC	2019	0.0251	44.0451	57.3720	62.8551	51.5328	76.0547
CONOIL PLC	2020	0.0295	41.4617	54.9085	60.8972	48.5102	73.6857
CONOIL PLC	2021	0.0310	42.8235	57.5274	63.5849	50.1035	76.9377
CONOIL PLC	2022	0.0295	28.3799	43.9288	48.8647	33.2044	59.1262
CONOIL PLC	2023	0.0571	31.4006	49.6766	53.9813	36.7387	65.3174
CONOIL PLC	2024	0.0752	40.1452	62.2174	65.9092	46.9698	79.7502
OANDO PLC	2015	-0.0080	93.5434	188.4143	36.5815	109.4458	44.2637
OANDO PLC	2016	-0.2016	326.0022	195.9075	14.1099	381.4225	17.0730
OANDO PLC	2017	-0.0526	365.5831	106.2396	20.4634	427.7322	24.7607
OANDO PLC	2018	0.0039	404.4212	140.6611	31.6338	473.1728	38.2769
OANDO PLC	2019	0.0190	400.0636	106.9401	39.3002	468.0744	47.5533
OANDO PLC	2020	0.0268	448.6028	130.1185	40.0683	524.8653	48.4827
OANDO PLC	2021	-0.2162	621.4758	0.0000	247.9603	727.1267	300.0320
OANDO PLC	2022	-0.1013	648.6308	0.0000	6.4853	758.8980	7.8473
OANDO PLC	2023	0.0348	805.1718	0.0000	9.0045	942.0509	10.8954
OANDO PLC	2024	0.2743	583.9344	2.9357	8.1052	683.2032	9.8073
RAK UNITY	2015	0.0048	0.0077	0.3292	10.8355	0.0090	13.1110
RAK UNITY	2016	0.0454	0.8024	0.0000	11.6765	0.9389	14.1285
RAK UNITY	2017	0.1289	0.2217	0.5863	0.6961	0.2594	0.8423

RAK UNITY	2018	0.0304	0.8274	1.2552	1.3843	0.9681	1.6750
RAK UNITY	2019	0.0227	0.7553	0.0000	1.3363	0.8836	1.6169
RAK UNITY	2020	0.0149	1.3879	1.8381	1.9938	1.6239	2.4125
RAK UNITY	2021	-0.0196	1.4807	1.8765	2.0339	1.7325	2.4610
RAK UNITY	2022	-0.1117	0.1368	0.4748	0.5749	0.1601	0.6957
RAK UNITY	2023	0.1825	0.1278	0.0000	0.2178	0.1495	0.2636
RAK UNITY	2024	0.0373	0.1531	0.0000	0.1434	0.1791	0.1735

Source: Annual reports of listed oil and gas firms in Nigeria (2015-2024)

COMPANIES	YEARS	ROA	OSC	EFP	CEO	WMC	ERC
TOTAL OIL PLC	2015	0.0672	4.1276	4.0275	4.3745	4.2846	4.5652
TOTAL OIL PLC	2016	0.0463	4.3386	4.2532	4.5593	4.4956	4.7499
TOTAL OIL PLC	2017	0.0484	4.1581	4.0276	4.4267	4.3151	4.6173
TOTAL OIL PLC	2018	0.1081	4.7284	4.6707	4.9195	4.8854	5.1101
TOTAL OIL PLC	2019	0.0743	4.3430	6.5822	4.6820	4.5000	4.8726
TOTAL OIL PLC	2020	0.0601	4.5642	4.4988	4.8867	4.7212	5.0774
TOTAL OIL PLC	2021	0.0169	4.6165	4.4774	4.9055	4.7735	5.0961
TOTAL OIL PLC	2022	0.0144	4.6988	4.5676	4.9671	4.8558	5.1577
TOTAL OIL PLC	2023	0.0808	5.0717	5.0700	4.7760	5.2287	4.9666
TOTAL OIL PLC	2024	0.0524	5.5133	5.5445	5.7295	5.6703	5.9201
JAPAUL OIL PLC	2015	0.0062	1.8695	2.3296	3.6578	2.0265	3.8484
JAPAUL OIL PLC	2016	-0.0682	2.1977	0.0000	3.6555	2.3547	3.8461
JAPAUL OIL PLC	2017	-0.2372	2.0925	0.0000	3.5231	2.2495	3.7137
JAPAUL OIL PLC	2018	-0.2638	2.3828	0.0000	3.3995	2.5398	3.5901
JAPAUL OIL PLC	2019	-0.4717	2.4576	0.0000	3.3323	2.6146	3.5229
JAPAUL OIL PLC	2020	-0.2743	2.5921	0.9306	3.1797	2.7491	3.4488
JAPAUL OIL PLC	2021	0.1762	2.5370	2.3912	3.1515	2.6940	3.3422
JAPAUL OIL PLC	2022	-0.0639	1.9704	1.5954	2.7477	0.0000	2.9383
JAPAUL OIL PLC	2023	-0.2373	2.1707	1.3474	2.5718	0.0000	2.7624
JAPAUL OIL PLC	2024	0.0118	2.0433	1.4839	2.5800	0.0000	2.6709
CAPITAL OIL PLC	2015	-0.2556	5.5476	6.3226	3.5995	5.7046	3.4851
CAPITAL OIL	2016	-0.0772	5.0853	6.1383	2.6469	5.2423	2. 8375

PLC							
CAPITAL OIL PLC	2017	-0.0376	5.0416	7.4061	3.0186	5.1986	3.2093
CAPITAL OIL PLC	2018	-0.2604	5.0266	0.0000	3.4542	5.1836	3.6448
CAPITAL OIL PLC	2019	0.0746	4.9502	0.0000	3.6712	5.1072	3.8619
CAPITAL OIL PLC	2020	0.0670	5.0831	2.7748	3.6906	5.2401	3.8812
CAPITAL OIL PLC	2021	722.1271	5.3410	3.0362	-4.0818	5.4980	0.0000
CAPITAL OIL PLC	2022	89.9124	5.7295	3.0755	-4.2428	5.8865	-4.0522
CAPITAL OIL PLC	2023	88.0085	3.6578	3.2072	-2.5160	3.8148	-2.3253
CAPITAL OIL PLC	2024	96.3127	3.6555	-2.2761	-2.9495	3.8125	-2.7589
ETERNAL OIL PLC	2015	159.1787	3.5231	0.0000	2.9043	3.6801	3.0950
ETERNAL OIL PLC	2016	0.0695	3.3995	0.0000	2.9214	3.5565	3.1120
ETERNAL OIL PLC	2017	0.0447	2.8778	3.0983	3.3522	3.0348	3.5428
ETERNAL OIL PLC	2018	0.0466	2.9071	3.2212	3.4560	3.0641	3.6466
ETERNAL OIL PLC	2019	0.0417	3.5168	3.6830	3.8722	3.6738	4.0628
ETERNAL OIL PLC	2020	0.0190	3.5995	3.7686	3.9729	3.7565	4.1635
ETERNAL OIL PLC	2021	-0.0051	2.6469	0.0000	3.3511	2.8039	3.5417
ETERNAL OIL PLC	2022	0.0263	3.0186	3.0763	3.5770	3.1756	3.7677
ETERNAL OIL PLC	2023	-0.0239	3.4542	3.4316	3.8304	3.6112	4.0210
ETERNAL OIL PLC	2024	0.0187	3.6712	3.6725	3.9888	3.8282	4.1794
MRS OIL PLC	2015	0.0097	3.6906	0.0000	4.1850	3.8476	4.3756
MRS OIL PLC	2016	0.0129	3.4686	3.6184	4.0578	3.6256	4.2484
MRS OIL PLC	2017	0.0140	3.7036	3.8604	4.2031	3.8606	4.3937
MRS OIL PLC	2018	0.0180	3.9903	4.1272	4.3989	4.1473	4.5896
MRS OIL PLC	2019	0.0237	3.5044	0.0000	4.0696	3.6614	4.2603
MRS OIL PLC	2020	-0.0233	3.4730	3.6032	3.9942	3.6300	4.1848
MRS OIL PLC	2021	-0.0365	3.1648	3.2903	3.7889	3.3218	3.9796
MRS OIL PLC	2022	-0.0618	2.9377	0.0000	3.6017	3.0947	3.7923
MRS OIL PLC	2023	0.0091	2.9888	3.0755	3.6165	3.1458	3.8071
MRS OIL PLC	2024	0.0325	3.0544	3.2072	3.7019	3.2114	3.8926
SEPLAT ENERGY	2015	0.4216	-2.7213	-2.2761	-1.5964	-2.5643	-1.4058
SEPLAT ENERGY	2016	0.0968	-1.9891	0.0000	-0.8715	-1.8321	-0.6809
SEPLAT ENERGY	2017	0.0238	-2.0575	-1.0550	-0.6066	-1.9005	-0.4160

SEPLAT ENERGY	2018	-0.0683	-1.8766	-0.9057	-0.4085	-1.7196	-0.2178
SEPLAT ENERGY	2019	0.1014	-1.5240	-0.7448	-0.2237	-1.3670	-0.0331
SEPLAT ENERGY	2020	0.0578	-1.9419	-0.6653	-0.2540	-1.7849	-0.0634
SEPLAT ENERGY	2021	0.0847	-1.3990	-0.6173	0.0042	-1.2420	0.1948
SEPLAT ENERGY	2022	-0.0234	-1.6042	-2.6156	0.2707	-1.4472	0.4613
SEPLAT ENERGY	2023	0.0360	-0.2536	-0.5127	0.2647	-0.0966	0.4554
SEPLAT ENERGY	2024	0.0281	0.0316	-0.2336	0.4584	0.1886	0.6491
CONOIL PLC	2015	0.0373	4.1504	0.0000	4.4113	4.3074	4.6019
CONOIL PLC	2016	0.0096	4.2480	0.0000	4.4612	4.4050	4.6518
CONOIL PLC	2017	0.0333	3.9209	0.0000	4.2397	4.0779	4.4303
CONOIL PLC	2018	0.0406	3.9197	4.1600	4.2461	4.0767	4.4367
CONOIL PLC	2019	0.0251	3.7852	4.0496	4.1408	3.9422	4.3315
CONOIL PLC	2020	0.0295	3.7248	4.0057	4.1092	3.8818	4.2998
CONOIL PLC	2021	0.0310	3.7571	4.0523	4.1524	3.9141	4.3430
CONOIL PLC	2022	0.0295	3.3457	3.7826	3.8891	3.5027	4.0797
CONOIL PLC	2023	0.0571	3.4468	3.9055	3.9886	3.6038	4.1793
CONOIL PLC	2024	0.0752	3.6925	4.1306	4.1883	3.8495	4.3789
OANDO PLC	2015	-0.0080	4.5384	5.2386	3.5995	4.6954	3.7902
OANDO PLC	2016	-0.2016	5.7869	5.2776	2.6469	5.9439	2.8375
OANDO PLC	2017	-0.0526	5.9015	4.6657	3.0186	6.0585	3.2093
OANDO PLC	2018	0.0039	6.0025	4.9464	3.4542	6.1595	3.6448
OANDO PLC	2019	0.0190	5.9916	4.6723	3.6712	6.1486	3.8619
OANDO PLC	2020	0.0268	6.1061	4.8684	3.6906	6.2631	3.8812
OANDO PLC	2021	-0.2162	6.4321	0.0000	5.5133	6.5891	5.7039
OANDO PLC	2022	-0.1013	6.4749	0.0000	1.8695	6.6319	2.0602
OANDO PLC	2023	0.0348	6.6911	0.0000	2.1977	6.8481	2.3883
OANDO PLC	2024	0.2743	6.3698	1.0770	2.0925	6.5268	2.2831
RAK UNITY	2015	0.0048	-4.8717	-1.1112	2.3828	-4.7147	2.5735
RAK UNITY	2016	0.0454	-0.2201	0.0000	2.4576	-0.0631	2.6482
RAK UNITY	2017	0.1289	-1.5063	-0.5339	-0.3622	-1.3493	-0.1716
RAK UNITY	2018	0.0304	-0.1894	0.2273	0.3252	-0.0324	0.5158
RAK UNITY	2019	0.0227	-0.2807	0.0000	0.2899	-0.1237	0.4805
RAK UNITY	2020	0.0149	0.3278	0.6088	0.6900	0.4848	0.8807
RAK UNITY	2021	-0.0196	0.3925	0.6294	0.7099	0.5495	0.9006
RAK UNITY	2022	-0.1117	-1.9891	-0.7448	-0.5535	-1.8321	-0.3629
RAK UNITY	2023	0.1825	-2.0575	0.0000	-1.5240	-1.9005	-1.3334
RAK UNITY	2024	0.0373	-1.8766	0.0000	-1.9419	-1.7196	-1.7513

Source: Researcher's computation (2025) using Ms Excel

APPENDIX II: RESULTS

	ROA	OSC	EFP	CEC	WMC	ERC
Mean	12.84083	2.831798	2.049971	2.602806	2.914854	2.833036
Median	0.025712	3.510587	2.360387	3.489556	3.667591	3.645735
Maximum	722.1271	6.691056	7.406070	5.729501	6.848059	5.920122
Minimum	-0.471715	-4.871743	-2.615599	-4.242774	-4.714740	-4.052153
Std. Dev.	79.11538	2.581134	2.366880	2.218322	2.633932	2.121424
Skewness	8.242561	-0.886294	0.096585	-1.266829	-0.797986	-1.177786
Kurtosis	73.56876	3.011574	1.861866	3.847714	2.738613	3.600384
Jarque-Bera	19693.91	11.78327	4.997489	26.76764	9.807945	22.15942
Probability	0.000000	0.002762	0.082188	0.000002	0.007417	0.000015
Sum	1155.674	254.8619	184.4974	234.2526	262.3368	254.9732
Sum Sq. Dev.	557072.7	592.9405	498.5888	437.9647	617.4463	400.5393
Observations	90	90	90	90	90	90

	ROA	OSC	EFP	CEC	WMC	ERC
ROA	1.000000	0.011368	-0.028556	-0.089198	0.014710	-0.081255
OSC	0.011368	1.000000	0.152325	0.513712	0.199193	0.520534
EFP	-0.028556	0.152325	1.000000	0.590651	0.150244	0.590092
CEC	-0.089198	0.513712	0.590651	1.000000	0.513951	0.297880
WMC	0.014710	0.199193	0.150244	0.513951	1.000000	0.520757
ERC	-0.081255	0.520534	0.590092	0.297880	0.520757	1.000000

Dependent Variable: ROA
Method: Least Squares
Date: 08/17/25 Time: 21:52
Sample: 1 90
Included observations: 90

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-19.48838	4.048850	-4.813313	0.0000
OSC	6.647595	5.651152	3.176326	0.0028
EFP	-0.580181	1.238939	-0.468289	0.6408
CEC	-174.4241	5.501478	-31.70495	0.0000
WMC	-1.423376	5.470741	-0.260180	0.7954
ERC	1.329004	5.974171	1.093700	0.0853

R-squared	0.935831	Mean dependent var	12.84083
Adjusted R-squared	0.932012	S.D. dependent var	79.11538
S.E. of regression	20.62900	Akaike info criterion	8.955614
Sum squared resid	35746.69	Schwarz criterion	9.122268
Log likelihood	-397.0026	Hannan-Quinn criter.	9.022818
F-statistic	245.0095	Durbin-Watson stat	1.353927
Prob(F-statistic)	0.000000		

Estimation Command:
==========
LS ROA C OSC EFP CEC WMC ERC

Estimation Equation:

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ROA = C(1) + C(2)*OSC + C(3)*EFP + C(4)*CEC + C(5)*WMC + C(6)*ERC

Substituted Coefficients:

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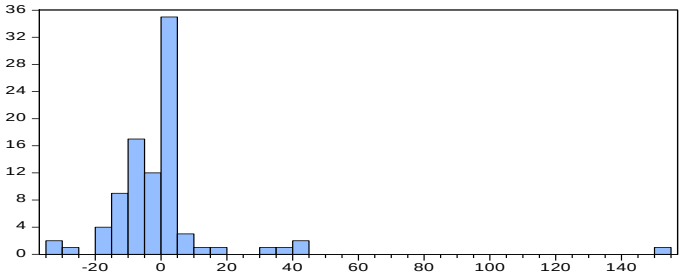
ROA = -19.4883829504 + 6.64759485813*OSC - 0.580181405109*EFP - 174.424083827*CEC - 1.42337553099*WMC + 1.3290042694*ERC



Series: Residuals	
Sample 1 90	
Observations 90	
Mean	2.75e-14
Median	0.019644
Maximum	150.5217
Minimum	-31.96432
Std. Dev.	20.04116
Skewness	4.934148
Kurtosis	37.02877
Jarque-Bera	4707.527
Probability	0.000000

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.622451	Prob. F(5,84)	0.6830
Obs*R-squared	3.215427	Prob. Chi-Square(5)	0.6668
Scaled explained SS	50.45819	Prob. Chi-Square(5)	0.0000