

Firm-Level Traits and Environmental Responsibility of Listed Industrial Goods Firms in Nigeria: Moderating Effect of Female Board Representation

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<https://doi.org/10.56201/ijefm.v11.no9.2026.pg177.204>

Abstract

The study examined the moderating effect of female board representation on the relationship between firm-level traits and corporate environmental responsibility of listed industrial goods firms in Nigeria. The specific objectives were: to ascertain the moderating effect of female board representation on the relationship between firm leverage and environmental disclosure index; to determine the extent to which female board representation moderates the relationship between firm size and environmental disclosure index; to analyse the moderating effect of female board representation on the relationship between firm liquidity and environmental disclosure index. Ex-post facto research design was deployed. The study population comprised thirteen listed industrial goods firms in Nigeria. A sample size of nine was chosen. Secondary data were collected from the firms' annual reports from 2012 to 2024. Analyses were first done using descriptive and correlational tools. Moderated panel regression was carried out to ascertain the nexus between firm-level traits and environmental responsibility. The hypotheses were tested using moderated panel regression analysis, which revealed that: female board representation has a negative and significant moderating effect on the effect of firm leverage on environmental disclosure ($\beta = -0.1558$; $p = 0.0156$); female board representation has a positive and significant moderating effect on the effect of firm size on environmental disclosure ($\beta = 0.0440$; $p = 0.0000$); female board representation has a negative and significant moderating effect on the effect of firm liquidity on environmental disclosure index of listed industrial goods firms in Nigeria ($\beta = -0.1245$; $p = 0.0000$). The study recommends that female board appointments should prioritize individuals with expertise in financial risk management and sustainability reporting to effectively mitigate the negative moderating effect of leverage on environmental disclosure.

Keywords: *Corporate Environmental Responsibility, Environmental Disclosure Index, Female Board Representation, Firm Leverage, Firm Liquidity*

1.0 Introduction

In recent years, the global business environment has witnessed an increasing emphasis on corporate environmental responsibility (CER). As the world grapples with the challenges posed by climate change, environmental degradation, and the depletion of natural resources, businesses are expected to not only focus on profitability but also adopt practices that contribute positively to the environment (Mbonu & Okoye, 2023; Orajekwe & Okenwa, 2023). The concept of corporate environmental responsibility has evolved significantly over the past few decades. Initially, it was viewed as a mere regulatory compliance issue, but today it encompasses a range of voluntary initiatives aimed at reducing environmental harm and contributing to sustainable development (Jing, Muhamad, Said & Daud, 2025). In Nigeria, like many other emerging economies, the call for corporate environmental responsibility has become more pronounced, especially with the growing awareness of environmental issues and the increased global attention on corporate sustainability (Chekwube–Aziekwe & Nworie, 2026). However, the extent to which firms in Nigeria embrace environmental responsibility often varies, and it is important to examine the factors influencing their approach to environmental practices. One such factor is firm-level traits, which include a range of internal characteristics that influence how a company operates, makes decisions, and responds to external pressures (Onyali & Okafor, 2018; Benjamin, Okpanachi & Muhammad, 2017).

Firm-level traits such as leverage, firm size, and liquidity have been identified as crucial elements that determine a firm's ability and willingness to invest in environmental initiatives (Orajekwe & Okenwa, 2023). The growing recognition of these traits underscores their importance in shaping the business decisions that ultimately affect a firm's environmental behavior. In today's highly competitive and socially conscious business landscape (Anaike & Nworie, 2026), the role of firm-level traits in shaping corporate environmental responsibility cannot be overstated. It is essential to explore the dynamic interaction between these internal factors and environmental practices, particularly in the context of Nigerian industrial firms. The significance of effective firm-level traits in today's business environment extends beyond just the bottom line. In an era where sustainability is becoming a central concern for businesses worldwide, companies are under increasing scrutiny regarding their environmental impact (Yahaya, 2025). As such, the alignment of firm-level traits with environmental responsibility is of paramount importance for organizational success. Effective firm-level traits contribute to improved decision-making processes, better resource allocation (Rashata, 2021), and enhanced long-term sustainability (Jeroh, 2020). The adoption of environmental practices is not merely a matter of compliance but a strategic decision that can influence a firm's competitive advantage, brand image, and relationship with stakeholders.

In this context, environmental disclosure is not just about compliance with regulatory frameworks but also reflects a company's commitment to transparency, accountability, and proactive engagement with environmental issues. The Nigerian industrial goods sector presents a unique setting for this study due to the sector's significant contribution to environmental degradation and its potential for improvement through responsible environmental practices. Over the past decade, there has been growing pressure on firms in Nigeria to adopt sustainable practices, particularly in the industrial sector, where environmental impacts tend to be more pronounced (Igwebuike & Onyali, 2023). The role of gender diversity on corporate boards has garnered significant attention in recent years, with studies suggesting that women bring unique perspectives to decision-making processes (Mbonu & Okoye, 2023). In the context of environmental responsibility, female directors may be more inclined to prioritize sustainability

and corporate social responsibility due to differing values and risk aversion tendencies. It is hypothesized that the presence of women on boards may enhance a firm's commitment to environmental practices, particularly in firms where firm-level traits such as leverage, size, and liquidity suggest an ability to invest in sustainability initiatives. Abdelazim, Metwally, and Aly (2023) argued that the moderating role of female board representation could serve as a catalyst for better environmental disclosures, thus making this study an important contribution to understanding the intersection of gender, firm characteristics, and environmental responsibility. It is argued that leverage, as a firm-level trait, plays a critical role in determining a firm's capacity to invest in environmental responsibility. Firms with high leverage may prioritize debt repayment over environmental investments due to financial constraints, which could hinder their ability to engage in sustainable practices (Igwebuike & Onyali, 2023). In contrast, firms with lower leverage may have greater flexibility in channeling resources into environmental initiatives. Firm size also plays a significant role in corporate environmental responsibility. Larger firms typically have more resources at their disposal to implement eco-friendly practices and technologies, thus influencing their environmental responsibility positively. Liquidity, or the ability to access cash and liquid assets, further influences a firm's capacity to invest in environmental responsibility. Firms with higher liquidity may be better positioned to fund environmental initiatives without jeopardizing their day-to-day operations, enabling them to prioritize sustainability in their decision-making processes. Environmentally responsible firms often use their resources to balance profitability with social and environmental responsibilities (Orajekwe & Okenwa, 2023). Industrial firms, given the nature of their operations, are particularly expected to uphold high standards of corporate environmental responsibility (CER) to mitigate the environmental impact of their activities. Firm-level traits such as inadequate financial liquidity, high leverage, and insufficient firm size thwart proactive environmental initiatives. Furthermore, diverse board compositions—especially with female representation—is expected to ideally contribute to more ethical, transparent, and sustainability-oriented decisions. There will be no problem in this area if corporate decisions reflect a strong commitment to environmental stewardship, transparency in environmental disclosures, and alignment with global sustainability standards.

However, many listed industrial firms struggle with inadequate environmental disclosures, and corporate environmental responsibility is often treated as a secondary concern rather than a strategic imperative (Igwebuike & Onyali, 2023). Despite having the capacity in terms of size or liquidity, some firms fail to allocate sufficient resources to environmental initiatives, while others with high leverage may deprioritize sustainability in pursuit of short-term financial goals. In addition, female board representation remains low across many industrial firms in Nigeria, potentially limiting the diversity of perspectives necessary for sound environmental governance. This disconnect suggests that firm-level traits are not being effectively leveraged to promote environmental responsibility, and the potential moderating influence of gender diversity on corporate decision-making is underutilized.

In fact, weak corporate environmental responsibility practices not only harm the environment but also expose firms to reputational risks, regulatory penalties, and reduced investor confidence. The failure to adequately disclose environmental practices limits transparency and accountability, reducing trust among stakeholders (Igwebuike & Onyali, 2023). Furthermore, the underrepresentation of women in boardrooms may lead to missed opportunities for inclusive, balanced, and socially responsible decision-making. In the broader context, these shortcomings undermine Nigeria's progress toward achieving environmental sustainability goals and compromise the long-term viability of firms operating within the industrial goods sector. Without addressing these gaps, firms risk lagging behind in global sustainability rankings, losing competitive advantage, and contributing to the ongoing degradation of

Nigeria's environment. While numerous studies have explored the relationship between firm characteristics and environmental disclosure, few have focused specifically on the moderating role of female board representation in this context. For instance, Okorie, Ofoegbu, Nnajeze, Iyidiobi-Agaba, Ugwu, and Mgbobi (2024) and Ayuba, Ndirmbitah, and Bashiru (2024) found that firm profitability, size, leverage, and liquidity influence environmental disclosure, yet did not account for board gender dynamics. Although Sabiya, Idriss, Bukar, and Zannah (2024) and Zhu, Osei, and Agyemang (2024) examined the link between female board membership and disclosure, they offered mixed results and did not analyze moderating effects across specific firm traits. Studies by Mbonu and Okoye (2023) and Maggi, Gjergji, Vena, Sciascia, and Cortesi (2023) emphasized gender diversity but lacked sector-specific analysis, particularly for industrial goods firms. Moreover, Abdelazim, Metwally, and Aly (2023) as well as Aimuyedo, Nyor, Agbi, Ahmed, and Mustapha (2023) acknowledged gender as a factor but didn't dissect its interaction with firm-level characteristics such as leverage, liquidity, and size. Furthermore, while Okafor, Egbunike, and Amahalu (2022) and Nworie, Obi, Anaike, and Uchechukwu-Obi (2022) focused on leverage and environmental disclosure, and Moshud, Sani, and Olanrewaju (2021) addressed firm size, none assessed the conditional influence of female board representation. This leaves a significant gap in understanding how female board presence may moderate the effects of firm leverage, size, and liquidity on environmental disclosure within Nigeria's industrial goods sector, which this study aims to fill. The main aim of the study is to examine the moderating effect of female board representation on the relationship between firm-level traits and corporate environmental responsibility of listed industrial goods firms in Nigeria.

The specific objectives are as follows:

1. To ascertain the moderating effect of female board representation on the relationship between firm leverage and environmental disclosure index of listed industrial goods firms in Nigeria.
2. To determine the extent to which female board representation moderates the relationship between firm size and environmental disclosure index of listed industrial goods firms in Nigeria.
3. To analyse the moderating effect of female board representation on the relationship between firm liquidity and environmental disclosure index of listed industrial goods firms in Nigeria.

2.0 Review of Related Literature

2.1 Conceptual Review

2.1.1 Female Board Representation

Female board representation refers to the presence and participation of women as members of a company's board of directors (Ardhaoui, Ben Amar & Fakhfakh, 2024). It is a governance-related concept that emphasizes gender inclusion at the highest level of corporate decision-making. The term denotes how women are represented in terms of number or proportion relative to the total board composition (Zhu, Osei & Agyemang, 2024). This representation can be expressed quantitatively as a percentage or as an indicator variable denoting whether at least one woman is present on the board. The concept is rooted in broader themes of diversity, equality, and inclusive governance, reflecting growing global efforts to ensure that leadership structures within corporations mirror the demographic diversity of the societies in which they operate (Aimuyedo, Nyor, Agbi, Ahmed & Mustapha, 2023). Female board representation is more than a numerical count; it captures the essence of gendered perspectives in corporate oversight and strategic direction (Zhu, Osei & Agyemang, 2024). It symbolizes the increasing challenge to traditional, male-dominated corporate governance structures, advocating for more

equitable participation in decision-making roles. The presence of women on boards has been widely linked to changes in organizational behavior, ethical standards, risk management, and social responsibility practices (Ardhaoui, Ben Amar & Fakhfakh, 2024). In essence, female board representation acknowledges the value of diverse leadership and the unique perspectives women bring to boardroom discussions and policies. These perspectives can influence how firms prioritize issues such as environmental sustainability, ethical conduct, stakeholder engagement, and long-term planning (Maggi, Gjergji, Vena, Sciascia & Cortesi, 2023). Over the years, this concept has gained prominence due to mounting empirical evidence and advocacy pointing to the positive impacts of gender-diverse boards (Zhu, Osei & Agyemang, 2024). Many jurisdictions have introduced policies or quotas to promote female inclusion, recognizing that increased representation can lead to more balanced, deliberative, and socially attuned corporate governance. In developing economies like Nigeria, the conversation around female board representation is evolving, and it highlights the intersection between corporate leadership and social equity (Mbonu & Okoye, 2023). Although the inclusion of women on boards may still be limited in some contexts, the term remains a critical benchmark for evaluating progress in corporate diversity and gender-sensitive governance. Hence, female board representation serves as both a descriptive and normative concept: it describes the actual participation of women on boards and also embodies the broader normative goals of gender fairness, democratic governance, and inclusive corporate leadership (Ardhaoui, Ben Amar & Fakhfakh, 2024).

2.1.2 Firm-Level Traits

Firm-level traits refer to the internal characteristics, attributes, or features that define a company's operational profile and influence its strategic choices, financial decisions, and overall performance (Amanamah, 2024). These traits, according to Nworie, Okafor and John-Akamelu (2022), are intrinsic to each firm and often differ widely across firms, even within the same industry. They serve as foundational variables in empirical research that seeks to understand differences in firm behavior, responses to external pressures, and outcomes such as profitability, governance practices, and sustainability efforts. Unlike macroeconomic variables or industry-level indicators, firm-level traits are specific to the individual organization and are generally under the control or influence of the firm's management (Egbunike & Okerekeoti, 2018). The concept of firm-level traits encompasses various dimensions such as capital structure, firm size, profitability, liquidity, leverage, ownership structure, age, and governance quality (Jeroh, 2020). These attributes are typically used to classify firms in comparative studies and to assess their readiness, capacity, or likelihood of engaging in particular activities, such as corporate environmental responsibility. Because these traits are embedded within the firm's internal environment, they shape its risk appetite, innovation potential, and responsiveness to stakeholder expectations (Amanamah, 2024).

Firm-level traits also mediate in the firm's interaction with its external environment. For instance, a firm with high liquidity may be more agile in responding to regulatory changes or market opportunities, while a firm with a high debt ratio may be more conservative in undertaking socially responsible investments. As such, firm-level traits are integral to understanding why certain firms act in particular ways, even when exposed to the same external conditions (Rashata, 2021). These traits can serve as indicators of a firm's structure and capability, influencing both internal decision-making and external perceptions. In academic research, firm-level traits are often used as independent or control variables in models assessing firm behavior and performance (Jeroh, 2020; Rahman, Zhu & Chen, 2023).

2.1.2.1 Firm Leverage

Firm leverage refers to the extent to which a company utilizes borrowed funds (debt) to finance its operations and investment activities (Abubakar & Anyonje, 2025). It is a financial metric that indicates the proportion of a firm's capital structure that is made up of debt as opposed to equity. The term reflects the firm's reliance on external financing to support its business activities, with the goal of increasing returns to shareholders through the strategic use of debt. Firm leverage is typically measured using ratios such as the debt-to-equity ratio or the total debt-to-total assets ratio, and it is a key determinant of a firm's financial risk and long-term sustainability (Afolabi, Olabisi, Kajola & Asaolu, 2019). The concept of leverage is grounded in the principle of financial amplification—whereby borrowing can enhance potential returns on equity if the returns on investment exceed the cost of borrowing (Abubakar & Anyonje, 2025). However, it also introduces financial risk, as excessive leverage can lead to increased debt servicing obligations, reduced operational flexibility, and greater vulnerability to economic downturns or interest rate fluctuations. Therefore, firm leverage is not just a financing decision; it is a strategic choice that influences a company's risk profile, creditworthiness, and financial health (Abubakar, 2020).

Leverage has profound implications for a firm's decision-making behavior. Firms with high leverage may be constrained in their ability to invest in long-term, non-revenue-generating initiatives such as environmental sustainability projects (Ayuba, Ndirmbitah & Bashiru, 2024). These firms are often under pressure to meet debt obligations and may prioritize short-term financial performance over long-term social or environmental goals. Conversely, firms with lower leverage may have greater freedom to allocate resources toward corporate social responsibility, innovation, and other strategic initiatives that may not yield immediate financial returns but contribute to long-term value creation (Nworie, Obi, Anaike & Uchechukwu-Obi, 2022). From a governance and stakeholder perspective, leverage also signals important information about a firm's financial strategy and risk tolerance. Creditors, investors, and regulators closely monitor leverage levels as indicators of solvency and financial discipline. In research contexts, firm leverage is often used as a proxy for financial constraint or risk exposure, especially when examining the determinants of corporate behavior, including environmental responsibility (Okafor, Egbunike & Amahalu, 2022).

2.1.2.2 Firm Size

Firm size refers to the scale or magnitude of a company's operations and resources, typically measured by indicators such as total assets, sales revenue, market capitalization, or number of employees (Sabiya, Idriss, Bukar & Zannah, 2024). It is a central concept in business and finance that describes the economic weight or capacity of a firm relative to others in its industry or the broader market. The size of a firm is often used as a structural characteristic that reflects its ability to mobilize resources (Moshud, Sani & Olanrewaju, 2021), absorb risks, and exert influence in the marketplace. It captures the physical and financial dimensions of the company's operations and serves as a key reference point in understanding corporate behavior, strategic potential, and competitive advantage. The meaning of firm size goes beyond its numerical measurement; it represents a firm's institutional presence, organizational complexity, and market positioning. A large firm, for instance, is typically assumed to have more extensive networks, diversified operations, and greater access to capital markets compared to a smaller firm (Sabiya, Idriss, Bukar & Zannah, 2024).

Moreover, firm size is a crucial factor in understanding how firms engage with social, environmental, and governance-related issues (Ayuba, Ndirmbitah & Bashiru, 2024). Larger firms are often more visible to the public and more scrutinized by regulators, investors, and civil society, which can shape their responsiveness to non-financial obligations. As a

descriptive variable, firm size captures the magnitude of a firm's internal and external responsibilities and its potential impact on stakeholders. It is often assumed that larger firms possess the scale necessary to institutionalize best practices, adopt sustainable strategies, and manage stakeholder expectations effectively (Sabiya, Idriss, Bukar & Zannah, 2024). From a conceptual standpoint, firm size serves as a foundational attribute that influences nearly all aspects of business activity, including strategic decisions, resource allocation, and risk management (Moshud, Sani & Olanrewaju, 2021).

2.1.2.3 Firm Liquidity

Firm liquidity refers to the ability of a company to meet its short-term financial obligations using its readily available assets, such as cash, marketable securities, or receivables (Ayuba, Ndirmbitah & Bashiru, 2024). It is a financial concept that captures the ease with which a firm can convert its current assets into cash without significant loss in value, thereby ensuring the smooth continuation of daily operations and the avoidance of financial distress. Liquidity reflects a firm's financial resilience, especially in the face of unforeseen expenses, cyclical downturns, or operational disruptions. It is a critical indicator of a firm's short-term financial health and stability (Haldane & Sakouvogui, 2023). The meaning of liquidity goes beyond its immediate financial function; it embodies a firm's capacity to operate independently without excessive reliance on external financing in the short run. A liquid firm is one that is equipped to respond promptly to emerging needs, settle obligations as they fall due, and maintain operational continuity under varying economic conditions. Liquidity is thus integral to business solvency, as it influences the firm's flexibility in financial planning and decision-making (Ayuba, Ndirmbitah & Bashiru, 2024). Firm liquidity is often viewed as a signal of prudent financial management and efficient resource allocation. The ability to maintain optimal liquidity reflects a balance between profitability and risk avoidance (Haldane & Sakouvogui, 2023). A highly liquid firm typically has the freedom to pursue investment opportunities, respond to regulatory demands, and engage in discretionary spending, such as on sustainability or social initiatives, without compromising its financial position (Adibeli & Nworie, 2026; Ukoh, Amedu & Nworie, 2026). Liquidity, in this sense, symbolizes both a buffer and an enabler—it cushions the firm against shocks while empowering strategic action. As a concept, firm liquidity is widely used in both academic research and financial analysis to assess how internal financial strength affects corporate performance and behavior (Orajekwe & Okenwa, 2023). It is often positioned as a core firm-level trait that influences a company's capacity to pursue long-term goals while managing short-term risks (Uyar, Abdelqader & Kuzey, 2023).

2.1.3 Corporate Environmental Responsibility

Corporate Environmental Responsibility (CER) refers to a company's ethical obligation and voluntary commitment to minimize the negative impact of its operations on the natural environment (Iredele, 2020). It embodies the idea that firms, as major economic actors, have a responsibility not only to shareholders but also to society and the planet (Amahalu, 2019). This responsibility involves integrating environmental considerations into business strategies, policies, and practices to ensure sustainable development (Ardhaoui, Ben Amar & Fakhfakh, 2024). CER reflects a firm's recognition that environmental stewardship is not separate from its core objectives but is integral to long-term success and legitimacy. In essence, corporate environmental responsibility is about accountability—acknowledging the firm's role in issues such as pollution, resource depletion, and climate change, and taking deliberate steps to mitigate these effects (Iredele, 2020). This concept implies that businesses must go beyond compliance with environmental regulations and actively contribute to ecological preservation and restoration. The responsibility is both operational and strategic; it informs how firms

manage their production processes, supply chains, waste disposal, energy usage, and carbon emissions. By embracing CER, firms demonstrate a commitment to doing business in a way that respects environmental boundaries and supports intergenerational equity (Zhu, Osei, & Agyemang, 2024).

CER also speaks to the broader philosophical shift in how firms view their place in society. No longer seen solely as profit-maximizing entities, firms are now expected to act as responsible corporate citizens, embedding sustainability into their governance and culture (Amahalu, 2019). This shift has been driven by growing stakeholder awareness, investor pressure, global policy frameworks, and the realization that environmental degradation poses material risks to business continuity. Thus, CER is not merely an idealistic principle but a pragmatic business imperative in a world facing ecological crises and resource constraints. The concept has gained increasing relevance in the context of globalization, where environmental challenges transcend national borders and corporate operations span multiple jurisdictions. Firms that adopt strong environmental responsibility practices often gain reputational capital, stakeholder trust, and competitive advantage (Jeroh, 2020).

2.1.3.1 Environmental Disclosure Index

The Environmental Disclosure Index (EDI) is a quantitative measure used to assess the extent and quality of environmental information voluntarily or mandatorily disclosed by a firm in its public reports, such as annual reports or sustainability statements (Pinheiro, Oliveira & Lozano, 2025). It serves as a metric for evaluating how transparent a firm is about its environmental policies, performance, risks, and initiatives. The EDI reflects the degree to which a firm communicates its environmental responsibility to stakeholders, including investors, regulators, and the public (Vig, 2024). As such, it captures not only the content of disclosures but also the depth and consistency with which environmental matters are addressed in corporate reporting. Fundamentally, the Environmental Disclosure Index is an accountability tool. It translates qualitative environmental disclosures into a standardized, comparable score or index that can be analyzed across firms, industries, and time periods. By quantifying disclosure, the index enables objective assessment of how seriously a firm treats environmental concerns in its communication. The EDI acts as a proxy for corporate transparency in environmental matters and is often adopted from Global Reporting Initiatives to evaluate corporate environmental responsibility, especially where direct performance data may be lacking or difficult to obtain (Singhania & Gandhi, 2015). The meaning of EDI extends beyond measurement—it represents a firm's willingness to be scrutinized on its environmental impact. A high score on the index suggests that the firm is proactive in sharing environmental information, potentially reflecting genuine environmental commitment, risk management practices, and responsiveness to stakeholder demands (Pinheiro, Oliveira & Lozano, 2025). Conversely, a low index score may indicate minimal transparency or a reluctance to disclose potentially damaging environmental performance, raising concerns about governance quality or environmental neglect. Thus, the EDI also serves as a signaling mechanism that influences how firms are perceived in terms of their environmental ethics and openness (Orajekwe & Okenwa, 2023). Environmental Disclosure Index fosters a culture of transparency by encouraging firms to improve the quality of their environmental reporting in line with international best practices. Thus, the Environmental Disclosure Index is a key conceptual and practical tool in advancing corporate environmental responsibility through clear, measurable, and verifiable public communication (Pinheiro, Oliveira & Lozano, 2025).

2.1.4 Influence of Firm-Level Traits on Corporate Environmental Responsibility

Firm-level traits - as fundamental characteristics unique to each company that significantly influence its strategic decisions and overall behavior - serve as internal determinants that shape a firm's willingness and capacity to engage in corporate environmental responsibility (Orajekwe & Okenwa, 2023). While external pressures such as regulations and stakeholder expectations may drive sustainability efforts, it is the internal structure and capacity of the firm that largely determine how effectively such demands are met (Okafor, Egbunike & Amahalu, 2022). Highly leveraged firms may be financially constrained and focused more on meeting debt obligations than investing in non-revenue-generating activities like environmental initiatives (Nworie, Obi, Anaike, & Uchechukwu-Obi, 2022). As a result, firms with lower leverage may be in a better financial position to pursue long-term sustainability goals, including environmental disclosures and eco-friendly operational practices. In contrast, companies burdened by debt may view CER as a secondary priority, especially in environments where regulatory enforcement is weak. Larger firms are typically more visible to the public and subject to greater scrutiny from regulators, media, and stakeholders. This visibility often motivates larger firms to adopt more comprehensive environmental strategies and reporting frameworks to maintain legitimacy and public trust. In addition, larger firms usually have more resources—financial, technological, and human—to invest in sustainability, thereby enabling more extensive engagement in CER (Moshud, Sani & Olanrewaju, 2021). Smaller firms, by contrast, may lack the scale or incentive to adopt such practices unless externally pressured. Firms with high liquidity have the financial flexibility to invest in green technologies, pollution control, and sustainability disclosures without risking operational stability (Ayuba, Ndirmbitah, & Bashiru, 2024). Liquidity acts as a buffer that enables proactive environmental engagement, especially in volatile economic conditions. In sum, firm-level traits are not just descriptive attributes; they are dynamic elements that influence how firms perceive and respond to environmental challenges. Understanding these traits provides useful hints on the internal motivations and constraints that shape corporate environmental responsibility, particularly in emerging economies like Nigeria.

2.1.5 Moderating Role of Female Board Representation on the Relationship Between Firm-Level Traits and Corporate Environmental Responsibility

Female board representation introduces a unique dimension to corporate governance that can influence how internal firm traits relate to environmental responsibility. As more women gain access to leadership roles, their presence on corporate boards is increasingly recognized as a factor that brings diverse perspectives, ethical orientation, and stakeholder-focused values into decision-making processes (Sabiya, Idriss, Bukar & Zannah, 2024). In this regard, female board members can act as moderators—shaping or altering the relationship between firm-level traits and a firm's engagement in corporate environmental responsibility (CER). Their influence becomes especially important in environments where traditional financial or operational pressures might otherwise hinder sustainability efforts (Abdelazim, Metwally & Aly, 2023). One-way female board representation moderates these relationships is through enhanced sensitivity to ethical and social issues, including environmental sustainability. Research suggests that female directors are often more attuned to long-term social and ecological outcomes, which may influence board discussions and decisions in ways that promote environmental accountability (Sabiya, Idriss, Bukar & Zannah, 2024). For instance, in highly leveraged firms where financial stress might typically discourage investment in environmental initiatives, the presence of women on the board could prompt a more balanced perspective—highlighting the reputational and strategic benefits of sustainability even in the face of financial constraints. Similarly, in the context of firm size, female board representation may amplify the

pressure and responsiveness of larger firms to engage in environmental disclosure and performance. While large firms already face significant scrutiny, having women on the board may encourage even greater transparency and commitment to environmental goals (Mbonu & Okoye, 2023). Female directors can serve as advocates for more robust disclosure practices and foster a governance culture that integrates sustainability into strategic priorities (Abdelazim, Metwally & Aly, 2023). Their involvement may transform firm size from a passive characteristic into a platform for leadership in environmental responsibility. Firm liquidity also presents an opportunity for moderation through gender-diverse boards. In liquid firms with sufficient financial flexibility, female board members may be instrumental in directing surplus resources toward green innovations, sustainability reporting, and environmental impact assessments. Their presence could ensure that available resources are allocated not only for financial gain but also for long-term ecological benefit (Abdelazim, Metwally & Aly, 2023). Thus, female board representation does not merely reflect diversity; it reshapes corporate priorities and governance dynamics. As a moderating factor, it can either strengthen or redirect the influence of firm-level traits on CER, enabling firms to balance economic imperatives with environmental stewardship. This moderating role is particularly significant in contexts like Nigeria, where gender diversity on boards is evolving alongside broader shifts toward sustainability and inclusive governance.

2.2 Theoretical Framework and Statement of Hypotheses

2.2.1 Stakeholder Theory

Stakeholder Theory was first articulated by R. Edward Freeman in 1984 in his influential work *Strategic Management: A Stakeholder Approach* (Kivits, Sawang, Kivits & Sawang, 2021). The theory emerged as a response to the limitations of traditional shareholder-centric models of corporate governance, which primarily emphasized maximizing shareholder wealth. Freeman proposed that firms operate within a network of relationships involving various parties—employees, customers, suppliers, communities, governments, and even the environment—and that these parties, known as stakeholders, all have a legitimate interest in corporate actions and outcomes (Dmytriiev & Freeman, 2023). Stakeholder Theory assumes that firms should create value not only for shareholders but for all stakeholders who are affected by the firm's activities (Hörisch, Schaltegger & Freeman, 2020). The theory emphasizes ethical management and accountability, suggesting that companies have a duty to operate in ways that respect the rights and interests of diverse stakeholder groups. Stakeholder engagement is therefore not a peripheral concern but a core component of strategic decision-making. Under this framework, environmental responsibility is not just a regulatory obligation but a moral and strategic necessity, as the social environment itself is considered a key stakeholder (Elijido-Ten, 2007). Transparency, fairness, inclusiveness, and responsiveness to stakeholder concerns are integral to the successful implementation of the stakeholder approach.

Stakeholder Theory is particularly relevant to this study as it provides the theoretical foundation for understanding the effect of firm-level traits on corporate environmental responsibility, as well as the moderating role of female board representation. By considering the environment as a critical stakeholder, the theory supports the idea that firms—especially those with the capacity (size, liquidity) or financial limitations (leverage)—must align their internal strategies to reflect environmental concerns (Husillos & Álvarez-Gil, 2008). The presence of women on corporate boards can enhance this alignment by bringing diverse perspectives, ethical sensitivity, and stakeholder-focused governance to decision-making processes. Thus, Stakeholder Theory helps explain why and how firms differ in their environmental disclosure practices based on internal traits and board composition, especially in the industrial goods

sector of Nigeria, where environmental impacts are significant and stakeholder expectations are increasingly evolving.

In line with the above, the study hypothesized that:

H1. Female board representation has a significant moderating effect on the relationship between firm leverage and environmental disclosure index of listed industrial goods firms in Nigeria.

H2. Female board representation significantly moderates the relationship between firm size and environmental disclosure index of listed industrial goods firms in Nigeria.

H3. Female board representation has a significant moderating effect on the relationship between firm liquidity and environmental disclosure index of listed industrial goods firms in Nigeria.

2.3 Empirical Review

A review of the empirical literature reveals a strong and recurring association between firm-level characteristics and environmental disclosure practices across different countries and sectors. Firm size emerged as the most consistently significant determinant of environmental disclosure and environmental responsibility. Studies by Sabiya et al. (2024), Ayuba et al. (2024), Abdelazim et al. (2023), Moshud et al. (2021), Ntui et al. (2021), Chowdhury et al. (2020), Bello and Usman (2020), Eneh and Amakor (2019), Amahalu (2019), Onyali and Okafor (2018), and Benjamin et al. (2017) reported a positive relationship between firm size and environmental disclosure. Similar evidence was provided by Maulia and Yanto (2020), who found that larger firms disclosed more environmental information than smaller firms. These findings suggest that larger firms are generally more visible to stakeholders and face greater public scrutiny, compelling them to engage more actively in environmental reporting. However, the findings of Okafor et al. (2022), who reported a negative relationship between firm size and effluent disclosure among Nigerian oil and gas firms, challenge the dominant narrative and indicate that the effect of firm size may vary depending on industrial context and measurement approaches. The empirical evidence on leverage also demonstrates substantial support for its influence on environmental disclosure, although some inconsistencies remain. Ayuba et al. (2024), Okafor et al. (2022), Nworie et al. (2022), Salawu et al. (2021), Ntui et al. (2021), Chowdhury et al. (2020), and Benjamin et al. (2017) all found that leverage positively affects environmental disclosure or environmental responsibility. These findings imply that highly leveraged firms may disclose more environmental information to reduce information asymmetry and reassure creditors regarding their long-term sustainability. Nevertheless, Maulia and Yanto (2020) found that leverage had no significant effect on environmental disclosure, suggesting that debt obligations alone may not always motivate firms to improve environmental reporting. Similarly, evidence regarding profitability appears largely positive. Okorie et al. (2024), Oranefo (2022), Amahalu (2019), Onyali and Okafor (2018), Benjamin et al. (2017), and Maulia and Yanto (2020) reported that profitability positively influences environmental disclosure and environmental performance. Profitable firms appear to possess the financial resources necessary to undertake environmental initiatives and communicate such efforts through disclosure practices. Another dominant theme in the literature concerns the role of female board representation and gender diversity in strengthening environmental responsibility. Sabiya et al. (2024) found that firm size enhanced the positive influence of female board membership on environmental disclosure, while Abdelazim et al. (2023) reported that female board presence strengthened the effects of firm attributes on disclosure practices. Similarly, Aimuyedo et al. (2023) established that gender diversity positively influenced sustainability disclosure and that firm age further reinforced this relationship. Maggi et al.

(2023) found that although family-owned firms tended to disclose less environmental information, gender diversity moderated this tendency and improved disclosure outcomes. Mbonu and Okoye (2023) also reported that female board presence significantly improved environmental disclosure among oil and gas firms in Nigeria and South Africa. Collectively, these studies support the argument that women directors contribute unique perspectives, stronger stakeholder orientation, and greater sensitivity to environmental concerns. However, the findings of Zhu et al. (2024), who documented a negative relationship between gender diversity and environmental disclosure in Sub-Saharan African manufacturing firms, contradict the prevailing evidence and suggest that institutional and cultural contexts may influence the effectiveness of female board representation.

The literature further highlights the relevance of other firm-specific characteristics such as age, liquidity, ownership structure, board composition, and governance mechanisms in explaining environmental disclosure behavior. Ayuba et al. (2024) found that liquidity positively influenced sustainability reporting, whereas firm age exerted a negative effect. In contrast, Abdelazim et al. (2023), Ntui et al. (2021), Amahalu (2019), Onyali and Okafor (2018), and Benjamin et al. (2017) reported positive effects of firm age on disclosure and environmental performance. Bello and Usman (2020), however, found that firm age negatively influenced environmental disclosure, further illustrating the mixed evidence surrounding this variable. Governance-related variables also featured prominently in the literature. Salawu et al. (2021) reported positive effects of foreign directors and board composition, while Okafor et al. (2022) found that audit committee size positively influenced effluent disclosure. Similarly, Maulia and Yanto (2020) observed that audit committee effectiveness enhanced environmental disclosure. In all, the empirical literature suggests that environmental responsibility is shaped by a combination of firm-level characteristics and governance mechanisms. However, the conflicting findings regarding gender diversity, firm size, leverage, and age indicate the need for further investigation, particularly within the context of Nigerian industrial goods firms where the moderating role of female board representation remains insufficiently explored.

3.0 Methodology

This study adopted an ex-post facto research design, which is appropriate for investigating the relationships between variables that cannot be manipulated by the researcher (Ukoh & Nworie, 2026; Ibobo, Nworie & Oyewole, 2026). Ex-post facto design is particularly useful when exploring the effects of past events on present outcomes, especially when the events under study have already occurred and cannot be altered (Ikwuo et al., 2025; Muomaife et al., 2026; Nworie et al., 2024). This design was used to analyze panel data, which captures the financial behavior of listed industrial goods firms in Nigeria. The population of this study consisted of all the industrial goods firms listed on the Nigerian Exchange Group (NGX) as of December 31, 2023. According to the NGX Daily Stock Listing, there were 13 industrial goods firms, which formed the initial population for the study. These firms represent a wide spectrum of the industrial sector, including cement, chemicals, and construction, and provide a diverse set of operational environments. The full list of firms is shown below:

Table 3.1: Population of the Study

1. Austin Laz & Company Plc.
2. Berger Paints Plc.
3. Beta Glass Plc.
4. Bua Cement Plc.
5. Cap Plc.
6. Cutix Plc.

7. Dangote Cement Plc.
8. Greif Nigeria Plc.
9. Lafarge Africa Plc.
10. Meyer Plc.
11. Notore Chemical Ind. Plc.
12. Premier Paints Plc.
13. Tripple Gee and Company Plc.

Source: Nigerian Exchange Group (2023)

For this study, 9 industrial goods firms were selected using purposive sampling. This sampling technique was used because it allows for the selection of firms that meet specific criteria relevant to the research objectives. The criterion for selection was that the firm must have been listed on the NGX from 2012 onward, ensuring availability of consistent and reliable data for the analysis. The following firms were selected:

Table 3.2: Sample Size of the Study

1. Austin Laz & Company Plc.
2. Berger Paints Plc.
3. Beta Glass Plc.
4. Cap Plc.
5. Cutix Plc.
6. Dangote Cement Plc.
7. Lafarge Africa Plc.
8. Meyer Plc.
9. Tripple Gee and Company Plc.

Source: Researcher's Compilation (2025)

Secondary data were collected for this study from the publicly available annual reports and financial statements of the selected firms. These reports covered the period from 2012 to 2024, providing a comprehensive overview of the firms' financial performance and environmental disclosure practices. Secondary data are valuable for this study as they are reliable, audited, and publicly disclosed, which allows for robust analysis of the relationships between firm characteristics and environmental responsibility. The key variables in this study included firm-level traits (leverage, size, liquidity), female board representation, and corporate environmental responsibility (proxied by the environmental disclosure index). These variables were measured as follows:

Table 3.3: Operational Measurement of Variables

Variable	Measurement Method
Firm Leverage	Total Liabilities/Total Asset
Firm Size	Natural log of total assets
Firm Liquidity	Current asset/Current liabilities
Female Board Representation	Number of female directors/Total Number of directors on the board
Environmental Disclosure Index	Scores based on the Global Reporting Initiatives shown in Table 3.4 below

Source: Researcher's Compilation (2025)

Table 3.4: GRI Measure for Environmental Disclosure Index

Content Analysis	Content Analysis Score
GRI 306: Effluents and waste management	Score “1” if disclosed; otherwise score “0”
GRI 304: Biodiversity conservation	Score “1” if disclosed; otherwise score “0”
GRI 305: Emissions reduction	Score “1” if disclosed; otherwise score “0”
GRI 403: Occupational Health and Safety	Score “1” if disclosed; otherwise score “0”

Source: Researcher’s Compilation (2025)

The study adopted and modified the model used by Orajekwe and Okenwa (2023) while examining the effect of firm attributes on environmental disclosure of energy corporations in Nigeria. The model is stated below:

$$EDLit = \beta_0 + \beta_1 SZEit + \beta_2 AGEit + \beta_3 LEVit + \beta_4 PROit + \beta_5 LIQit + \mu_t \text{-----(1)}$$

Where:

B_0 = Intercept

$EDLit$ = Environmental Disclosure Index of firm i in year t

$\beta_1 - \beta_5$ = Parameter estimates

$SZEit$ = Size of firm i in year t

$AGEit$ = Age of firm i in year t

$LEVit$ = Leverage of firm i in year t

$PROit$ = Profitability of firm i in year t

$LIQit$ = Liquidity of firm i in year t

μ = Error term

The above model was modified thus to be in line with the variables selected for the study. Hence, the study utilized the regression model below to examine the moderating effect of female board representation on the relationship between firm-level traits (leverage, size, liquidity) and corporate environmental responsibility.

Unmoderated Model:

$$EDLit = \alpha_0 + \beta_1 LEVit + \beta_2 SIZit + \beta_3 LIQit + \mu_{it} \text{-----eqii}$$

Moderated Model using female board representation as the moderator:

$$EDLit = \alpha_0 + \beta_1 (LEVit \times FBRit) + \beta_2 (FSZit \times FBRit) + \beta_3 (LIQit \times FBRit) + \mu_{it} \text{-----eqiii}$$

Where:

$EDLit$ = Environmental Disclosure Index of firm i at time t

$LEVit$ = Leverage of firm i at time t

$SIZit$ = Size of firm i at time t

$LIQit$ = Liquidity of firm i at time t

$FBRit$ = Female Board Representation of firm i at time t

μ_{it} = Error term

$\beta_1 - \beta_3$ = Coefficients to be estimated

μ = Error term

Data analysis involved both descriptive and inferential statistics. Descriptive statistics provided an overview of the dataset, including measures of central tendency and dispersion. Inferential statistics, specifically panel regression analysis, were employed to assess the relationships between firm traits, female board representation, and corporate environmental responsibility. The Moderated Panel Least Squares regression technique was used to test the hypotheses, accounting for both time-specific and firm-specific effects. The following table outlines the expected signs for the variables:

Table 3.5: A Priori Expectations

Variable	Expected Sign	Explanation
Leverage	-	High leverage may decrease environmental disclosures due to financial pressure.
Size	+	Larger firms are expected to have better environmental disclosures due to higher visibility and resources.
Liquidity	+	More liquidity allows firms to invest in corporate social responsibility initiatives.
Female Board Representation	+	A higher percentage of female board members is expected to positively influence environmental disclosure.

Source: Researcher's Compilation (2025)

The decision rule for hypothesis testing is based on the significance of the regression coefficients. The null hypothesis will be rejected if the p-value is less than 0.05, indicating a significant effect. If the p-value is greater than 0.05, the null hypothesis will be accepted, suggesting no significant effect.

4.0 Data Analyses and Discussion

4.1 Descriptive Analysis of Data

The descriptive analysis was conducted to summarise the data set collected. This was done to show the central tendency together with the dispersion.

Table 4.1 Descriptive Analysis

	<i>EDI</i>	<i>LEV</i>	<i>SIZ</i>	<i>LIQ</i>	<i>FBR</i>
Mean	1.606838	0.419759	7.159503	2.559334	0.218686
Maximum	4.000000	0.872973	9.715570	36.41061	0.600000
Minimum	0.000000	0.028268	5.973871	0.220739	0.000000
Std. Dev.	0.955540	0.186673	1.065667	4.372291	0.166714
Skewness	0.258359	-0.006250	0.955228	5.815872	0.398062
Kurtosis	2.669160	3.112736	2.451862	41.04411	2.361773
Jarque-Bera	1.835204	0.062720	19.25770	7715.427	5.075596
Probability	0.399476	0.969127	0.000066	0.000000	0.079040
Observations	117	117	117	117	117

Source: Eviews 10 Statistical Output (2025)

The **Environmental Disclosure Index (EDI)**, measured using scores derived from the Global Reporting Initiative (GRI) indicators (see Table 3.4), has a mean score of 1.61. This suggests that, on average, firms disclosed slightly more than one out of the four environmental disclosure indicators considered. The maximum score of 4.00 indicates that some firms fully disclosed all four GRI elements—effluents and waste, biodiversity, emissions, and occupational health and safety—while the minimum score of 0 shows that some firms provided no environmental disclosures at all. The standard deviation of 0.96 implies moderate variation in disclosure levels across firms. The skewness (0.26) shows a slight rightward tilt, indicating more firms disclosed fewer environmental items, while the kurtosis (2.67) suggests a distribution close to normal. The Jarque-Bera probability of 0.40 confirms the data for EDI is normally distributed, which supports the use of parametric tests in subsequent analyses.

Firm Leverage (LEV), defined as total liabilities divided by total assets, has a mean of 0.42, indicating that, on average, 42% of firm assets are financed by liabilities. The range spans from

a minimum of 0.03 to a maximum of 0.87, showing wide variability in how firms use debt in their capital structure. The standard deviation of 0.19 reflects moderate dispersion around the mean. With a skewness close to zero (-0.006), the distribution is nearly symmetrical, and a kurtosis of 3.11 suggests a mesokurtic (normal) distribution. The Jarque-Bera p-value of 0.97 further confirms normality, suggesting no concern for extreme values in leverage.

Firm Size (SIZ), measured as the natural logarithm of total assets, has a mean of 7.16, implying that most firms in the sample are of moderate size. The firm sizes range from 5.97 to 9.72, indicating significant differences in asset base across companies. The standard deviation of 1.07 indicates a reasonable spread in firm sizes. A skewness of 0.96 shows a right-skewed distribution, meaning a few firms are considerably larger than the average. The kurtosis of 2.45 is slightly below normal, and the Jarque-Bera probability of 0.000066 indicates the variable is not normally distributed—likely due to the presence of very large firms.

Firm Liquidity (LIQ), calculated as current assets divided by current liabilities, shows a high mean of 2.56, suggesting that on average, firms have more than twice the current assets needed to cover their current liabilities, indicating strong short-term solvency. However, the maximum value of 36.41 compared to a minimum of 0.22 reveals extreme disparities in liquidity levels. The standard deviation of 4.37 confirms a very wide spread, and the high skewness of 5.82 indicates a long right tail, likely due to a few firms with exceptionally high liquidity. The kurtosis of 41.04 further confirms the presence of outliers and a highly peaked distribution. The Jarque-Bera probability of 0.0000 shows the liquidity data is not normally distributed and may require transformation or robust techniques in regression analysis.

Female Board Representation (FBR), measured as the number of female directors divided by the total number of board members, has a mean of 0.22, indicating that women occupy about 22% of board seats on average. The values range from 0.00 (no female representation) to 0.60 (60% female representation), suggesting considerable variation in gender diversity across firms. The standard deviation of 0.17 shows moderate variability. The distribution is slightly skewed to the right (0.40), implying more firms with lower female representation, and the kurtosis of 2.36 suggests a slightly flatter distribution than normal. The Jarque-Bera probability of 0.079 is above the 5% threshold, suggesting approximate normality in the distribution of female board representation.

4.2 Analysis of Research Questions

The correlational analysis presented in Table 4.2 examines the strength and direction of the linear relationships between the dependent variable, Environmental Disclosure Index (EDI), and the independent variables: firm leverage (LEV), firm size (SIZ), firm liquidity (LIQ), and female board representation (FBR). This analysis is vital as it offers preliminary hints on how firm-level characteristics and board gender diversity relate to environmental reporting practices among listed industrial goods firms in Nigeria. Although correlation does not establish causality (Aslam, 2015), it helps determine whether variables move together in a statistically significant manner (Rohrer, 2018), thus providing foundational support for subsequent regression analysis.

Table 4.2 Correlational Analysis

Correlational Analysis: Ordinary

Date: 04/17/25 Time: 21:05

Sample: 2012 2024

Included observations: 117

Correlation Probability	EDI	LEV	SIZ	LIQ	FBR
EDI	1.000000 -----				
LEV	0.102985 0.2692	1.000000 -----			
SIZ	0.156380 0.0922	-0.049112 0.5990	1.000000 -----		
LIQ	-0.200026 0.0306	-0.475266 0.0000	-0.258743 0.0049	1.000000 -----	
FBR	0.030377 0.7451	0.193230 0.0369	0.056483 0.5453	-0.068977 0.4599	1.000000 -----

Source: *Eviews 10 Statistical Output (2025)*

The correlation between **firm leverage (LEV)** and environmental disclosure (EDI) is weak and positive, with a coefficient of 0.103 and a p-value of 0.2692. This indicates that more leveraged firms tend to report slightly more environmental information, though the relationship is not statistically significant. The weak nature of the association suggests that firms' capital structures may not be a strong driver of their environmental disclosure behavior. This implies that debt obligations do not significantly motivate or hinder the adoption of transparent environmental reporting in the sampled firms.

The relationship between **firm size (SIZ)** and EDI is also positive, with a correlation coefficient of 0.156 and a p-value of 0.0922. While still statistically insignificant at the 5% level, the p-value is marginally close to the 10% threshold, suggesting a weak-to-moderate tendency for larger firms to disclose more environmental information. This finding aligns with the notion that larger firms face more public scrutiny and stakeholder pressure, which may push them toward greater transparency in their sustainability and environmental practices.

Conversely, **firm liquidity (LIQ)** shows a negative and statistically significant relationship with EDI, having a correlation coefficient of -0.200 and a p-value of 0.0306. This implies that firms with higher liquidity levels tend to disclose less environmental information. One possible interpretation is that highly liquid firms may not feel compelled to engage in extensive environmental disclosure, possibly due to fewer financial pressures or lesser stakeholder demands, or they might prioritize short-term financial management over long-term environmental reporting.

Lastly, **female board representation (FBR)** has a very weak positive correlation with EDI, with a coefficient of just 0.030 and a high p-value of 0.7451. This suggests no significant linear relationship between the proportion of women on boards and the extent of environmental disclosure in the sampled firms. Despite the growing global emphasis on gender-diverse

leadership and its potential influence on sustainability reporting, the result indicates that in the Nigerian industrial goods sector, female board presence alone may not be sufficient to drive environmental transparency. However, this variable's potential moderating role could still emerge in later regression models.

4.2.2 Unmoderated Regression Analysis

The results presented in Table 4.3 reveals the effect of firm-level characteristics—namely, leverage, size, and liquidity—on the environmental disclosure index (EDI) of listed industrial goods firms in Nigeria for the period 2012 to 2024. The regression was estimated using the Panel EGLS method with cross-section SUR, which is appropriate for correcting any contemporaneous correlation and heteroskedasticity across firms. The unmoderated regression model is rested below:

$$EDLit = \alpha_0 + \beta_1 LEV_{it} + \beta_2 SIZ_{it} + \beta_3 LIQ_{it} + \mu_{it}$$

Table 4.3 Unmoderated Panel Regression Analysis

Dependent Variable: EDI

Method: Panel EGLS (Cross-section SUR)

Date: 04/04/25 Time: 20:40

Sample: 2012 2024

Periods included: 13

Cross-sections included: 9

Total panel (balanced) observations: 117

Linear estimation after one-step weighting matrix

Cross-section SUR (PCSE) standard errors & covariance (d.f. corrected)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LEV	0.146321	0.021920	6.675322	0.0000
SIZ	0.098551	0.005064	19.46154	0.0000
LIQ	-0.016937	0.003260	-5.195765	0.0000
C	0.894254	0.038681	23.11888	0.0000
Weighted Statistics				
R-squared	0.775329	Mean dependent var		35.72244
Adjusted R-squared	0.769364	S.D. dependent var		58.46205
S.E. of regression	0.915664	Sum squared resid		94.74375
F-statistic	129.9860	Durbin-Watson stat		1.677615
Prob(F-statistic)	0.000000			

Source: *Eviews 10 Statistical Output (2025)*

Table 4.3 above shows the output of the unmoderated regression. The coefficients represent the marginal effect of each explanatory variable on the EDI, while the probability values (p-values) indicate the significance of the effects at a 5% confidence level. In terms of model validity, the Adjusted R-squared value is 0.7694, indicating that approximately 77% of the variation in the environmental disclosure index is explained by the firm-level traits (leverage, size, and liquidity). This shows a high explanatory power of the model. Additionally, the Prob(F-statistic) is 0.0000, which confirms that the overall model is statistically significant and reliable for making inferences. In other words, the joint effect of the explanatory variables on EDI is not due to chance. The constant term (C) has a coefficient of 0.8943 and is significant

at the 5% level (p-value = 0.0000), implying that when all independent variables are zero, the baseline level of environmental disclosure is 0.894. While this is more of a model calibration figure, it helps contextualize the baseline from which the effects of the independent variables adjust the dependent variable. Beginning with firm leverage (LEV), the coefficient value of 0.1463 suggests that a unit increase in leverage (i.e., increase in the debt-to-assets ratio) marginally increased the environmental disclosure index by approximately 0.15 units, holding other variables constant. This effect is statistically significant at the 5% level, as indicated by the p-value of 0.0000. The result implies that more leveraged firms in the industrial goods sector in Nigeria tended to disclose more environmental information, possibly as a way to legitimize their operations or signal transparency to lenders and stakeholders.

For firm size (SIZ), the coefficient is 0.0986, indicating that a unit increase in firm size (as measured by the natural logarithm of total assets) led to a 0.10 unit increase in the environmental disclosure index, all else being equal. The p-value of 0.0000 confirms that this effect is statistically significant. The positive effect aligns with the expectation that larger firms are more visible and exposed to stakeholder pressures, which compels them to adopt broader and more comprehensive environmental reporting practices to maintain legitimacy and public image. Regarding firm liquidity (LIQ), the coefficient of -0.0169 reveals a negative effect on EDI. This means that for every unit increase in liquidity (i.e., the current asset-to-liability ratio), the environmental disclosure index decreased by approximately 0.017 units. This effect is also statistically significant at the 5% level with a p-value of 0.0000. The negative relationship suggests that more liquid firms may deprioritize environmental disclosure, perhaps due to lower financing constraints or less perceived need to signal responsible behavior through sustainability disclosures. Hence, the unmoderated regression analysis reveals that: firm leverage had a positive and significant effect on environmental disclosure ($\beta = 0.1463$; $p = 0.0000$); firm size had a positive and significant effect on environmental disclosure ($\beta = 0.0986$; $p = 0.0000$); firm liquidity had a negative and significant effect on environmental disclosure ($\beta = -0.0169$; $p = 0.0000$).

4.3 Test of Hypotheses

The main aim of the study is to establish the moderating effect of female board representation in the relationship between firm-level traits and environmental responsibility. To achieve this, the unmoderated regression was merely interpreted without using it to test the hypotheses. Thus, Table 4.4 below provides basis for the test of hypotheses from which findings and consequent recommendations would emanate.

The moderated regression model is presented below:

$$EDI_{it} = \alpha_0 + \beta_1(LEV_{it} \times FBR_{it}) + \beta_2(SIZ_{it} \times FBR_{it}) + \beta_3(LIQ_{it} \times FBR_{it}) + \mu_{it}$$

Table 4.4 Test of Hypotheses Using Moderated Panel Regression

Dependent Variable: EDI

Method: Panel EGLS (Cross-section SUR)

Date: 04/04/25 Time: 20:39

Sample: 2012 2024

Periods included: 13

Cross-sections included: 9

Total panel (balanced) observations: 117

Linear estimation after one-step weighting matrix

Cross-section SUR (PCSE) standard errors & covariance (d.f. corrected)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
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LEV*FBR	-0.155821	0.063454	-2.455642	0.0156
SIZ*FBR	0.043984	0.006178	7.120016	0.0000
LIQ*FBR	-0.124478	0.015713	-7.922110	0.0000
C	1.629732	0.002347	694.2998	0.0000
Weighted Statistics				
R-squared	0.350219	Mean dependent var	30.65383	
Adjusted R-squared	0.332968	S.D. dependent var	67.91853	
S.E. of regression	0.841626	Sum squared resid	80.04178	
F-statistic	20.30157	Durbin-Watson stat	1.576950	
Prob(F-statistic)	0.000000			

Source: *Eviews 10 Statistical Output (2025)*

The moderated regression results presented in Table 4.4 assess the effect of the interaction between female board representation and firm-specific attributes (leverage, size, and liquidity) on the environmental disclosure index (EDI) of listed industrial goods firms in Nigeria from 2012 to 2024. This analysis helps evaluate whether the inclusion of female directors on boards alters the extent to which these firm-level traits influence environmental disclosures. Each interaction term represents the marginal effect of a firm characteristic on EDI when moderated by the presence of women on the board.

The Adjusted R-squared of 0.3330 indicates that the interaction model explains approximately 33.3% of the variation in environmental disclosure index, which, while moderate, still suggests a meaningful level of explanatory power for models involving interaction terms. The Prob(F-statistic) is 0.0000, confirming that the overall model is statistically significant. This validates the inclusion of female board representation as a meaningful moderator in the model, affecting how firm characteristics influence environmental disclosure.

The constant term (C) in Table 4.4 has a coefficient of 1.6297 and is statistically significant at the 5% level ($p = 0.0000$). This implies that when all the explanatory variables—namely, the interaction terms between firm leverage, size, liquidity, and female board representation—are held at zero, the baseline environmental disclosure index (EDI) is expected to be approximately 1.63 units. In practical terms, this constant reflects the average level of environmental disclosure in listed industrial goods firms in Nigeria in the absence of moderating effects from female board representation on firm characteristics.

4.3.1 Test of Hypothesis I

H01. Female board representation has no significant moderating effect on the relationship between firm leverage and environmental disclosure index of listed industrial goods firms in Nigeria.

The interaction between firm leverage and female board representation (LEV*FBR) produced a coefficient of -0.1558, indicating that for every additional unit of leverage, the presence of female board members reduced the environmental disclosure index by approximately 0.156 units, all else being equal. This negative effect is statistically significant at the 5% level, as shown by the p-value of 0.0156. This suggests that the presence of women on the board significantly weakened the positive effect that leverage alone had on environmental disclosures. It implies that leveraged firms with higher female board participation may focus on financial caution or governance compliance rather than using environmental disclosures as signaling tools. Therefore, H01 is rejected. In other words, the alternate hypotheses was accepted, which implies that Female board representation has a negative and significant

moderating effect on the effect of firm leverage on environmental disclosure index of listed industrial goods firms in Nigeria ($\beta = -0.1558$; $p = 0.0156$).

4.3.2 Test of Hypothesis II

H02. Female board representation does not significantly moderate the relationship between firm size and environmental disclosure index of listed industrial goods firms in Nigeria.

The coefficient of the interaction term between firm size and female board representation (SIZ*FBR) is 0.0440, implying that for each unit increase in firm size, the effect on environmental disclosure index is enhanced by approximately 0.044 units when moderated by female board representation. This positive effect is statistically significant at the 5% level, with a p-value of 0.0000. This indicates that the presence of female directors strengthened the positive effect of firm size on EDI, possibly because larger firms with diverse boards are more responsive to stakeholder expectations and are more committed to sustainability practices. Thus, H02 is rejected. In other words, the alternate hypotheses was accepted, which implies that Female board representation has a positive and significant moderating effect on the effect of firm size on environmental disclosure index of listed industrial goods firms in Nigeria ($\beta = 0.0440$; $p = 0.0000$).

4.3.3 Test of Hypothesis III

H03. Female board representation has no significant moderating effect on the relationship between firm liquidity and environmental disclosure index of listed industrial goods firms in Nigeria. The interaction term between firm liquidity and female board representation (LIQ*FBR) has a coefficient of -0.1245, indicating that an increase in liquidity reduced the environmental disclosure index by approximately 0.124 units in the presence of female board members. This effect is statistically significant at the 5% level, as denoted by the p-value of 0.0000. This suggests that when firms have strong liquidity positions, the presence of female directors tends to diminish the positive effect liquidity might otherwise have had on environmental reporting. It may be that highly liquid firms, guided by cautious or risk-averse female board perspectives, allocate resources more conservatively and prioritize core financial stability over expanded disclosures. Hence, H03 is rejected. In other words, the alternate hypotheses were accepted, which implies that Female board representation has a negative and significant moderating effect on the effect of firm liquidity on environmental disclosure index of listed industrial goods firms in Nigeria ($\beta = -0.1245$; $p = 0.0000$).

4.4 Discussion of Findings

The first major finding reveals that female board representation exerts a negative and significant moderating effect on the effect of firm leverage on environmental disclosure among listed industrial goods firms in Nigeria ($\beta = -0.1558$; $p = 0.0156$). This suggests that when female board presence is high, the otherwise positive effect of leverage on environmental disclosure diminishes. A possible explanation for this could be that female board members, often perceived as risk-averse and ethically inclined, may discourage over-leveraged firms from engaging in extensive environmental disclosures if such efforts are deemed financially burdensome or strategic rather than genuine. In highly leveraged situations, women may prioritize financial health over expansive sustainability communication, tempering the aggressive disclosure behavior typically expected from highly leveraged firms. This finding aligns with the study by Zhu, Osei, and Agyemang (2024), which documented a negative relationship between gender diversity and environmental disclosure in Sub-Saharan African manufacturing firms. Similarly, Okafor, Egbunike, and Amahalu (2022) found that while leverage positively influences effluent disclosure, it may not always align with board-level

gender dynamics. However, it disagrees with Salawu et al. (2021) and Nworie et al. (2022), who reported that leverage positively influences disclosure and did not find female representation as a constraint. Interestingly, Maggi et al. (2023) observed that gender diversity enhances disclosure, which contrasts with this study's moderated result, suggesting that the interplay between leverage and gender diversity might be context-dependent and industry-specific. The second finding indicates that female board representation positively and significantly moderates the effect of firm size on environmental disclosure ($\beta = 0.0440$; $p = 0.0000$). This implies that as the size of a firm increases, the presence of women on the board further enhances the firm's commitment to environmental disclosure. This outcome could be attributed to the synergy between large firms' resources and female directors' ethical orientation, which jointly promote sustainable and transparent corporate practices. Female directors may leverage the financial and structural capabilities of large firms to push for better sustainability standards and environmental reporting. Empirically, this result finds strong support in Sabiya et al. (2024), who observed that firm size strengthens the positive influence of female board members on environmental disclosure in the Nigerian oil and gas sector. Also, Aimuyedo et al. (2023) in Nigeria's industrial goods sector found that gender diversity positively influences disclosure, especially in larger, more mature firms. Further corroborating studies include Moshud et al. (2021) and Benjamin et al. (2017), both of which noted a positive linkage between size and environmental reporting. Amahalu (2019) also concluded that firm size, alongside female board presence, positively affects environmental performance in the Nigerian context. The third finding shows that female board representation negatively and significantly moderates the effect of firm liquidity on environmental disclosure ($\beta = -0.1245$; $p = 0.0000$). This means that while liquidity on its own may allow firms the flexibility to fund environmental initiatives, the presence of female directors tempers this effect. One explanation could be that female directors, being financially prudent, may advocate for more strategic use of liquid resources, directing them toward essential operations instead of extensive disclosure, especially if such disclosures are not mandated by regulation. This may suggest a conservative approach to spending liquid assets on voluntary environmental reporting. This outcome resonates with the findings of Zhu et al. (2024), where gender diversity was associated with reduced environmental disclosure, potentially due to cautious governance styles. It also partially agrees with Ayuba et al. (2024), who found that while liquidity influences sustainability reporting, the influence may not always be enhanced by board composition. On the other hand, Abdelazim et al. (2023) concluded that female board presence enhances disclosure, even in financially flexible firms, which stands in contrast to this finding. Similarly, Maggi et al. (2023) emphasized the enhancing role of gender diversity, highlighting potential sectoral or cultural variances across study contexts.

5.0 Conclusion and Recommendations

Environmentally responsible firms strive to balance profitability with environmental and social obligations, a standard especially critical for industrial firms due to the nature of their operations. While traits like liquidity, high leverage, and small size can influence environmental efforts, diverse boards—particularly with female representation—are ideally positioned to enhance ethical decision-making, transparency, and sustainability alignment. However, the findings from this study revealed the subtle role of female board representation in shaping the environmental disclosure behavior of industrial goods firms. The statistically significant moderating effects suggest that female representation on corporate boards does not uniformly influence how firm-specific attributes translate into environmental disclosure outcomes. Instead, the presence of female directors introduces both amplifying and attenuating dynamics depending on the attribute in question. This complexity reflects the multidimensional

nature of board governance, where female directors may simultaneously advocate for ethical reporting, strategic financial management, and prudent resource allocation. These dynamics highlight that female representation on boards interacts with internal firm characteristics in ways that can either promote or restrain environmental transparency.

Furthermore, the mixed moderating effects suggest that the influence of board gender composition is context-sensitive and deeply intertwined with operational and financial realities. While larger firms may benefit from female directors' support for greater transparency due to broader stakeholder visibility, firms with high liquidity or leverage may experience more restrained disclosure practices, potentially due to the cautious and conservative financial perspectives often associated with female board members. These implications contribute to the growing discourse on the importance of internal governance structures and their differentiated impacts across firm conditions, highlighting the significance of understanding how gender diversity determines corporate environmental behavior in varying organizational and financial contexts.

Thus, the study recommended that:

1. Female board appointments should prioritize individuals with expertise in financial risk management and sustainability reporting to effectively mitigate the negative moderating effect of leverage on environmental disclosure.
2. The Nigerian Securities and Exchange Commission should develop a policy framework that encourages large firms to strengthen the influence of female board members by integrating size-driven board diversity strategies that enhance transparency in environmental disclosure.
3. The executive management teams of financially liquid industrial goods firms should establish a structured capacity-building programmes to equip female directors with decision-making tools that align liquidity management with proactive environmental reporting.

5.1 Contribution to Knowledge

This study contributes to the existing literature by addressing a critical gap concerning the moderating role of female board representation on the relationship between firm-level characteristics and corporate environmental responsibility. Unlike previous studies that have independently examined the effects of firm leverage, size, and liquidity on environmental disclosure (e.g., Okorie et al., 2024; Ayuba et al., 2024; Okafor et al., 2022), or those that explored board gender diversity without assessing its interaction with these firm traits (e.g., Sabiya et al., 2024; Zhu et al., 2024; Mbonu & Okoye, 2023), this research uniquely investigates how female board representation conditions these relationships within the context of listed industrial goods firms in Nigeria. By focusing on sector-specific dynamics and employing a moderation framework, the study offers novel hints into the intersection of gender diversity and firm attributes in shaping environmental disclosure practices, thereby extending the frontiers of corporate governance and sustainability disclosure literature.

5.2 Limitations of the Study and Suggestions for Further Studies

A major limitation of this study is that it focused only on listed industrial goods firms in Nigeria, which means the results may not apply to companies in other sectors or countries. Also, the study only looked at three firm traits—leverage, size, and liquidity—so it did not consider other factors like profitability, board independence, or ownership structure that might also affect environmental disclosure. Lastly, the study used secondary data from financial and sustainability reports, which may sometimes lack full details or consistency across firms. Future researchers can expand this study by including more sectors beyond industrial goods, such as financial services, oil and gas, or consumer goods, to see if the findings hold across

different industries. They could also explore other firm characteristics like profitability, firm age, or board structure. In addition, future studies might look into how other types of board diversity—like age or education level—affect environmental responsibility, and they could use interviews or surveys to gather more in-depth information from the firms themselves.

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