

Examining How Green Finance and Investments Drive Sustainable Performance in Nigerian Manufacturing Industries

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Abstract

This study investigates how green investment and green finance affect the sustainable business performance of listed manufacturing firms in Nigeria. Using an ex-post facto design, the research analysed secondary data from 35 companies over ten years (2015–2024), totalling 350 firm-year observations. Data came from audited annual reports and sustainability reports. The study analysed descriptive statistics, correlation, Random Effects GLS regression, and Panel Corrected Standard Errors for robustness. The findings reveal that both green investment and green finance have a positive and significant influence on sustainable business performance. Their relative effects vary across estimation methods, indicating that both are important. Manufacturing firms should treat green finance and internal green investment as complementary strategies. Policymakers should develop green finance infrastructure and tighten environmental regulations to encourage sustainable practices. Overall, this paper provides longitudinal evidence from Africa's largest economy, showing that green capital allocations are strategic drivers of sustainability, not unrecoverable costs.

Keywords: Green Finance; Green Investment; Manufacturing Firms; Nigeria; Sustainable Business Performance.

1. Introduction

Sustainability has become an essential element of business operations (Dentchev et al., 2016). In light of environmental concerns, stringent regulations, and corporate social responsibility, sustainability has found place in contemporary business practices (Haladu & Lawan, 2024). The objective is broader than just establishing occasional eco-friendliness, but securing long-term competitiveness and global value creation (Carp et al., 2019; Hahn & Kühnen, 2013). The technology and the trends worldwide are aimed at stakeholders' sustainability and have taken bold steps towards reducing climate risks (Zheng et al., 2022). Green investment and green finance have gained global recognition as a vital tool to mitigate

environmental degradation and sustain development. Firms using these tools are no longer limited by the traditional profit maximisation models and can effectively fulfil broader social responsibilities, achieve global standards, and ensure long-term sustainability (Ullah et al., 2022; Tran et al., 2020). Green investment refers to the allocation of public and private funds towards initiatives that are intended to protect and sustain the environment (Khan et al., 2022; Rokhmawati, 2021), thus aligning their growth trajectory with their desired objectives. Meanwhile, green finance refers to financial markets and certain products, such as green bonds, eco-loans, climate grants, and sustainability-linked stocks (Wang & Zhi, 2022; Li et al.,

2022). By investing in these financial instruments, corporations aim to finance their environmental projects, including renewable energy systems, pollution control schemes, and sustainable infrastructure (Afum et al., 2021).

The manufacturing sector in Nigeria is among the pillars of economic advancement as it contributed 34.39 and 36.59 per cent of the Gross Domestic Product (GDP) in 2022 and 2023, respectively (Nigerian Bureau of Statistics, 2023). Nevertheless, heavy industry activities have led to disastrous challenges, for instance, resource depletion, environmental degradation and a social accountability deficit, which is often due to extensive industrial activities that contribute adversely to resource overuse and coastal ecological degradation in the Niger Delta (Uwaoma & Ordu, 2016). This is why the emergence of green finance practice is perceived to be mostly necessary to reverse the heavy industrialisation outcome. Although the green finance policy in Nigeria has been on a steady progression, creating facilitation for banks and financial institutions that, in turn, enhance risk management and resource allocation to innovative sectors (Rehman et al., 2021), only a thin channel is created for utilisation across the entire manufacturing sector. The green finance practice is also interesting to foster accountability through green consumption and production education (Olaoye & Alao, 2022); yet, there still exist some bottlenecks in the implementation. Industries across several sectors, including cement, steel, textile, power, oil and gas, chemicals, etc., are seen as the main culprits behind the widespread pollution (Lin et al., 2020; Khairunnesa et al., 2021), hence contributing to the domestic environmental crisis in the form of floods, desertification, oil spills, and water contamination, among others (Fasesin et al., 2022).

Despite environmental regulations, enforcement and corporate accountability is still weak. Using green finance methods is hampered by awareness, weak capital markets, regulatory uncertainty and lack of incentives for adoption (Dong & Li, 2019; Rehman et al., 2021). Therefore, many manufacturing firms continue to depend on traditional financing methods and overlook green investment possibilities (Okere, 2017). Moreover, the empirical literature concerning the relationship between green investment and sustainable business performance remains ambiguous. Even though many studies demonstrate a significant positive relationship (Cheema et al., 2017; Chariri et al., 2019; Zhu et al., 2020; Shafique & Majeed, 2020; Zhang et al., 2021; Katsikeas et al., 2021; Zheng et al., 2022; Ye & Dela, 2023), otherwise, it reports that these results vary from one enterprise to another and they are determined by unexplored environmental variables, respectively, in developing countries such as Nigeria (Okere, 2017; Shaumya & Arulrajah, 2017; Risal & Joshi, 2018; Kala & Vidyakala, 2020; Ngwenya & Simatele, 2020; Xi et al., 2021). Based on these research gaps, the following research questions were posed: How does green investment influence the sustainable business performance of listed manufacturing firms in Nigeria?

How does green finance influence sustainable business performance of listed manufacturing firms in Nigeria?

The main objective of this study is to explore the influence of green investment and green finance on the sustainable business performance of manufacturing firms in Nigeria. The objectives are to:

- (1) Examine the effect of green investment on the sustainable business performance of listed manufacturing firms in Nigeria.
- (2) Investigate the effect of green finance on the sustainable business performance of listed manufacturing firms in Nigeria.

H₀₁: Green investment does not significantly affect the sustainable business performance of Nigerian listed manufacturing firms.

H₀₂: Green finance does not significantly contribute to the sustainable business performance of Nigerian listed manufacturing firms.

This paper provides a systematic template for manufacturing executives to depart from the conventional manufacturing processes, along with a provable link between the greenification of the production processes and business performance. It also provides empirical evidence for Nigerian regulators such as Nigerian Exchange Group and Central Bank of Nigeria to prescribe green reporting guidelines for their respective sectors. Additionally, it also provides direct support for the United Nations Sustainable Development Goals, i.e. Goal 7 (Affordable and Clean Energy), Goal 9 (Industry, Innovation and Infrastructure), Goal 12 (Responsible Consumption and Production), and Goal.

2. Literature review

2.1.1 Green investment

According to previous studies, green investment mainly refers to the public or private procurement of activities and projects related to the environment (Tran et al., 2020; Rokhmawati, 2021). These activities can involve a wide range of measures, from protecting biodiversity and reducing the emission of carbon to constructing green buildings. In all these measures, the source of capital used for these purposes is deliberately diverted from one type of economic activity to another with the long-term interest of both the environment and socio-economic development. While purely benevolent, Zhang et al. (2024) argue that these investments also do the work of creating and strengthening trust between companies and stakeholders by reducing energy

consumption and the emissions of greenhouse gases, thereby reducing the environmental harmful effects of business activities. Manufacturing firms in Nigeria regularly report on their investments in waste management, the adoption of clean technologies, sustainable procurement and pollution reduction.

Green investment can be initially understood in this common sense, with many scholars giving complementary concepts and definitions to green investment, such as Eyraud, Wane, Zhang and Clements (2011) defined it narrow as “the investment of capital needed to reduce the emission of greenhouse gases and air pollutants without sacrificing the output of non-energy goods, with specific emphasis on renewable energy, energy efficiency and carbon capture”, the OECD likewise has set out broad definitions of green investment in terms of infrastructure investments, including those in the areas of renewable energy, water treatment, transport and housing. As well as that in the sustainable use of natural resources. Moreover, recent scholars have widened the scope to include investment in intellectual property and technological innovation to reduce human impact on environmental degradation, thereby recognising knowledge as a kind of physical infrastructure. Recently, green investment has been increasingly conceptualised as an investment of capital that has a positive impact on the environment, and also creates a positive return on investment for investors. To do good and well.

2.1.2 Green Finance

Green finance is a financial construction that steers financial flows towards environmentally benign and sustainable purposes (Zhang et al., 2024). Practically, it is represented by green loans and green bonds issued by governments, banks and firms to finance environmentally sustainable projects. Green finance also

includes the build-up of capital for green power, low-carbon transport and sustainable buildings. In their work, the Global Commission on the Economy and Climate shows that green finance is one of the key drivers to increase green capital. Comparing banks, funds and stock markets, firms that invest in sustainability deliver better results than their peers (Eccles & Serafeim, 2013).

However, there is no single definition. The G20 (2016) briefly defines green finance as “financing investment that generates environmental benefits in the larger context of environmentally sustainable development” and emphasises risk management and the mobilisation of private capital. The United Nations Environment Programme (UNEP) points out, from a profitability perspective, that green financing is a profitable and environmentally sustainable investment in technologies, infrastructure and assets. A more detailed approach can be found in Höhne, Khosla Fekete and Gilbert (2012), who define green finance as “financial flows towards sustainable development projects, environmental products and supportive policies” encompassing much more than only climate issues (i.e. water, sanitation, pollution, biodiversity). The Green Finance Platform presents the definition of green finance as “any financial instrument with proceeds that are used in a way to promote a green economic transformation, channelling capital into low-carbon, inclusive and sustainable pathways and favouring a long-term thinking consistent with the material priorities of the UN Sustainable Development Goals.”

2.1.3 Sustainability of business performance

Sustainability is a concept that is associated with the notion of sustaining well-being at a certain level over a certain period of time, preferably for an infinite time (Zimmermann, 2019). A

comprehensive assessment of a firm's activities concerning its total sustainability should also be taken into account for all aspects that contribute to the long-term sustainability and viability of the business. Zimmermann (2019) also says that strategic sustainability efforts for a company are conscious planning for long-term economic, ecological and social benefit within the corporation. The Global Reporting Initiative (GRI) provides a framework for sustainability reporting and includes the use of the GRI Standards (Universal, Sector, and Topic Standards (emissions, energy, labour, governance)), facilitating companies to quantify and report performance (GRI, 2022).

Many different viewpoints exist which add to our knowledge of this concept. Elkington (1998) proposed what proved to be the most long-standing one. The Triple Bottom Line is frequently used to measure corporate performance under three mutually interdependent pillars, namely economic prosperity, planetary health or environmental integrity, and social equity. The Teitz (2007) perspective uses the definition of sustainable performance as the firm's ability to produce economic productivity, social responsibility and environmental efficiency simultaneously. Another one gives a different perspective on sustainable performance. It is the firm's ability to protect the interconnectedness of its operations whilst simultaneously managing conflicting economic, environmental, and social concerns (Barlow, 2009). Similarly, the Greenpath (2005) provides a definition taking into account a theoretical approach-to sustainable performance-centers around the firm creating value for their external encompassing ecosystem, including the well-being of employees, local communities, and the natural environment, to support the firm's long-term success from a stakeholder theory perspective. Still another provides a new interpretation.

Sustainable business performance can be measured by quantifying the use of resources, the extent of pollution, the standards of labour, and the impacts on communities, indicating a significant departure from the sole focus on financial measures. And for the GRI framework, sustainable business performance is defined as the measurement of resource efficiency and pollution reduction in the context of financial performance, and considering both the impacts of the firm's activities on people (world) and on Earth's capacity to support them (planet). It is made possible by providing standardised indicators with which a company's sustainability performance can be quantitatively measured in all three pillars of sustainability.

2.2 Theoretical Framework

2.2.1 Stakeholder Theory

The stakeholder theory emerges to address the limitations of the agency theory that solely concentrates on protecting the interests of shareholders (Umar et al., 2024). The Stakeholder Theory, as originally conceptualised by Freeman (1984), is underpinned by the premise that businesses ought to engage in business activities in equitable ways and reasonably advance the interests and expectations of all parties associated with such businesses (Freeman et al., 2021; Kolawole et al., 2023). These parties include employees, managers, financiers, shareholders, suppliers, customers, host communities, relevant authorities, and government agencies. Therefore, this theory ensures that the interests of the entire stakeholders that have indirect or indirect contact with the companies are protected (Umar, 2024). The theory argues that companies that give priority to environmental issues are expected to have their financial performance and efficiency improved (Firmansyah et al., 2023).

Hence, this study considers stakeholder theory as a suitable framework to explore

green investment and green finance for sustainable business performance in the manufacturing sector in the Nigerian economy. Manufacturing companies have to look for a balance between profitability and responsible engagement with employees, host communities, the government, and the environment.

2.2.2 Sustainability Theory

The theory of sustainability presupposes that firms need to meet the needs of the current generation without jeopardising the needs of future generations (Zhang et al., 2022). Sustainability integrates economic, social, and environmental factors through the triple bottom line: people, planet, and profit. The theory states that every agent, whether corporate or not, must integrate activities that ensure the sustainability of the business, protect the environment, and act as good corporate citizens while ensuring financial viability.

In this research, the theory of sustainability is used as the basis to analyse green investment and green finance for sustainable business performance. It highlights the necessity for businesses to integrate environmentally friendly strategies to meet economic, social, and environmental challenges.

2.2.3 Stakeholder Legitimacy Theory and the Dual Pathway of Green Capital

The Stakeholder Theory explains why firms respond to stakeholder expectations, and Sustainability Theory explains what firms aim to achieve; Stakeholder Legitimacy Theory explains how firms signal their commitment to stakeholders and maintain their social license to operate. Legitimacy is the generalised perception that a firm's actions are desirable, proper, and appropriate within a socially constructed system of norms and values (Suchman, 1995). Firms that align their activities with stakeholder expectations gain legitimacy, which in turn enhances access to resources, reduces regulatory risk, and improves reputational capital

(Firmansyah et al., 2023; Umar et al., 2024).

A central insight of legitimacy theory is that firms can signal legitimacy through various channels, and these channels may have distinct effects on performance. In the context of green capital, two pathways emerge: internal green investment and external green finance. Each pathway signals legitimacy to different stakeholder audiences through distinct mechanisms.

Internal spending on pollution abatement, waste management, and clean technology signals substantive legitimacy: the firm is willing to sacrifice current profits for environmental improvement. This pathway primarily addresses regulators,

Conceptual Model (Framework)

Independent variables

Green Investment (GI)
Green Finance (GF)



Dependent variable

Sustainable Business
performance
(SBP)

Research Framework

2.3 Empirical Review

2.3.1 Green Finance and Sustainable Business Performance

Green finance, green bonds, green loans and a wide variety of other eco-friendly initiatives have become tools to promote sustainable conduct in corporations.

Risal and Joshi (2018) studied the impact of green banking operations on environmental performance in Nepal using a sample of 189 commercial bank respondents with a causal design. The findings revealed a significant and positive effect of employee, operational, and policy-based actions on environmental performance.

Zheng et al. (2021) investigated the nexus between green banking activities and environmental performance in Bangladesh through a cross-sectional survey of bankers with a sample of 302. The results showed that economic, social and environmental attributes of green finance had significant positive effect on bankers' outlook.

communities, and employees, who value demonstrable environmental commitment (Zhao et al., 2023; Haladu et al., 2025). Substantive legitimacy is earned through action; it is difficult to fake because it requires real resource allocation. However, the external capital raised through green bonds, green loans, and sustainability-linked instruments signals procedural legitimacy: the firm has been validated by external gatekeepers such as banks, investors, and rating agencies (Zhang et al., 2024). This pathway addresses a broader set of financial and international stakeholders, who require credible environmental commitments as a condition for capital provision.

Rehman et al. (2021) investigated the linkage between green banking activities and environmental performance in Pakistan by conducting a cross-sectional survey of 200 management-level respondents using purposive sampling. The results showed significant and positive effect of green banking operations, policies and investments on environmental performance.

Fasesin et al., (2022). among the selected institutions, as the study explored the interrelationship between green finance and environmental performance, where the authors used purposive sampling to select 150 senior managers. The results of the study indicated that green training and green technology exert a positive beneficial influence upon environmental performance. In contrast, green financing and green investment show significant positive relation upon environmental performance.

More recently, Appah and Tebepah (2025) found that the relationship between green financing and sustainable business performance is positive and statistically significant by analysing non-financial firms in Nigeria. Akinsowon et al. (2026) observed that green investment and green credit have a significant positive effect on sustainable development in Nigeria. The overall available evidence also indicates that access to green financing and green investment increases the probability of better sustainability outcomes. However, the study contexts and sustainability dimensions were different, suggesting that the green financing and sustainability relationship among firms needs to be estimated at a more granular level, such as within listed manufacturing firms.

2.3.2 Green investment and sustainable business performance

Green investment is one of the important factors for achieving sustainable success of organisations as organisations focus on implementing environmentally friendly practices in their operations.

In the study, Okere (2017). employed an ex post facto research design and panel regression analysis of secondary data to analyse the effect of environmental investment on financial performance of listed manufacturing companies in Nigeria. The study found that investment in staff welfare and training has positive and significant (statistical) impacts on the financial performance of the organisations. Joseph (2018) used a mixed-methods strategic approach to investigate the effect of green investment on the performance of organisations in the pulp and paper industry in Nigeria. The result of the study found that green investment is very useful in improving the performance of organisations and that organisations in the manufacturing sub-sector of this industry are more engaged in green investment than those in other developing economies.

Zhang and Berhe (2022) made use of a mixed-methods study employing primary and secondary data to investigate green marketing, green investment and business performance in Ethiopia. The results of the study exposed the significant (positive) impact of green investment on business performance.

Jianmu and Dela (2023) investigated the impact of green investment and green financing on the sustainable business performance of 238 foreign-owned chemical companies in Indonesia and found a positive impact of green investment and green financing on sustainable business performance.

3. Methodology

This research adopts an ex-post facto research design as used in previous studies (Owolabi, 2010; Okere, 2017 and Haladu 2019). The research employs a quantitative methodology using descriptive and explanatory techniques. The quantitative approach is convenient for using collected data to test hypotheses on the relationships between variables. The explanatory design enables an explanation of how and why green investment and green finance influence the sustainability of a business. This study covers all manufacturing companies listed on the Nigeria Exchange Group (NGX) Limited as of December 2024. These include companies from Consumer Goods, Industrial Goods, Health, and Oil and Gas sectors. The choice of the manufacturing sector enables us to capture all the companies that play an important role in industrial growth and have a major effect on the environment. Purposive sampling technique was used. A sample size was obtained from the total population of 48 manufacturing firms to represent the population size by meeting the following conditions:

1. Firms must have published annual reports for all the years 2015-2024.

2. Firms must not have been delisted during the study period.
3. The company's data required in constructing each variable must be readily available.

After applying these criteria to 48 manufacturing firms, the final sample includes 35 firms. This results in 350 firm-year observations, covering 35 firms over 10 years from 2015 to 2024.

Table 1: Sample Selection Procedure

Description	Number of Firms
Total listed manufacturing firms (NGX, 2024)	48
Less: Excluded – Listed after 2015	(3)
Less: Excluded – Mergers, Acquisitions, or Delisting	(6)
Less: Firms with incomplete data	(4)
Final Sample Size	35

The data for this study are purely secondary, drawn from the annual reports and accounts of selected companies from 2015 to 2024. Data were also obtained

from sustainability reports, the Nigerian Exchange Group (NGX) website, Company websites and National Bureau of Statistics (NBS) for macroeconomic data.

3.4 Variable Measurement

Table 2: Variable Measurement

Variable	Proxy	Measurement	Level	Source	Reference
Dependent Variable					
Sustainable Business Performance (SBP)	Sustainability disclosure score	GRI-based index (0–10) reflecting environmental, social, and economic disclosures	Firm level	Sustainability reports	Haladu et al. (2024); GRI (2022)
Independent Variables					
Green Investment (GIV)	Green investment disclosure level	Index (0–10) reflecting the extent of disclosure on pollution abatement costs and waste management costs	Firm level	Sustainability reports/ financial statements	Zhao et al. (2023)
Green Finance (GFN)	Green finance disclosure level	Index (0–10) reflecting the extent of disclosure on green bonds, green loans, and	Firm level	Annual reports/sustainability reports	Zhang et al. (2024)

sustainability-linked instruments

Source: Author's compilation (2026)

Based on the research objectives and hypotheses, the following model was established:

This model tests the direct impacts of green investment and green finance on sustainable business performance.

$$SBP_{it} = \beta_0 + \beta_1 GIV_{it} + \beta_2 GFN_{it} + \varepsilon_{it} \dots \dots \dots (1)$$

This research utilised multiple regression analysis techniques to identify and explain the relationships between independent variables (Green investment, Green finance) and the dependent variable (Sustainable business performance).

STATA 17.0 statistical package was employed in carrying out the data analysis. Descriptive statistics (mean, standard deviation, minimum, maximum, skewness, and kurtosis) were computed for all variables to describe the nature and distribution of the data.

Using Pearson correlation analysis, the pairwise correlation relationships between the variables were investigated in order to confirm that none of the variables is multicollinearity.

The following diagnostic tests were performed to select the most appropriate estimation technique:

Table 3 Test Description

Test	Description
Hausman specification test	Choose between Fixed and Random Effects
Breusch-Pagan Lagrangian Multiplier (LM) test	Choose between Pooled OLS and Random Effects
Pesaran CD test (xtcsd)	Detect cross-sectional dependence
Wooldridge test (xtserial)	Detect first-order autocorrelation
Modified Wald test (xttest3)	Detect heteroskedasticity

Based on the outcomes of the diagnostic tests:

- Random Effects GLS regression was used for the main SBP models
- Panel Corrected Standard Errors (xtpcse, hetonly) were used as a

robustness check against heteroskedasticity

4. Results Discussion

4.1 Descriptive Statistics

Table 4: Descriptive Statistics

Variable	Observations	Mean	Std. Dev.	Min	Max	Skewness	Kurtosis
SBP	350	5.7143	1.8132	0.0000	10.0000	-0.3304	2.7135
GIV	350	5.8600	1.8606	0.0000	10.0000	-0.8432	3.8647
GFN	350	6.1286	1.9851	0.0000	10.0000	-0.6076	3.4593

Source: STATA 17 Descriptive results (2026)

The Sustainable Business Performance (SBP) has a mean value of 5.7143, which can be interpreted as approximately 57.14% disclosure of sustainability items according to the GRI index, reflecting

moderate sustainability disclosures among the listed manufacturing firms in Nigeria. The minimum of 0 represents companies disclosing nothing on sustainability items, while 10 represents full disclosure.

Green Investment (GIV) has a mean of 5.8600 and standard deviation of 1.8606 (Max of 10 and Min of 0), indicating that Nigerian firms engage in green investment activities to a minimal degree. Green

Finance (GFN) has a mean of 6.1286 and a standard deviation of 1.9851, indicating that Nigerian enterprises reveal a greater utilisation of green finance instruments than green investment.

4.2 Correlation Analysis

Table 5: Correlation Matrix

Variable	SBP	GIV	GFN	VIF
SBP	1.0000			
GIV	0.4748*	1.0000		1.46
GFN	0.4958*	0.5619*	1.0000	1.46

Note: * indicates $p < 0.05$

Source: STATA 17 correlation results (2026)

The correlation results demonstrate a significant positive correlation between green investment and sustainable business performance (0.4748, $p < 0.001$). Green finance also has a positive and significant relationship with sustainable business performance (0.4958, $p < 0.001$). These findings imply that manufacturing firms that to a large extent use green investment and green finance instruments have better sustainability performance.

companies that invest are more likely to engage in green financial activities, but the relationship is not strong enough to cause severe multicollinearity.

The Variance Inflation Factor test was conducted to detect multicollinearity among the independent variables. A VIF value exceeding 5 is generally considered a moderate concern, while a value exceeding 10 indicates severe multicollinearity. In the above Table, both values are well below the critical threshold of 5.

Green investment has a moderately positive correlation with green finance (0.5619, $p < 0.001$). This shows that

4.3 Panel Data Diagnostics and Model Selection

4.3.1 Breusch and Pagan Lagrangian Multiplier (LM) Test

Table 6: Breusch-Pagan LM Test Results

Model	chibar2(01)	Prob > chibar2	Decision
SBP Model	172.59	0.0000	RE preferred over OLS

Source: STATA 17 LM result (2026)

The Breusch and Pagan LM test was conducted to test for the presence of random effects. The null hypothesis is that $\text{Var}(u) = 0$, meaning no panel-level

variance, and that pooled OLS is appropriate. The result shows a p-value of 0.0000, rejecting the null hypothesis and indicating that Random Effects is preferred over Pooled OLS.

4.3.2 Hausman Specification Test

Table 7 Hausman Test Results

Model	chi ²	df	Prob > chi ²	Decision
SBP Model	7.85	2	0.0197	Random Effects preferred

Source: STATA 17 Hausman result (2026)

The Hausman test was run to choose between fixed-effects and random-effects models. The null hypothesis is that the coefficient differences are not systematic and implies the use of random effects. The

p-value of 0.0197 is greater than 0.05, indicating that the null hypothesis cannot be rejected. Therefore, the random-effects model is preferred to the fixed-effects model.

4.3.3 Diagnostic Tests

Table 8 Heteroskedasticity, Autocorrelation, and Cross-Sectional Dependence Tests

Test	SBP Model
Heteroskedasticity (xttest3)	$\chi^2(35) = 251.06$, $p = 0.000$
Autocorrelation (xtserial)	$F(1,34) = 0.163$, $p = 0.689$
Cross-sectional Dependence (xtcsd)	Pesaran = 1.127, $p = 0.260$

Source: STATA 17 Diagnostic results (2026)

Results in Table 8 indicate that heteroskedasticity is present at the 1% significance level. Autocorrelation is not a concern for the SBP model ($p > 0.05$). Cross-sectional dependence is not a concern for the SBP model ($p > 0.05$). To address heteroskedasticity, the study applied random-effects regression with

robust standard errors, and Panel Corrected Standard Errors (xtpcse) as a robustness check.

4.5 Results of Regression

The random-effects regression results of the total effects of green investment and green finance on sustainable business performance are shown in Table 4.7

Table 9: Random Effects Regression Results

Dependent Variable: Sustainable Business Performance (SBP)

Variables	Coefficient	z-value	p-value
Green Investment (GIV)	0.1040	2.07	0.038
Green Finance (GFN)	0.1385	2.85	0.004
Constant	4.1917	11.87	0.000
Overall R ²	0.5141		
Within R ²	0.6285		
Between R ²	0.1947		
Wald chi ² (2)	47.26		
Prob > chi ²	0.0000		
Observations	350		
Number of Groups	35		

Source: STATA 17 regression results (2026)

The coefficient is 0.1040, and the p-value is 0.038, which is positive and statistically significant at the 5% significance level with sustainable business performance. A one-unit increase in green investment is associated with a 0.1040-unit improvement in sustainable company performance, all other variables unchanged. The research finds that Nigerian manufacturing firms with higher green expenditure (pollution abatement and waste management) are more likely to achieve higher sustainability performance. The coefficient value is 0.1385, and the p-value is 0.004, which shows that green finance has a strong and statistically significant correlation with sustainable business performance at 1% level of significance. A unit increase in

green finance is associated with a 0.1385 unit increase in sustainable business performance. The finding shows that manufacturing firms that use green financial instruments (green bonds, green loans, and sustainability-linked finance) are more likely to have much higher sustainable business performance.

4.6 Robustness Check (Panel Corrected Standard Errors)

To ensure the robustness of the findings for the SBP model, given the presence of heteroskedasticity, a Panel Corrected Standard Errors regression was conducted. This method produces standard errors that are consistent in the presence of panel-level heteroskedasticity.

Table 10: Robustness Check (xtpcse with Heteroskedastic Panels)
Dependent Variable: Sustainable Business Performance (SBP)

Variables	Coefficient	z-value	p-value
Green Investment (GIV)	0.1117	2.36	0.018
Green Finance (GFN)	0.1042	2.35	0.019
Constant	3.8943	8.61	0.000
R²	0.5431		
Wald chi ² (2)	18.69		
Prob > chi ²	0.0000		
Observations	350		
Number of Groups	35		

Source: STATA 17 regression results (2026)

The xtpcse results confirm the main findings from the random effects models. Green investment remains positive and significant (0.1117, $p = 0.018$). Green finance remains positive and significant (0.1042, $p = 0.019$). The estimated coefficients are of a similar order of magnitude as in the random-effects estimation and also share the same significance levels. Thus, the conclusion

about the main results is confirmed regarding robustness.

4.7 Discussion of Findings

The finding shows that green investment positively and significantly influences sustainable business performance ($\beta = 0.1040$, $p = 0.038$). This result is consistent with international evidence. Chariri et al. (2019) have reported a similar result in Indonesian manufacturing firms. Zheng et al. (2021) have reported a positive effect in Bangladeshi financial institutions. Zhang

and Berhe (2022) have reported a positive effect of green investment on business performance in Ethiopia. Jianmu and Dela (2023) have reported a positive effect of green investment on sustainable business performance in chemical firms in Indonesia.

From a stakeholder theory perspective (Freeman, 1984), the adoption of green investment sends positive signals of environmental responsibility to regulators, communities, and green consumers, who value environmental commitment. These signal corporate legitimacy. In Nigeria, manufacturing firms that proactively undertake environmentally responsible investments in pollution abatement, waste management, and the adoption of clean technologies in their production processes are likely to differentiate themselves from competitors in the Nigerian market and cope with forthcoming stricter environmental regulations. The significant positive relationship can also be explained through the sustainability theory. Green investment directly addresses the environmental pillar of the triple bottom line.

By investing in renewable energy, pollution control and waste management, the companies are lessening their environmental impact which is a dimension of sustainable performance. This study found a positive, and statistically significant relationship between green finance and sustainable

business performance ($\beta = 0.1385$, $p = 0.004$), in line with the findings of Rehman et al. (2021), Zheng et al. (2021) and Appah and Tebepah (2025). The green finance coefficient (0.1385) is higher than the green investment coefficient (0.1040), suggesting that external green finance might have a somewhat higher influence than the internal green investment, perhaps because external financing is a complement to internal financing. Green finance affords firms access to capital they would not have had otherwise, allowing them to carry out environmental projects without having to cut other operational requirements. Moreover, the availability of green finance products, the development of the Nigerian green bond market, and the Central Bank of Nigeria's sustainable banking principles have contributed to facilitating green financing among manufacturers in Nigeria. From a theoretical standpoint, green finance allows firms to meet the expectations of stakeholders for environmental responsibility. Banks, investors and regulators are increasingly requiring firms to show environmental responsibility, and green finance makes this possible. Green finance is a catalyst for businesses to move toward sustainable business models; from a sustainability theory perspective, green finance provides firms the resources they need to make the transition.

4.8 Summary of Hypothesis Testing

Table 11: Summary of Hypothesis Testing

Hypothesis	Statement	Decision	Evidence
H01	There is no significant relationship between green investment and sustainable business performance.	REJECTED	Model I: GIV = 0.1040, $p = 0.038$; xtpcse: GIV = 0.1117, $p = 0.018$
H02	Green finance does not significantly influence sustainable business performance.	REJECTED	Model I: GFN = 0.1385, $p = 0.004$; xtpcse: GFN = 0.1042, $p = 0.019$

Source: STATA 17 Regression result (2026)

Both null hypotheses are rejected, indicating that both green investment and green finance have significant positive effects on sustainable business performance.

5. Summary, Conclusion and Recommendations

5.1 Summary

This study examined how green investment (GIV) and green finance (GFN) impact sustainable business performance (SBP) in listed Nigerian manufacturing firms. Grounded in Stakeholder Theory and Sustainability Theory, it used an ex-post facto design. Secondary panel data came from annual and sustainability reports of 35 listed manufacturing companies from 2015 to 2024, totalling 350 firm-year observations. SBP was evaluated using a GRI disclosure index across environmental, social, and economic areas.

The main findings are:

1. **Extent of Green Practices:** Nigerian manufacturing firms showed moderate sustainability disclosures, with an average SBP score of 5.71 out of 10. Firms used external green finance mechanisms (mean = 6.13) slightly more than internal green investments (mean = 5.86).
2. **Impact of Green Investment:** Random Effects GLS regression showed that green investment has a positive, statistically significant effect on SBP ($\beta = 0.1040$, $p = 0.038$). Directing capital to pollution control, waste management, and clean technology significantly boosts corporate sustainability.
3. **Impact of Green Finance:** Green finance also showed a strong positive effect on SBP ($\beta = 0.1385$, $p = 0.004$). Its larger coefficient in the main model indicates that external green tools, such as green bonds and eco-loans, drive

corporate sustainability slightly more than internal funding.

4. **Model Fit and Robustness:** The constant term was 4.26%, which falls within the plausible 0–10 range of the dependent variable, confirming appropriate model specification. The model explained approximately 41.03% of the variation in sustainable business performance. Panel-corrected standard errors confirmed these positive effects for both green investment ($\beta = 0.1117$, $p = 0.018$) and green finance ($\beta = 0.1042$, $p = 0.019$) under heteroskedastic conditions. Both null hypotheses (H_{01} and H_{02}) were rejected.

5.2 Conclusion

This study examined the impact of green investment and green finance on the sustainable business performance of listed manufacturing firms in Nigeria. Based on the analysis of 35 listed manufacturing companies for the period 2015–2024, using 350 firm-year observations, a lot of conclusions are drawn. This study reveals that green investment plays a significant positive role in the sustainable business performance of listed manufacturing companies in Nigeria. Investments in pollution control, waste management, clean technology, and other sustainable environmental projects tend to enhance sustainable business performance among manufacturing firms. This effect was found to be stable under the various estimation techniques employed (random effects and xtpcse) and when controlling for green finance, firm characteristics, and macroeconomic variables. These results indicate that green investment is not a fair expenditure but a strategic investment associated with improved environmental and social performance. From a stakeholder theory perspective, investment in green practices provides legitimacy and support from environmental stakeholders (including the government, local

communities, and international markets). This is more important for Nigerian manufacturing corporations that face a dilemma of environmental degradation and escalating environmental regulation; green investments provide both compliance and competitive benefits.

Such findings suggest that green finance has positive impacts on the sustainable business performance of a firm's stakeholder groups. The coefficient for green finance is higher than that for green investment, indicating that external green financing is somewhat more effective than internal green investment. The results above further suggest that external green finance allows firms to allocate more financial resources towards environmental initiatives, the adoption of clean technologies, waste treatment plants, and better environmental company disclosure. Green finance is found to play a very important role in the sustainable business performance of Nigerian firms at the 1 per cent significance level, green finance being a very important determinant of sustainable business performance in Nigeria. The high level of support from the Sustainable Banking Principles, the Nigerian Green Bond Market Development Programme and the NGX sustainability disclosure guidelines provides impetus in terms of regulation and institutions.

5.3 Recommendations

This study reveals that green finance has a higher coefficient (0.1385) relative to green investment (0.1040) and may be used rather than using the company's own financial resources to invest the same amount. Managers should consider green bonds, green loans, and sustainability-linked financial instruments and their benefits, including additional funding that complements more than replaces the company's own financial resources; lower interest rates or other attractive financing terms; technical assistance; and improved

visibility to stakeholders due to reporting and validation requirements.

Overall, green investment has a coefficient of 0.1040, which is shown to have a positive impact on sustainable business performance, and this may be a sign that managers are valued in using green investments in reducing pollution, waste management and adopting clean technologies, with benefits arising from regulatory compliance and other competitive advantages. The policy implications include:

- a. The significant positive coefficient of green finance on sustainable business performance implies that government is required to develop green finance infrastructure in Nigeria. This includes promoting green bonds, providing corporate green bond issues in the market with necessary loans and guarantors; developing a National Green Finance roadmap and requirements; providing appropriate green loan support from the Central Bank of Nigeria; promoting sustainability-linked loans in an appropriate regulatory environment with the right incentives; disclosing Green Finance activities in company annual reports through the listing requirements of NGX and providing functional technical assistance.
- b. As green investment has a significant effect on green investment and sustainable business performance, this implies that environmental policy that provides incentives to firms' green investments has been good. Therefore, such policies should be strengthened by enforcing existing legislation; providing incentives such as tax incentives on green investment (accelerated pollution equipment depreciation); requiring Nigeria to have Environmental impact assessments on all newly built and operating manufacturing plants; reporting sustainability performance

with third-party verification and tightening the standard in accordance with global development.

5.4 Limitations and Suggestions for Future Research

- i. The binary scoring of green finance and green investment cannot accurately reflect the magnitude or value of these practices in firms.
- ii. The sample of 35 listed manufacturing firms may neglect the wide spectrum of SMEs and non-listed companies.
- iii. The study covers 2015-2024, which may not capture longer-term effects of green finance and green investment.

- iv. Future research should use continuous measures of actual monetary spending on green finance mechanisms and green investment.
- v. Increasing the sample by including unlisted firms, small and medium enterprises, and various industries would improve generalizability.
- vi. Comparative studies between Nigeria and other developing countries should be conducted in the future.
- vii. Additional factors such as corporate governance practices and external pressures can be added to the model.

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