Green Innovation and Sustainable Competitive Advantage in Nigeria: A Reconciliation Between Environmental Sustainability and Economic Competitiveness

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ABSTRACT

This study examines the effect of green innovation on sustainable competitive advantage in Nigeria over the period 1990–2025. The study is motivated by the growing need to reconcile environmental sustainability with economic competitiveness and the limited empirical evidence on the long-run and short-run effects of green innovation in Nigeria. Green innovation was proxied by renewable energy consumption as a share of total final energy consumption, while sustainable competitive advantage was measured by manufacturing value added as a share of gross domestic product. GDP growth, foreign direct investment, trade openness, and inflation were included as control variables. The Augmented Dickey-Fuller and Phillips-Perron unit root tests were employed to determine the stationarity properties of the variables, while the Autoregressive Distributed Lag (ARDL) model was used to estimate the long-run and short-run relationships. The unit root test results revealed a mixture of I(0) and I(1) variables. Furthermore, the ARDL bounds test confirmed the existence of a long-run relationship among the variables, with an F-statistic of 5.043 exceeding the upper-bound critical value at the 1% significance level. The long-run estimates indicated that green innovation has a positive and statistically significant relationship with sustainable competitive advantage (coefficient = 0.149; p = 0.039). However, its short-run relationship was positive but statistically insignificant (coefficient = 0.147; p = 0.138). Foreign direct investment exhibited a negative and statistically significant relationship with sustainable competitive advantage, while inflation showed a positive and statistically significant relationship in both the long run and short run. GDP growth and trade openness were statistically insignificant in both periods. The error correction term was negative and statistically significant at -0.182, indicating an adjustment of approximately 18.2% of the previous period's disequilibrium towards long-run equilibrium per period. The study concludes that green innovation is associated with improved sustainable competitive advantage in Nigeria over the long term. It recommends sustained investment in cleaner production technologies, renewable energy, resource efficiency, and environmentally sustainable industrial practices, alongside appropriate financial and technical support to facilitate adoption.

Keywords: Green innovation, sustainable competitive advantage, ARDL, Nigeria

INTRODUCTION

Environmental degradation, climate change, and resource scarcity have pushed firms and economies to rethink how they create and sustain value. Green innovation, defined as the development of new or improved products, processes, and management practices that reduce environmental harm while meeting business needs, is now widely seen as a strategic response to these pressures (Rennings, 2000; Chen et al., 2006). Early arguments held that environmental regulation and investment raise costs and weaken competitiveness. Porter and van der Linde (1995) challenged this view, arguing that well-designed environmental standards can stimulate innovation that offsets compliance costs and improves resource productivity. Subsequent studies have supported the proposition that green innovation can generate differentiation, efficiency gains, and enhanced reputation (Chen, 2008; Dangelico & Pujari, 2010; Eiadat et al., 2008).

Theoretically, the link between green innovation and competitive advantage rests on the resource-based view, which holds that valuable, rare, inimitable, and non-substitutable resources underpin sustained advantage (Barney, 1991). The natural-resource-based view extends this logic, suggesting that capabilities in pollution prevention, product stewardship, and sustainable development can become sources of advantage in an environmentally constrained world (Hart, 1995). The dynamic capabilities perspective adds that firms must continually sense, seize, and reconfigure resources to respond to changing environments, including shifts in environmental regulation and stakeholder expectations (Teece et al., 1997).

Nigeria presents an important context for examining these relationships. As Africa's largest economy, it faces serious environmental challenges, including oil pollution and gas flaring in the Niger Delta, waste management problems, and vulnerability to climate change (United Nations Environment Programme [UNEP], 2011). Policy responses, such as the establishment of the National Environmental Standards and Regulations Enforcement Agency in 2007 and the enactment of the Climate Change Act in 2021 (Federal Republic of Nigeria, 2021), signal growing institutional pressure to adopt cleaner practices. Meanwhile, the manufacturing sector operates in a competitive environment characterised by high energy costs, infrastructural deficits, and increasing stakeholder scrutiny. Competitive advantage is only sustainable if it persists, so the question of whether sustained movement toward cleaner and more efficient technologies strengthens Nigeria's competitiveness is best answered by tracking both over time rather than at a single point. That question remains an open empirical one.

Despite global evidence that green innovation can improve firm performance and competitiveness (Chen et al., 2006; Eiadat et al., 2008), its adoption in Nigeria remains limited and uneven. Many firms still view environmental initiatives as compliance costs rather than strategic investments, partly because of weak regulatory enforcement, inadequate access to green finance and technology, and uncertainty about financial returns (UNEP, 2011). As a result, environmentally sensitive sectors continue to contribute significantly to pollution and resource depletion, even as local and international stakeholders demand more sustainable practices.

The existing literature compounds the problem. Much of the evidence on the green innovation competitive advantage relationship comes from developed and Asian economies, whose institutional, regulatory, and market conditions differ markedly from Nigeria's (Chen, 2008; Dangelico & Pujari, 2010). The few recent Nigerian studies examine general organisational innovation (Sulaimon et al., 2024), green capability and behaviour (Olaleye, 2025), or conceptual links between green innovation and financial performance (Ibrahim & Ibrahim, 2024), and the studies reviewed in this paper rely on single-period surveys. Such designs cannot show whether advantage persists, how quickly it adjusts after a shock, or whether short-run and long-run effects differ. Without this evidence, managers lack guidance on whether sustained investment in green innovation pays off, and policymakers lack an empirical basis for designing incentives. This study addresses that gap by using annual time series data to examine the effect of green innovation on sustainable competitive advantage in Nigeria covering the period of 35 years (1990 to 2025).

In terms of measurement of variables, green innovation is limited to eco-efficiency and cleaner-energy innovation, proxied by renewable energy consumption as a share of total final energy consumption (Rennings, 2000; Chen et al., 2006). Sustainable competitive advantage is limited to the persistent competitiveness of the Nigerian manufacturing sector, proxied by manufacturing value added as a share of GDP, consistent with the resource-based and natural-resource-based views (Barney, 1991; Hart, 1995). Gross domestic product growth, foreign direct investment, trade openness, and inflation enter the analysis as control variables.

The scope unit of analysis is the Nigerian economy with attention to the manufacturing sector, rather than individual firms or respondents. Geographically, the study is confined to Nigeria, whose environmental pressures and institutional conditions differ from those of the developed and Asian settings that dominate the literature. The study relies entirely on secondary data sources from the World Bank World Development Indicators, the Central Bank of Nigeria Statistical Bulletin, and the National Bureau of Statistics.

The significance of the study is well situated as it extends the green innovation literature by testing established theories with time series evidence from a developing economy, where infrastructural constraints and uneven enforcement may change how green innovation affects competitiveness. Secondly, if green innovation

strengthens competitiveness, there is an economic reason to reduce pollution, gas flaring, and waste, which benefits communities affected by environmental degradation.

LITERATURE REVIEW

Empirical Literature Review

There have been several empirics on green innovation and sustainable competitive advantage using time series and cross-sectional data sets. These studies have come with mixed results. Some of these studies are selected and reviewed as follows:

i. Evidence from Nigeria. Recent Nigerian studies show that innovation can build advantage, but few test green innovation directly. Sulaimon et al. (2024) surveyed 131 manufacturing firms in Lagos State and found that product, process, and administrative innovation each had a significant effect on sustainable competitive advantage, both individually and jointly. The study measures organisational innovation in general, so it says little about the environmental dimension. Olaleye (2025) comes closer to the green question. Using PLS-SEM on data from 351 respondents in 12 listed agro-allied firms, the study found that firms with environmentally conscious practices can secure a long-term market advantage through green development behaviour and green dynamic capability. That study centres on dynamic capability and behavioural drivers rather than on green innovation types as such. Ibrahim and Ibrahim (2024) note that findings on green innovation and firm performance are inconsistent, and propose a conceptual framework with environmental cost as a moderator, but they offer no empirical test.

ii. Evidence from other emerging economies. Studies elsewhere in the developing world more directly address green innovation and advantage. Padilla-Lozano et al. (2024) surveyed 325 managers of Ecuadorian manufacturing firms and, using structural equation modelling, confirmed a positive effect of green innovation on competitiveness. In Bangladesh, Uddin et al. (2025) used PLS-SEM on 164 usable responses and found that green product innovation significantly affected sustainable competitive advantage, whereas green process and green technology innovation showed no significant relationship. This suggests that market-visible green initiatives may pay off before deeper operational ones. Evidence from Ghana points the same way on capability-based drivers. Forenten et al. (2026) surveyed 264 managers in transport and logistics and found that green creativity mediates the link between green intellectual capital and environmental performance, with the effect depending on green transformational leadership and environmental regulation.

iii. Evidence from developed economies. Ntanos et al. (2022) studied 225 managers of medium and large Greek firms and confirmed that firm strategies mediate the relationship between green entrepreneurship, green innovation, and competitive advantage. This shows that the green innovation–advantage link often runs through strategic choices rather than operating directly.

Summary of the evidence. The studies reviewed above share a common design: each relies on a one-time survey of managers or firms and on regression or structural equation modelling of that single cross-section (Ntanos et al., 2022; Padilla-Lozano et al., 2024; Sulaimon et al., 2024; Uddin et al., 2025). They show that green innovation is often associated with advantage, but they cannot show how that relationship evolves over time.

Research Gap. The reviewed studies reveal five gaps that this study addresses.

1. Green innovation and sustainable competitive advantage are rarely tested together in Nigeria. Nigerian studies either examine general organisational innovation and advantage (Sulaimon et al., 2024), green capability and behaviour (Olaleye, 2025), or green innovation and financial outcomes (Ibrahim & Ibrahim, 2024). None isolates the effect of green innovation on sustainable competitive advantage in Nigeria.

2. The evidence is cross-sectional. The studies reviewed rely on single-period surveys (Ntanos et al., 2022; Padilla-Lozano et al., 2024; Uddin et al., 2025), even though advantage is only "sustainable" if it persists. Evidence on durability, as opposed to short-term association, remains thin.

3. Short-run and long-run effects are not separated. None of the studies reviewed tests for a long-run (cointegrating) relationship or estimates how quickly advantage adjusts after a shock, which an autoregressive distributed lag framework can do.

4. Findings are inconsistent across contexts and dimensions. A positive effect in Ecuador (Padilla-Lozano et al., 2024) contrasts with the Bangladesh result, where only green product innovation mattered (Uddin et al., 2025), suggesting that context and measurement matter and that the Nigerian evidence remains unresolved.

5. Little is known about how the post-2021 policy environment shapes these effects. The Climate Change Act (Federal Republic of Nigeria, 2021) has not been examined as a context in which green innovation produces advantage, even though Forenten et al. (2026) show that regulation can condition green outcomes elsewhere.

This study reacts by using annual time series data to examine the effect of green innovation on sustainable competitive advantage in Nigeria.

METHODOLOGY

Research Design

The study adopts an ex-post facto research design using annual time series data. This design suits the objective because the effect of green innovation on sustainable competitive advantage is examined from observed outcomes over time rather than from respondents' opinions, which allows short-run and long-run effects to be separated. It also addresses a limitation of earlier work, which relies mostly on single-period surveys that cannot show whether advantage persists.

Data, Variables and Sources

The study uses annual data for Nigeria covering (1990 to 2025), drawn from the World Bank World Development Indicators (WDI), the Central Bank of Nigeria (CBN) Statistical Bulletin, and the National Bureau of Statistics. Because direct national measures of green innovation are scarce for Nigeria, proxies are used. All variables are converted to natural logarithms where appropriate to reduce heteroskedasticity and allow coefficients to be read as elasticities.

Table 1: Data Sources

Variable	Role	Proxy	Source	Expected sign
Sustainable competitive advantage (SCA)	Dependent	Manufacturing value added (% of GDP) [alternative: non-oil exports as % of total exports]	WDI / CBN	n/a
Green innovation (GRI)	Independent	Renewable energy consumption (% of total final energy consumption) [add energy intensity if available]	WDI	+
GDP growth (GDG)	Control	Annual GDP growth rate (%)	WDI	+
Foreign direct investment (FDI)	Control	Net inflows (% of GDP)	WDI	+
Trade openness (TOP)	Control	Exports plus imports (% of GDP)	WDI	+
Inflation (INF)	Control	Consumer price inflation (%)	CBN	–

Source: Compiled by the Researcher (2026)

Model Specification

The long-run relationship is specified as:

$$SCA(t) = \beta0 + \beta1\ GRI(t) + \beta2\ GDG(t) + \beta3\ FDI(t) + \beta4\ TOP(t) + \beta5\ INF(t) + \varepsilon(t)$$

where t denotes the year, β0 is the intercept, β1 to β5 are coefficients, and ε is the error term.

Estimation Technique

Step 1: Unit root tests. The Augmented Dickey-Fuller test (Dickey & Fuller, 1979) and the Phillips-Perron test (Phillips & Perron, 1988) determine the order of integration of each variable. This matters because regressing non-stationary series on each other can produce spurious results, and the autoregressive distributed lag (ARDL) approach requires that no variable be integrated of order two.

Step 2: ARDL bounds test. If the variables are a mix of I(0) and I(1), the ARDL bounds testing approach is used to test for a long-run relationship (Pesaran & Shin, 1999; Pesaran et al., 2001). It is chosen because it works with variables of mixed integration order and performs well in small samples, so the small-sample critical values of Narayan (2005) are used. The ARDL model takes the form:

$$\Delta SCA(t) = \alpha0 + \Sigma\ \alpha1i\ \Delta SCA(t-i) + \Sigma\ \alpha2i\ \Delta GRI(t-i) + \Sigma\ \alpha3i\ \Delta GDG(t-i) + \Sigma\ \alpha4i\ \Delta FDI(t-i) + \Sigma\ \alpha5i\ \Delta TOP(t-i) + \Sigma\ \alpha6i\ \Delta INF(t-i) + \lambda1\ SCA(t-1) + \lambda2\ GRI(t-1) + \lambda3\ GDG(t-1) + \lambda4\ FDI(t-1) + \lambda5\ TOP(t-1) + \lambda6\ INF(t-1) + \mu(t)(1)$$

where Δ is the first difference operator and the lag length is selected with the Akaike Information Criterion. Cointegration is confirmed when the F-statistic exceeds the upper critical bound.

Step 3: Long-run and short-run estimates. If cointegration exists, the long-run coefficients are estimated and the short-run dynamics are captured through an error correction model. The coefficient on the error correction term should be negative and significant, and its size shows how quickly sustainable competitive advantage returns to its long-run path after a shock.

Step 4: Diagnostic and stability tests. The model is checked for serial correlation (Breusch-Godfrey LM test), heteroskedasticity (Breusch-Pagan-Godfrey test), normality of residuals (Jarque-Bera test), and functional form (Ramsey RESET test). Parameter stability is assessed with the CUSUM and CUSUM of squares tests (Brown et al., 1975). The null hypothesis is rejected at the 5% level of significance, and estimation is carried out in EViews. The variables are integrated of order one and zero only, and are cointegrated. The bounds test replaced the Johansen cointegration test.

Ethical Considerations

The study uses publicly available secondary data and involves no human participants. All data sources are acknowledged, the data and estimation procedures are reported so that the results can be replicated.

Data Presentation And Analysis

Unit Root Test

Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests were conducted on the variables in order to determine whether they are stationary or non-stationary. The two tests were employed to reinforce one another, to ensure their robustness and to boost confidence in their reliability. The decision rule is to reject the null hypothesis when the reported p-value is less than 0.05 (William, Hill, and Lim, 2008). The variables examined as envisaged in Table 2 are Sustainable Competitive Advantage (SCA), Green Innovation (GRI), GDP Growth (GDG), Foreign Direct Investment (FDI), Trade Openness (TOP), and Inflation (INF). The tests were conducted at level and first difference. The null hypothesis of both tests is that a variable has a unit root and is therefore non-stationary. At the 5% significance level, the null hypothesis is rejected when the reported p-value is less than 0.05.

Sustainable Competitive Advantage (SCA) is non-stationary at level, with ADF and PP p-values of 0.696 and 0.678, respectively. After first differencing, the p-values decrease to 0.009 and 0.000. This indicates that SCA becomes stationary after first differencing and is classified as I(1). Green Innovation (GRI) is non-stationary at

level, as indicated by ADF and PP p-values of 0.541 and 0.547. At first difference, both tests produce p-values of 0.000, indicating rejection of the unit-root null hypothesis. Thus, GRI is stationary after first differencing and can be classified as I(1). For GDP Growth (GDG), the ADF and PP tests at level produce p-values of 0.019 and 0.018, respectively. Since both values are below the 5% significance level, the null hypothesis of a unit root should be rejected. This indicates that GDG is already stationary at level and is therefore I(0). The first-difference results also indicate stationarity, but differencing an already stationary variable is generally unnecessary. Foreign Direct Investment (FDI) is non-stationary at level, with ADF and PP p-values of 0.392 and 0.203, respectively. At first difference, both tests yield p-values of 0.000, suggesting that the variable becomes stationary after first differencing and is therefore I(1). Trade Openness (TOP) is non-stationary at level, with ADF and PP p-values of 0.955 and 0.897. At first difference, the reported p-values are 0.003 and 0.000, respectively, suggesting stationarity after first differencing. Inflation (INF) is non-stationary at level, with ADF and PP p-values of 0.183 and 0.111, respectively. After first differencing, the p-values fall to 0.001 and 0.000, indicating that inflation becomes stationary. Therefore, INF is classified as I(1).

In a nutshell, the results suggest that five variables SCA, GRI, FDI, TOP, and INF become stationary after first differencing, while GDG is stationary at level. In conclusion, the unit root tests indicate a mixture of I(0) and I(1) variables. This may support the use of an Autoregressive Distributed Lag (ARDL) model, provided that none of the variables is integrated of order two, I(2) and the other model requirements are satisfied.

Table 2: Unit Root Test

Variable	Level ADF	PP	1ST Difference ADF	PP	Result
SCA_t	-1.120 (0.696)	-1.144 (0.678)	-3.651 (0.009)*	-5.713 (0.000)*	I(1)
GRI_t	-1.460 (0.541)	-1.447 (0.547)	-6.096 (0.000)*	-6.100 (0.000)*	I(1)
GDG_t	-3.360 (0.019)*	-3.393 (0.018)*	-9.608 (0.000)*	-12.584 (0.000)*	I(0)
FDI_t	-1.761 (0.392)	-2.217 (0.203)	-7.198 (0.000)*	-7.344 (0.000)*	I(1)
TOP_t	0.029 (0.955)	-0.407 (0.897)	4.077 (0.003)*	-4.077 (0.000)*	I(1)
INF_t	-2.280 (0.183)	-2.556 (0.111)	-4.480 (0.001)*	-4.798 (0.000)*	I(1)

Source: Computed and Compiled by the Researcher using E-Views 12 (2026)
The asterisks *, indicates rejection of null hypothesis at 5% level
Figures in ( ) are p-values

Autoregressive Distributed Lag Model (ARDL)

The results of the Augmented Dickey-Fuller (ADF, 1979) and Phillips-Perron (PP, 1988) unit root tests, as presented in Table 2, provide the basis for adopting the Autoregressive Distributed Lag (ARDL) model. Consequently, the study proceeds to estimate the long-run and short-run relationships among the variables. Specifically, to achieve the objective of examining the effect of green innovation on sustainable competitive advantage in Nigeria, the study employs the ARDL model to analyse both the long-run and short-run parameter estimates.

Long-Run Estimates

Green innovation (GRI) has a positive coefficient of 0.149 and a p-value of 0.039. This indicates that a one-unit increase in green innovation is associated with a 0.149-unit increase in sustainable competitive advantage (SCA) in the long run, holding other variables constant. Since the p-value is below 0.05, the relationship is statistically significant at the 5% level. This suggests that green innovation contributes positively to sustainable competitive advantage in Nigeria over the long term. GDP growth (GDG) has a positive coefficient of 0.147 and a p-value

of 0.315. This suggests a positive long-run relationship with sustainable competitive advantage, but the relationship is not statistically significant at the 5% level. Therefore, the estimates do not provide sufficient evidence that GDP growth has a significant long-run effect on sustainable competitive advantage. Foreign direct investment (FDI) has a negative coefficient of -0.948 and a p-value of 0.003. This indicates that a one-unit increase in FDI is associated with a 0.948-unit decrease in sustainable competitive advantage in the long run, holding other variables constant. The relationship is statistically significant at the 5% level. Trade openness (TOP) has a negative coefficient of -0.508 and a p-value of 0.738. This implies a negative but statistically insignificant long-run relationship with sustainable competitive advantage. The estimates do not establish a significant long-run effect at the 5% level. Inflation (INF) has a positive coefficient of 0.065 and a p-value of 0.002. This indicates that a one-unit increase in inflation is associated with a 0.065-unit increase in sustainable competitive advantage in the long run, holding other variables constant. The relationship is statistically significant at the 5% level. The economic explanation for this positive result requires further investigation (Table 3).

Short-Run Estimates

Green innovation has a positive coefficient of 0.147 and a p-value of 0.138. The relationship with sustainable competitive advantage is positive but not statistically significant at the 5% level. The evidence is therefore insufficient to conclude that green innovation has a significant short-run effect. GDP growth has a negative coefficient of -0.068 and a p-value of 0.835. This indicates a negative but statistically insignificant short-run relationship with sustainable competitive advantage. FDI has a negative coefficient of -0.948 and a reported p-value of 0.000. The relationship is statistically significant at the 5% level. A reported p-value of 0.000 should be understood as a rounded value, not a probability that is literally zero. Trade openness has a negative coefficient of -0.508 and a p-value of 0.612. The relationship is negative but statistically insignificant at the 5% level. Inflation has a positive coefficient of 0.065 and a reported p-value of 0.000. The relationship is positive and statistically significant at the 5% level (Table 3).

The error correction term (ECT) as expected, has a reported coefficient of -0.182 and a p-value of 0.000. Its negative and statistically significant value is consistent with adjustment toward the long-run equilibrium. Thus, approximately 18.2% of the previous period's deviation from long-run equilibrium is corrected in each period (Table 3).

Table 3 Long-Run and Short-Run ARDL Estimates

Dependent variable: SCA_t

Long-Run Estimates			
Variable	**Coefficient**	**S.E**	**P-Value**
GRI_t	0.149	0.143	0.039*
GDG_t	0.147	0.143	0.315
FDI_t	-0.948	0.285	0.003*
TOP_t	-0.508	1.505	0.738
INF_t	0.065	0.019	0.002*
Short-Run Estimates			
GRI_t	0.147	0.095	0.138
GDG_t	-0.068	0.322	0.835
FDI_t	-0.948	0.207	0.000*
TOP_t	-0.508	0.988	0.612
INF_t	0.065	0.015	0.000*
ECT_t	-0.182	-0.042	0.000*

Source: Computed and Compiled by the Researcher using E-Views 12 (2026)
Note: The asterisks *, denotes significance at 5%
The Lag structure is ARDL (1, 1, 1, 1, 1, 1)

ARDL Bounds Test

The ARDL bounds test examines whether a long-run relationship exists among sustainable competitive advantage, green innovation, and the control variables. The reported F-statistic is 5.042506. At the 1% significance level, the lower-bound critical value is 3.06 and the upper-bound critical value is 4.15. Since the calculated F-statistic exceeds the upper-bound critical value, the null hypothesis of no long-run relationship is rejected at the 1% level. This supports the existence of a long-run relationship among the variables and it pave ways to employ ARDL model (Table 4).

Table 4: Bound Test

		1%	2.5%	5%	10%
F-statistic	5.042506				
	(0) BOUND	3.06	2.7	2.39	2.08
	(1) BOUND	4.15	3.73	3.38	3

Source: Computed and Compiled by the Researcher using E-Views 12 (2026)

DISCUSSION OF THE RESEARCH FINDINGS

The long-run estimates show that green innovation has a positive and statistically significant relationship with sustainable competitive advantage in Nigeria (coefficient = 0.149; p-value = 0.039). In the short run, its coefficient is also positive (0.147), but the relationship is not statistically significant (p-value = 0.138). Thus, the evidence for a positive relationship between green innovation and sustainable competitive advantage is stronger in the long run than in the short run. The bounds test supports a long-run relationship among the model variables, while the negative and significant error correction term indicates adjustment toward equilibrium.

CONCLUSION AND RECOMMENDATIONS

Based on the reported estimates, the study concludes that green innovation has a positive and statistically significant long-run relationship with sustainable competitive advantage in Nigeria. This finding suggests that green innovation may be associated with stronger sustainable competitive advantage over time. The short-run coefficient is positive but statistically insignificant, indicating that the estimates do not provide sufficient evidence of an immediate short-run relationship at the 5% significance level. The bounds test supports the existence of a long-run relationship amongst the variable under study. The reported negative and significant error correction coefficient is consistent with adjustment toward equilibrium. Regarding the control variables, the estimates report a statistically significant negative relationship for foreign direct investment and a statistically significant positive relationship for inflation in both the short run and long run. GDP growth and trade openness are statistically insignificant in both periods.

In line with the research findings as embedded, it becomes expedient that deductions from the findings be made to advice policy makers and implementers on the best way to handle policy issues and programs regarding green innovation and sustainable competitive advantage in Nigeria. In the light of this, the following policy recommendations are germane and apropos to ensure progress and growth of Ngeria.

Promote sustained investment in green innovation.

Relevant policymakers and business organisations should encourage firms to adopt cleaner production methods, resource-efficient technologies, waste-reduction practices, and environmentally sustainable products. The positive and significant long-run relationship suggests that green innovation deserves sustained attention, while recognising that its benefits may not be immediate.

Support firms during the adoption period.

Because the short-run green innovation coefficient is not statistically significant, firms and policymakers should consider the transition costs associated with green technologies. Practical support could include technical

training, access to appropriate financing, information on cleaner technologies, and assistance with implementation and evaluation. These are policy options suggested by the pattern of results, not effects directly tested by the model.

Strengthen the link between foreign investment and domestic capabilities.

The reported negative and significant FDI coefficient warrants further investigation by policymakers and researchers. Policies may focus on evaluating the quality and sectoral distribution of investment, encouraging productive linkages with domestic firms, and assessing whether technology transfer, skills development, and local value creation are occurring. The negative coefficient alone does not identify the cause of the relationship.

Assess the relationship between inflation and competitiveness carefully.

Although inflation is positively associated with sustainable competitive advantage in the reported estimates, this should not be interpreted as a recommendation to increase inflation. Policymakers should continue to consider price stability and examine whether the estimated result reflects omitted factors, variable measurement, or model specification.

Avoid assuming that aggregate growth automatically improves competitiveness.

Since GDP growth is statistically insignificant in both periods, policies intended to improve sustainable competitive advantage should also consider firm-level productivity, innovation capacity, infrastructure, skills, and the ability to implement sustainable practices. The present estimates do not establish which of these factors is most important.

Review trade-related support for domestic firms.

The trade-openness coefficients are negative but statistically insignificant. Policymakers should therefore avoid drawing a firm conclusion that trade openness reduces sustainable competitive advantage. Instead, they may monitor how domestic firms respond to international competition and identify barriers to technology adoption, productivity, and access to markets.

Contribution to Knowledge

The study contributes empirical evidence on the relationship between green innovation and sustainable competitive advantage in Nigeria by distinguishing between long-run estimates and short-run dynamics within an ARDL framework. The reported results show a positive and statistically significant long-run coefficient for green innovation, alongside a positive but statistically insignificant short-run coefficient. This distinction highlights the importance of examining both time horizons when evaluating the relationship. The study also reports estimates for GDP growth, foreign direct investment, trade openness, and inflation as control variables. The contribution should be understood within the scope of the data, measurement choices, and model specification used in the study.

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