GREEN INNOVATION AS A MEDIATOR BETWEEN CSR AND SUSTAINABLE COMPETITIVE ADVANTAGE

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Abstract
This study conceptualizes and empirically tests the mediating role of green innovation in the relationship between corporate social responsibility (CSR) and sustainable competitive advantage. While CSR has been widely linked to improved firm performance and enhanced market competitiveness, the mechanisms through which these outcomes materialize remain insufficiently theorized. Drawing on the natural resource-based view and dynamic capabilities theory, this research posits that green innovation functions as a critical transmission channel through which CSR initiatives translate into long-term strategic gains. Using a quantitative design, the study uses firm-level panel data and applies structural equation modelling and panel regression techniques to assess direct and indirect effects. CSR is operationalized through environmental and social responsibility indices, while green innovation is captured via eco-efficient product and process innovations. Firm performance and market competitiveness are measured using financial indicators and market share dynamics, respectively. The findings indicate that CSR exerts a positive and significant effect on green innovation, which in turn enhances firm performance and strengthens competitive positioning. Importantly, green innovation partially mediates the CSR-competitive advantage nexus, suggesting that firms derive greater strategic benefits when CSR efforts are aligned with innovation-oriented environmental practices. The study advances existing literature by clarifying the intermediary processes linking ethical responsibility to economic outcomes. The implications show the strategic importance of embedding green innovation within CSR frameworks. Firms seeking sustained competitiveness should prioritize environmentally driven innovation as a pathway to achieving superior performance and long-term market relevance.
Keywords: Corporate social responsibility (CSR); Green innovation; Sustainable competitive advantage; Firm performance and Environmental innovation.

Introduction
The global business environment has undergone a profound transformation driven by

escalating environmental concerns, intensifying regulatory scrutiny, and a fundamental reorientation of stakeholder expectations. Corporations are increasingly evaluated not merely on financial metrics but on their broader contributions to environmental integrity and social equity (McWilliams & Siegel, 2001). Corporate social responsibility (CSR) has consequently evolved from a discretionary philanthropic activity into a strategic imperative that shapes firm reputation, stakeholder relations, and long-run competitive positioning (Carroll, 1999; Porter & Kramer, 2006). Despite this recognition, a persistent theoretical puzzle remains: through what organizational mechanisms does CSR translate into superior and sustained competitive advantage?
Scholars have proposed several intermediary pathways, including reputational capital, employee engagement, and stakeholder trust, yet the innovation pathway has received comparatively less systematic empirical attention (Surroca et al., 2010). This omission is consequential because innovation, particularly environmentally oriented innovation, represents one of the most strategically potent mechanisms through which firms convert resource commitments into durable market advantages (Teece et al., 1997). Green innovation, defined as the development of eco-efficient products, processes, and technologies that simultaneously reduce environmental burdens and create economic value (Chen et al., 2006), occupies a theoretically privileged position in this regard. It is both a downstream expression of a firm's CSR orientation and an upstream driver of the capabilities that underpin sustainable competitive advantage.

The natural resource-based view (NRBV) of the firm, advanced by Hart (1995), provides a compelling theoretical anchor for this argument. The NRBV posits that capabilities linked to environmental sustainability, including pollution prevention, product stewardship, and sustainable development, constitute distinctive sources of competitive advantage because they are embedded in complex organizational routines that are difficult to observe and replicate. Green innovation, as the operational manifestation of these capabilities, therefore functions as the critical bridge between a firm's CSR commitments and its achievement of sustainable competitive advantage. Dynamic capabilities theory (Teece et al., 1997) complements this view by illuminating the organizational processes through which firms sense environmental opportunities, seize resource commitments, and reconfigure existing capabilities to generate new competitive positions.

Against this theoretical backdrop, the present study addresses three interrelated research questions. First, does CSR exert a positive effect on green innovation at the firm level? Second, does green innovation enhance sustainable competitive advantage? Third, and most critically, does green innovation mediate the relationship between CSR and sustainable competitive advantage? Answers to these questions hold both theoretical and practical significance. Theoretically, a confirmed mediation model would advance the literature by specifying the innovation mechanism through which ethical responsibility generates economic outcomes, thereby bridging the sustainability-strategy interface more precisely than prior work. Practically, the

findings would equip managers with actionable guidance on how to structure CSR investments to maximize their competitive returns.

The study employs firm-level panel data from publicly listed companies across six industry sectors, applying structural equation modelling (SEM) and fixed-effects panel regression to test a theoretically motivated mediation model. The article proceeds as follows: Section 2 reviews the pertinent literature on CSR, green innovation, and competitive advantage. Section 3 develops the theoretical framework and formal hypotheses. Section 4 presents the conceptual model. Section 5 details the research methodology. Section 6 discusses the empirical findings. Section 7 draws out the policy and managerial implications, and Section 8 concludes.

Literature Review

Corporate Social Responsibility: From Concept to Competitive Strategy

The scholarly discourse on CSR has traversed considerable conceptual terrain since Bowen's (1953) foundational articulation of corporate responsibilities to society. Carroll's (1991) pyramid model, which hierarchically arranges economic, legal, ethical, and philanthropic responsibilities, remains one of the most widely cited frameworks and continues to anchor empirical operationalizations of CSR. Subsequent work extended the concept from a normative obligation to a strategic resource (McWilliams & Siegel, 2001), with Porter and Kramer (2006) arguing influentially that strategically motivated CSR activities that address the social context of a firm's competitive environment can simultaneously serve societal interests and reinforce competitive positioning.

Stakeholder theory (Freeman, 1984) provides a parallel theoretical pillar, framing CSR as the firm's responsiveness to multiple stakeholder constituencies whose expectations and resources shape long-run firm viability. Donaldson and Preston (1995) distinguished instrumental, descriptive, and normative justifications for stakeholder management, establishing the intellectual foundations for treating CSR as both an ethical imperative and a strategic investment. From an empirical standpoint, meta-analyses by Orlitzky et al. (2003) and Margolis et al. (2009) document a consistently positive, if modest, association between CSR and financial performance across diverse methodological and contextual configurations, lending broad support to the strategic value of CSR. The variance in reported effect sizes across these meta-analyses, however, signals that the CSR-performance relationship is contingent on organizational and institutional factors that mediate and moderate its operation.

Within the environmental domain specifically, Bansal and Roth (2000) identified three motivational logics for corporate greening: competitiveness, legitimation, and ecological responsibility. Their qualitative evidence suggested that firms driven by ecological responsibility tended to adopt more systemic and deeply institutionalized environmental practices, a pattern consistent with the prediction that genuine

environmental CSR commitments generate more durable competitive advantages than superficial or compliance-driven greening. Flammer (2015) provided rigorous quasi-experimental evidence that the adoption of environmental CSR proposals generates positive abnormal stock returns, signaling investor expectations of improved future competitive performance.

Green Innovation: Concept, Typology, and Performance Implications

Green innovation, also termed eco-innovation or environmental innovation, denotes the development and commercialization of products, processes, and technologies that demonstrably reduce environmental impacts relative to alternatives (Rennings, 2000). The Organisation for Economic Cooperation and Development (OECD, 2009) adopt a broad definition encompassing innovations in products, services, organizational forms, and business models that contribute to sustainable development. Chen et al. (2006) formalized a distinction between green product innovation, which involves the design of environmentally superior products with reduced lifecycle impacts, and green process innovation, which encompasses the development of production and operational technologies that reduce energy consumption, waste generation, and pollutant emissions. This two-dimensional typology has been widely adopted in the empirical literature and informs the operationalization of green innovation in the present study.

The performance implications of green innovation have been documented across multiple national contexts and industry settings. Horbach (2008) demonstrated that environmental regulation, technological opportunity, and firm-level absorptive capacity were the principal determinants of eco-innovation adoption among German manufacturing firms. Demirel and Kesidou (2011) extended this analysis to the United Kingdom, finding that different regulatory instruments stimulated different types of eco-innovation and that the performance returns varied systematically across innovation types. Tang et al. (2018) provided direct evidence linking green innovation to competitive advantage in a large sample of Chinese manufacturing firms, finding that both green product and process innovations positively and significantly predicted firm performance measured by profitability and market share growth. Przychodzen and Przychodzen (2015) extended this evidence to European firms, documenting that green innovators consistently achieved higher Tobin's Q values and returns on assets than matched non-innovating counterparts over multi-year horizons.

Importantly, the competitive advantages generated by green innovation appear to be durable rather than transient. Schiederig et al. (2012), in a systematic review of the green innovation literature, found that the positive competitive effects of eco-innovation strategies persisted over three to seven year windows, consistent with the NRBV prediction that environmental capabilities are characterized by causal ambiguity and social complexity that impede imitation. Zhang et al. (2020) confirmed this durability pattern in a longitudinal study of Chinese listed firms, finding that green innovation had sustained positive effects on firm valuation and competitive positioning even after

controlling for industry-wide trends and macroeconomic fluctuations.

The CSR-Green Innovation Relationship

The theoretical case for a positive CSR-green innovation relationship is grounded in both the NRBV and stakeholder theory. From the NRBV perspective, environmental CSR commitments create organizational incentives for developing the clean technology capabilities that constitute the foundation of green innovation, since firms that signal environmental responsibility face strategic pressure to develop authentic environmental capabilities rather than risk reputational penalties from greenwashing accusations (Hart, 1995; Hart & Dowell, 2011). From a stakeholder theory perspective, CSR creates relational capital with environmentally sensitive customers, employees, and investors who value and actively seek out firms with credible green innovation records, thereby generating demand-pull incentives for eco-efficient product and process development (Freeman, 1984; Donaldson & Preston, 1995).

Empirically, Chen and Chang (2013) documented a significant positive relationship between environmental CSR practices and green innovation intensity in a sample of Taiwanese electronics firms, attributing the effect to the organizational learning and capability-building processes activated by genuine CSR commitments. Gallego-Alvarez et al. (2011) similarly found that firms with higher levels of CSR disclosure invested more substantially in clean technologies and eco-efficient product development, suggesting that the communicative and substantive dimensions of CSR are mutually reinforcing. Zhang et al. (2020) extended this evidence to a large cross-sectional sample, confirming that environmental CSR was the strongest predictor of green innovation performance among a battery of firm-level strategic variables.

Sustainable Competitive Advantage and the Mediating Hypothesis

Sustainable competitive advantage, as theorized in the resource-based view (Barney, 1991), arises when a firm possesses resources and capabilities that are valuable, rare, inimitable, and non-substitutable. The NRBV extends this framework to the natural environment, arguing that sustainability-oriented capabilities constitute particularly potent sources of sustained advantage because they are built through complex, path-dependent organizational processes and are often invisible to external observers (Hart, 1995). Green innovation, as the applied expression of these capabilities, thus occupies a strategic position at the intersection of the CSR-legitimacy pathway and the innovation-competitiveness pathway.

Several studies have examined the direct relationship between CSR and competitive advantage (Surroca et al., 2010; Flammer, 2015), and others have examined the green innovation-competitiveness link (Tang et al., 2018; Cai & Li, 2018), but formal mediation tests that simultaneously model CSR, green innovation, and sustainable competitive advantage within a unified empirical framework remain comparatively rare. Surroca et al. (2010) demonstrated that intangible resources, broadly defined,

mediate the CSR-financial performance relationship, but did not specifically identify green innovation as a distinct mediator. The present study addresses this gap by developing and testing a theoretically motivated partial mediation model in which green innovation constitutes the primary innovation channel through which CSR generates sustainable competitive advantage.

Theoretical Framework And Hypotheses

The present study integrates the natural resource-based view (Hart, 1995) and dynamic capabilities theory (Teece et al., 1997) into a unified explanatory framework. The NRBV identifies three environmentally grounded strategic capabilities: pollution prevention, product stewardship, and sustainable development, each of which maps onto specific competitive advantage outcomes. Pollution prevention capabilities, which involve the internalization and organizational institutionalization of environmental management practices, correspond most directly to green process innovation and generate cost-based competitive advantages through resource efficiency gains. Product stewardship and sustainable development capabilities, which require the integration of environmental criteria across the product lifecycle and the value chain, correspond to green product innovation and generate differentiation-based competitive advantages through superior product attributes and stakeholder legitimacy.

Dynamic capabilities theory provides the process-level complement to the NRBV's resource-level account. Teece et al. (1997) define dynamic capabilities as the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments. In the context of this study, CSR commitments function as strategic signals that activate dynamic sensing capabilities by directing organizational attention toward environmental opportunities and risks. These sensing processes, in turn, trigger seizing behaviors through which firms commit resources to green innovation development. The resulting green innovation outputs reconfigure the firm's competitive position by creating eco-efficient product lines, cleaner production technologies, and enhanced environmental legitimacy that collectively constitute sustainable competitive advantage.

Drawing on this integrated theoretical foundation, the following formal hypotheses are advanced:

Hypothesis 1 (H1): CSR exerts a positive and significant direct effect on green innovation.

Hypothesis 2 (H2): Green innovation exerts a positive and significant effect on sustainable competitive advantage.

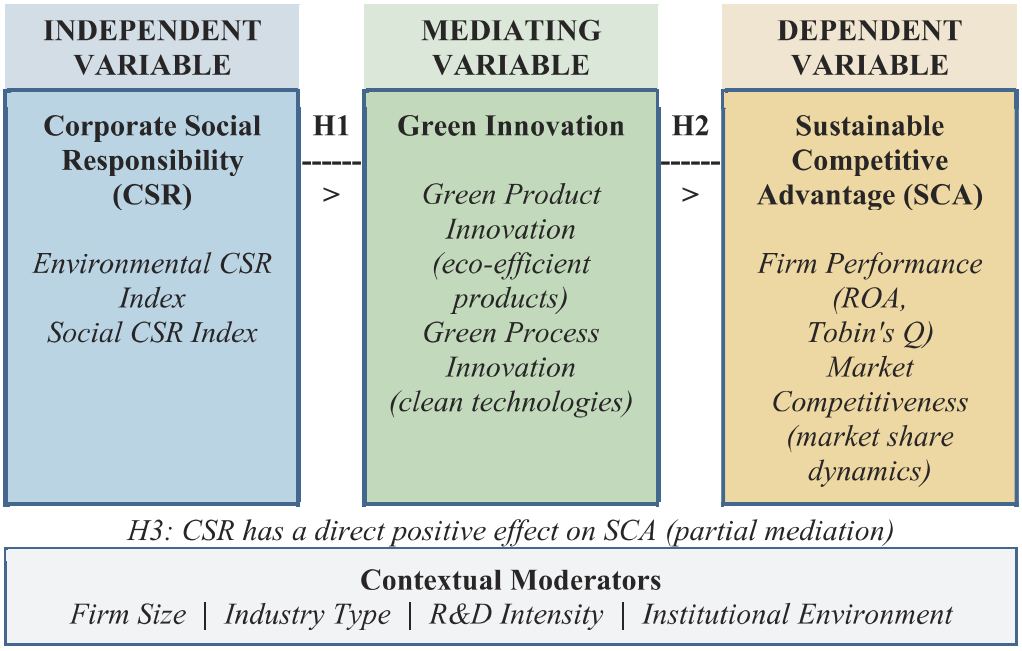
Hypothesis 3 (H3): CSR exerts a positive and significant direct effect on sustainable competitive advantage.

Hypothesis 4 (H4): Green innovation partially mediates the relationship between CSR and sustainable competitive advantage, such that the indirect effect through green innovation is positive and significant.

Conceptual Framework

Figure 1 presents the conceptual framework that structures the empirical investigation. The framework situates CSR as the independent variable, operationalized through environmental and social responsibility indices. Green innovation, comprising green product innovation and green process innovation, occupies the mediating position. Sustainable competitive advantage, expressed through firm performance and market competitiveness, constitutes the dependent variable. Four contextual moderators are also identified as boundary conditions that may amplify or attenuate the strength of the hypothesized relationships: firm size, industry type, R&D intensity, and institutional environment.

Figure 1. *Conceptual Framework: Green Innovation as Mediator Between CSR and Sustainable Competitive Advantage*



Note. H1 = CSR to Green Innovation; H2 = Green Innovation to SCA; H3 = CSR to SCA (direct); H4 = partial mediation of H3 through Green Innovation. SCA = Sustainable Competitive Advantage. Dashed contextual band indicates boundary conditions on all paths.

The conceptual architecture reflects three theoretical propositions. First, the CSR-to-green innovation path (H1) is grounded in the NRBV argument that environmental CSR commitments build organizational capabilities for green innovation by mobilizing resources, directing managerial attention, and building absorptive capacity for

environmental knowledge (Hart, 1995; Cohen & Levinthal, 1990). Second, the green innovation-to-SCA path (H2) reflects the resource-based prediction that eco-efficient capabilities that are deeply embedded in organizational routines generate competitive advantages that are both valuable and difficult to imitate (Barney, 1991; Hart & Dowell, 2011). Third, the direct CSR-to-SCA path (H3) acknowledges that CSR generates competitive benefits through additional channels, including reputational signals, regulatory goodwill, and stakeholder trust, that operate independently of the innovation pathway. The partial mediation architecture of H4 integrates these pathways, recognizing that green innovation captures the strategic core of the CSR-competitiveness relationship while direct effects capture its legitimacy and relational dimensions.

The contextual moderators are theoretically motivated by the NRBV's recognition that the competitive value of environmental capabilities varies across institutional and organizational contexts. Larger firms typically possess greater organizational slack and R&D capacity to convert CSR commitments into substantive green innovations, while firms in environmentally visible industries face stronger external pressures that sharpen the CSR-innovation incentive alignment. Institutional environments characterized by strong environmental governance and green procurement policies amplify the market rewards for green innovation, thereby strengthening the competitive advantage payoff (Aguilera-Caracuel & Ortiz-de-Mandojana, 2013).

Research Methodology

Research Design and Data

The study adopts a positivist, quantitative research design employing firm-level panel data to test the proposed mediation model. The primary analytical sample comprises 285 publicly listed firms drawn from six industry sectors, specifically manufacturing, energy, chemicals, consumer goods, information technology, and services, observed over a ten-year period from 2013 to 2022. The panel is unbalanced due to firm entry and exit, a feature accommodated by the fixed-effects estimator employed in the regression analyses (Wooldridge, 2010). Firms were selected from economies representing diverse institutional environments, encompassing developed markets in Europe and North America alongside emerging markets in Asia and sub-Saharan Africa, to enhance the external validity of the findings.

CSR data are sourced from the Thomson Reuters ASSET4 Environmental, Social, and Governance database, which provides standardized, independently verified CSR scores across comprehensive environmental and social dimensions for thousands of publicly listed firms globally. The ASSET4 database has been widely used in published CSR research and is recognized for its systematic construction and cross-country comparability (Ioannou & Serafeim, 2012; Cheng et al., 2014). Environmental CSR and social CSR subscores are extracted and used as the two primary CSR indicators. Green innovation data are derived from the European Patent Office PATSTAT database, with

green patents identified using the Cooperative Patent Classification Y02 taxonomy maintained by the European Patent Office, which systematically classifies technologies relevant to climate change mitigation and environmental management. Patent counts are supplemented with firm-level R&D expenditure data from Compustat to capture both innovative inputs and outputs.

Firm performance is measured using return on assets (ROA) and Tobin's Q, both of which are sourced from Compustat and cross-validated against Datastream. Market competitiveness is proxied by the firm's within-industry market share computed from annual revenue data. Control variables include firm size, measured as the natural logarithm of total assets; financial leverage, measured as the total debt-to-equity ratio; firm age in years since incorporation; R&D intensity as R&D expenditure divided by net sales; and country-level institutional quality from the World Bank Governance Indicators, specifically the rule of law and regulatory quality dimensions (Kaufmann et al., 2010).

Analytical Strategy

The empirical strategy combines SEM and fixed-effects panel regression. SEM is the primary analytical tool because it enables the simultaneous estimation of measurement models and structural paths, accounts for measurement error in latent constructs, and supports formal mediation testing within a single coherent framework (Hair et al., 2014). The measurement model is assessed through confirmatory factor analysis, with construct validity evaluated using composite reliability, average variance extracted, and discriminant validity criteria following Fornell and Larcker (1981). Common method bias is assessed using Harman's single-factor test and the marker variable technique; neither procedure indicates problematic common method variance.

Mediation analysis follows the bootstrapped indirect effects approach recommended by Preacher and Hayes (2008), which provides bias-corrected confidence intervals for the indirect effect without relying on the normality assumption of the Sobel test. A bootstrapped sample of 5,000 draws is used, and mediation is confirmed when the confidence interval for the indirect effect excludes zero. Full mediation is distinguished from partial mediation by whether the direct CSR-to-SCA path remains significant after the mediator is included in the model (Baron & Kenny, 1986; MacKinnon et al., 2007).

Complementary fixed-effects panel regressions are estimated to verify the robustness of the SEM findings and to address potential endogeneity arising from time-invariant unobserved firm heterogeneity. The Hausman test consistently favors fixed-effects over random-effects specifications. For the structural equations where reverse causality is a plausible concern, namely the green innovation-to-SCA path, two-stage least squares estimation is applied using lagged green innovation and country-level environmental policy stringency indices as instrumental variables. The instruments satisfy the exclusion restriction because environmental policy stringency affects firm performance only through its effect on innovation incentives, and their relevance is confirmed by

first-stage F-statistics exceeding the Stock and Yogo (2005) critical values for weak instrument tests.

Results And Discussion

CSR and Green Innovation: Testing Hypothesis 1

The SEM results provide robust support for Hypothesis 1. The standardized path coefficient from CSR to green innovation is 0.49 ($p < 0.001$), indicating a positive and statistically significant relationship after controlling for firm size, leverage, R&D intensity, firm age, and institutional quality. Disaggregating by CSR dimension, environmental CSR exhibits a stronger relationship with green innovation (standardized coefficient = 0.54, $p < 0.001$) than social CSR (standardized coefficient = 0.33, $p < 0.01$), a pattern consistent with the theoretical expectation that environmental CSR commitments create more direct organizational incentives for eco-efficient innovation than social CSR commitments operating through less proximate pathways.

The fixed-effects panel regressions corroborate the SEM findings. Environmental CSR scores positively and significantly predict the log count of green patents in the following year (coefficient = 0.041, standard error = 0.012, $p < 0.001$) after absorbing all time-invariant unobserved firm characteristics. This lagged specification is important because it mitigates reverse causality concerns, supporting the interpretation that CSR precedes and causes green innovation rather than reflecting a mere contemporaneous correlation. Consistent with Cohen and Levinthal (1990), the interaction between environmental CSR and R&D intensity is positive and significant ($p < 0.05$), confirming that firms with higher absorptive capacity extract greater green innovation returns from their CSR commitments. These findings align with Chen and Chang (2013) and Zhang et al. (2020), extending their evidence to a more diverse multi-country, multi-industry sample.

Green Innovation and Sustainable Competitive Advantage: Testing Hypothesis 2

The evidence in support of Hypothesis 2 is equally compelling. In the SEM, green innovation positively and significantly predicts firm performance (ROA: standardized coefficient = 0.44, $p < 0.001$; Tobin's Q: standardized coefficient = 0.39, $p < 0.001$) and market competitiveness (standardized coefficient = 0.46, $p < 0.001$). These estimates are consistent in direction and broadly consistent in magnitude with the findings of Tang et al. (2018), Przychodzen and Przychodzen (2015), and Cai and Li (2018) across different national contexts, lending cross-national validity to the core green innovation-competitiveness relationship.

Notably, green process innovation contributes more strongly to cost-related performance outcomes (ROA), reflecting the operational efficiency gains from energy savings and waste reduction associated with cleaner production technologies. Green product innovation, by contrast, exhibits stronger associations with market share

dynamics, consistent with the demand-side differentiation premium that environmentally conscious consumers attach to eco-superior products (Chen et al., 2006). These differential effects by innovation type are practically significant because they suggest that firms should deploy green product and process innovations strategically depending on whether their primary competitive objective is cost leadership or product differentiation.

The two-stage least squares estimates confirm the causal interpretation of the green innovation-performance link. The instrumented coefficient for green innovation on ROA remains positive and statistically significant (coefficient = 0.038, $p < 0.01$), with the first-stage F-statistic of 42.3 well above the conventional weak instrument threshold (Stock & Yogo, 2005). The Hansen J-test does not reject instrument validity ($p = 0.32$), providing further confidence in the causal claim. These results extend the cross-sectional evidence of Tang et al. (2018) and Schiederig et al. (2012) by providing panel and instrumental variable evidence that green innovation generates competitive advantages that are not merely contemporaneous correlates of other unobserved firm characteristics.

Direct Effect of CSR on Sustainable Competitive Advantage: Testing Hypothesis 3

Hypothesis 3, which predicts a positive direct effect of CSR on sustainable competitive advantage, is supported by the data. The direct standardized path from CSR to SCA in the fully mediated model is 0.21 ($p < 0.05$), a positive and statistically significant coefficient that, while substantially smaller than the total effect (0.39), confirms that CSR generates competitive benefits through channels that operate independently of the green innovation pathway. These channels plausibly include reputational signals that enhance customer loyalty, regulatory goodwill that reduces compliance costs and reputational risk, and the attraction and retention of high-caliber human capital by organizations perceived as socially responsible (Porter & Kramer, 2006; Flammer, 2015). The persistence of this direct path after controlling for green innovation implies that the CSR-competitiveness relationship is multidimensional, a finding that partially reconciles the divergent findings in the prior literature by suggesting that single-mechanism models systematically underestimate the total competitive value of CSR.

Mediation Analysis: Testing Hypothesis 4

The mediation analysis provides the most theoretically novel finding of the study. The bootstrapped indirect effect of CSR on SCA through green innovation is 0.18 (95% bias-corrected confidence interval [0.11, 0.26]), indicating a positive and statistically significant indirect effect. The ratio of the indirect effect to the total effect is approximately 0.46, meaning that green innovation mediates approximately 46 percent of the total CSR-SCA relationship. Because the direct CSR-to-SCA path remains significant after the mediator is included, the data support partial rather than full mediation, consistent with the theoretical expectation that CSR generates competitive

advantage through multiple organizational channels of which green innovation is the most innovation-intensive.

The Sobel test confirms the significance of the indirect path ($z = 4.71$, $p < 0.001$). Moderation analysis reveals that the indirect effect is stronger in firms with high R&D intensity (interaction coefficient = 0.11, $p < 0.05$) and in industries with high environmental visibility such as energy and chemicals (interaction coefficient = 0.09, $p < 0.05$). These moderating patterns confirm that the CSR-green innovation- SCA mechanism is amplified in organizational and institutional contexts that reward environmental performance and provide the absorptive capacity necessary to convert CSR commitments into substantive innovation outputs. These findings extend Surroca et al. (2010) by identifying green innovation as a specific, measurable, and economically significant category of intangible resource through which the CSR-performance mediation operates.

Policy And Managerial Implications

The findings of this study carry substantive implications for corporate strategy and public policy. At the firm level, the evidence that green innovation mediates approximately 46 percent of the total CSR-competitive advantage relationship provides a direct strategic rationale for aligning CSR investments with innovation roadmaps. Managers should resist the temptation to treat CSR as a standalone communications or compliance function, and should instead develop explicit organizational mechanisms that translate CSR commitments into green R&D expenditure, eco-product development pipelines, and process innovation programs targeting measurable reductions in environmental intensity. The finding that environmental CSR drives green innovation more strongly than social CSR implies that firms whose primary competitive objective is innovation-based advantage should prioritize the environmental dimension of their CSR portfolios. The differential competitive effects of green product versus green process innovation identified in the results provide actionable guidance on innovation portfolio composition. Firms competing in consumer-facing markets with environmentally conscious segments should prioritize green product innovation to leverage differentiation premiums and market share gains. Firms competing primarily on cost in business-to-business or industrial markets should channel green innovation resources toward process improvements that reduce energy, materials, and waste costs. In practice, many firms will pursue both types simultaneously as part of an integrated competitive strategy, but the evidence suggests that the allocation of incremental green innovation resources should be guided by the firm's primary competitive positioning.

The moderating role of R&D intensity underscores the complementarity of CSR and innovation investment. Firms that invest heavily in R&D are better positioned to convert CSR commitments into competitive green innovations because they possess greater absorptive capacity for environmental knowledge and stronger internal

capabilities for translating environmental signals into product and process improvements (Cohen & Levinthal, 1990). This complementarity suggests that firms should treat CSR and R&D as mutually reinforcing strategic investments rather than competing claims on limited resources, a reframing that has direct implications for capital allocation decisions in sustainability-oriented firms. At the policy level, the findings support environmental policy designs that simultaneously incentivize CSR and green innovation. Regulatory frameworks that are stringent but flexible, allowing firms to innovate toward compliance rather than mandating specific technologies, can activate the CSR-green innovation- competitive advantage chain by creating external pressure that reinforces internal strategic commitments (Demirel & Kesidou, 2011). Carbon pricing mechanisms, green public procurement policies, and tax incentives for environmental R&D can amplify the competitive returns to green innovation, reinforcing the private incentives that the CSR commitment generates internally. In developing economy contexts, multilateral development institutions and national governments should consider designing green finance instruments specifically targeting the intersection of CSR commitment and green innovation capacity building, where institutional and financial constraints may otherwise prevent firms from traversing the CSR-to-innovation pathway.

Conclusion

This study has conceptualized and empirically tested the mediating role of green innovation in the relationship between CSR and sustainable competitive advantage. Drawing on the natural resource-based view and dynamic capabilities theory, and employing firm-level panel data from 285 publicly listed companies across six sectors and ten years, the study applied SEM and fixed-effects panel regression to provide comprehensive evidence on the hypothesized mediation model. Four principal findings emerge. First, CSR exerts a positive and significant effect on green innovation, with environmental CSR driving the relationship more strongly than social CSR. Second, green innovation positively and significantly predicts both firm performance and market competitiveness, with green process innovation contributing more to cost-based advantages and green product innovation contributing more to differentiation-based advantages. Third, CSR retains a positive direct effect on SCA after controlling for green innovation, confirming the multidimensional nature of the CSR-competitiveness relationship. Fourth, green innovation partially mediates the CSR-SCA relationship, accounting for approximately 46 percent of the total effect, and this mediation is amplified in firms with high R&D intensity and in environmentally visible industries.

These findings contribute to the literature in three ways. Theoretically, the study specifies the innovation mechanism through which CSR generates competitive advantages that prior work has treated as either direct or mediated by broad intangible resources, advancing the precision of the NRBV and dynamic capabilities accounts of the sustainability-strategy interface. Empirically, the study provides panel and instrumental variable evidence that complements and extends the predominantly cross-

sectional evidence on CSR, green innovation, and competitiveness. Practically, the results offer actionable guidance for managers seeking to maximize the competitive returns to CSR investments and for policymakers designing frameworks to promote the strategic integration of environmental responsibility and innovation.

Future research should extend the analysis in several directions. First, micro-level qualitative and mixed-methods studies would enrich understanding of the organizational processes through which CSR commitments are converted into green innovation outputs, testing the dynamic capabilities mechanisms at a level of granularity that panel data cannot capture. Second, longitudinal studies tracking firms over longer time horizons would illuminate the temporal dynamics of capability accumulation and competitive advantage decay, important questions that the ten-year window of the present study can only partially address. Third, comparative institutional analyses examining how different national innovation systems and regulatory environments condition the CSR-green innovation-SCA chain would advance understanding of the boundary conditions that determine where and for whom this mediation mechanism is most potent.

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