

Green Innovation Effects on Firm Performance with ESG Performance as Mediating and Financial Constraints as Moderating Variable

Eny Maryanti*^{ID}, Fauziatun Najwa, Sarwenda Biduri^{ID}
Accounting Department, Muhammadiyah University of Sidoarjo, Indonesia.

*Corresponding author email: envmarvanti@umsida.ac.id

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ABSTRACT

Purpose: This study aims to examine the impact of Green Innovation on firm performance, using ESG performance as the mediating variable and financial constraints as the moderating variable.

Method: This research used a numbers driven approach, working with existing data from 30 consumer goods companies (non-cyclical) on the Indonesia Stock Exchange between 2020 and 2024. The companies were handpicked based on specific criteria, and the dataset was an unbalanced panel. To crunch the numbers, the study used a multiple linear regression model analyzed with SPSS version 26.

Findings: The results showed a few key things. While Green Innovation didn't have any effect on a company's ESG Performance, it did have a strong, positive impact on overall Firm Performance. Interestingly, ESG Performance itself actually had a significant negative effect on Firm Performance. The research also found that ESG Performance does not act as a middleman in the link between Green Innovation and Firm Performance. On a different note, Financial Constraints were found to strengthen the effect of ESG Performance on Firm Performance, acting as a positive moderator.

Implications: From a managerial perspective, the findings indicate that green innovation can directly support better firm performance. This result provides a practical basis for managers to implement sustainability-oriented strategies, not only to improve ESG ratings or strengthen external recognition, but also because green innovation may create real business benefits for the company. From a theoretical perspective, this study enriches the accounting and management literature by providing additional evidence on the relationship between environmentally oriented innovation and corporate performance.

Novelty/Value: This study contributes by demonstrating that financial constraints do not necessarily hinder firm performance, rather in contexts where ESG implementation is sub-optimal, they can serve as a mechanism prompting firms to be more selective in allocating resources to ESG activities. Furthermore, the study provides evidence that green innovation can directly enhance firm performance without relying on improved ESG performance, thereby broadening the understanding of the value-creation pathways associated with green innovation.

Keywords: Green Innovation, Firm Performance, ESG Performance, Financial Constraints.



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INTRODUCTION

The intensifying business competition demands that companies optimize their performance as a key strategy for maintaining competitiveness and ensuring business sustainability. Firm performance serves as a critical metric for assessing profitability success (Monogina & Rachmawati, 2023). The achievement of corporate goals and objectives covering both financial and non-financial dimensions is measured through performance indicators, though the focus typically remains on commercial objectives (Febrianti & Amin, 2024). However, amid globalization and economic transformation, the definition of firm performance has broadened from purely financial indicators to incorporate long-term sustainability (Sanyoto & Mulyani, 2024). For companies to preserve their competitive edge particularly in the face of growing stakeholder expectation this paradigm shift is vital.

As a result, the move towards a more holistic performance model is compelling firms to embed sustainability into the fabric of their core business strategies. Among the various strategic endeavors utilized to drive sustainable outcomes, green innovation has emerged as a primary focus. Growing mandates from regulatory bodies, consumers, and investors concerning ethical business operations have compelled organizations to adopt eco-friendly innovative practices (Achmad et al., 2023; Hellenikapoulos & Supramono, 2025). Historically, green innovation operates as an extension of traditional innovation frameworks, though it places a distinct and paramount emphasis on mitigating ecological degradation. It is realized through the development of new products, processes, and services, including improvements in energy efficiency, waste reduction, and the utilization of renewable resources. In line with this development, corporate governance mechanisms and company characteristics play an important role in encouraging the disclosure of sustainability-related activities, reflecting corporate accountability to stakeholders and the broader environment (Biduri et al., 2023; Nofita et al., 2024). Today, green innovation is no longer merely a trend but a strategic imperative for business sustainability. Therefore, companies that implement this approach have the potential to improve their performance, enhance their corporate image, and gain greater opportunities to enter international markets (Cahyaningtyas et al., 2022).

Measuring Environmental, Social, and Governance (ESG) performance has become a global standard for investors assessing a corporation's commitment to sustainability. To meet these market demands, companies are encouraged to make strategic decisions involving the adoption of green innovations whether through product updates or improvements in operational process efficiency (Gultom & Khomsiyah, 2025). Conceptually, this approach is considered effective for reducing emissions and conserving energy, thereby directly contributing to an improved corporate ESG score (Dwijayanti & Jayanti, 2024; Xu et al., 2025). In reality, however, the pressure to innovate often conflicts with a company's internal capacity. Implementing eco-friendly technologies requires substantial upfront investment, raising managerial concerns about escalating production costs and a decline in short-term financial efficiency (Nuryanto et al., 2024; Erdoğan et al., 2025). It is precisely these cost implications that often obscure the positive impact of green innovation on overall ESG performance.

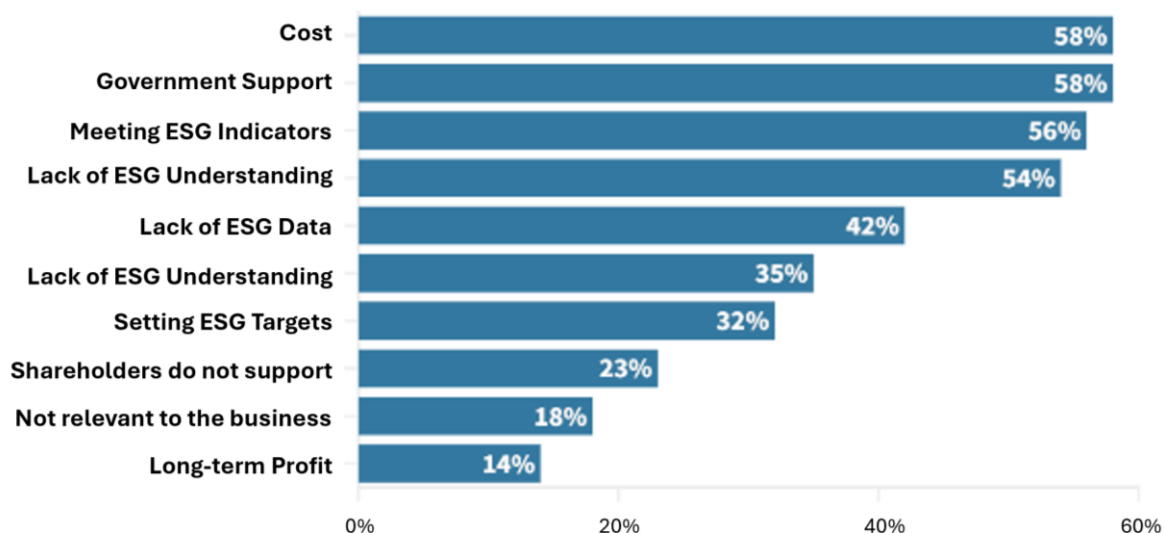
Companies currently face significant pressure to maintain environmental sustainability while simultaneously sustaining growth. This imperative serves as a primary driver for corporations to reduce energy consumption and curb pollution levels (Novitasari & Agustia, 2022). As a concrete measure, the adoption of environmentally conscious technologies and business practices has emerged as an effective strategy to support this sustainability (Febrianti & Amin, 2024). Ideally, investing in green innovation yields tangible benefits such as improved operational efficiency (Dewi & Rahmianingsih, 2020) and expanded market share (Faturachman, 2023) while also signaling a positive outlook that attracts investors and strengthens the company's financial stability (Rajendra, 2025). In reality, however, these positive outcomes do not always materialize. When companies adopt green innovations without making them a top priority, a gap often emerges between available resources and actual execution capabilities. Consequently, high research costs and limited market interest in eco-friendly products risk becoming a financial burden that hinders the company from achieving optimal performance (Candy et al., 2024; Novitasari & Agustia, 2023).

The effective implementation of ESG is fundamentally driven by a company's need to build trust and a positive reputation, theoretically, this fosters more stable revenue growth through the circulation of investment capital among stakeholders (Marisa & Istiqomah, 2025). This motivation stems from the expectation that ESG investments can enhance profitability by reducing operational

costs while simultaneously safeguarding the business against potential losses (Tahmid et al., 2022). Ultimately yielding a significant positive impact on corporate performance (Tahmid et al., 2022; Boulhaga et al., 2023). When determining strategic direction, the social responsibility dimension is often prioritized, as it stands out as a powerful driver for establishing competitive advantage and attracting investors (Tahmid et al., 2022). However, the decision to commit to sustainability often presents companies with an operational dilemma in balancing environmental and social responsibilities with financial efficiency. When companies fail to align these strategic choices with their specific industry characteristics and business scale, the anticipated ESG benefits may fail to materialize, as evidenced by research indicating that ESG performance does not always significantly influence corporate performance (Haryono & Wirianata, 2025). Consequently, external support, particularly from the government, serves as a crucial factor in motivating companies to contribute to the Sustainable Development Goals (SDGs) without compromising operational efficiency (Nareswari et al., 2023).

Corporate efforts to boost financial performance are now inextricably linked to sustainability demands. As a strategic response, many companies are adopting green innovations, which have been shown to drive operational efficiency while strengthening Environmental (E), Social (S), and Governance (G) dimensions (Zheng et al., 2022). Ideally, this strategic choice serves as a positive signal to the market, bolstering reputation and building investor confidence (Lu et al., 2024). Through this mechanism, ESG performance acts as a mediating channel that translates environmental values into tangible financial and operational outcomes (Maldonado-Guzmán et al., 2023). However, the positive impact of these green investment choices is not always linear. Discrepancies arise when innovation activities do not align with broader ESG strategies, or when actual ESG practices fail to become key drivers of corporate profitability (Maryati & Listya, 2023). A failure to integrate green innovation into the ESG framework can cause sustainability-related expenditures to become a financial burden rather than a driver of profit.

A firm's financial standing plays a pivotal moderating role in the nexus between green innovation and corporate performance. The implementation of green initiatives demands substantial initial capital outlay for research, development, and technological upgrades, potentially imposing a significant burden on short-term financial resources. This financial challenge is a well-documented barrier.



Source: Mandiri Institute Survey

GoodStats

Figure 1. Challenges Faced by Public Companies in Indonesia in Implementing ESG (2024)

Source: <https://goodstats.id/article/biaya-dan-dukungan-pemerintah-menjadi-kendala-utama-perusahaan-dalam-menerapkan-esg-Q96gw>

The Mandiri Institute (2024), for example (see Figure 1), highlights elevated costs as a primary impediment to innovation-centric ESG implementation, a finding consistent with the experiences of 58% of firms in a recent survey (Iswenda, 2025). Consequently, the effectiveness of green innovation in improving ESG performance and firm performance largely depends on the company's internal capabilities, particularly its access to financial resources.

Based on Figure 1, although financial constraints remain a limiting factor, global and national trends indicate a growing awareness of the importance of sustainability principles. Research by the Mandiri Institute in 2023 found that 71% of Indonesian public companies believe implementing ESG principles in their business practices will be a top priority in the future and a key factor in ensuring business sustainability both now and in the future (Sulaiman, 2023). This development can also be seen in the behavior of the capital market. One example is the performance of the SRI-KEHATI Index on the Indonesia Stock Exchange (IDX), which consists of companies with strong sustainability profiles. In 2022, the index increased by 14%, a growth rate that was considerably higher than that of the broader Composite Stock Price Index (IHSG) *Fokus Investasi Berkelanjutan, 13 Perusahaan Indonesia Ini Sabet Penghargaan ESG Award 2023 By KEHATI*, 2023. (Liputan6, 2023). This difference suggests that investors increasingly attach greater value to companies with stronger ESG commitments, which may support their overall performance.

This study employs financial constraints as a moderating variable that strengthens or weakens the impact of ESG performance on corporate performance. Financial constraints are a crucial aspect, as they reflect a company's ability to meet funding needs and are linked to bankruptcy risk. Under certain conditions, financial constraints manifested through debt interest expenses and dividend cash flow obligations can serve as a control mechanism over managerial behavior, thereby curbing the tendency toward opportunistic actions that prioritize personal interests (Sutisna & Salman, 2025). Such conditions also encourage greater discipline in resource allocation, including the execution of ESG initiatives, ensuring that ESG activities are conducted in a more focused and efficient manner that aligns with shareholder interests (Dinçergök & Pirgaip, 2025). Conversely, however, financial limitations may lead companies to implement ESG activities superficially or merely to satisfy external demands consequently, these activities fail to generate real value and do not significantly enhance corporate performance (Ho et al., 2024). Therefore, financial constraints warrant further examination as a factor influencing the relationship between ESG performance and corporate performance (Marisa & Istiqomah, 2025).

The conceptual framework for this research is built upon the dual theoretical pillars of the Resource-Based View (RBV) and Stakeholder Theory. Introduced by (Wernerfelt, 1984), the RBV reorients the analytical emphasis from a company's market outputs to its internal asset base, proposing that this unique configuration of resources offers the clearest understanding of a firm's capacity for competition. This principle is systematically captured by the VRIO model (Barney, 1991), which posits that market outperformance and durable competitive advantage stem from the possession and strategic mobilization of resources that are valuable, rare, inimitable, and organizationally embedded. Within this perspective, green innovation is regarded as a strategic resource that carries unique characteristics capable of supporting sustainable competitive advantage (Khanra et al., 2022). Green innovation is considered difficult to imitate and has the potential to become an important foundation for improving long-term firm performance and maintaining business competitiveness. In addition, this research also adopts Stakeholder Theory introduced by Freeman and McVea (Littahayu & Sulistiyoningsih, 2023). This theory emphasizes that companies are required to identify, assess, and respond to stakeholders who may influence business activities in order to fulfill stakeholder expectations. By implementing green innovations, companies address pressures, build trust, and ultimately secure stakeholder resource support a critical pathway to achieving optimal firm performance (Ha & Nguyen, 2022; Rizaldi & Arrozi, 2025).

This study builds upon the research conducted by Zheng et al. (2022), where the researchers modified the original framework by replacing the variables of political connection strength and regional innovation capacity with financial constraints. Based on the findings of (Marisa & Istiqomah, 2025), this adjustment was made because implementing ESG entails significant costs; consequently, financial constraints may lead companies to forgo essential ESG investments or focus only on specific ESG initiatives. Such an approach risks reducing ESG practices to mere branding tactics rather than tangible efforts that enhance firm performance (Ho et al., 2024). The study's sample comprises companies listed on the Indonesia Stock Exchange in the non-cyclical consumer goods sector, as these firms meet daily

or fundamental societal needs, offering promising future prospects for the sector (Kammagi & Veny, 2023). As previously outlined, inconsistent findings persist regarding the impact of green innovation on ESG performance, the effect of green innovation on firm performance, the relationship between ESG performance and firm performance, the mediating role of ESG performance in the green innovation-corporate-performance relationship, and the moderating effect of financial constraints on this relationship. Consequently, this study aims to re-examine the influence of green innovation on firm performance, using ESG performance as the mediating variable and financial constraints as the moderating variable. This study aims to contribute to the development of theory in both accounting and management. It deepens the academic understanding of how green innovation affects company performance, particularly by shedding light on the mediating role played by ESG metrics and the way financial constraints moderate those effects. Apart from its theoretical contribution, the results are likely to offer practical guidance for corporate managers, investors, creditors, and the wider community. The study is also expected to act as a helpful reference point for future research exploring similar topics.

LITERATURE REVIEW

The Impact of Green Innovation on ESG Performance

Green innovation can enhance a company's ESG performance because the adoption of eco-friendly innovations in products, processes, and technologies supports the company in implementing ESG principles more effectively. According to the Resource-based View theory, green innovation represents valuable, scarce, difficult-to-replicate, and irreplaceable resources and capabilities (VRIN), thereby creating unique competitive advantages and enabling companies to integrate sustainability strategies more deeply (Barney & Arian, 2005). Green innovation acts as a strategic driver of ESG performance improvement through three primary mechanisms: first, it directly improves the Environmental (E) dimension by reducing emissions, waste, and natural resource consumption; second, it strengthens the Social (S) dimension by building stakeholders' trust in the company's commitment to social responsibility. Third, enhance the Governance (G) dimension by monitoring R&D activities and achieving sustainability targets (Yadav et al., 2025). It can be concluded that the higher a company's level of green innovation, the better its ESG performance. This is supported by research demonstrating that green innovation has a significant positive impact on ESG performance (Xu et al., 2025; Yadav et al., 2025).

H₁: Green innovation has a positive impact on ESG performance.

The Impact of Green Innovation on Firm Performance

Green innovation enables companies to optimize resource use through the implementation of more efficient technologies and production processes. These efforts not only yield economic benefits but also strengthen a company's positive image and reputation among the public, while boosting stakeholder confidence. When companies demonstrate environmental responsibility, their sales opportunities increase as consumers tend to favor sustainable products (Candy et al., 2024). Thus, green innovation holds promise as an effective strategy for companies to achieve both economic and social benefits (Novitasari & Agustia, 2022). In line with the Resource-based View theory, companies possessing valuable, scarce, difficult-to-imitate, and irreplaceable resources (VRIN) can build competitive advantages and outperform their competitors (Barney & Arian, 2005). Previous research findings also indicate that green innovation has a significantly positive impact on firm performance (Febrianti & Amin, 2024; Saputra et al., 2024).

H₂: Green innovation has a positive impact on firm performance.

The Impact of ESG Performance on Firm Performance

ESG performance reflects how effectively a company implements responsible environmental, social, and governance practices. According to the Stakeholder Theory, a company's success is determined not only by shareholder interests but also by its ability to meet the expectations of all stakeholders (Hartomo

& Adiwibowo, 2023). This theory is closely linked to the concept of ESG, as it emphasizes the need for companies to create value for all stakeholders through the balanced management of economic, social, environmental, and governance aspects. Consequently, the implementation of ESG serves as a form of corporate responsibility in maintaining sustainable relationships with stakeholders (Indrawati et al., 2023). Participation in sustainability initiatives strengthens a company's ethical identity, leading to higher stakeholder satisfaction and improved firm performance. The implementation of sound ESG practices reflects a company's commitment to environmental stewardship, social responsibility, and transparent governance. This commitment can enhance operational efficiency, strengthen stakeholder relationships, and mitigate various business risks, thereby creating conditions that foster improved corporate performance (Antonius & Ida, 2023). In addition, companies with higher ESG performance are often associated with better firm performance, while weaker ESG practices tend to correspond with lower performance levels (Tahmid et al., 2022). Several previous studies have also confirmed that ESG performance exerts a significant positive influence on firm performance (Boulhaga et al., 2023; Jung & Yoo, 2023).

H₃: ESG performance has a positive impact on firm performance.

The Impact of Green Innovation on Firm Performance, with ESG Performance serving as the Mediating Variable

Green innovation represents a corporate strategy for implementing sustainability principles, such as energy efficiency, waste reduction, and the development of environmentally friendly products. Through the implementation of green innovations, companies can integrate sustainability principles into their operational activities and decision-making processes. This integration supports the more consistent application of ESG practices, enabling companies to enhance the quality of their sustainability management, as reflected in their ESG performance. These conditions position green innovation as one of the key determinants in improving ESG performance (Yadav et al., 2025). Sustainability also plays an essential role in supporting both green innovation and the improvement of firm performance, as it represents an important basis for stakeholder acceptance of a company's economic, social, and environmental responsibilities (Maldonado-Guzmán et al., 2023). This concept is consistent with stakeholder theory, where ESG implementation demonstrates the company's effort to fulfill stakeholder expectations (Angelina & Nursasi, 2021). Support from stakeholders provides the company with better access to various strategic resources, such as funding, partnerships, and business opportunities. The availability of these resources helps the company maintain business sustainability while enhancing its performance. As a result, progress in green innovation is likely to boost a firm's ESG performance, and that improved ESG performance then helps drive better financial and operational results. In this proposed framework, ESG performance acts as a channel or intermediary through which the effects of green innovation flow through to shape overall firm performance. Empirical evidence from previous studies also shows that ESG performance partially mediates the relationship between green innovation and firm performance (Zheng et al., 2022).

H₄: ESG performance mediates the impact of Green Innovation on firm performance.

The Impact of ESG Performance on Firm Performance, Considering Financial Constraints as a Moderating Variable

Optimal ESG performance requires adequate financial resources, as implementation entails various forms of investment, such as adopting eco-friendly technologies, enhancing human resource competencies, and strengthening corporate governance systems. Consequently, the level of financial constraints a company faces can influence the effectiveness of ESG implementation in creating corporate value. Research by (Xu & Zhu, 2024) indicates that financial constraints can weaken the impact of ESG performance on corporate performance. Companies facing financial pressure tend to prioritize meeting operational needs and short-term obligations, thereby limiting the funds allocated to ESG programs. This situation prevents the full realization of the economic and non-economic benefits of ESG implementation, resulting in a diminished contribution to improved corporate performance. These findings align with the study by (Marisa & Istiqomah, 2025), which states that financial constraints weaken the relationship between ESG performance and corporate performance. However, other studies report contrasting results, suggesting that financial constraints actually strengthen the impact of ESG performance on corporate performance (Sutisna & Salman, 2025). These divergent

findings indicate that the role of financial constraints as a moderating variable remains inconsistent, warranting further investigation.

H₅: Financial constraints moderate the impact of ESG performance on firm performance.

After formulating hypotheses based on theoretical foundations and previous research findings, the next step is to develop a conceptual framework that illustrates the relationships among the variables in this study as follows:

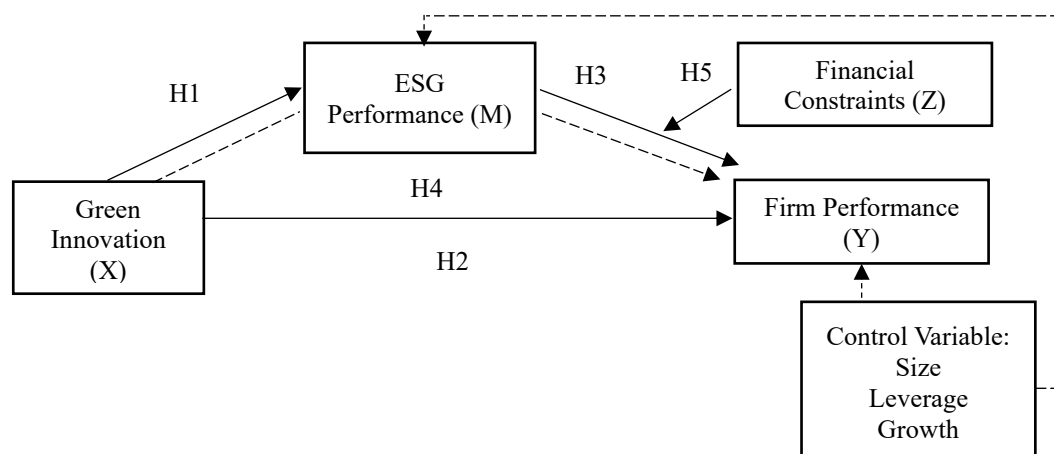


Figure 2. Conceptual Framework (Baron & Kenny, 1986).

Explanation of Arrow Directions in Figure 2:

- ✓ Solid Arrow Lines (—>): Indicate the presence of a direct effect between variables specifically, Green Innovation on ESG Performance (H1), Green Innovation on Firm Performance (H2), and ESG Performance on Firm Performance (H3).
- ✓ Dashed Arrow Lines Between Variables (- - ->): Indicate an indirect effect pathway specifically, the role of ESG Performance in mediating the relationship between Green Innovation and Firm Performance (H4).
- ✓ Arrow Lines Pointing Toward a Relationship Line: Indicate a moderating effect, where Financial Constraints moderate (strengthen or weaken) the relationship between ESG Performance and Firm Performance (H5).
- ✓ Dashed Lines from the Control Variable Box: Indicate that the variables Size, Leverage, and Growth serve as control variables, accounting for external influences on the dependent variable (Firm Performance).

RESEARCH METHOD

Types and Subjects of Research

This study employs a quantitative methodology, focusing on hypothesis testing using numerical data analyzed through statistical techniques. The subjects of the study are non-cyclical consumer goods companies listed on the Indonesia Stock Exchange (BEI) during the 2020–2024 period.

Data Types and Sources

This research relied on secondary data taken from publicly accessible, already published sources. Financial data was obtained from the official website of the Indonesia Stock Exchange (www.idx.co.id), and the accompanying ESG scores were drawn from the Bloomberg database.

Population and Research Sample

The sample population consists of non-cyclical consumer goods companies listed on the Indonesia Stock Exchange (BEI): 87 companies in 2020, 98 in 2021, 113 in 2022, 125 in 2023, and 129 in 2024. This study employs the purposive sampling technique, which selects samples based on criteria tailored to the research objectives.

This study also uses Unbalanced panel data because not all companies in the non-cyclical consumer goods sector had complete data available throughout the 2020-2024 observation period. Some companies were listed on the Indonesia Stock Exchange during the study period and, consequently, did not yet have a full five years of data. Furthermore, ESG score data obtained from Bloomberg was not consistently available for all companies across all years of the observation period. The use of an unbalanced panel is a common approach in empirical research when data availability varies across companies or time periods, allowing analysis to proceed without discarding information that remains usable. The specific criteria employed are stated in [Table 1](#).

Table 1. Criteria for Sample Selection

No	Criteria	2020	2021	2022	2023	2024
1.	A company specializing in non-cyclical consumer goods registered on the BEI from 2020 to 2024	87	98	113	125	129
2.	Companies that possess ESG score data Bloomberg, for the period 2020–2024	(72)	(69)	(86)	(97)	(115)
	Research sample	15	29	27	28	14
	The total amount of research data			113		
	Non-normal data			(21)		
	Total amount of research data			92		

Source: The data was processed by researchers.

Table 2. Variable Indicator

No	Variable	Indicator	Scale
1.	Firm Performance (Y)	$ROA = \frac{\text{Net Income}}{\text{Total Assets}}$ (Marisa & Istiqomah, 2025); (Febrianti & Amin, 2024)	Ratio
2.	Green Innovation (X)	$GPROD = \frac{\text{Current period net cash flow operation} - \text{Net cash flow operation of the prior period}}{\text{Sales for the previous period}}$ (Wahyuni et al., 2024)	Ratio
3.	ESG Performance (M)	ESG Performance=Bloomberg ESG Score (Rahelliamelinda & Handoko, 2024)	Nominal
4.	Financial Constraints (Z)	$SA = -0,737 \times \text{Size} + 0,043 \times \text{Size}^2 - 0,040 \times \text{Age}$ $\text{Size} = \ln(\text{Total Company Assets})$ $\text{Age} = \text{Research Years} - \text{The Years Since the Company Was Established}$ (Xu & Zhu, 2024)	Nominal
5.	Size (Variable control)	$\text{Size} = \ln(\text{Total Assets})$ (Xu & Zhu, 2024)	Ratio
6.	Leverage (Variable control)	$\text{Lev} = \frac{\text{Total Liabilities}}{\text{Total Assets}}$ (Xu & Zhu, 2024)	Ratio
7.	Growth (Variable control)	$\text{Growth} = \frac{\text{Total assets at the end of the current period} - \text{Total assets at the end of the previous period}}{\text{Total assets at the end of the previous period}}$ (Xu & Zhu, 2024)	Ratio

Definition, Variable Identification, and Variable Indicators

The dependent variable in this study is firm performance. The independent variable is green innovation. The mediating variable is ESG performance. The moderating variable is financial constraints. The control variables in this study are size, leverage, and growth. The size variable was selected to control for a company's operational scale and resource capacity. Large-scale companies generally possess greater stability and stronger access to funding, factors that can directly influence financial performance and the capacity to undertake long-term investments such as green innovation and adherence to ESG standards. This variable is operationalized using the natural logarithm of total assets to normalize asset values, which tend to be very large, thereby making the data distribution more symmetrical. Leverage is employed as a control variable to account for the impact of capital structure and financial risk. High debt levels can limit managerial flexibility and constrain the financial resources available for funding green innovation projects or sustainability initiatives, as priority must be given to meeting short- and long-term obligations to creditors. This variable is measured by the ratio of total liabilities to total assets. Growth is included to control for business expansion dynamics and future profit prospects. Companies in a high-growth phase typically encounter greater investment opportunities and tend to be more dynamic in converting assets into profit; consequently, failing to control for this variable could distort the analysis. This variable is operationalized by measuring the percentage change in total assets from the previous period to the current period. Table 2 summarises the variables and indicators.

Technical Analysis

In this study, researchers employed Multivariate Analysis. First, descriptive statistical tests were conducted. Subsequently, classical hypothesis tests were performed to verify the validity of the regression model. The normality and assumption test are depicted in Table 3. Normality testing was carried out using the Kolmogorov-Smirnov test to assess whether the residuals followed a normal distribution; residuals were considered normal if the asymptotic significance (Sig) exceeded 0.05 (Ghozali, 2018). Multicollinearity was evaluated by examining the tolerance value and the Variance Inflation Factor (VIF); a model was deemed free of multicollinearity if the tolerance exceeded 0.10 and the VIF was below 10. Heteroskedasticity was then tested, with Sig > 0.05 indicating the absence of heteroskedasticity in the model. Finally, the Durbin-Watson test was applied to confirm the absence of autocorrelation among the residuals (Haryono & Wirianata, 2025).

Table 3. Distribution Table

Test	Decision-Making Basis	Source
Normality Test	The residual value can be considered normal if its asymptotic significance (Asym. Sig) is greater than 0.05.	(Ghozali, 2018)
Multicollinearity Test	If the tolerance value is > 0.10 and the VIF (Variance Inflation Factor) is <10, then the model is considered free from multicollinearity.	(Haryono & Wirianata, 2025)
Heteroskedasticity Test	When the value of sig > 0.05, there are no signs of heteroskedasticity in the model.	(Haryono & Wirianata, 2025)

This study employed the SPSS software (Statistical Product and Service Solution) along with an additional tool for testing mediation effects the Sobel test calculator. The model used was as follows:

Regression Model 1

$$ROA = \alpha + \beta_1 GI + \beta_2 ESG + \beta_3 SIZE + \beta_4 LEV + \beta_5 GROWTH + \epsilon \quad (1)$$

Regression Model 2

$$ESG = \alpha + \beta_1 GI + \beta_2 SIZE + \beta_3 LEV + \beta_4 GROWTH + \epsilon \quad (2)$$

Regression Model 3

$$ROA = \alpha + \beta_1 ESG + \beta_2 SA + \beta_3 (ESG \times SA) + \beta_4 SIZE + \beta_5 LEV + \beta_6 GROWTH + \epsilon \quad (3)$$

Description:

ESG = Environmental, Social, and Governance Performance

GI	= Green Innovation
Size	= Company Size
LEV	= Leverage
GROWTH	= Company Growth
ROA	= Return on Assets, or the Company's Performance.
SA	= Financial Constraints
€	= Standard Error

Hypothesis Testing

Hypothesis testing is a decision-making process employed by researchers to evaluate research findings against predefined objectives or problems. To assess model validity, this study employed methods such as the partial t-test and the coefficient of determination test (Haryono & Wirianata, 2025). The significance level for hypothesis testing was determined by comparing t-table values with t-statistics: if the t-statistic exceeds the t-table threshold, the hypothesis is accepted; otherwise, it is rejected (Shonchoy, 2016). Additionally, mediation and moderation tests were conducted. The mediation test aimed to determine whether ESG performance variables serve as mediators in the relationship between green innovation and firm performance, while the moderation test examined whether financial constraints could strengthen or weaken the relationship between ESG performance and return on assets (ROA).

RESULTS AND DISCUSSION

Results

Descriptive Statistical Test

Descriptive statistics aim to provide an overview of the research data characteristics. The measures used include the minimum value (minimum), maximum value (maximum), mean, and standard deviation. The presentation of the descriptive statistical results in this study is shown in Table 4.

Table 4. Results of Descriptive Statistical Tests

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Green Innovation (X)	92	-.1712	.2594	.020162	.0829577
ESG Performance (M)	92	25.73	65.84	48.6151	8.55024
Financial Constraints (Z)	92	12.1673	21.0156	15.876753	2.1150824
Size (K1)	92	27.9298	32.9379	30.490813	1.1799333
Leverage (K2)	92	.0928	1.0000	.468798	.2148616
Growth (K3)	92	-.2002	.2966	.037330	.0877937
Firm Performance (Y)	92	-.1536	.1762	.055992	.0582845
Valid N (listwise)	92				

Source: Data processed – SPSS 26

Table 4 presents the descriptive statistics for the 92 observations used in this study. The Green Innovation variable (X) has a mean value of 0.020162, indicating that, on average, the sample firms showed a relatively low level of cash flow growth associated with innovation activities. In this study, green product innovation was proxied by the growth rate of operating cash flow relative to sales. This proxy is based on the idea that innovation activities, such as the development of environmentally friendly products and the improvement of employee competencies, represent strategic investments intended to strengthen firms' competitiveness in the global market. Higher operating cash flow reflects the firm's ability to convert innovation efforts and environmental compliance costs into more sustainable financial outcomes through operational efficiency and wider market opportunities (Wahyuni et al., 2024).

The minimum value of Green Innovation is -0.1712, while the maximum value is 0.2594. It's standard deviation of 0.0829577 shows that the data are relatively dispersed, suggesting that the implementation of green innovation varied considerably across the sample companies during the observation period.

The Environmental, Social, and Governance (ESG) Performance variable (M), measured using the Bloomberg ESG score, has an average value of 48.6151. The ESG score ranges from a minimum of 25.73 to a maximum of 65.84. The standard deviation of 8.55024 is lower than the mean, indicating that ESG performance among the sample firms is relatively homogeneous and does not show substantial differences between companies.

The Financial Constraints variable (Z) was calculated using the SA formula, namely $SA = -0.737 \times \text{Size} + 0.043 \times \text{Size}^2 - 0.040 \times \text{Age}$. In this formula, Size is measured using the natural logarithm of total assets, while Age is obtained from the difference between the research year and the company's founding year. The mean value of Financial Constraints is 15.876753, with a minimum value of 12.1673 and a maximum value of 21.0156. The standard deviation of 2.1150824 indicates that the level of financial constraints among the sample firms is relatively stable, with no substantial deviation from the average value.

The Size variable (K1), which is used as the first control variable, is measured by the natural logarithm (LN) of total assets. The mean value of Size is 30.490813, with values ranging from 27.9298 to 32.9379. Its standard deviation of 1.1799333 is far below the mean, indicating that the companies included in the study are generally large and have relatively similar asset levels.

The Leverage variable (K2), as the second control variable, reflects the extent to which companies use debt to finance their assets. Leverage is measured by dividing total liabilities by total assets. The average leverage value is 0.468798, with a minimum value of 0.0928 and a maximum value of 1.0000. The standard deviation of 0.2148616 suggests relatively low variation. This indicates that, on average, the sample companies finance almost half of their assets through debt.

The Growth variable (K3), used as the third control variable, measures the growth of company assets. It is calculated by subtracting the previous year's total assets from the current year's total assets and dividing the result by the previous year's total assets. The average value of Growth is 0.037330, with a minimum value of -0.2002 and a maximum value of 0.2966. The standard deviation of 0.0877937 is higher than the mean, indicating that asset growth varied considerably among the sample firms.

Firm Performance (Y) is measured using Return on Assets (ROA), which is calculated by dividing net income by total assets. The mean value of Firm Performance is 0.055992, with a minimum value of -0.1536 and a maximum value of 0.1762. The standard deviation of 0.0582845, which is slightly higher than the mean, indicates that the firms' ability to generate net income from their total assets differed noticeably across the sample.

Determination Coefficient Test (R^2)

The R^2 test is used to determine the extent to which the independent variables influence the dependent variable; this can be seen from the Adjusted R-Square value in [Table 5](#).

Table 5. Results of the R^2 Performance Test for Companies (Y)

Model Summary ^b				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.561 ^a	.315	.275	.0496166

a. Predictors: (Constant), Green Innovation (X), ESG Performance (M), Size (K1), Leverage (K2), Growth (K3)
b. Dependent Variable: Firm Performance (Y)

Source: Data processed – SPSS 26

[Table 5](#) shows an adjusted R-squared value of 0.275. It can be concluded that the influence of the independent variables green innovation (X), ESG performance (M), company size (K1), leverage (K2), and growth (K3) on firm performance (Y) accounts for 27.5%, while the remaining 72.5% is attributed to factors not included in this study or excluded from the regression model.

Table 6. Results of the R² Performance Test for ESG Performance (M)

Model Summary^b				
Model	R	R Square	Adjusted R-Square	Std. Error of the Estimate
2	.317 ^a	.100	.059	8.29462

a. Predictors: (Constant), Green Innovation (X), Size (K1), Leverage (K2), Growth (K3)

b. Dependent Variable: ESG Performance (M)

Source: Data processed – SPSS 26

Based on the Adjusted R-Square value of 0.059 in Table 6, the research model explains only 5.9% of the variation in ESG Performance (M) through the variables of green innovation (X), size (K1), leverage (K2), and growth (K3). This value indicates that the model's ability to explain changes in ESG performance (M) remains relatively low. Consequently, approximately 94.1% of the variation in ESG performance (M) is influenced by factors outside the research model.

Table 7. Results of the R² Performance Test for Companies (Y)

Model Summary^b				
Model	R	R Square	Adjusted R-Square	Std. Error of the Estimate
3	.596 ^a	.356	.310	.0484083

a. Predictors: (Constant), ESG Performance (M), Financial Constraints (Z), Moderation (M_Z), Size (K1), Leverage (K2), Growth (K3)

b. Dependent Variable: Firm Performance (Y)

Source: Data processed – SPSS 26

Based on Table 7, the Adjusted R-Square value of 0.310 indicates that the regression model explains 31% of the variation in firm performance (Y) through the variables of ESG performance (M), financial constraints (Z), moderation (M_Z), and control variables namely size (K1), leverage (K2), growth (K3). This suggests that the model's explanatory power regarding changes in firm performance (Y) is moderate, while the remaining 69% is influenced by factors outside the research model that were not analyzed in this study.

Partial T-test

The T-test is used to determine whether each independent variable individually influences the dependent variable. The results of the T-test are shown in Table 8.

Table 8. Results of the Firm Performance T-Test (Y)

Coefficients^a					
		Unstandardized Coefficients	Standardized Coefficients		
		B	Std. Error	Beta	t
Model					Sig.
1	(Constant)	-.203	.138		-1.469
	Green Innovation (X)	.144	.064	.205	2.231
	ESG Performance (M)	.000	.001	.043	.462
	Size (K1)	.010	.005	.195	2.099
	Leverage (K2)	-.119	.025	-.440	-4.688
	Growth (K3)	.105	.061	.158	1.713

a. Dependent Variable: Firm Performance (Y)

Source: Data processed – SPSS 26

In Table 8, the dependent variable Y representing firm performance, shows that the significance values for green innovation (X), size (K1), and leverage (K2) are all <0.05, indicating that these variables influence firm performance. In contrast, the significance values for ESG (M) and growth (K3) are > 0.05, suggesting that these variables do not affect firm performance.

Table 9. Results of the ESG Performance T-Test (M)

		Coefficients ^a			
		Unstandardized Coefficients		Standardized Coefficients	
Model		B	Std. Error	Beta	t
2	(Constant)	9.224	23.110		.399
	Green Innovation (X)	3.637	10.768	.035	.338
	Size (K1)	1.447	.752	.200	1.924
	Leverage (K2)	-9.699	4.129	-.244	-2.349
	Growth (K3)	-6.829	10.227	-.070	-.668

a. Dependent Variable: ESG Performance (M)

Source: Data processed – SPSS 26

In [Table 9](#), with the dependent variable M representing ESG performance, it is evident that the significance values for green innovation (X), size (K1), and growth (K3) are all greater than 0.05, indicating that these variables do not influence ESG performance. In contrast, leverage (K2) has a significance value less than 0.05, suggesting that it does affect ESG performance.

Moderated Regression Analysis

MRA analysis is used to determine whether the moderating variables can moderate or fail to moderate the relationship between the independent and dependent variables. The results of the MRA analysis are presented in [Table 10](#).

Table 10. Results of the MRA Analysis Test

		Coefficients ^a			
		Unstandardized Coefficients		Standardized Coefficients	
Model		B	Std. Error	Beta	t
3	(Constant)	-2.850	1.144		-2.491
	ESG Performance (M)	-.298	.103	-.3.235	-2.903
	Financial Constraints (Z)	-.135	.043	-4.883	-3.150
	Moderation (M_Z)	.254	.086	5.910	2.963
	Size (K1)	.966	.367	.642	2.631
	Leverage (K2)	-.156	.032	-.446	-4.830
	Growth (K3)	.051	.061	.077	.842

a. Dependent Variable: Firm Performance (Y)

Source: Data processed – SPSS 26

The MRA test results presented in [Table 10](#), with firm performance as the dependent variable Y, indicate that the significance levels for ESG performance (M), financial constraints (Z), the moderation interaction between ESG performance and financial constraints (M_Z), firm size (K1), and leverage (K2) are all <0.05, suggesting these variables influence firm performance. In contrast, growth (K3) has a significance level > 0.05, indicating no significant effect. Thus, it can be concluded that financial constraints (Z) moderate the impact of ESG performance on firm performance.

Mediation Test

This study employed the Sobel test to examine the indirect effect of independent variables on dependent variables through intervening variables. The analysis was conducted using Daniel Soper's online Sobel test statistic calculator. The presence of a mediation effect was determined when the Sobel test statistic value exceeded 1.96 and the two-tailed probability was less than 0.05. The mediation test results are presented in [Table 11](#).

Table 11. Results of the Sobel Test

	Green Innovation (X)	Sobel test statistic	One-tailed probability	Two-tailed probability	Conclusion
A	3.637				No
B	-0.298				mediation
Sa	10.768	-0.335	0.369	0.737	(H4 Rejected)
Sb	0.103				

Source: Data processed – Sobel test calculator Daniel Soper

Based on the Sobel test results in Table 11, the Sobel test statistic value is -0.335, which is significantly below the minimum threshold of 1.96. Additionally, the two-tailed probability is 0.737, indicating that this value far exceeds the significance level of 0.05. It can be concluded that ESG performance does not mediate the impact of green innovation on firm performance.

Multiple Linear Regression Analysis

Classic hypothesis testing was conducted to ensure that the regression model used could more accurately represent the data conditions. Referring to Tables 8, 9, and 10, the results of the multiple linear regression analysis performed using the SPSS 26 software are presented as follows:

$$\text{ROA} = -0.203 + 0.144 \text{ GI} + 0.000 \text{ ESG} + 0.010 \text{ Size} - 0.119 \text{ Lev} + 0.105 \text{ Growth} \quad (4)$$

The regression equation shows a constant value of -0.203. This indicates that when Green Innovation (GI), ESG Performance (ESG), Company Size (Size), Leverage, and Growth are assumed to be 0, the predicted value of Return on Assets (ROA) is -0.203. The coefficient of Green Innovation is 0.144, showing a positive relationship with firm performance. This means that every one-unit increase in Green Innovation is associated with an increase in ROA of 0.144, assuming the other variables remain constant. In other words, firms with higher levels of green innovation tend to show better performance. The coefficient of ESG Performance is 0.000, indicating that changes in ESG Performance do not contribute to changes in ROA in this regression model. Meanwhile, Company Size has a positive coefficient of 0.010, meaning that a one-unit increase in firm size is associated with an increase in ROA of 0.010. Leverage has a negative coefficient of -0.119, which suggests that higher debt usage tends to reduce firm performance; specifically, each one-unit increase in Leverage is associated with a decrease in ROA of 0.119. In contrast, Growth has a positive coefficient of 0.105, indicating that firms with higher asset growth tend to achieve better performance, with each one-unit increase in Growth associated with an increase in ROA of 0.105.

$$\text{ESG} = 9.224 + 3.637 \text{ GI} + 1.447 \text{ Size} - 9.699 \text{ Lev} - 6.829 \text{ Growth} \quad (5)$$

The constant value is 9.224; this means that if Green Innovation (GI), Size, Leverage, and Growth are all equal to 0, the ESG Performance value is 9.224. The regression coefficient for the GI variable is 3.637, indicating a positive correlation each one-unit increase in green innovation enhances ESG performance by 3.637. This positive coefficient underscores the direct positive relationship between green innovation and ESG performance: higher green innovation leads to higher ESG performance. The regression coefficient for the control variable Size is 1.447, also indicating a positive relationship each one-unit increase in size boosts ESG performance by 1.447. In contrast, the regression coefficient for the control variable Leverage is -9.699, suggesting a negative correlation each one-unit increase in leverage reduces ESG performance by 9.699. The regression coefficient for the control variable Growth is -6. The value of 829 also indicates a negative correlation: every one-unit increase in growth reduces ESG performance by 6.829.

$$\begin{aligned} \text{ROA} = & -2.850 - 0.298 \text{ ESG} - 0.135 \text{ SA} + 0.254 \text{ ESGxSA} + 0.966 \text{ Size} - 0.156 \text{ Lev} \\ & + 0.051 \text{ Growth} \end{aligned} \quad (6)$$

The constant value is -2.850; this means that if the ESG Size-Age Index (SA) interaction moderation effect between ESG performance and financial constraints (ESGxSA) – measured by Size, Leverage, and Growth – equals 0, then the Return on Assets (ROA) is -2.850. The regression coefficient

for the ESG variable is -0.298 , indicating a negative correlation: a one-unit increase in ESG performance reduces ROA by 0.298 . The regression coefficient for the SA variable is -0.135 , also indicating a negative correlation: a one-unit increase in financial constraints decreases ROA by 0.135 . In contrast, the regression coefficient for the ESGxSA variable is 0.254 , indicating a positive correlation: a one-unit increase in the ESG-finance interaction moderation effect enhances ROA by 0.254 . This positive coefficient indicates a positive correlation between the moderating interaction of ESG performance and financial constraints on firm performance meaning a stronger interaction between these factors leads to higher firm performance. The regression coefficient for the control variable (Size) is 0.966 , indicating that a one-unit increase in size enhances firm performance by 0.966 . The coefficient for the control variable (Leverage) is -0.156 , suggesting a negative relationship where a one-unit increase in leverage reduces performance by 0.156 . Conversely, the coefficient for the control variable (Growth) is 0.051 , reflecting a positive relationship where a one-unit increase in growth improves performance by 0.051 .

Discussion

Green Innovations for ESG Performance

According to Table 9, the test results indicate that Green Innovation has no significant impact on ESG Performance. The coefficient value of this variable exceeds the significance threshold of 0.05 by 0.736 . Hypothesis 1, which posits that Green Innovation positively influences ESG Performance, is rejected. The primary reasons include managers' skepticism about its benefits, low environmental awareness, and concerns about increased production costs (Nuryanto et al., 2024; Erdoğan et al., 2025). From the Resource-Based View perspective, green innovation cannot yet be classified as a strategic resource capable of generating competitive advantages, as it fails to meet the VRIN criteria (Valueable, Rare, Inimitable, Non-substitutable), thus failing to deliver optimal contributions to ESG Performance. This finding aligns with previous studies showing that green product innovation has no effect on ESG Performance (Nuryanto et al., 2024), in contrast to earlier research that reported a positive impact (Xu et al., 2025; Yadav et al., 2025).

Green Innovations for Firm Performance

According to Table 8, the significance value of Green Innovation is recorded as 0.028 , which is below 0.05 ; therefore, Hypothesis 2 that Green Innovation positively impacts firm performance is accepted. These findings indicate that the greater the role of green innovation in enhancing corporate profitability, the more efficient the production costs and resource utilization become, as evidenced by reduced energy consumption and lower pollution levels (Novitasari & Agustia, 2022). Green innovation, defined as the application of environmentally conscious technologies and business practices, is recognized as a strategy that improves performance while supporting corporate sustainability (Febrianti & Amin, 2024). This finding aligns with the RBV theory, which emphasizes that a company's competitive advantage stems from its ability to effectively manage and utilize its resources. In this context, green innovation is regarded as a unique and difficult-to-replicate strategic resource that can add value to companies by enhancing their performance. The findings of this study align with previous research, which demonstrates a positive correlation between green innovation and firm performance (Febrianti & Amin, 2024; Saputra et al., 2024). However, other studies have found no significant relationship between the two variables (Candy et al., 2024; Novitasari & Agustia, 2022).

The Impact of ESG on Firm Performance

According to Table 10, the test results indicate that ESG performance significantly impacts firm performance, albeit in a negative direction (correlation coefficient: -0.298). The coefficient's significance level (p-value: 0.005) is below 0.05 , thereby rejecting Hypothesis 3 which posits that ESG performance positively influences firm performance. A key factor underlying these results is that ESG implementation often creates a dilemma between sustainability commitments and financial efficiency. Improving ESG scores requires substantial investment such as developing eco-friendly technologies, enhancing governance, and launching social programs which entails significant costs and opportunity

costs. Such expenditures can reduce short-term corporate profits, thereby negatively impacting company performance. Furthermore, investors in the Indonesian capital market tend to prioritize short-term gains and have yet to fully factor in the long-term economic benefits of ESG adoption. Consequently, improvements in ESG performance fail to garner positive market appreciation and may even trigger a negative response, contributing to a decline in corporate performance (Nareswari et al., 2023). These findings contradict the third hypothesis, which posited that ESG performance positively influences corporate performance. This discrepancy suggests that the economic benefits of ESG implementation had not yet fully materialized for the sampled companies during the study period. From a stakeholder theory perspective, companies are encouraged to address the interests of all stakeholders through ESG adoption, as this is expected to generate legitimacy, reputation, and competitive advantage ultimately boosting corporate performance (Hartomo & Adiwibowo, 2023). However, these benefits are inherently long-term in nature. During the initial implementation phase, companies incur relatively high investment costs, while the associated economic benefits and positive stakeholder responses have yet to be fully realized. However, since ESG does not always yield immediate economic benefits, it may temporarily undermine firm performance. This finding aligns with previous research indicating that ESG performance negatively impacts firm performance (Nareswari et al., 2023), although other studies have demonstrated a positive correlation (Tahmid et al., 2022; Boulhaga et al., 2023; Jung & Yoo, 2023).

ESG Performance Mediates the Relationship Between Green Innovation and Firm Performance

Based on the Sobel test results in Table 11, the two-tailed probability value of 0.737 exceeds 0.05. This result rejects Hypothesis 4, indicating that ESG performance does not mediate the impact of green innovation on firm performance. This finding aligns with stakeholder theory, which posits that companies must meet the expectations of various stakeholders such as investors, the public, and the government (Angelina & Nursasi, 2021). However, ESG performance in this study has not optimally fulfilled stakeholder expectations, as it has not emerged as a significant driver of corporate profitability (Senjani & Putra, 2024). Consequently, even when companies implement green innovations, their impact on performance is not mediated through ESG metrics but directly enhances firm performance, consistent with Hypothesis 2. This finding is consistent with previous studies indicating that ESG performance does not mediate this relationship (Maryati & Listya, 2023), but differs from other studies that found ESG to exert a partial mediating effect (Zheng et al., 2022).

Financial Constraints Moderating the Impact of ESG on Firm Performance

Based on the MRA test results in Table 10, the findings indicate a positive moderation coefficient of 0.254 with a significance level of 0.004 (below 0.05), demonstrating that financial constraints moderate the impact of ESG performance on firm performance thereby supporting Hypothesis 5. Consequently, financial constraints are confirmed to amplify the effect of ESG performance on corporate outcomes. Financial constraints, manifested through debt interest burdens and dividend cash flow obligations, serve as regulatory mechanisms that curb managerial opportunistic behavior, reducing the tendency toward self-serving actions (Sutisna & Salman, 2025). Under these constraints, companies exhibit greater discipline in resource allocation, including ESG performance implementation, resulting in more targeted, efficient, and shareholder-aligned ESG activities (Dinçergök & Pirgaip, 2025). The findings of this study are consistent with previous research indicating that financial constraints positively moderate the relationship between ESG performance and firm performance (Sutisna & Salman, 2025), although other studies have reported a negative correlation (Marisa & Istiqomah, 2025; Xu & Zhu, 2024).

This study has limitations regarding the population size, sample size, and the availability of ESG data. Therefore, future research is recommended to expand the population coverage and consider the use of different analytical methods.

CONCLUSION

Based on the research findings, it can be concluded that green innovation directly boosts corporate performance by enhancing operational efficiency and optimizing resource utilization. However, investment in green innovation has not yet significantly shaped ESG performance a situation driven by

managerial skepticism regarding long-term benefits, low environmental awareness, and concerns over rising production costs. This disconnect explains why ESG performance fails to mediate the impact of green innovation on corporate performance. Green innovation directly influences profitability without requiring ESG intervention, as sustainability measures are not yet viewed as primary profit drivers. Conversely, ESG performance shows a negative trend regarding corporate performance, reflecting a market where investors remain focused on short-term gains and have yet to appreciate the intrinsic value of ESG. An interesting phenomenon emerges when financial constraints are introduced as a moderating variable; these constraints are shown to positively strengthen the impact of ESG performance on corporate performance. Capital limitations act as an effective external control mechanism that curbs opportunistic managerial behavior. When fiscal space tightens, management is compelled to be more disciplined, focused, and efficient in allocating ESG budgets to ensure alignment with shareholder interests, thereby transforming the negative impact of ESG into a positive contribution to firm value.

The validity and generalizability of these findings are subject to several structural limitations. The primary constraints lie in the relatively limited population scope and small sample size, compounded by the scarcity of comprehensive ESG disclosure data on Bloomberg. Furthermore, the linear model employed may not fully capture the dynamic fluctuations of inter-variable relationships over the long term. Consequently, future research should expand the geographical and industrial scope of the population and consider alternative analytical methods capable of detecting non-linear relationships or time-lag effects with greater accuracy.

Implications theoretically, these findings enrich the academic literature in accounting and management specifically regarding the impact of green innovation on corporate performance by considering the role of ESG performance as a mediating variable and financial constraints as a moderating variable; the study also serves as a reference for future researchers exploring similar topics. For practitioners, this research suggests that management should focus green innovation directly on operational efficiency, as this has proven effective in boosting profitability independently of ESG scores. Companies need to be more selective in allocating sustainability budgets to avoid financial strain, while investors are encouraged to prioritize a company's technical innovation capabilities rather than focusing solely on ESG reports. From a policy perspective, stock exchange authorities and the government need to formulate more concrete incentives for long-term investors and establish stricter ESG reporting standards, ensuring that sustainability disclosures offer real market value rather than serving merely as corporate window dressing.

This research makes a novel contribution to management accounting literature by uncovering an anomaly regarding the function of financial constraints. Unlike the majority of studies that view capital limitations as operational hurdles, this study demonstrates that in the immature ESG implementation, financial constraints actually serve as a natural governance tool that compels efficient resource allocation. Furthermore, establishing the direct link between green innovation and corporate performance offers a fresh perspective: environmental investments can independently generate competitive advantages without relying on formal validation from external ESG ratings.

List of Abbreviations

ESG – Environmental, Social, and Governance
SDG – Sustainable Development Goals
VRIO – Value, Rareness, Imitability, and Organization
RBV – Resource-Based View
VRIN –Valuable, Rare, Inimitable, Non-substitutable
ROA – Return on Assets
SPSS – Statistical Product and Service Solution

Authors' Information

Eny Maryanti (EM) works at the Accounting Department, Muhammadiyah University of Sidoarjo, Indonesia, as a lecturer. Email: enymaryanti@umsida.ac.id

Fauziatun Najwa (FN) graduated from the Accounting Department, Muhammadiyah University of Sidoarjo, Indonesia. Email: 222010300080@mhs.umsida.ac.id

Sarwenda Biduri (SB) works at the Accounting Department, Muhammadiyah University of Sidoarjo, Indonesia, as a lecturer. Email: sarwendabiduri@umsida.ac.id

Authors' Contribution

EM conceived and designed the study, supervised the research process, analyzed and interpreted the data, and drafted and finalized the manuscript. FN collected the data, conducted the literature review, and assisted in data processing and manuscript preparation. SB provided methodological guidance, critically reviewed the manuscript, and contributed to the interpretation of the findings and the final revision of the manuscript. All authors read and approved the final version of the manuscript.

Conflict of Interest

The authors declare no competing interests

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Availability of Data and Materials

Data are available publicly in the IDX and firms' website.

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APPENDIX

Classical Assumption Test

Normality Test

The normality test is used to assess whether the residuals in the regression model follow a normal distribution. This study employed the Kolmogorov-Smirnov test to examine the normality of the residuals. Residuals are considered normally distributed if the Asymptotic Significance Probability (ASSP) exceeds 0.05. The results of the normality test are presented in the table below:

Table 12. Results of the Normality Test for the Company's Performance Dependent Variable (Y)
One-Sample Kolmogorov-Smirnov Test

		Unstandardized Residual
N		92
Normal Parameters ^{a,b}	Mean	.0000000
	Std. Deviation	.04823429
Most Extreme Differences	Absolute	.086
	Positive	.086
	Negative	-.070
Test Statistic		.086
Asymp. Sig. (2-tailed)		.090 ^c

Source: Data processed – SPSS 26

According to Table 12, the firm performance variable (Y) exhibits a Kolmogorov-Smirnov statistic value of 0.086. The normality test results indicate that the Asymptotic Significance (two-tailed) is 0.090, which is greater than 0.05. This confirms that the regression equation in this study satisfies the normal distribution assumption (Aplikasi Analisis Multivariete Dengan Program IBM SPSS 23, 2018).

Multicollinearity Test

To evaluate whether inter-correlations or linear dependencies exist among the independent variables within the proposed model, a multicollinearity test was performed. This diagnostic assessment is strictly required in empirical models that incorporate multiple independent variables. The quantitative outcomes of this multicollinearity evaluation are summarized in the table below:

Table 13. Results of the Multicollinearity Test for firm performance (Y)

		Coefficients ^a	
		Collinearity Statistics	
Model		Tolerance	VIF
1	Green Innovation (X)	.946	1.057
	ESG Performance (M)	.900	1.111
	Size (K1)	.921	1.085
	Leverage (K2)	.903	1.107
	Growth (K3)	.933	1.072

a. Dependent Variable: Firm Performance (Y)

Source: Data processed – SPSS 26

According to the test results in Table 13, the Green Innovation variable (X) exhibits a Variance Inflation Factor (VIF) of 1.057, an ESG Performance (M) of 1.111, a Size (K1) of 1.085, a Leverage (K2) of 1.107, and a Growth (K3) of 1.072. Consequently, it can be concluded that there is no multicollinearity among the independent variables (X, M, K1, K2, K3) in the model with the firm performance (Y) as the dependent variable. This is evidenced by the tolerance values of all independent

variables exceeding 0.10 and the VIF values remaining below 10 (Aplikasi Analisis Multivariate Dengan Program IBM SPSS 23, 2018).

Heteroskedasticity Test

The heteroskedasticity test was used to determine whether the residual variance at each observation in the regression model was equal or different. The results of this test are shown in [Figure 3](#).

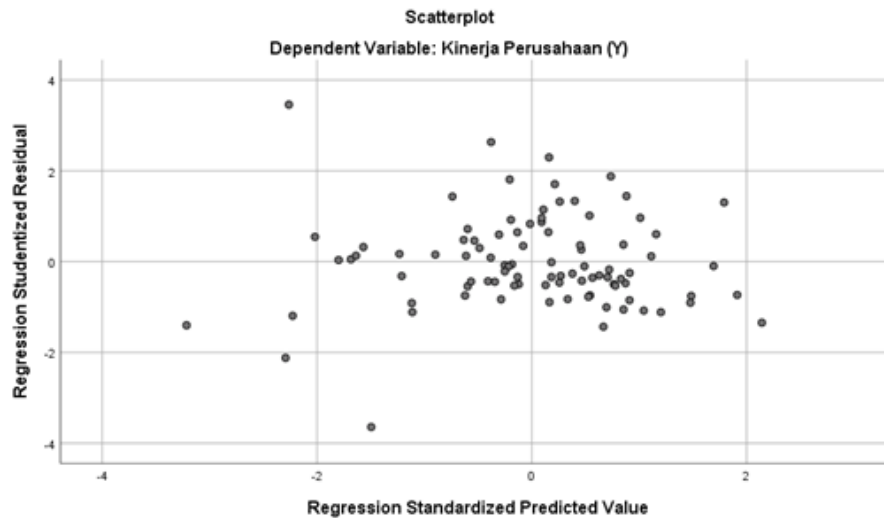


Figure 3. Results of the Heteroskedasticity Test for Firm Performance (Y)

Source: Data processed – SPSS 26

The heteroskedasticity test results in [Figure 3](#) indicate that the residuals of the firm performance variable (Y) are randomly distributed around the horizontal axis without forming any discernible pattern. This suggests the absence of heteroskedasticity in the variable, as the residual variance remains constant and unpatronized (Aplikasi Analisis Multivariate Dengan Program IBM SPSS 23, 2018).

Autocorrelation Test

An autocorrelation test was conducted to determine whether there is a relationship or correlation between the variables or between the observed data. The results of this test are presented in the table below:

Table 14. Results of the Autocorrelation Test for Firm Performance (Y)

Model Summary ^b					
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.561 ^a	.315	.275	.0496166	1.385

a. Predictors: (Constant), Green Innovation (X), ESG Performance (M), Size (K1), Leverage (K2), Growth (K3)

b. Dependent Variable: Firm Performance (Y)

Source: Data processed – SPSS 26

The autocorrelation test was conducted using the Durbin-Watson Test (DW-test). According to [Table 14](#), the DW value for firm performance (Y) is 1.385, falling within the range of -2 to $+2$. This suggests that the test results do not indicate any autocorrelation ([Binus, 2021](#)).