



Board Characteristics, Gender Diversity, and Green Innovation as Drivers of Firm Value

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Abstract

Original Research Article

This study examines the role of board characteristics and gender diversity in shaping green innovation and firm value in Indonesian non-financial companies. The growing importance of sustainability in emerging markets has highlighted the need for effective governance structures that align corporate strategies with environmental and stakeholder expectations. Using purposive sampling, data were collected from 50 non-financial firms listed on the Indonesia Stock Exchange over the period 2019–2023. Board characteristics were measured through board size and female representation in both directors and commissioners, while green innovation was assessed through environmental disclosures aligned with international standards. Firm value was proxied by Tobin's Q, capturing market perceptions of performance and growth potential.

The results reveal that the board size of directors positively influences green innovation but negatively affects firm value, underscoring the trade-off between diverse expertise and decision-making efficiency. Female directors negatively affect green innovation but positively enhance firm value, reflecting their cautious approach to high-risk environmental investments alongside broader contributions to governance and market confidence. Female commissioners, however, do not show a significant impact on either green innovation or firm value. Furthermore, green innovation itself is found to have a positive and significant effect on firm value, although it does not mediate the relationship between board characteristics and firm value.

These findings provide important implications for theory, practice, and policy. They suggest that board structures and diversity play complex roles in advancing sustainability while enhancing firm value. The study contributes to corporate governance literature in emerging markets and offers guidance for companies and policymakers seeking to optimize board composition for sustainable value creation.

Keywords: Board Characteristics; Gender Diversity; Green Innovation; Firm Value.

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1. INTRODUCTION

Firm value represents the market's assessment of a company's overall performance and long-term sustainability. It is not only a reflection of shareholders' wealth but also of the trust and confidence that stakeholders, investors, regulators, consumers, and society at large place in the firm. In emerging markets such as Indonesia, where businesses operate under heightened environmental and social pressures, firm value increasingly depends on how effectively companies integrate sustainability into their strategies (de Jong et al., 2021; Godfrey et al., 2009). The rising awareness of climate change, environmental degradation, and global calls for sustainability compel companies to adopt innovative approaches that balance

economic goals with environmental and social responsibility. One such approach is green innovation, which has become a critical determinant of long-term value creation.

Green innovation refers to the development and implementation of environmentally friendly technologies, processes, and products designed to minimize ecological impact while maintaining or enhancing competitiveness. By adopting green innovation, companies can achieve dual objectives: reducing negative environmental externalities and improving organizational legitimacy among stakeholders. In Indonesia, several large corporations such as PT Unilever Indonesia Tbk. have introduced sustainability-driven innovations, including waste reduction, circular economy



initiatives, and eco-friendly product design as a demonstration of corporate responsibility. These efforts show that green innovation is no longer a peripheral strategy but a central component of firm value creation in competitive and regulated markets (Hung, 2023).

Despite its recognized importance, the relationship between green innovation and firm value remains inconclusive in empirical studies. Some research finds a positive link, indicating that green practices improve market reputation, operational efficiency, and long-term growth prospects. Others, however, argue that green innovation entails high costs and uncertain returns, potentially reducing short-term profitability and market value. This inconsistency highlights the need to examine the contextual factors that shape the effectiveness of green innovation. One such factor is corporate governance, particularly the role of the board of directors and commissioners in influencing strategic decisions. (Ahmed & Elfaki, 2024; Miao et al., 2017; Shen et al., 2025)

Boards serve as both monitors and advisors, ensuring that firms align with stakeholder expectations and long-term sustainability goals. Their characteristics as size, composition, and gender diversity may critically shape how companies approach green innovation. Larger boards may offer diverse expertise and networks that facilitate sustainable strategies, but they may also face coordination challenges that hinder swift decision-making. Similarly, gender diversity on boards has been associated with broader perspectives, ethical sensitivity, and stronger commitments to corporate social responsibility, yet empirical evidence on its role in promoting green innovation is mixed (Benzidia et al., 2021; Li & Xiao, 2024; Saqib & Dincă, 2023).

In Indonesia's two-tier board system, directors are responsible for strategic management, while commissioners provide oversight and guidance. This structure offers a unique context for studying how board characteristics influence sustainability initiatives and firm value. By integrating board features with green innovation, this study seeks to fill a gap in the literature on how governance mechanisms shape value creation in emerging markets.

Therefore, this research examines the influence of board size and gender diversity measured through the proportion of female directors and commissioners, on green innovation, and subsequently on firm value, in non-financial companies listed on the Indonesia Stock Exchange (IDX). Furthermore, the study investigates whether green innovation mediates the relationship between board characteristics and firm value. Through this approach, the paper contributes to the ongoing debate on the governance-sustainability-performance nexus and provides practical insights for firms and policymakers aiming to strengthen sustainability-driven corporate strategies.

2. METHODOLOGY

This study adopts a quantitative research design to empirically test the relationship between board characteristics, green innovation, and firm value. The methodological framework is structured to ensure objectivity, reliability, and

reproducibility of the findings, following standard practices in corporate governance and sustainability research.

2.1 Research Design

The study employs an explanatory research approach that examines causal relationships between independent variables (board characteristics), the mediating variable (green innovation), and the dependent variable (firm value). The explanatory nature of the research is suitable for assessing whether board composition and size influence the adoption of green innovation and, in turn, enhance firm value.

2.2 Population and Sample

The population of this study consists of non-financial companies listed on the Indonesia Stock Exchange (IDX) during the period 2019–2023. Financial institutions such as banks, insurance companies, and other financial service providers were excluded due to differences in regulatory requirements, reporting standards, and governance structures that could bias the results.

A purposive sampling method was employed to ensure the inclusion of firms that meet specific criteria:

1. Firms must publish annual reports and sustainability reports consistently during the research period (2019–2023).
2. Firms must disclose relevant information on board structure and gender composition.
3. Firms must provide measurable indicators of green innovation in their reports, either directly or indirectly, through compliance with ISO 14001 or other environmental management standards.

Based on these criteria, a total of 50 companies were selected as the research sample, representing various non-financial industries such as manufacturing, mining, consumer goods, and infrastructure.

2.3 Data and Sources

The study relies exclusively on secondary data, obtained from publicly available annual reports, sustainability reports, and company disclosures. Data on board size, female directors, and female commissioners were extracted from corporate governance sections of annual reports. Green innovation data were drawn from sustainability disclosures, particularly those aligned with environmental management standards. Firm value data were derived from market-based indicators, specifically the Tobin's Q ratio, which captures the market's assessment of firm performance relative to book value.

2.4 Operational Definition and Measurement of Variables

1. Firm Value (Dependent Variable): Measured using Tobin's Q, calculated as the ratio of the market value of

equity plus book value of debt to the book value of total assets.

2. Green Innovation (Mediating Variable): Measured through environmental initiatives disclosed in sustainability reports, referencing ISO 14001 standards. Indicators include product eco-design, waste reduction, energy efficiency, and pollution control.
3. Board Size of Directors (Independent Variable 1): Total number of directors in the company's board of directors.
4. Board Size of Commissioners (Independent Variable 2): Total number of commissioners in the supervisory board.
5. Female Directors (Independent Variable 3): Percentage of female members on the board of directors.
6. Female Commissioners (Independent Variable 4): Percentage of female members on the board of commissioners.

2.5 Data Analysis Techniques

Data analysis was performed using multiple linear regression and path analysis. The analytical steps include:

1. Descriptive Statistics – To summarize the characteristics of the sample firms and key variables.
2. Classical Assumption Tests – Including normality, multicollinearity, autocorrelation, and heteroskedasticity tests to ensure the validity of regression results.
3. Regression Analysis – To test the direct effects of board characteristics on green innovation and firm value.
4. Path Analysis – To examine both direct and indirect effects, enabling an assessment of green innovation's mediating role.
5. Sobel Test – To statistically verify whether green innovation mediates the relationship between board characteristics and firm value.

3. LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

3.1 Theoretical Framework

Stakeholder Theory

Stakeholder theory views a company as an entity that must serve not only shareholders but also employees, customers, regulators, and society (Dolezal & Novelli, 2022; Godfrey, 2005; Velandia et al., 2024). In this perspective, sustainability is an obligation as well as a strategic tool for building legitimacy. Green innovation is a way for firms to respond to environmental and social demands, showing accountability to stakeholders. Board characteristics are essential in this framework because they influence how

management aligns organizational strategies with stakeholder expectations (Fedorowicz et al., 2010).

Agency Theory

Agency theory emphasizes the separation between owners and managers, which creates potential conflicts of interest. Strong governance structures, such as effective boards, help reduce agency problems. Larger boards can provide stronger monitoring, while gender diversity can bring broader perspectives and increase accountability. These elements may affect how firms make long-term investment decisions, including those in green innovation. (Boučková, 2015; Englund & Gerdin, 2018; Kothari et al., 2006a, 2006b; Loutschina, 2005)

3.2 Firm Value

Firm value reflects the perception of investors and stakeholders about the company's performance and prospects. It indicates the success of management in using resources efficiently and generating sustainable returns. Higher firm value suggests that the market appreciates not only financial results but also long-term strategies, such as innovation and sustainability initiatives (de Jong et al., 2021; Joliet & Muller, 2016; Lin & Wang, 2011; Sassen et al., 2016).

3.3 Green Innovation

Green innovation refers to environmentally friendly innovations in products, processes, and technologies. It involves initiatives such as pollution reduction, recycling, energy efficiency, and eco-friendly design. These innovations provide companies with a dual benefit: improving efficiency and reputation, while also meeting environmental obligations. However, the impact of green innovation on firm value can vary (Ahmed & Elfaki, 2024; Dillard & Reynolds, 2007; Hung, 2023; Shen et al., 2025). For some firms, the benefits outweigh the costs, while others may experience reduced short-term profitability due to high investment requirements.

3.4 Board Characteristics

Board Size of Directors

The number of directors on a board influences how decisions are made. A larger board may offer more knowledge, expertise, and connections, which can facilitate green innovation. However, overly large boards may slow decision-making and create inefficiencies, which could reduce firm value (Coy & Garcia-Feijoo, 2020; Jiang et al., 2008a, 2008b).

Board Size of Commissioners

In a two-tier board system, commissioners play a supervisory and advisory role. A larger board of commissioners may improve oversight and reduce managerial opportunism, which could encourage sustainable practices. On the other hand, too many commissioners can lead to diluted accountability and weaker monitoring effectiveness (Kothari et al., 2006a).

Female Directors

Gender diversity at the director level can bring unique perspectives, particularly in areas related to ethics, risk, and long-term orientation. Female directors may encourage greater attention to sustainability. However, in some cases, their more cautious approach may limit investment in risky projects such as green innovation (Bobek et al., 2015; Mehrotra & Parida, 2017; Sarkar et al., 2019; Singh et al., 2008).

Female Commissioners

Female commissioners can enhance the quality of supervision and encourage companies to be more socially responsible. Their presence on the supervisory board may increase awareness of environmental issues, but their influence is more indirect since operational decisions are made by directors (Naiyananont & Smuthranond, 2017).

3.5 Hypotheses Development

Based on the theoretical and conceptual arguments above, the following hypotheses are developed:

H1: Board size of directors positively influences green innovation.

H2: The Board size of commissioners positively influences green innovation.

H3: Female directors positively influence green innovation.

H4: Female commissioners positively influence green innovation.

H5: Green innovation positively influences firm value.

H6: Board size of directors positively influences firm value.

H7: Board size of commissioners positively influences firm value.

H8: Female directors positively influence firm value.

H9: Female commissioners positively influence firm value.

H10: Green innovation mediates the relationship between the board size of directors and firm value.

H11: Green innovation mediates the relationship between the board size of commissioners and firm value.

H12: Green innovation mediates the relationship between female directors and firm value.

H13: Green innovation mediates the relationship between female commissioners and firm value.

4. RESULT AND DISCUSSION

4.1 Descriptive Statistics

Table 1 presents the descriptive statistics for the variables used in this study.

Table 1. Descriptive Statistics

Variable	Mean	Min	Max	Std. Dev.
Board Size of Directors	5.00	3	11	1.80
Board Size of Commissioners	4.00	2	8	1.20
Female Directors (%)	12.0	0	40	10.5
Female Commissioners (%)	15.0	0	45	12.7
Green Innovation (Index)	0.55	0.10	0.92	0.20
Firm Value (Tobin's Q)	1.35	0.80	2.50	0.45

These results indicate that Indonesian non-financial companies typically have relatively small boards, with limited female representation. Green innovation disclosure levels vary considerably, while Tobin's Q suggests that most firms are valued above their book value, reflecting investor confidence in long-term sustainability.

4.2 Regression Analysis

Table 2 shows the regression results testing the relationships between board characteristics, green innovation, and firm value.

Table 2. Regression Results

Independent Variable	Coefficient (β)	p-value	Significance
Board Size of Directors to Green Innovation	0.214	0.032	Significant
Board Size of Commissioners to Green Innovation	0.093	0.214	Not Sig.
Female Directors to Green Innovation	-0.176	0.041	Significant
Female Commissioners to Green Innovation	0.084	0.298	Not Sig.
Green Innovation to Firm Value	0.225	0.004	Significant
Board Size of Directors to Firm Value	-0.189	0.027	Significant
Board Size of Commissioners to Firm Value	0.163	0.036	Significant
Female Directors to Firm Value	0.142	0.048	Significant
Female Commissioners to Firm Value	0.076	0.317	Not Sig.

The findings highlight several interesting dynamics:

1. Larger boards of directors enhance green innovation but reduce firm value, consistent with the trade-off between knowledge diversity and decision-making inefficiency.
2. Female directors negatively influence green innovation but positively affect firm value, suggesting that women may adopt risk-averse approaches toward costly environmental investments while still improving governance quality.
3. Female commissioners do not significantly affect either green innovation or firm value, reflecting their limited influence in Indonesia's supervisory board system.
4. Green innovation itself has a strong positive effect on firm value, confirming that the market increasingly rewards sustainability strategies.

4.3 Model Summary

Table 3 provides the explanatory power of the models.

Table 3. Model Summary

Model	R ²	Adjusted R ²
Green Innovation (DV)	0.42	0.39
Firm Value (DV)	0.46	0.43

The results indicate that board characteristics explain 42% of the variance in green innovation and 46% of the variance in firm value, showing that governance variables have a substantial role but that other contextual factors also contribute.

4.4 Mediation Analysis (Sobel Test)

Table 4 reports the mediation test results for green innovation.

Table 4. Sobel Test Results

Mediation Path	Sobel Z	p-value	Result
Board Size of Directors to Green Innovation to Firm Value	1.21	0.23	Not Mediated
Board Size of Commissioners to Green Innovation to Firm Value	0.88	0.38	Not Mediated
Female Directors to Green Innovation to Firm Value	-1.34	0.18	Not Mediated
Female Commissioners to Green Innovation to Firm Value	0.97	0.33	Not Mediated

The results show that although green innovation positively impacts firm value, it does not statistically mediate the relationship between board characteristics and firm value. This suggests that governance structures influence firm value through other mechanisms, such as strategic oversight, risk management, and investor confidence.

4.5 Discussion

The findings align with stakeholder theory, which posits that firms must consider multiple stakeholders, including environmental concerns, to create sustainable value. Board size contributes positively to green innovation, as larger boards can bring diverse perspectives and expertise. However, the negative impact of board size on firm value resonates with agency theory, which warns against inefficiencies in overly large boards.

Gender diversity findings are mixed. Female directors' negative effect on green innovation may reflect cautious decision-making in the face of high financial risks associated with sustainability investments. Yet their positive effect on firm value indicates that their broader governance role enhances accountability, ethics, and stakeholder trust. This duality underscores the complexity of board diversity in emerging markets.

The absence of significant results for female commissioners suggests that, in Indonesia's two-tier system, commissioners' oversight role may not directly influence operational sustainability strategies. Future reforms could strengthen their involvement in environmental governance.

Finally, the strong positive relationship between green innovation and firm value provides evidence that the market increasingly rewards firms for sustainability initiatives. This confirms prior studies in emerging markets but also highlights that governance structures alone are insufficient; effective execution of green innovation strategies is crucial for value creation.

5. CONCLUSION, IMPLICATIONS, LIMITATIONS, AND ACKNOWLEDGMENTS

Conclusion

This study set out to examine the influence of board characteristics on green innovation and firm value in non-financial companies listed on the Indonesia Stock Exchange over the 2019–2023 period. The findings provide several important insights. First, the board size of directors has a positive effect on green innovation but a negative effect on firm value, indicating a trade-off between the benefits of broader expertise and the drawbacks of inefficiency in larger boards. Second, female directors negatively affect green innovation but positively affect firm value, suggesting that their cautious approach may limit risky environmental investments while still improving governance quality and market confidence. Third, female commissioners show no significant effect on either green innovation or firm value, reflecting their limited role in

operational decision-making within Indonesia's two-tier system. Finally, green innovation is found to positively influence firm value but does not mediate the relationship between board characteristics and firm value.

These results demonstrate that governance structures play a nuanced role in shaping sustainability strategies and corporate value creation. While green innovation strengthens firm value, its effectiveness depends on how boards balance risk, oversight, and strategic direction.

IMPLICATIONS

Theoretical Implications

The findings enrich the literature on corporate governance and sustainability by showing that board characteristics do not uniformly affect green innovation and firm value. Stakeholder theory is supported in the sense that sustainability-oriented innovation enhances value, while agency theory is reflected in the inefficiencies of overly large boards. The study highlights the complex role of gender diversity, with female directors contributing differently depending on whether the outcome is innovation or value.

Practical Implications

For corporate leaders, the results suggest that board composition requires careful consideration. Expanding board size may bring more knowledge, but it must be balanced against the risks of inefficiency. Gender diversity at the director level contributes positively to firm value, underlining the importance of promoting women in executive decision-making roles. At the same time, female directors may need greater empowerment and resources to play a stronger role in supporting environmental initiatives.

Policy Implications

Regulators and policymakers can take note of the limited influence of female commissioners, which points to potential structural weaknesses in the supervisory role within Indonesia's governance system. Policies that strengthen the authority of commissioners in sustainability oversight, as well as gender diversity quotas, could encourage more effective governance practices and better integration of green innovation.

Limitations

This study has several limitations that should be acknowledged. First, the analysis is limited to non-financial firms in Indonesia, which may restrict the generalizability of the findings. Second, the study relies on secondary data from annual and sustainability reports, which may vary in quality and disclosure detail across firms. Third, green innovation is measured through disclosures that may not fully capture the depth or impact of actual environmental practices. Finally, the time period of 2019–2023 captures only recent dynamics, and longer-term effects of board characteristics on innovation and value may differ.



Future Research

Future studies may extend this research by including financial institutions or conducting cross-country comparisons to better understand the role of governance in different institutional contexts. Qualitative approaches, such as interviews with board members and sustainability managers, could also provide richer insights into the mechanisms behind decision-making. Furthermore, expanding the scope to include broader ESG dimensions would allow a more holistic view of how governance structures shape sustainability and firm value.

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