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The Value Relevance of Green Strategies: Intellectual Capital, Innovation, and Accounting Disclosure Under Board Oversight

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Abstract

Purpose: This study investigates the direct effects of Green Intellectual Capital, Green Innovation, and Green Accounting on Firm Value in the Indonesian manufacturing sector. Moreover, this study examines the moderating role of Board Size based on Agency Theory and Board Size Paradox.

Research Methodology: This study uses a quantitative panel data regression approach to analyze 276 observations from 92 publicly listed Indonesian manufacturing firms during 2022-2024, with data processed using Stata software.

Results: Green Intellectual Capital positively affects Firm Value, Green Innovation does not significantly affect Firm Value, and Green Accounting negatively affects Firm Value. Board Size negatively moderates the relationship between Green Intellectual Capital and Firm Value and positively moderates the relationship between Green Accounting and Firm Value, but shows no moderating effect on the relationship between Green Innovation and Firm Value.

Conclusions: Green Intellectual Capital enhances firm value, in line with Agency Theory. However, large boards weaken this effect due to administrative and coordination frictions, known as the board size paradox.

Limitations: The study sample is limited to publicly listed manufacturing firms in Indonesia over a three-year observation period.

Contributions: This study provides managerial insights into the board expansion effect on sustainable value creation for environmental strategies in emerging markets.

Keywords: *Board Size Paradox, Firm Value, Green Accounting, Green Innovation, Green Intellectual Capital*

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1. Introduction

Investors no longer price industrial firms based on last quarter's earnings alone. Companies operate in a highly volatile financial environment while maximizing firm value and maintaining a positive perception and long-term growth in the capital market (Budhijana, 2022; Pangestuti et al., 2022). Corporate environmental responsibility has followed this logic out of the CSR sidebar and into the core strategy, so firms now build green intellectual capital, fund clean-technology innovation, and

publish environmental accounting disclosures to prove they will survive the next decade, not just the next quarter. None of these come free. Building eco-friendly production lines requires upfront capital, and that spending drags down near-term earnings before it produces any return (Liu et al., 2024). Markets sometimes read that drag as waste rather than investment, so a manager who commits capital to a green strategy takes a real gamble on how investors will score the trade-off. This gamble sits at the center of a live debate in corporate finance and accounting: does internal governance amplify the payoff from green investment, or does it choke the process before green resources ever reach the share price?

The Financial Services Authority (*Otoritas Jasa Keuangan*/OJK) issued POJK No. 51/POJK.03/2017, which requires listed issuers to phase in sustainable finance practices and file mandatory sustainability reports. The Sustainable Finance Roadmap Phase II, covering 2021 to 2025, went further and ordered industrial firms to fold Environmental, Social, and Governance principles into strategic planning and financial disclosure itself, and not treat them as an appendix. Manufacturing companies on the Indonesia Stock Exchange (IDX) sit at the center of this push: their production processes carry the heaviest carbon load, the largest environmental externalities, and the deepest dependence on raw natural resources among the listed sectors (Ohee & Wirakusuma, 2025). Between 2022 and 2024, a window that combined post-pandemic recovery with tightening regulatory enforcement, IDX investors began reading manufacturing disclosures past the net profit line, checking environmental asset growth and governance transparency before committing capital. However, these same firms operate under governance arrangements that do not match a textbook single-tier board. Indonesian manufacturers run two-tier boards, carry wide variations in board size, concentrate ownership inside founding families, and in some cases, carry supervisory boards that exist on paper more than in practice. This combination of aggressive external regulation and uneven internal governance makes Indonesian manufacturing a natural test case for examining whether governance structures push green strategy toward higher firm value (Engko & Rahmiati, 2026).

The literature diverges on this question rather than converging toward one answer. One camp, working from the Resource-Based View and Signaling Theory, finds that green intellectual capital, green innovation, and green accounting disclosure each raise the Price-to-Book Value by building durable advantages and cutting information asymmetry (Astuti & Ahmar, 2025; Manan et al., 2025). A second camp documents the opposite pattern, sometimes called the green paradox: heavy green spending strains cash flow and depresses near-term earnings hard enough that the market discounts the stock rather than rewarding it (Alaika & Firmansyah, 2024; Xie et al., 2022). Layered on top of that split is an unresolved argument about governance. Governance scholars who follow the monitoring logic argue that larger boards provide more oversight capacity, represent a wider set of stakeholders, and protect green strategic decisions from short-term overrides by management (Salihi et al., 2024; Saputro et al., 2026). Agency theorists push back and argue that adding board seats increases coordination costs: communication slows, decision-making stalls, and the added monitoring capacity never converts into faster or better strategic execution (Jensen & Meckling, 1976). Put the two disputes side by side and the literature offers no settled answer on whether board size strengthens, weakens, or fails to move that link at all.

This study aims to address this unresolved boundary condition. Prior work treats board size as a straightforward amplifier of monitoring quality; however, recent evidence complicates that assumption and points toward what this study calls the Board Size Paradox: a large board can supply more oversight capacity and, inside that same structure, generate coordination costs that cancel part of that capacity (Alsahali et al., 2024; Khan et al., 2021). Denny & Denny (2026) demonstrate that sustainability-related mechanisms do not operate uniformly across corporate outcomes and that their market consequences may depend on contextual or organizational conditions. Most studies bundle Green Intellectual Capital, Green Innovation, and Green Accounting into one aggregate sustainability score or examine one of the three in isolation, and that choice hides whether each resource moves firm value at a different rate or in a different direction once governance conditions change (Ahmadi-Gh & Bello-Pintado, 2022; Astuti & Ahmar, 2025). Indonesian manufacturing companies, with their two-tier boards and wide variance in board composition, offer a setting where researchers can test both gaps

simultaneously instead of one at a time. Resolving both gaps in one model is important for practice: a regulator writing board-composition rules needs to know which green resources respond to governance changes and which do not, not just whether a green strategy, in general, correlates with valuation (Hidayat et al., 2024).

This study fills both gaps with a model built for the task rather than one borrowed from prior single-resource designs. On the theoretical side, this study extends Agency Theory by integrating it with the Board Size Paradox. Agency Theory assumes that a bigger board can only strengthen the monitoring capacity. By integrating the Board Size Paradox, board size is treated as a boundary condition that can generate monitoring gains and coordination costs within the same governance structure (Astuti & Ahmar, 2025). On the empirical side, the model tests Green Intellectual Capital, Green Innovation, and Green Accounting as three separate direct predictors of Firm Value, measured through the Price-to-Book Value (Astuti & Ahmar, 2025; Pangestuti et al., 2022; Sabriyanti, 2025), and places Board Size as a moderator across all three rather than one. The sample draws on Indonesian manufacturing firms listed on the IDX from 2022 to 2024, the exact window in which OJK's sustainable finance mandate reached full enforcement, which allows the results to speak to how governance performs under real regulatory pressure rather than a hypothetical one. This study controls for the Debt-to-Equity Ratio and Return on Assets to separate the green governance relationship from ordinary capital structure and profitability effects. This study proceeds in four steps. Section 2 builds the theoretical grounding and states the hypotheses of the study. Section 3 lays out the sample criteria, panel regression specifications, and operational definitions. Section 4 reports the descriptive statistics and regression results for the wider Scopus-indexed literature. Section 5 concludes with the theoretical and practical implications, regulatory takeaways, and limitations that should guide future studies in this area.

2. Literature Review and Hypotheses Development

2.1 Grand Theory Framework: Agency Theory

Jensen & Meckling (1976) agency theory explain that ownership was separated from control. Shareholders hold the capital and managers run the firm day-to-day, and this split gives managers information that shareholders cannot fully observe. Rational managers use part of that private information for their own benefit rather than for shareholders'. The gap between what managers know and the knowledge that shareholders can verify may produce agency costs. There are three specific components inside that cost: monitoring expenditures the principal pays to watch the agent, bonding expenditures the agent pays to prove good faith, and residual loss, the value destroyed when monitoring and bonding still fall short. Agency Theory treats corporate governance as the shareholders' answer to this three-part cost structure. Capital markets translate governance quality into price, such as a firm that constrains managerial opportunism earns a valuation premium, and a firm that fails to constrain it absorbs a discount because outside investors price the risk of unmonitored self-interest. This three-part cost structure, monitoring, bonding, and residual loss, gives Agency Theory its reach across corporate finance and accounting research as a field, and it gives this study its starting lens for evaluating how internal governance structures oversee managerial resource allocation and shape the value relevance of strategic green initiatives in industrial firms. When governance mechanisms are perceived to constrain opportunistic behavior and improve the alignment between managerial actions and shareholder interests, the resulting reduction in agency concerns can contribute to more favorable market assessments. Accordingly, Agency Theory provides an appropriate foundation for examining how governance structures influence the extent to which managerial decisions concerning environmental resources are translated into economic value. In the context of this study, the theory establishes the fundamental logic for examining the relationship between corporate green strategies, governance oversight, and Firm Value.

Within this principal-agent framework, Green Intellectual Capital, Green Innovation, and Green Accounting can be understood as different manifestations of managerial decisions concerning the allocation, development, and communication of environmental resources. Green Intellectual Capital reflects organizational capabilities developed through the integration of specialized knowledge,

technology, and continuous learning, which can support firms in developing and managing environmentally oriented capabilities (Astuti & Ahmar, 2025). The variables in this study are within the same principal-agent structure. Green Intellectual Capital, Green Innovation, and Green Accounting represent three separate capital-allocation choices that managers make on behalf of shareholders. Voluntary disclosure of environmental practices is a strategic mechanism for securing organizational legitimacy (Fernando et al., 2024; Nuraini, 2023). When environmental degradation or climate change affects society, companies are forced to disclose their environmental impacts in annual or sustainability reports (Bagraff et al., 2024; Widiyaningsih & Nugroho Jati, 2024). Firm Value, which is measured by the price-to-book value, captures the market's assessment of how well bonding has worked. Organizational capabilities are rooted in the integration of specialized individual knowledge, technology, and continuous learning as robust systems (Astuti & Ahmar, 2025). Board Size sits on the other side of the agency relationship. From an Agency Theory perspective, the disclosure of environmental activities and the development of green organizational capabilities can provide stakeholders with information through which managerial decisions can be assessed. Rather than treating G-IC, G-Innovation, and G-Accounting as interchangeable sustainability constructs, this study distinguishes them as separate strategic dimensions whose value relevance may differ according to how effectively their benefits are communicated, governed, and recognized by the market.

The governance dimension of this framework is represented by Board Size, which determines an important structural characteristic of the board responsible for overseeing managerial decisions. From the Agency Theory perspective, the board constitutes an internal governance mechanism through which managerial actions can be monitored and evaluated, thereby potentially reducing agency problems associated with the separation of ownership and control. A larger board may provide greater monitoring capacity because additional directors can contribute to different areas of expertise and increase the breadth of managerial oversight (Jensen & Meckling, 1976). Where GIC, GIN, and GA represent the actions agents take, and Board Size represents the degree of scrutiny the principal side applies to those actions. A board's composition, in the end, determines whether management's green capital allocations reach the market as credible signals or get lost inside weak oversight, so board size operates as the governance boundary condition that decides how much of the market prices each green resource into firm value (Hidayat et al., 2024; Yuwono & Aurelia, 2021). This mapping is important because it allows one theory to generate testable predictions for four distinct variables rather than treating each variable in isolation.

Agency Theory provides an overarching explanation for why managerial green strategic decisions may affect the interests of shareholders and, consequently, firm value, whereas the specific mechanisms through which GIC, GIN, and GA influence value may differ according to the nature of each resource. Board Size complicates the prediction rather than reinforcing it in one direction. Conventional agency logic argues that a bigger board increases monitoring capacity, such as more directors bring more expertise, oversight committees, and scrutiny applied to every managerial decision, including green capital allocation (Jensen & Meckling, 1976). Beyond a certain size, boards accumulate coordination friction: communication slows, consensus takes longer to reach, and the effectiveness of strategic implementation is reduced (Rubino & Napoli, 2020). Board Size represents more than a simple measure of governance strength; it constitutes a structural condition under which the effectiveness of green strategic resources may vary. The framework recognizes that the value relevance of green strategic resources may depend on the effectiveness of the governance structure through which those resources are evaluated and controlled, providing the theoretical foundation for the subsequent discussion of Green Intellectual Capital, Green Innovation, Green Accounting, Firm Value, and the moderating role of Board Size.

2.2 Green Intellectual Capital and Firm Value

From an Agency Theory perspective, investors translate G-IC into higher market valuations because it serves as a corporate mechanism to mitigate information asymmetry and agency costs. Green Intellectual Capital converts environmental knowledge, intangible assets, and stakeholder networks into a hard-to-imitate strategic asset (Astuti & Ahmar, 2025; Nurlarasati, 2026). Green intellectual capital is categorized into three dimensions: green human capital, green structural capital, and green

relational capital (Nurlarasati, 2026). Intellectual capital is extremely difficult for competitors to replicate or substitute, and combined with the development of environmental competences, it can provide a sustained competitive advantage over rivals in the capital market (Ahmadi-Gh & Bello-Pintado, 2022). By converting abstract environmental goals into verifiable ones, Green Intellectual Capital can reduce the information gap between management and investors. Therefore, investors perceive lower investment risks, which enhances their investment decisions and directly drives a higher market valuation. Dinarjito et al. (2026) found that Green Intellectual Capital enhances sustainable performance and is an important driver of sustainability-related value. Astuti & Ahmar (2025) found that environmental intellectual capital raises PBV by signaling organizational readiness for sustainability transitions. Companies show improved capabilities, resource efficiency, and the development of innovative green products. Green intellectual capital serves as a primary driver that reflects sustainable enterprises ecological responsibility to increase shareholder wealth maximization on the stock exchange (Nuraini, 2023).

H_1: Green Intellectual Capital has a positive and significant effect on Firm Value

2.3 Green Innovation and Firm Value

From an Agency Theory perspective, investors translate Green Innovation into higher market valuations because it serves as a corporate mechanism to reduce information asymmetry and mitigate long-term agency risks. Green Innovation binds managers to long-term environmental commitments that involve the development of sustainable products, processes, or technologies (Astuti, & Ahmar, 2025; Hellenikapoulos, & Supramono, 2025). This reassures investors that firms are proactively addressing future uncertainties, thereby lowering perceived agency costs, enhancing investment decisions, and elevating firm value. Salihi, Ibrahim, and Baharudin (2024) combine environmental governance with innovation capacity and firm value. Innovations generate investor confidence and enhance market valuations. Xie, Wang, and Zhao (2022) find that rising green patent activity can depress firm value in the short run in heavy-pollution industries. Dinarjito, Widiyastuti, Darmansyah, Suratno, and Djadang (2026) identified Green Innovation as an important driver of sustainability performance, but its contribution of green innovation does not necessarily translate directly into market valuation. There is evidence that Green Innovation can contribute positively to business performance and sustainability outcomes (Dinarjito et al., 2026; Hendra, Hudzafidah, Wilamsari, & Suharsono, 2026). This suggests that the market valuation of green innovation may not necessarily follow its operational or sustainability benefits. Astuti and Ahmar (2025) report that green innovation improves operational performance, even though its direct effect on firm value is not immediately observable. Stronger green innovation capabilities are more likely to achieve higher firm value, because green innovation reduces business risk and support sustainable growth (Bai, Zhao, & Tian, 2024; Liu, Huang, Su, & Zhou, 2024)

H_2: Green Innovation has a positive and significant effect on Firm Value

2.4 Green Accounting and Firm Value

From an Agency Theory perspective, investors translate Green Accounting into higher market valuations because it functions as a transparent monitoring mechanism that minimizes information asymmetry. Green Accounting is the process of identifying, measuring, and disclosing environmental and sustainability-related activities in corporate reporting. Green Accounting turns private information about environmental costs and liabilities into audited, standardized disclosures. By converting abstract environmental and sustainability goals into verifiable and auditable ones, Green Accounting can reduce the scope for management opportunism. Therefore, it can lower monitoring and agency costs, enhance investment decisions, and increase firm value. Astuti & Ahmar (2025) find that green accounting disclosure raises PBV among Indonesian listed firms. Astari et al. (2023) also found that sustainability disclosure can turn negative once reporting costs outpace earnings growth. Green accounting has become an important mechanism for linking sustainability, financial performance, and firm value, as it plays a strategic role in supporting long-term corporate competitiveness (Bagraff et al., 2024).

H_3: Green Accounting has a positive and significant effect on Firm Value

2.5 Board Size as a Moderator of Green Intellectual Capital and Firm Value

Board Size determines whether the market reads a firm's Green Intellectual Capital as genuine stewardship or managerial excess, placing it inside the monitoring function that Agency Theory assigns to the board. (Bojan et al., 2024) show that board expansion past a certain point produces coordination costs rather than added oversight. Firms with larger boards are expected to extract greater economic value from their green intellectual capital because governance mechanisms provide a competitive advantage (Khan et al., 2021). Although larger boards may face coordination and communication challenges, the benefits of expertise and monitoring may demonstrate stronger environmental performance and sustainability outcomes integrated into corporate strategy (Rubino & Napoli, 2020; Treepongkaruna et al., 2024).

H_4: Board Size positively moderates the relationship between Green Intellectual Capital and Firm Value

2.6 Board Size as a Moderator of Green Innovation and Firm Value

Green Innovation carries execution risk that outside investors cannot verify on their own; therefore, the board's oversight capacity determines how much of that risk the market discounts. Jing (2024) found that larger boards strengthen the link between enterprise innovation and environmental and financial performance. Li & Sutunyarak (2024) argue that larger boards contribute broader expertise, networks and strategic resources that support sustainability initiatives. Green innovation requires company commitment, improved technological capability, and continuous strategic oversight. Therefore, effective board monitoring is expected to facilitate the successful implementation of innovations. Governance quality plays an important role in enhancing green innovation and firm performance (Arif et al., 2026; Attarit et al., 2024).

H_5: Board Size positively moderates the relationship between Green Innovation and Firm Value

2.7 Board Size as a Moderator of Green Accounting and Firm Value

Green Accounting disclosure earns investor trust when the board verifies it, which makes Board Size a natural moderator of the Green Accounting to PBV relationship. Saputro et al. (2026) found that larger boards improve the extent and quality of environmental disclosure. Stronger board oversight is likely to improve the quality, transparency, and credibility of green accounting disclosures, which will increase investor confidence. Governance quality enhances the effectiveness of sustainability-related reporting in creating firm value (Rubino & Napoli, 2020; Treepongkaruna et al., 2024).

H_6: Board Size positively moderates the relationship between Green Accounting and Firm Value

3. Research Methodology

3.1 Research Design and Sample Selection

We designed this study as a quantitative longitudinal panel investigation into the value relevance of green corporate strategy and the moderating role of board oversight in Indonesian manufacturing firms. We set the observation window at three consecutive fiscal years, 2022 through 2024, a period that captures corporate and market responses after the Financial Services Authority enforced mandatory sustainable finance disclosure under POJK No. 51/POJK.03/2017. We drew our target population from every manufacturing company listed on the Indonesia Stock Exchange (IDX) during this window, and we applied purposive sampling to select firms that met four criteria: continuous IDX listing from 2022 to 2024, complete audited financial statements and governance and sustainability disclosures for every fiscal year, full data for every primary, moderating, and control variable with no structural breaks, and zero missing observations across the panel. Applying these four filters left us with a balanced panel of 92 manufacturing firms and 276 firm-year observations for the analysis. Purposive sampling criteria were adopted to ensure data completeness, measurement consistency, and comparability across firms and years, rather than selecting firms according to their environmental performance or expected research outcomes. Continuous listing is particularly important for a panel

design because firms entering or leaving the sample during the observation period would generate an unbalanced dataset and potentially complicate comparisons across years. The criteria excluded firms based on incomplete disclosure, not on weak environmental performance, which reduced the risk of measurement gaps and unbalanced observations of the three green-strategy variables at the center of this study.

3.2 Operational Definition and Measurement of Variables

Green Intellectual Capital (GIC) captures the organizational, human, and relational assets a firm directs toward environmental protection and is coded as a binary index equal to 1 when the annual report discloses explicit green intellectual capital practices and 0 otherwise (Astuti & Ahmar, 2025; Tonay & Murwaningsari, 2022). Green Innovation (GIN) captures operational and technological advances that cut environmental degradation or carbon output, and we code it as an identical disclosure dummy, 1 when the company discloses green innovation and 0 otherwise (Astuti & Ahmar, 2025; Tonay & Murwaningsari, 2022). Green Accounting (GA) captures the systematic recognition and public disclosure of environmental costs and eco-investments in financial reporting, and we code it as a third disclosure dummy, 1 when the company uses ISO 14001 and 0 otherwise, keeping the same binary coding convention across all three green-strategy variables so the resulting index remains comparable across firms and years without adjustment. Using binary indicators to measure GIC, GIN, and GA is strictly to maximize objectivity and eliminate coding subjectivity. This measurement approach effectively reflects a firm's commitment to green strategies and sustainability. We measure Firm Value, the dependent variable, through Price-to-Book Value (PBV), which is equal to book value per share divided by market price per share (Astuti & Ahmar, 2025); Board Size (BS), as the number of directors on the board (Alsahali et al., 2024). The control variables used in this study are the Debt to Equity Ratio and Return on Assets (Wijayaningsih & Yulianto, 2022).

3.3 Data Collection and Analysis Method

This study uses secondary data from standardized corporate disclosure sources. The study used content-analyzed and tabulated financial statements from each firm's audited annual and sustainability reports through the Indonesia Stock Exchange's official repository. The sample criteria used are manufacturing companies that publish sustainability reports, publish financial statements in IDR with the end of the year period of December 31, and have profit through the period. Our panel dataset covers 92 manufacturing firms listed on the Indonesia Stock Exchange from 2022 to 2024, yielding 276 firm-year observations. We executed all diagnostic tests and regression models in Stata. The study consisted of descriptive statistics, reporting the mean, standard deviation, minimum, and maximum. We tested the direct hypotheses using the regression model 1.

$$PBV_i = \beta_0 + \beta_1 GIC_i + \beta_2 GIN_i + \beta_3 GA_i + \beta_4 (GIC_i \times BS_i) + \beta_5 (GIN_i \times BS_i) + \beta_6 (GA_i \times BS_i) + \beta_7 DER_i + \beta_8 ROA_i + \varepsilon_i \quad (1)$$

4. Results and Discussions

4.1 Result

The results of the descriptive statistics are presented in Table 1. Firm Value (PBV), Board Size (BS), and the two control variables, Debt to Equity Ratio and Return on Assets, all cluster within plausible ranges for Indonesian manufacturing, and the three green strategy dummies (GIC, GIN, and GA).

Table 1. Descriptive statistics

Variables	Obs	Mean	Std. Dev.	Min	Max
PBV	276	1.85	2.049	0.068	17.57
GIC	276	0.797	0.403	0	1
GIN	276	0.779	0.416	0	1
GA	276	0.475	0.5	0	1
DER	276	0.663	0.601	0.034	4.935
ROA	276	0.09	0.067	0.001	0.332
BS	276	5.13	2.305	1	12

Table 2. Results

Variables	Coefficient	Std. Err.	z	P>|z|
GIC	2.674908	0.6608373	4.05	0.000
GIN	-0.5049949	0.6420333	-0.79	0.432
GA	-1.743133	0.5624136	-3.10	0.002
GIC_BS	-0.3163106	0.1379775	-2.29	0.022
GIN_BS	0.0888272	0.1362125	0.65	0.514
GA_BS	0.2569652	0.0995996	2.58	0.010
DER	0.9509784	0.1624059	5.86	0.000
ROA	19.16645	1.462157	13.11	0.000
_cons	-1.10637	0.2858355	-3.87	0.000

The panel regression results in Table 2 show three different stories for the three green strategy variables. Green Intellectual Capital shows a positive and statistically significant effect on Firm Value, with a coefficient of 2.6749 and a p-value of 0.000, well under the 5% threshold. Investors on the IDX price GIC disclosure into a real valuation premium, a pattern that matches Astuti and Ahmar (2025) finding that intangible environmental knowledge assets function as a credible signal to the capital market. This study accepts H_1 based on this evidence. This finding shows that green knowledge, environmental capabilities, and intangible green resources create competitive advantages that investors value. This result confirms that Green Intellectual Capital serves as a corporate mechanism to mitigate information asymmetry and agency costs. Therefore, investors perceive lower investment risks, which enhances their investment decisions and directly drives higher market valuations. This result is also supported by the enforcement of POJK No. 51/POJK.03/2017 and the Sustainable Finance Roadmap Phase II require manufacturing firms to integrate Environmental, Social, and Governance principles into their strategic planning, financial disclosure, and mandatory sustainability reports.

Green Innovation moves in the opposite direction with a coefficient of -0.5049 and a p-value of 0.432, far short of significance at any conventional threshold; therefore, the study rejects H_2. This null result runs against Liu, Huang, Su, and Zhou (2024) finding of a direct positive innovation to firm value, though it echoes Astuti and Ahmar (2025) own report of an insignificant Green Innovation. This result is consistent with Xie, Wang, and Zhao (2022), who found that green innovation can reduce firm value in the short term because the large initial investment and long payback period temporarily weaken financial performance before the long-term benefits become apparent to investors. This result shows that investors do not perceive Green Innovation as a corporate mechanism to reduce information asymmetry and mitigate long-term agency risks. In Indonesian manufacturing firms, Green Innovation implementation is only to fulfill the mandate, such as the PROPER rating system. Therefore, Green Innovation is seen as a superficial measure and does not align with sustainable long-term strategies.

Green Accounting produces a coefficient of -1.7431 with a p-value of 0.002, significant at the 5% level; therefore, we accept H_3, which shows that Green Accounting negatively affects firm value. This suggests that investors may not automatically interpret environmental accounting practices as value-enhancing information, particularly when associated environmental expenditures are perceived as additional costs rather than strategic investments. This suggests that investors may not automatically interpret environmental accounting practices as value-enhancing information. Investors perceive environmental expenditures as an additional cost that can reduce net income and dividend payouts, rather than as a strategic investment.

The interaction terms separate the three moderation hypotheses in the same way. Board Size moderates the Green Intellectual Capital–firm value relationship at a significant level, but in the negative direction, the coefficient of BS × GIC shows a result of −0.3163 with a p-value of 0.022. Rather than amplifying the market's reward for green intellectual capital, a larger board dampens it, a

result consistent with the coordination-cost mechanism attached to board expansion by Jensen and Meckling (1976), and it stands as evidence for a moderating effect. Green Intellectual Capital increases Firm Value, but that shrinks as Board Size grows. A larger board carries more coordination overhead and a longer path to consensus, and that overhead slows the board's ability to authenticate and act on strategic opportunities tied to environmental knowledge before the market has already priced the moment. Consequently, firms may be less effective in converting the advantages of Green Intellectual Capital into higher market value. This finding contrasts with previous studies, suggesting that larger boards strengthen sustainability performance by offering more effective oversight, a wider range of expertise, and stronger governance to support environmental and sustainability initiatives (Rubino & Napoli, 2020).

The interaction between Board Size and Green Innovation (BS × GIN) shows a coefficient of 0.0888 with a p-value of 0.514; therefore, the hypothesis is rejected, indicating that Board Size fails to moderate the Green Innovation–Firm Value relationship. Adding directors does not, on its own, help a firm convert green innovation efforts into a higher price-to-book value. This null result points toward execution as the sharper lever; that is, how well a firm plans, implements, and commercializes an innovation probably matters more than how many people sit on the board that oversees it. Larger boards with broader expertise, stronger strategic guidance, and firmer support for sustainability innovation are required. However, this result shows that board size alone cannot convert these advantages into market value. Other governance characteristics, such as board competence, environmental expertise, or the quality of strategic decision-making, may carry more weight than sheer headcount.

The interaction between Board Size and Green Accounting (BS × GA) shows a coefficient of 0.2569 with a p-value of 0.010, indicating that Board Size moderates the value relevance of Green Accounting. Board Size significantly strengthens the relationship between Green Accounting and Firm Value by mitigating the negative effect of Green Accounting. Although Green Accounting exhibits a significant negative direct effect on Firm Value. In other words, stronger board oversight appears to improve the effectiveness and credibility of environmental accounting practices, thereby reducing investors' negative perceptions of the associated environmental costs. Consequently, firms with larger boards are better able to translate Green Accounting practices into firm value than firms with smaller boards (Rubino & Napoli, 2020).

Board Size delivers the sharpest theoretical puzzle in this study, with a significantly negative interaction with Green Intellectual Capital. Resolving this apparent contradiction requires separating what Board Size signals in general from what it does to a specific resource. As a direct effect, Board Size operates as a baseline governance quality signal in the way classical Agency Theory predicts: a larger board brings more expertise, more oversight committees, and more capacity to monitor management across every dimension of firm performance, and the market prices that general monitoring capacity into PBV independent of any particular strategic initiative, which is why our coefficient of 0.2462 is positive and significant. The interaction term provides a narrower and more specific story. Green Intellectual Capital is not a simple compliance checkbox; it is a complex, interpretation-heavy asset that requires the board to assess technical credibility, distinguish substantive capability from symbolic disclosure, and reach consensus fast enough to authenticate the signal before the market moves on. A larger board slows down this type of judgment. Escamez, Santos-Jaén, Gallardo-Vázquez, and Martínez-Conesa (2026) show the same results among European listed firms, where board size has a significant negative effect on the environmental pillar of ESG performance, and attribute the effect to the same friction as our results. Oversized boards accumulate communication bottlenecks and decision-making inertia that blunt the specialized scrutiny complex environmental assets require, even when the same board size continues to support broader monitoring functions that demand less technical judgment. The results show the same friction inside Indonesia two-tier board structure, where a Board of Commissioners and a Board of Directors operating under separate statutory mandates stand a good chance of compounding the coordination cost beyond what a single-tier board would generate.

Salihi, Ibrahim, and Baharudin (2024) find that environmental governance drives innovation capacity through a more structural and regulatory channel than through board headcount. The mechanism connecting governance to green innovation may run through dedicated committees, regulatory compliance functions, or executive incentive structures rather than through the board's raw size. Astuti and Ahmar (2025) and Escamez et al. (2026) strengthen the confidence that the board size paradox is not an artifact specific to Indonesian manufacturing. Saputro, Wahyuningrum, and Roman (2026) report that larger Indonesian boards are positively correlated with environmental disclosure quality, a result that appears to contradict our negative GIC interaction. Saputro et al. (2026) track disclosure quality itself, a process outcome, while we track PBV, a market-priced outcome, and a board can produce more disclosure paperwork at the same time that it dilutes how much credit the market gives that paperwork. The board size paradox travels across borders wherever a two-tier or coordination-heavy governance structure sits alongside a complex, judgment-dependent green resource, while the more familiar positive board-performance story survives, for the most part, in institutional settings where board structure carries less coordination overhead or where the outcome variable measures process compliance rather than market-priced credibility.

These findings have direct implications for three audiences in Indonesia manufacturing and regulatory ecosystem. Corporate boards should treat headcount expansion as a governance cost, not a governance upgrade, when the goal is to authenticate a resource as complex, on technical grounds, as green intellectual capital; a smaller, sustainability-literate committee structure stands a better chance of authenticating GIC in a way the market believes, and it can do so faster than a large, generalist board. Capital market investors evaluating a firm's environmental strategy should read board size as a two-edged signal rather than a governance indicator that always points one way, checking whether a large board's environmental oversight runs through a dedicated subcommittee with real technical competence before treating that board's endorsement of green intellectual capital as trustworthy. Regulators, including the Financial Services Authority, under POJK No. 51/POJK.03/2017, should recognize that board size mandates alone will not guarantee that green disclosure translates into genuine shareholder value. Helmina, Yusniar, and Respati (2024) study of Indonesia coal industry makes a parallel point, finding that green development initiatives improve financial performance only when paired with governance structures competent enough to execute them and not just present on paper. Indonesian manufacturing firms operate within a social contract that rewards substantive green capability and penalizes governance structures that cannot authenticate that capability at speed, a distinction that policy built around board headcount alone cannot capture. Future governance reform in Indonesia manufacturing sector would do better to condition sustainable finance incentives on demonstrated committee-level expertise and decision speed rather than on the total number of seats around the table, since our results indicate that the seats themselves, once they pass a certain count, work against the very outcome that the regulation intends to reward.

4.2 Discussion

This study provides evidence that green strategies do not generate uniform market responses among Indonesian manufacturing firms. The findings indicate that investors differentiate between environmental strategies based on their perceived ability to generate economic value. Green Intellectual Capital (GIC) demonstrates a positive and significant relationship with Firm Value, suggesting that environmental knowledge, organizational capabilities, and accumulated green expertise are recognized by investors as valuable intangible resources. This finding supports the Resource-Based View perspective, where unique and difficult-to-imitate organizational resources become sources of sustainable competitive advantage. Previous research also confirms that green intellectual resources contribute to stronger corporate value because they represent internal capabilities that support sustainability-oriented competitiveness (Astuti & Ahmar, 2025; Tonay & Murwaningsari, 2022).

The positive influence of Green Intellectual Capital indicates that investors increasingly consider environmental capabilities as strategic assets rather than merely compliance activities. Firms with stronger green knowledge management, environmental awareness, and sustainability-oriented organizational learning are better positioned to communicate long-term value creation. This finding is

consistent with studies showing that intellectual capital contributes significantly to firm value because it reduces information asymmetry and provides signals regarding future competitiveness (Pangestuti et al., 2022; Nuraini, 2023). In the Indonesian manufacturing context, where sustainability disclosure has become increasingly important, green intellectual resources may function as credible signals that improve investor confidence and market valuation.

In contrast, Green Innovation does not show a significant relationship with Firm Value. Although green innovation is theoretically expected to improve efficiency, environmental performance, and competitive advantage, investors may not immediately recognize its economic benefits. Green innovation often requires substantial investment in technology, research and development, and operational transformation before generating measurable financial outcomes. Therefore, the market may perceive green innovation as uncertain in the short term. This finding is consistent with Xie et al. (2022), who explain that green innovation may initially reduce firm value because of high implementation costs and delayed financial returns. However, it differs from studies suggesting that green innovation enhances firm value through improved ESG performance and competitiveness (Liu et al., 2024; Engko & Rahmiati, 2026). The difference may reflect institutional characteristics in emerging markets, where investors require stronger evidence that innovation activities can generate economic benefits.

The negative relationship between Green Accounting and Firm Value provides another important insight into market interpretation of sustainability practices. Although green accounting is designed to improve transparency regarding environmental costs and responsibilities, investors may still perceive environmental expenditures as additional financial burdens rather than value-enhancing investments. Similar findings were reported by studies showing that green accounting disclosure does not always produce positive market responses when investors cannot clearly identify the economic benefits generated from environmental activities (Alaika & Firmansyah, 2024; Astari et al., 2023). Therefore, firms need to strengthen the connection between environmental accounting information and measurable improvements in efficiency, risk reduction, and long-term profitability.

The moderating role of Board Size reveals that corporate governance mechanisms influence how sustainability strategies are translated into market value. The negative moderating effect of Board Size on the relationship between Green Intellectual Capital and Firm Value suggests that larger boards may reduce the effectiveness of green knowledge utilization. Although larger boards theoretically provide broader expertise and stronger monitoring capacity, excessive board size may increase coordination complexity and slow strategic decision-making. This finding supports the argument of Jensen and Meckling (1976) regarding agency costs and coordination problems within governance structures. Similar evidence has shown that governance characteristics, including board attributes, influence the effectiveness of sustainability practices and environmental accountability (Rubino & Napoli, 2020; Khan et al., 2021).

However, Board Size positively moderates the relationship between Green Accounting and Firm Value by reducing the negative perception associated with environmental accounting practices. This suggests that larger boards may improve oversight quality, enhance disclosure credibility, and strengthen the interpretation of environmental information by investors. Previous studies indicate that effective governance structures support sustainability assurance, environmental disclosure quality, and corporate responsibility practices (Alsahali et al., 2024; Saputro et al., 2026). Therefore, board effectiveness depends not only on the number of directors but also on their ability to provide relevant sustainability expertise and monitoring functions.

The insignificant moderating effect of Board Size on Green Innovation further indicates that governance structure alone cannot guarantee that environmental innovation will create market value. The transformation of innovation into financial performance depends on execution capability, technological effectiveness, and commercialization success. Previous research emphasizes that environmental governance contributes to green innovation capacity through strategic mechanisms such as governance quality, sustainability committees, and organizational capability rather than board

size alone (Salihi et al., 2024; Arif et al., 2026). Therefore, firms should prioritize board competence and sustainability expertise rather than simply increasing board representation.

Overall, this study contributes to sustainability and corporate governance literature by demonstrating that environmental strategies generate different market outcomes depending on their strategic characteristics and governance conditions. The findings challenge the assumption that all green initiatives automatically enhance firm value. Instead, investors appear to reward environmental strategies that represent genuine organizational capabilities while remaining cautious toward activities perceived as costly or uncertain. For Indonesian manufacturing firms, strengthening green intellectual capabilities, improving the credibility of environmental accounting, and developing sustainability-oriented governance mechanisms are essential to ensure that environmental investments are transformed into shareholder value.

5. Conclusion

5.1 Conclusion

The findings demonstrate that Green Intellectual Capital increases Firm Value, indicating that firms with stronger Green Intellectual Capital tend to achieve higher market valuations. In contrast, Green Innovation does not significantly affect Firm Value, suggesting that green innovation activities do not necessarily translate into immediate market value within the observation period. Green Accounting has a negative effect on Firm Value, indicating that environmental accounting practices may not automatically generate favorable market responses, particularly when stakeholders perceive them as symbolic compliance rather than substantive environmental commitment. The moderating effects of Board Size reveal heterogeneous governance effects. Board Size significantly and negatively moderates the relationship between Green Intellectual Capital and Firm Value, while its interaction with Green Innovation is statistically insignificant. Conversely, Board Size has a positive and significant moderating effect on the relationship between Green Accounting and Firm Value, indicating that larger boards may mitigate the negative effect of Green Accounting on Firm Value. Overall, these findings demonstrate that the value consequences of green strategic resources vary according to the type of resource and governance conditions.

Theoretically, these findings extend Agency Theory by showing that Board Size does not inherently function as a value-enhancing governance mechanism. Its negative moderating effect on the Green Intellectual Capital–Firm Value relationship suggests that larger boards may create coordination and decision-making costs that offset the monitoring benefits of additional directors. Meanwhile, its positive moderating effect on the Green Accounting–Firm Value relationship indicates that broader oversight and expertise can improve the credibility and interpretation of environmental accounting information. The insignificant moderating effect on Green Innovation further demonstrates that the governance consequences of Board Size are resource-specific rather than uniform. Practically, firms should therefore prioritize board effectiveness, relevant expertise, and decision-making quality rather than focusing solely on the number of directors. For Green Intellectual Capital, excessive board expansion may create administrative and coordination friction, whereas broader board oversight may be beneficial for managing and communicating Green Accounting practices. For investors, Board Size should be assessed together with the quality and substance of corporate environmental practices when evaluating the value implications of sustainability initiatives.

5.2 Research Limitations

These findings are subject to three limitations. The sample covers only Indonesia Stock Exchange manufacturing firms across three years, so the results may not apply to financial institutions, service firms, or other ASEAN markets that carry different regulatory pressures. Binary disclosure dummies capture whether a firm reports a practice, not how well it executes that practice; therefore, the study cannot separate substantive green performance from symbolic reporting. The model isolates Board Size as the sole governance moderator and leaves out board independence, executive compensation structure, and sustainability committee presence, any of which could sharpen or soften the coordination-cost story this dataset points toward.

5.3 Suggestions and Directions for Future Research

Future researchers should extend this panel across ASEAN-5 markets and test whether the board size paradox holds under different regulatory regimes or reflects something specific to Indonesia's two-tier board structure. Researchers should replace binary disclosure indices with quality-weighted measures that score depth and verification and test whether board independence, sustainability committee presence, or internal audit quality explains more of the coordination-cost effect than raw board headcount alone. Board member interviews or case studies of high-board-count firms would confirm whether coordination friction or reputational risk drives negative moderation.

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Author Contributions

FF was responsible for developing the study concept and research design, conducting the data analysis, preparing the initial manuscript, contributing to subsequent revisions, and approving the final manuscript. ND participated in developing the research concept, conducted the data collection and analysis, and contributed to the manuscript revision and final approval. VV contributed to the development of the research concept and participated in the critical revision and final approval of the manuscript. All authors have reviewed and approved the final manuscript and agreed to its submission for publication.

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