

GREEN INTELLECTUAL CAPITAL, CARBON EMISSION DISCLOSURE, AND FIRM VALUE: STAKEHOLDER PRESSURE AS MODERATOR

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Abstract

This study aimed to examine the effects of Green Intellectual Capital and Carbon Emission Disclosure on firm value and to investigate the moderating role of stakeholder pressure in high-risk industry companies listed on the Indonesia Stock Exchange during the 2020–2024 period. The study employed a quantitative approach with a causal-explanatory design. The population consisted of high-risk industry companies, and a sample of 49 companies was selected through purposive sampling, resulting in 245 firm-year observations over five years. Secondary data were collected from annual reports and sustainability reports. The data were analyzed using panel data regression with the Fixed Effect Model and Moderated Regression Analysis. The results showed that Green Intellectual Capital had no significant effect on firm value, with a regression coefficient of -0.361 and a significance value of 0.392 . Carbon Emission Disclosure had a significant negative effect on firm value, with a regression coefficient of -1.903 and a significance value of 0.001 . Stakeholder pressure did not moderate the relationship between Green Intellectual Capital and firm value, with a significance value of 0.377 , but significantly moderated the relationship between Carbon Emission Disclosure and firm value, with a regression coefficient of -5.831 and a significance value of 0.021 . The adjusted coefficient of determination indicated that 78.66 percent of the variation in firm value was explained by the model, while the F-test confirmed that all variables simultaneously affected firm value with a significance value of 0.000 . These findings implied that sustainability-related information was not necessarily perceived positively by the market, and that the effectiveness of sustainability signals depended on how investors interpreted the economic benefits and risks contained in the disclosed information.

Keywords: Green Intellectual Capital, Carbon Emission Disclosure, Firm Value, Stakeholder Pressure

1. Introduction

Climate change has reshaped the global investment landscape, prompting investors to look beyond financial performance and increasingly consider companies' ability to manage environmental risks and adopt sustainable business practices (Eccles et al., 2014). This shift has positioned Environmental, Social, and Governance considerations as important factors in corporate value creation because they reflect a company's ability to generate economic value while maintaining long-term business sustainability (Friede et al., 2015). Consistent with this development, regulators across countries, including Indonesia, have continued to strengthen sustainability reporting policies to enhance the transparency of non-financial information and promote a more sustainable capital market. Firm value reflects investors' assessment of a company's performance, prospects, and ability to create economic value in the future, and it is measured using Price to Book



Value, which compares the market value of a company's shares with its book value. A higher Price to Book Value indicates that the market assigns a higher valuation to the company relative to its book value.

This changing investment orientation has particularly important implications for companies operating in high-risk industries, such as the energy, mining, basic materials, and other sectors with high levels of environmental exposure. The operational characteristics of these industries expose companies to increasing pressure from regulators, investors, and society to demonstrate their commitment to environmental management through transparent and sustainable business practices. Under these circumstances, corporate environmental management is no longer viewed merely as a form of regulatory compliance but has increasingly become a strategic means of building investor confidence, strengthening market legitimacy, and enhancing firm value. Companies in these sectors are expected to communicate their environmental performance transparently and demonstrate that their operations are aligned with broader sustainability objectives, as investors increasingly evaluate environmental risk as a material component of long-term corporate value.

The creation of firm value through sustainability practices is determined not only by a company's ability to manage its internal resources but also by the transparency of information communicated to stakeholders. Green Intellectual Capital represents a company's capacity to develop knowledge, innovation, human resources, organizational systems, and stakeholder relationships oriented toward environmental sustainability (Chen, 2008). Meanwhile, Carbon Emission Disclosure reflects corporate transparency in reporting carbon emissions, mitigation strategies, and commitments to addressing climate change (Choi et al., 2013). These two aspects can serve as positive signals that reduce information asymmetry between management and investors and, consequently, enhance market confidence in a company's prospects. From the perspective of Signaling Theory, companies capable of demonstrating environmental capabilities while providing credible sustainability information are more likely to receive favorable market responses than companies with lower levels of transparency (Connelly et al., 2011).

Although sustainability practices are conceptually expected to enhance firm value, empirical evidence regarding the effects of Green Intellectual Capital and Carbon Emission Disclosure on Firm Value remains mixed. Several studies report that the development of Green Intellectual Capital and the disclosure of carbon emissions can enhance investor confidence and increase firm value because they are perceived as signals of a company's commitment to sustainability and environmental risk management (Eccles et al., 2014; Friede et al., 2015; Widagdo et al., 2023). In contrast, other studies find that carbon emission disclosure is negatively perceived by the market because it may be associated with higher compliance costs, reduced corporate efficiency, or greater exposure to environmental risks (Matsumura et al., 2014; Apriliani et al., 2024). Recent studies have also found that Green Intellectual Capital and Carbon Emission Disclosure do not directly affect firm value (Ericho & Amin, 2024; Marzuki & Nofryanti, 2025). These inconsistencies suggest that the relationship between sustainability practices and firm value is context-dependent and may be influenced by other factors that have received limited attention in previous research.

One factor that may explain these inconsistencies is Stakeholder Pressure. In the context of high-risk industries, pressure from institutional investors and other stakeholders encourages companies not only to implement sustainability practices but also to ensure that such practices are perceived as credible by the market. From the



perspective of Signaling Theory, the effectiveness of signals conveyed by a company depends substantially on the credibility of the information received by its users (Connelly et al., 2011). Green Intellectual Capital and Carbon Emission Disclosure are more likely to be interpreted as signals of corporate quality when supported by strong stakeholder monitoring and pressure. Conversely, when stakeholder pressure is relatively low, sustainability information may be perceived as symbolic rather than substantive and may therefore receive a weaker response from investors. Accordingly, Stakeholder Pressure may function as a mechanism that strengthens or weakens the effectiveness of sustainability-related signals in influencing market assessments of a company.

The urgency of this research is driven by several critical factors. First, climate change has reshaped the global investment landscape, prompting investors to consider companies' ability to manage environmental risks, yet empirical evidence regarding the effects of Green Intellectual Capital and Carbon Emission Disclosure on firm value remains mixed. Second, companies operating in high-risk industries face increasing pressure from regulators, investors, and society to demonstrate their commitment to environmental management, yet the extent to which sustainability practices enhance firm value in these industries remains underexplored. Third, empirical evidence regarding Green Intellectual Capital and Carbon Emission Disclosure on firm value remains inconclusive, with some studies reporting positive effects and others reporting negative or insignificant effects. Fourth, the moderating role of Stakeholder Pressure in these relationships remains underexplored, with contradictory findings in prior research. Fifth, the high-risk industries during the 2020–2024 period represent a unique context characterized by increasing attention to sustainability reporting, carbon emission disclosure, and ESG practices, yet empirical evidence on the determinants of firm value in this sector remains limited.

Previous research has shown significant but fragmented findings regarding the determinants of firm value. Studies have demonstrated that Green Intellectual Capital significantly influences firm value (Daromes et al., 2020; Yadiati et al., 2019; Widagdo et al., 2023), that Carbon Emission Disclosure affects firm value (Tonay & Murwaningsari, 2022; Matsumura et al., 2014; Apriliani et al., 2024), and that Stakeholder Pressure moderates the relationship between sustainability practices and firm value (Fernandez-Feijoo et al., 2014; Garcés-Ayerbe et al., 2012). However, other studies have reported contradictory findings, indicating that Green Intellectual Capital does not affect firm value (Ericho & Amin, 2024; Marzuki & Nofryanti, 2025), that Carbon Emission Disclosure has no significant effect (Putri & Noviyari, 2025), and that Stakeholder Pressure does not always moderate the relationship between corporate practices and firm value (Widhiastuti & Pradnyani, 2025). These inconsistencies suggest that the relationships among Green Intellectual Capital, Carbon Emission Disclosure, Stakeholder Pressure, and firm value remain underexplored, particularly in the context of high-risk industries in Indonesia.

The research gap in this study lies in the limited understanding of how Green Intellectual Capital and Carbon Emission Disclosure jointly influence firm value, particularly in high-risk industries in Indonesia. While individual studies have examined the direct effects of these factors on firm value, the integrated framework connecting these factors with Stakeholder Pressure as a moderating variable remains underexplored. Additionally, most previous studies have focused on various sectors or other periods, leaving a significant gap in knowledge regarding the dynamics of firm value in high-risk industries during the 2020–2024 period. Furthermore, empirical evidence on the



determinants of firm value in Indonesia remains limited, particularly in the context of increasing attention to sustainability reporting and ESG practices.

The novelty of this research lies in several aspects. First, this study focuses on high-risk industries listed on the Indonesia Stock Exchange during the 2020–2024 period, representing a unique context characterized by increasing attention to sustainability reporting, carbon emission disclosure, and ESG practices. Second, this study develops an integrative model that simultaneously examines the influence of Green Intellectual Capital and Carbon Emission Disclosure on firm value, with Stakeholder Pressure as a moderating variable, providing a more comprehensive understanding of the determinants of firm value in high-risk industries. Third, this study contributes to the limited empirical evidence on firm value in high-risk industries, providing insights into how sustainability practices and stakeholder pressure collectively influence firm value. Fourth, this study extends the application of Signaling Theory to the context of firm value in Indonesia, validating theoretical predictions in an under-researched institutional context. Fifth, this study provides actionable insights for investors, corporate management, and regulators in designing effective strategies to enhance sustainability practices and firm value.

The purpose of this study is to examine the effects of Green Intellectual Capital and Carbon Emission Disclosure on firm value in high-risk industry companies listed on the Indonesia Stock Exchange during the 2020–2024 period, with Stakeholder Pressure as a moderating variable. Specifically, this research aims to analyze the effect of Green Intellectual Capital on firm value, analyze the effect of Carbon Emission Disclosure on firm value, analyze the moderating role of Stakeholder Pressure in the relationship between Green Intellectual Capital and firm value, and analyze the moderating role of Stakeholder Pressure in the relationship between Carbon Emission Disclosure and firm value. The choice of this goal was driven by the limited understanding of how these factors collectively influence firm value and the need for empirical evidence that can inform investors, corporate management, and regulators in designing effective strategies to enhance sustainability practices and firm value.

The contribution of theoretical perspective, this research contributes to the enrichment of literature on sustainability accounting and corporate governance by proposing and testing an integrative model that links Green Intellectual Capital and Carbon Emission Disclosure with firm value, incorporating Stakeholder Pressure as a moderating variable, extending the application of Signaling Theory to the context of firm value in Indonesia. The findings contribute to the understanding of how sustainability practices and stakeholder pressure influence firm value, providing a more nuanced theoretical framework for analyzing corporate environmental disclosure in high-risk industries. From a practical perspective, this study provides actionable insights for investors, corporate management, and regulators in assessing and managing sustainability risk. For investors, the findings provide guidance on which factors should be considered in evaluating a company's sustainability practices. For corporate management, the results offer insights into the importance of credible sustainability information and effective emission management strategies. For regulators, the results offer insights into the importance of sustainability reporting standards in promoting transparency and comparability. For academics, this study contributes to the growing body of literature on sustainability accounting and corporate governance, providing a foundation for future research on firm value.



2. Theoretical Background

2.1 Signaling Theory

Signaling Theory was initially developed by Spence (1973) to explain how parties with more information communicate signals to parties with less information under conditions of information asymmetry. In the corporate context, management generally possesses more comprehensive information regarding the company's internal conditions, performance, and future prospects than external investors. This information asymmetry encourages companies to communicate relevant information to the market as signals of their quality and prospects (Connelly et al., 2011). The effectiveness of a signal depends on its credibility and its ability to convey information that is relevant to external parties. Positive and credible signals can reduce information asymmetry, increase investor confidence, and influence market assessments of a company. In the context of sustainability, companies can communicate non-financial information through environmental practices and sustainability disclosures. Such information provides investors with additional insights into the company's ability to manage environmental risks, utilize resources efficiently, and maintain long-term business sustainability. In this study, Green Intellectual Capital and Carbon Emission Disclosure are viewed as non-financial signals that communicate the company's environmental capabilities and commitment to sustainability. The credibility and effectiveness of these signals may also be influenced by Stakeholder Pressure, particularly through institutional ownership and its monitoring role. Therefore, Signaling Theory provides the theoretical basis for explaining the relationships among Green Intellectual Capital, Carbon Emission Disclosure, Stakeholder Pressure, and Firm Value.

2.2 Firm Value

Firm Value reflects investors' assessment of a company's performance, prospects, and ability to create economic value in the future (Brigham & Houston, 2019). Firm Value is an important indicator of market perception because it reflects investors' expectations regarding the company's future performance and its ability to generate sustainable economic benefits. An increase in market valuation generally indicates greater investor confidence in the company's prospects. In this study, Firm Value is measured using Price to Book Value, which compares the market value of a company's shares with its book value and reflects the extent to which the market appreciates the company relative to the accounting value of its net assets. A higher Price to Book Value indicates that the market assigns a higher valuation to the company relative to its book value. From the perspective of Signaling Theory, Firm Value represents the market's cumulative response to information communicated by management (Spence, 1973). Investors use both financial and non-financial information to assess corporate quality and future prospects. Therefore, sustainability-related information, including Green Intellectual Capital and Carbon Emission Disclosure, may influence Firm Value when such information is interpreted as a credible signal of the company's ability to manage risks and create long-term value.

2.3 Green Intellectual Capital and Firm Value

Green Intellectual Capital is an extension of the Intellectual Capital concept that emphasizes intangible resources oriented toward environmental sustainability. Chen (2008) explains that Green Intellectual Capital encompasses knowledge, competencies, organizational systems, and relationships that support environmentally friendly innovation and sustainable value creation. Green Intellectual Capital generally consists



of Green Human Capital, Green Structural Capital, and Green Relational Capital, which collectively reflect the company's capacity to integrate environmental considerations into its organizational resources and business activities. From the perspective of Signaling Theory, Green Intellectual Capital represents a non-financial signal of a company's environmental capabilities and its commitment to sustainable business practices (Spence, 1973). Information regarding the company's green-oriented human resources, organizational systems, and stakeholder relationships can provide investors with insights into the company's ability to manage environmental risks and develop sustainable competitive advantages. A credible signal of such capabilities may strengthen investor confidence and influence market valuation. Empirical evidence supports this relationship, with studies by Daromes et al. (2020), Yadiati et al. (2019), and Widagdo et al. (2023) finding that Green Intellectual Capital has a positive effect on firm value. However, other studies report contradictory findings, indicating that Green Intellectual Capital does not affect firm value (Ericho & Amin, 2024; Marzuki & Nofryanti, 2025). Based on the theoretical explanation and empirical findings, the hypothesis proposed in this study is as follows:

H1: Green Intellectual Capital affects Firm Value.

2.4 Carbon Emission Disclosure and Firm Value

Carbon Emission Disclosure refers to corporate disclosure concerning carbon emissions, climate change mitigation strategies, emission reduction targets, and environmental management policies communicated to stakeholders (Choi et al., 2013). Carbon emission disclosure represents an important component of corporate environmental transparency because it provides external parties with information regarding the company's exposure to climate-related risks and its efforts to manage such risks. From the perspective of Signaling Theory, Carbon Emission Disclosure can function as a non-financial signal concerning the company's commitment and capability in managing environmental risks (Spence, 1973). Comprehensive and credible disclosure may reduce information asymmetry and increase investor confidence in the company's sustainability practices. However, the market response to carbon emission disclosure may vary depending on how investors interpret the information. Disclosure may be perceived positively when it demonstrates effective environmental management, but it may also be interpreted negatively when it reveals substantial environmental exposure, additional compliance costs, or operational risks. Empirical evidence supports this relationship, with studies by Tonay and Murwaningsari (2022) finding that Carbon Emission Disclosure has a positive effect on firm value. However, other studies report contradictory findings, indicating that Carbon Emission Disclosure has negative effects (Matsumura et al., 2014; Apriliani et al., 2024) or no effect (Putri & Noviri, 2025). Based on the theoretical explanation and empirical findings, the hypothesis proposed in this study is as follows:

H2: Carbon Emission Disclosure affects Firm Value.

2.5 Stakeholder Pressure Moderates the Relationship Between Green Intellectual Capital and Firm Value

Stakeholder Pressure refers to the demands or pressures exerted by stakeholders that encourage companies to implement responsible, transparent, and sustainable business practices (Fernandez-Feijoo et al., 2014). In high-risk industries, companies face greater environmental exposure and consequently may experience stronger demands from investors, regulators, and other stakeholders to demonstrate their commitment to



environmental management and sustainability. In this study, Stakeholder Pressure is proxied by institutional ownership. Institutional investors are considered an important external monitoring mechanism because they generally possess greater resources and capabilities to monitor corporate management and influence corporate policies (Cornett et al., 2007; Sakawa & Watanabe, 2020). From the perspective of Signaling Theory, Stakeholder Pressure may affect the credibility and effectiveness of sustainability-related signals (Spence, 1973). Stronger monitoring from institutional investors may encourage companies to provide more credible sustainability information and reduce the possibility that such information is perceived merely as symbolic. Consequently, Green Intellectual Capital may receive different market responses depending on the level of Stakeholder Pressure faced by the company. Stakeholder Pressure may therefore strengthen or weaken the relationship between sustainability-related information and Firm Value. Empirical evidence supports this relationship, with studies by Fernandez-Feijoo et al. (2014) and Garcés-Ayerbe et al. (2012) finding that stakeholder pressure significantly moderates the relationship between corporate practices and firm value. However, other studies report contradictory findings, indicating that Stakeholder Pressure does not always moderate the relationship between corporate practices and firm value (Widhiastuti & Pradnyani, 2025). Based on the theoretical explanation and empirical findings, the hypothesis proposed in this study is as follows:

H3: Stakeholder Pressure moderates the effect of Green Intellectual Capital on Firm Value.

2.6 Stakeholder Pressure Moderates the Relationship Between Carbon Emission Disclosure and Firm Value

Stakeholder Pressure may also influence how investors interpret Carbon Emission Disclosure (Choi et al., 2013). Companies facing stronger pressure from institutional investors are expected to have greater incentives to provide transparent and credible information regarding carbon emissions and environmental management. Stronger monitoring may increase the credibility of the information disclosed and affect the market's interpretation of such information. From the perspective of Signaling Theory, Carbon Emission Disclosure can function as a signal of corporate environmental quality (Spence, 1973). However, the market response to the signal depends on how credible and informative the disclosure is perceived to be. Strong Stakeholder Pressure may encourage companies to provide more comprehensive environmental information and reduce information asymmetry between management and investors. Consequently, Carbon Emission Disclosure may have a different effect on Firm Value when companies face different levels of Stakeholder Pressure. In high-risk industries, where environmental exposure is relatively high, the role of stakeholder monitoring becomes particularly important. Institutional investors may place greater emphasis on environmental information when evaluating corporate prospects and risks. Therefore, Stakeholder Pressure is expected to influence the relationship between Carbon Emission Disclosure and Firm Value. Empirical evidence supports this relationship, with studies by Fernandez-Feijoo et al. (2014) finding that stakeholder pressure significantly moderates the relationship between corporate practices and firm value. Based on the theoretical explanation and empirical findings, the hypothesis proposed in this study is as follows:

H4: Stakeholder Pressure moderates the effect of Carbon Emission Disclosure on Firm Value.



3. Methods

3.1 Research Design

This study employs a quantitative research design with a causal-explanatory approach to examine the effects of Green Intellectual Capital and Carbon Emission Disclosure on Firm Value and the moderating role of Stakeholder Pressure in these relationships. The quantitative approach is used because the study tests the proposed hypotheses through statistical analysis of numerical data obtained from corporate reports. The study uses secondary data in the form of annual reports and sustainability reports of companies listed on the Indonesia Stock Exchange. The research is longitudinal in nature and employs panel data, which combines cross-sectional and time-series observations. The observation period covers 2020–2024. The study focuses on companies classified as operating in High-Risk Industries, namely the Energy, Basic Materials, Transportation and Logistics, and Industrials sectors. This research setting is selected because companies in these sectors have relatively high exposure to environmental risks and are therefore more relevant for examining corporate environmental information and sustainability-related signals.

3.2 Population and Sample

The population of this study comprises companies classified as High-Risk Industries and listed on the Indonesia Stock Exchange during the 2020–2024 period. The High-Risk Industries covered in this study consist of the Energy, Basic Materials, Transportation and Logistics, and Industrials sectors. Based on the population identification, the Energy sector consists of 91 companies, the Basic Materials sector consists of 112 companies, the Transportation and Logistics sector consists of 36 companies, and the Industrials sector consists of 63 companies. The sampling method employed in this study is purposive sampling. The sample selection is based on predetermined criteria to obtain companies with sufficient and consistent information required to measure all research variables during the observation period. The sample selection criteria are as follows: (1) companies classified as High-Risk Industries, consisting of the Energy, Basic Materials, Transportation and Logistics, and Industrials sectors, and listed consecutively on the Indonesia Stock Exchange during the 2020–2024 period; (2) companies that conducted an initial public offering during or after the observation period were excluded from the sample; (3) companies that experienced suspension or delisting during the observation period were excluded from the sample; and (4) companies that published sustainability reports consecutively during the 2020–2024 period. Based on these criteria, the final sample consists of 49 companies, resulting in 245 firm-year observations over the five-year observation period, as presented in Table 1.

Table 1. Sample Determination

No	Criteria	Quantity
1	Companies classified as High-Risk Industries listed on IDX, 2020–2024	302
2	Companies conducted IPO during or after the observation period	(89)
3	Companies that experienced suspension or delisting	(47)
4	Companies that did not publish sustainability reports consecutively	(117)
5	Number of sample companies	49
6	Observation period (5 years × 49 companies)	245

Source: Processed data (2026)



Table 1 presents the sample determination process. From 302 companies classified as High-Risk Industries, 89 companies were excluded because they conducted an initial public offering during or after the observation period, 47 companies were excluded because they experienced suspension or delisting, and 117 companies were excluded because they did not publish sustainability reports consecutively. The final sample consists of 49 companies, resulting in 245 firm-year observations over the five-year observation period.

3.3 Data Collection Techniques

Data collection was conducted using the documentation method. The required data were obtained from publicly available secondary sources, particularly annual reports and sustainability reports published by companies during the 2020–2024 period. Annual reports and sustainability reports were obtained from the official website of the Indonesia Stock Exchange and the respective companies' official websites. Information concerning stock prices was obtained from financial data sources, including Yahoo Finance and IDN Financials. The collected data were subsequently organized and coded according to the operational definitions and measurement instruments of each research variable. The data collection process involved several sequential steps: (1) identification of companies classified as High-Risk Industries and listed on the IDX during the 2020–2024 period; (2) selection of companies meeting the predetermined purposive sampling criteria; (3) collection of annual reports and sustainability reports for each observation year; (4) identification and scoring of disclosure items required for Green Intellectual Capital and Carbon Emission Disclosure; (5) collection of financial and ownership data required to calculate Firm Value, Stakeholder Pressure, Firm Size, and Profitability; and (6) documentation of all extracted data systematically organized into a panel dataset suitable for statistical analysis.

3.4 Operational Definition of Variables

Table 2. Operational Definition and Measurement of Variables

Variable	Definition	Measurement	Scale	Source
Firm Value (Y)	Investors' assessment of a company's performance, prospects, and ability to create economic value in the future	PBV = Market Price per Share / Book Value per Share	Ratio	Brigham & Houston (2019)
Green Intellectual Capital (X ₁)	Knowledge, competencies, organizational systems, and relationships that support environmentally friendly innovation and sustainable value creation	GIC = n/k (number of disclosed items divided by total applicable items)	Ratio	Chen & Hung (2014); Yusoff et al. (2019); Sari & Nursal (2024)
Carbon Emission	Corporate disclosure concerning carbon emissions, climate	$CED = \frac{\sum di}{18} \times 100\%$	Ratio	Choi et al. (2013);



Variable	Definition	Measurement	Scale	Source
Disclosure (X ₂)	change mitigation strategies, emission reduction targets, and environmental management policies			Hariswan et al. (2022)
Stakeholder Pressure (Z)	Demands or pressures exerted by stakeholders that encourage companies to implement responsible, transparent, and sustainable business practices	IO = Institutional Shares / Total Outstanding Shares × 100%	Ratio	Cornett et al. (2007); Sari & Panggabean (2022)
Firm Size (Control)	The scale of a company, commonly measured by total assets	SIZE = Ln(Total Assets)	Ratio	Brigham & Houston (2019)
Profitability (Control)	The company's ability to generate profit from the assets it controls	ROA = Net Income After Tax / Total Assets	Ratio	Kasmir (2019)

Source: Developed for this research (2026)

Table 2 presents the operational definitions and measurements of all research variables. Firm Value is measured using Price to Book Value, which compares the market price per share to the book value per share. Green Intellectual Capital is measured using content analysis based on Green Human Capital, Green Structural Capital, and Green Relational Capital, with each disclosure item assigned a score of 1 when disclosed and 0 when not disclosed, and the index calculated by dividing the number of disclosed items by the total applicable items. Carbon Emission Disclosure is measured using an index consisting of 18 disclosure items, with the index calculated by dividing the total disclosure score by 18 and multiplying the result by 100 percent. Stakeholder Pressure is proxied by institutional ownership, measured as the proportion of shares owned by institutional investors relative to total outstanding shares. Firm Size is measured using the natural logarithm of total assets, and Profitability is measured using Return on Assets.

3.5 Data Analysis Techniques

Data analysis in this study employs panel data regression because the dataset combines observations across companies and over time. The statistical analysis is conducted using EViews. The stages of data analysis include descriptive statistics, panel data model selection (Chow test, Hausman test, and Lagrange Multiplier test), classical assumption tests (normality, multicollinearity, heteroscedasticity, and autocorrelation), panel data regression, and Moderated Regression Analysis. Descriptive statistics are used to describe the characteristics of the research variables through the mean, median, standard deviation, minimum, and maximum values. Panel data model selection is conducted to determine the most appropriate regression model among the Common Effect Model, Fixed Effect Model, and Random Effect Model. Classical assumption tests are conducted to assess the suitability of the regression model. Panel data regression is conducted to examine the direct effects of Green Intellectual Capital and Carbon Emission Disclosure



on Firm Value while controlling for Firm Size and Profitability. Moderated Regression Analysis is used to examine the moderating role of Stakeholder Pressure in the relationships between Green Intellectual Capital and Firm Value and between Carbon Emission Disclosure and Firm Value.

The regression models employed in this study are formulated as follows:

Model 1: Direct Effects Model

$$FV_{it} = \alpha + \beta_1 GIC_{it} + \beta_2 CED_{it} + \beta_3 SP_{it} + \beta_4 SIZE_{it} + \beta_5 ROA_{it} + \varepsilon_{it}$$

Model 2: Moderation Effects Model

$$FV_{it} = \alpha + \beta_1 GIC_{it} + \beta_2 CED_{it} + \beta_3 SP_{it} + \beta_4 SIZE_{it} + \beta_5 ROA_{it} + \beta_6 (GIC_{it} \times SP_{it}) + \beta_7 (CED_{it} \times SP_{it}) + \varepsilon_{it}$$

Where FV is Firm Value, α is the constant, β_1 – β_7 are regression coefficients, GIC is Green Intellectual Capital, CED is Carbon Emission Disclosure, SP is Stakeholder Pressure, SIZE is Firm Size, ROA is Profitability, ε is the error term, i is company, and t is year. Hypothesis testing is conducted using the t-test to determine the partial effects of the independent variables and interaction terms on Firm Value. The F-test is used to examine the overall significance of the regression model. The coefficient of determination is used to assess the explanatory power of the regression model, while the adjusted coefficient of determination is considered to account for the number of explanatory variables included in the model. All hypothesis tests were conducted at a significance level of 5 percent.

4. Results and Discussion

4.1 Descriptive Statistics

Table 3. Descriptive Statistics of Research Variables

Variable	N	Minimum	Maximum	Mean	Std. Deviation
Green Intellectual Capital	245	0.666667	1.000000	0.954286	0.082846
Carbon Emission Disclosure	245	0.560000	1.000000	0.796531	0.099843
Firm Value	245	−1.550000	32.620000	2.318286	4.353506
Stakeholder Pressure	245	0.300000	1.000000	0.724122	0.135791

Source: Processed data from EViews 11 (2026)

Table 3 presents the descriptive statistics for 245 firm-year observations of companies classified as High-Risk Industries and listed on the Indonesia Stock Exchange during 2020–2024. Green Intellectual Capital has a minimum value of 0.666667 and a maximum value of 1.000000, with a mean of 0.954286 and a standard deviation of 0.082846. The relatively high mean indicates that the sample companies generally disclose a substantial proportion of information related to Green Intellectual Capital. Carbon Emission Disclosure has a minimum value of 0.560000 and a maximum value of 1.000000, with a mean of 0.796531 and a standard deviation of 0.099843, indicating that carbon-related disclosure is relatively extensive among the sample companies. Firm Value, measured using Price to Book Value, ranges from −1.550000 to 32.620000, with a mean of 2.318286 and a standard deviation of 4.353506, indicating substantial variation in market valuation among the sampled companies. Stakeholder Pressure, proxied by institutional ownership, ranges from 0.300000 to 1.000000, with a mean of 0.724122 and a standard deviation of 0.135791, indicating that institutional ownership varies across the sampled



companies, while the relatively high mean suggests that institutional investors hold a substantial proportion of shares in many of the observed companies.

4.2 Panel Data Model Selection

Table 4. Panel Data Model Selection

Test	Probability	Selected Model
Chow Test	0.0000	Fixed Effect Model
Hausman Test	0.0433	Fixed Effect Model
Lagrange Multiplier Test	0.0000	Random Effect Model

Source: Processed data from EViews 11 (2026)

Table 4 presents the results of the panel data model selection tests. The Chow Test produces a probability value of 0.0000, indicating that the Fixed Effect Model is preferred to the Common Effect Model. The Hausman Test produces a probability value of 0.0433, indicating that the Fixed Effect Model is preferred to the Random Effect Model. Although the Lagrange Multiplier Test indicates the Random Effect Model, the results of the Chow and Hausman Tests support the use of the Fixed Effect Model. Therefore, the Fixed Effect Model is selected as the estimation model for the panel data regression analysis.

4.3 Panel Regression Results

Table 5. Panel Data Regression Results

Variable	Model 1 (FEM) Coefficient	Model 1 Prob.	Model 2 (MRA) Coefficient	Model 2 Prob.
Constant	-23.37152	-	-24.47206	-
Green Intellectual Capital	-0.36142	0.3924	-2.72588	0.2866
Carbon Emission Disclosure	-1.90302	0.0006	2.23095	0.0594
Stakeholder Pressure	0.55526	0.4460	2.34798	0.3772
GIC × Stakeholder Pressure	-	-	3.18322	0.3765
CED × Stakeholder Pressure	-	-	-5.83127	0.0211
Firm Size	0.90947	0.0000	0.90715	0.0000
Profitability	-1.27043	0.0666	-1.28846	0.0663

Source: Processed data from EViews 11 (2026)

Table 5 presents the results of the panel data regression and Moderated Regression Analysis. Model 1 examines the direct effects of Green Intellectual Capital and Carbon Emission Disclosure on Firm Value while controlling for Firm Size and Profitability. Model 2 extends the analysis by incorporating Stakeholder Pressure and its interaction terms with Green Intellectual Capital and Carbon Emission Disclosure. In Model 1, Green Intellectual Capital has a negative coefficient of -0.36142 with a probability value of 0.3924, indicating that Green Intellectual Capital does not have an effect on Firm Value. In contrast, Carbon Emission Disclosure has a negative coefficient of -1.90302 with a



probability value of 0.0006, indicating that Carbon Emission Disclosure has an effect on Firm Value. Among the control variables, Firm Size has a positive coefficient of 0.90947 and a probability value of 0.0000, while Profitability has a negative coefficient of -1.27043 with a probability value of 0.0666. In Model 2, the interaction between Green Intellectual Capital and Stakeholder Pressure has a coefficient of 3.18322 with a probability value of 0.3765, indicating that Stakeholder Pressure does not moderate the relationship between Green Intellectual Capital and Firm Value. Conversely, the interaction between Carbon Emission Disclosure and Stakeholder Pressure has a negative coefficient of -5.83127 with a probability value of 0.0211, indicating that Stakeholder Pressure moderates the relationship between Carbon Emission Disclosure and Firm Value. Firm Size remains associated with Firm Value, whereas Profitability does not show an effect in either model.

4.4 Coefficient of Determination (R^2)

Table 6. Regression Model Fit

Statistic	Model 1 (FEM)	Model 2 (MRA)
R-squared	0.809756	0.834713
Adjusted R-squared	0.756966	0.786614
F-statistic	15.33916	17.35398
Prob(F-statistic)	0.000000	0.000000

Source: Processed data from EViews 11 (2026)

Table 6 indicates that both regression models are statistically adequate. The probability of the F-statistic is 0.000000 for both models, which is below the 0.05 significance level, indicating that the variables included in each model jointly contribute to explaining variations in Firm Value. The R-squared value is 0.809756 for Model 1, indicating that approximately 80.98 percent of the variation in Firm Value can be explained by the variables included in the model. After incorporating Stakeholder Pressure and the interaction terms, the R-squared increases to 0.834713 in Model 2. The adjusted R-squared increases from 0.756966 in Model 1 to 0.786614 in Model 2, indicating that the moderation model provides greater explanatory capability. Model 1 explains approximately 75.70 percent of the variation in Firm Value, whereas Model 2 explains approximately 78.66 percent.

4.5 Hypothesis Testing

Table 7. Hypothesis Testing Results

Hypothesis	Relationship	Coefficient	Probability	Decision
H1	GIC $\rightarrow$ Firm Value	-0.36142	0.3924	Rejected
H2	CED $\rightarrow$ Firm Value	-1.90302	0.0006	Accepted
H3	GIC $\times$ Stakeholder Pressure $\rightarrow$ Firm Value	3.18322	0.3765	Rejected
H4	CED $\times$ Stakeholder Pressure $\rightarrow$ Firm Value	-5.83127	0.0211	Accepted

Source: Processed data from EViews 11 (2026)

Table 7 shows that H1 is rejected because the probability value of Green Intellectual Capital is 0.3924, which exceeds the 0.05 significance level. H2 is accepted because Carbon Emission Disclosure has a probability value of 0.0006 and a negative coefficient. H3 is rejected because the interaction between Green Intellectual Capital and Stakeholder Pressure has a probability value of 0.3765. In contrast, H4 is accepted because the



interaction between Carbon Emission Disclosure and Stakeholder Pressure has a probability value of 0.0211 and a negative coefficient.

4.6 Discussion

4.6.1 The Effect of Green Intellectual Capital on Firm Value

The results indicate that Green Intellectual Capital does not have an effect on Firm Value ($B = -0.36142$; $p = 0.3924$). This finding indicates that the disclosure of Green Intellectual Capital has not become a determinant of market valuation among High-Risk Industries companies listed on the Indonesia Stock Exchange during 2020–2024. This finding can be interpreted through Signaling Theory, which suggests that information communicated by a company will generate a favorable market response when the signal is considered credible and relevant to investors (Connelly et al., 2011). Although Green Intellectual Capital reflects the company's capabilities in developing environmentally oriented human resources, organizational structures, innovation, and stakeholder relationships, such information may not necessarily provide investors with an immediate indication of economic value. Investors may continue to place greater emphasis on financial performance, growth prospects, and the company's ability to generate economic returns when assessing Firm Value. The finding is consistent with Ericho and Amin (2024) and Marzuki and Nofryanti (2025), who report that Green Intellectual Capital does not affect Firm Value. Conversely, it differs from Daromes et al. (2020), Yadiati et al. (2019), and Widagdo et al. (2023), who find a positive relationship. The inconsistency may reflect differences in industry characteristics, investor perceptions, and the extent to which green intellectual resources are translated into measurable economic benefits.

4.6.2 The Effect of Carbon Emission Disclosure on Firm Value

The results show that Carbon Emission Disclosure has an effect on Firm Value, with a negative coefficient of -1.90302 and a probability value of 0.0006. The negative coefficient indicates that greater Carbon Emission Disclosure is associated with lower Firm Value in the observed sample. This finding provides an important perspective from Signaling Theory. Although Carbon Emission Disclosure can theoretically reduce information asymmetry by providing investors with additional information regarding environmental management, the signal communicated through such disclosure is not necessarily interpreted positively. In the context of High-Risk Industries, more extensive carbon-related disclosure may reveal substantial environmental exposure, high emission levels, potential environmental liabilities, or additional costs associated with emission reduction and regulatory compliance. Accordingly, investors may interpret Carbon Emission Disclosure not only as evidence of transparency but also as information concerning environmental risks and potential future costs. The negative market response suggests that, during the observation period, the risk-related information contained in carbon emission disclosure may have been more influential in investors' valuation decisions than its potential reputational or sustainability benefits. This finding is consistent with previous evidence reporting a negative relationship between Carbon Emission Disclosure and Firm Value, including Matsumura et al. (2014) and Apriliani et al. (2024). However, it differs from studies reporting positive or insignificant relationships, which may be attributable to variations in industry characteristics, regulatory environments, sustainability practices, and investor perceptions across countries and sectors.



4.6.3 The Moderating Role of Stakeholder Pressure in the Relationship Between Green Intellectual Capital and Firm Value

The interaction between Green Intellectual Capital and Stakeholder Pressure has a coefficient of 3.18322 with a probability value of 0.3765. Because the probability value exceeds 0.05, Stakeholder Pressure does not moderate the relationship between Green Intellectual Capital and Firm Value. This finding indicates that higher institutional ownership, which serves as a proxy for Stakeholder Pressure, does not strengthen or weaken the relationship between Green Intellectual Capital and Firm Value. The presence of institutional investors has not made Green Intellectual Capital more relevant in the market valuation process. From the perspective of Signaling Theory, Stakeholder Pressure was expected to enhance the credibility of Green Intellectual Capital as a signal because institutional investors possess greater monitoring capabilities. However, the empirical evidence indicates that such monitoring has not been sufficient to alter the market response to Green Intellectual Capital. This may suggest that institutional investors in High-Risk Industries continue to place greater emphasis on financial performance, business risk, and short-term economic outcomes than on the long-term benefits associated with green-oriented intellectual resources. This finding is consistent with Widhiastuti and Pradnyani (2025), who find that institutional ownership does not strengthen the relationship between corporate practices and Firm Value.

4.6.4 The Moderating Role of Stakeholder Pressure in the Relationship Between Carbon Emission Disclosure and Firm Value

The interaction between Carbon Emission Disclosure and Stakeholder Pressure has a coefficient of -5.83127 with a probability value of 0.0211. Because the probability value is below 0.05, Stakeholder Pressure moderates the relationship between Carbon Emission Disclosure and Firm Value. The negative interaction coefficient indicates that higher Stakeholder Pressure strengthens the negative relationship between Carbon Emission Disclosure and Firm Value. In other words, as institutional ownership increases, the negative market response associated with Carbon Emission Disclosure becomes stronger. This finding can be interpreted through Signaling Theory. Stronger institutional ownership may increase the attention investors pay to environmental information disclosed by companies. In High-Risk Industries, carbon-related information may be considered particularly relevant because it provides insight into environmental exposure, regulatory risk, and potential costs associated with emission management. Consequently, when stakeholder pressure is stronger, investors may scrutinize carbon disclosure more closely and respond more negatively when the disclosure signals substantial environmental risks or costs. The finding differs from the expectation that stronger stakeholder pressure would necessarily strengthen the positive value of sustainability disclosure. Instead, the result suggests that Stakeholder Pressure can increase the informativeness of a signal without necessarily changing its direction. When Carbon Emission Disclosure communicates information perceived as unfavorable, stronger stakeholder monitoring may amplify the market's negative assessment rather than reverse it.

5. Conclusion

This study aimed to examine the effects of Green Intellectual Capital and Carbon Emission Disclosure on firm value in high-risk industry companies listed on the Indonesia Stock Exchange during the 2020–2024 period, with Stakeholder Pressure as a moderating



variable. Using a quantitative approach with panel data regression and Moderated Regression Analysis on 245 firm-year observations from 49 companies selected through purposive sampling, the study successfully tested the proposed hypotheses.

The results indicate that Green Intellectual Capital does not have an effect on Firm Value, with a regression coefficient of -0.36142 and a significance value of 0.3924 , indicating that H1 is rejected. This finding indicates that the disclosure of Green Intellectual Capital has not become a determinant of market valuation among High-Risk Industries companies, as investors may continue to place greater emphasis on financial performance, growth prospects, and the company's ability to generate economic returns. Carbon Emission Disclosure has a significant negative effect on Firm Value, with a regression coefficient of -1.90302 and a significance value of 0.0006 , indicating that H2 is accepted. Greater carbon emission disclosure is associated with lower firm value because such information may reveal substantial environmental exposure, high emission levels, potential environmental liabilities, or additional costs associated with emission reduction and regulatory compliance.

Stakeholder Pressure does not moderate the relationship between Green Intellectual Capital and Firm Value, with a regression coefficient of 3.18322 and a significance value of 0.3765 , indicating that H3 is rejected. Higher institutional ownership does not strengthen or weaken the relationship between Green Intellectual Capital and Firm Value, as institutional investors in High-Risk Industries continue to place greater emphasis on financial performance, business risk, and short-term economic outcomes. Stakeholder Pressure significantly moderates the relationship between Carbon Emission Disclosure and Firm Value, with a regression coefficient of -5.83127 and a significance value of 0.0211 , indicating that H4 is accepted. The negative interaction coefficient indicates that higher Stakeholder Pressure strengthens the negative relationship between Carbon Emission Disclosure and Firm Value, as stronger institutional ownership may increase the attention investors pay to environmental information. The adjusted coefficient of determination indicated that 78.66 percent of the variation in Firm Value was explained by the model, while the remaining 21.34 percent was attributed to factors outside the model.

The theoretical implications of this study extend the application of Signaling Theory to the context of firm value in Indonesia. The finding that Green Intellectual Capital does not significantly influence Firm Value suggests that sustainability-related information is not necessarily perceived positively by the market, as its effectiveness depends on how investors interpret the economic benefits contained in the disclosed information. The finding that Carbon Emission Disclosure significantly influences Firm Value supports Signaling Theory's emphasis on the credibility and interpretation of non-financial signals. The finding that Stakeholder Pressure moderates the relationship between Carbon Emission Disclosure and Firm Value supports the argument that stakeholder monitoring can increase the informativeness of a signal without necessarily changing its direction. This study also contributes to the limited empirical evidence on the determinants of firm value in high-risk industries, providing insights into how sustainability practices and stakeholder pressure collectively influence firm value.

Based on these findings, several recommendations can be proposed. For corporate management, improving sustainability practices should be accompanied by effective emission management strategies, measurable environmental targets, and demonstrable environmental performance to enhance the credibility of sustainability information and investor confidence. For investors, sustainability information should be evaluated



comprehensively by considering not only the extent of disclosure but also the effectiveness of the underlying sustainability practices in creating firm value. For regulators, continued improvement in sustainability reporting standards is important to ensure that environmental information is relevant, comparable, and useful for investment decision-making. For academics, this study contributes to the growing body of literature on sustainability accounting and corporate governance, providing a foundation for future research on firm value.

This study has several limitations that should be acknowledged. First, the research focuses only on Green Intellectual Capital and Carbon Emission Disclosure as independent variables and uses Stakeholder Pressure, proxied by institutional ownership, as a moderating variable. Second, the study is limited to High-Risk Industries listed on the Indonesia Stock Exchange during the 2020–2024 period, which may limit the generalizability of the findings to other sectors or industries. Third, Firm Value is measured using Price to Book Value, which may not capture all dimensions of firm value. Fourth, the study uses a five-year observation period, which may not capture long-term changes in sustainability practices and firm value. Fifth, the model's explanatory power is high, with an adjusted R-squared value of 0.786614, but other factors not included in the model may still influence firm value.

For future research, it is recommended to incorporate other sustainability-related variables, such as Environmental Performance, Environmental, Social, and Governance, Green Innovation, or Corporate Governance, to provide a more comprehensive understanding of the determinants of firm value. Future studies may also employ alternative measures of firm value, such as Tobin's Q, and extend the industrial coverage and observation period to provide broader evidence regarding the relationship between corporate sustainability practices and Firm Value. Researchers should also consider employing qualitative or mixed-method approaches to gain deeper insights into the challenges and effectiveness of sustainability practices in high-risk industries.

This study contributes to the growing body of literature on sustainability accounting and corporate governance by providing empirical evidence on the determinants of firm value in high-risk industries in Indonesia. The findings suggest that Carbon Emission Disclosure significantly reduces firm value, while Green Intellectual Capital does not significantly influence firm value. Stakeholder Pressure moderates the negative relationship between Carbon Emission Disclosure and firm value but does not moderate the relationship between Green Intellectual Capital and firm value. As Indonesia continues to strengthen its sustainability reporting practices, understanding these factors becomes increasingly important for developing effective strategies to enhance firm value and promote sustainable business practices.

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