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ESG Disclosure, Green Intellectual Capital, and Firm Value: The Moderating Role of Environmental Risk

[1] Dira Dwi Rahmani, [2] Christina Dwi Astuti

[1,2]Accounting, Universitas Trisakti, Indonesia
*Email: cdwi_astuti@trisakti.ac.id

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ABSTRACT

PURPOSE - This study aims to analyze the effect of Environmental, Social, and Governance (ESG) Disclosure and Green Intellectual Capital (GIC) on Firm Value, with Environmental Risk as a moderating variable.

METHODOLOGY - This study employs a quantitative research design with a moderating analysis approach. The data utilized consists of secondary panel data (longitudinal) gathered from the annual reports and sustainability reports of companies listed on the Indonesia Stock Exchange (IDX) for the period 2022–2025. Purposive sampling balanced total of 60 observations. Data analysis was performed using EViews 9.0 through the Fixed Effect Model (FEM) with a Cross-Section Weight approach to address heteroscedasticity.

FINDINGS - The empirical results indicate that, to some extent, neither ESG Disclosure ($p = 0.25845$) nor Green Intellectual Capital ($p = 0.1136$) has a positive or significant direct effect on Firm Value in the Indonesian capital market. Furthermore, Environmental Risk does not moderate the relationship between ESG Disclosure and Firm Value ($p = 0.46445$), suggesting that market participants still perceive ESG reporting merely as regulatory compliance rather than a risk-mitigation strategy. However, a crucial finding reveals that Environmental Risk significantly strengthens the positive effect of Green Intellectual Capital on Firm Value ($p = 0.0207$, with an interaction coefficient of 0.201993).

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INTRODUCTION

Developments in modern business indicate that a company's primary objective is no longer limited to achieving short-term profits but also includes the creation of sustainable firm value. Firm value reflects investors' perceptions of a company's performance and future prospects, making it a crucial indicator in investment decision-making (Ferjančič et al., 2024). High firm value indicates that a company is capable of managing its resources effectively and has good growth prospects. In this study, firm value is measured using the Tobin's Q approach, which is considered capable of reflecting a company's market value more comprehensively than accounting-based measures.

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However, a company's market value is not always stable and often fluctuates due to various factors, both financial and non-financial. In recent years, investors have not only considered financial performance but also the company's sustainability aspects. This has driven increased attention to the Environmental, Social, and Governance (ESG) concept as a key indicator in assessing corporate quality. ESG disclosure is viewed as a positive signal demonstrating a company's commitment to sustainable business practices and its ability to manage long-term risks (Shen, 2023).

The phenomenon of corporate value fluctuations in Indonesia has become a serious concern in recent years. Data from the Indonesia Stock Exchange indicates that the average Tobin's Q ratio for companies in the energy, basic materials, and non-cyclical consumer sectors experienced significant volatility during the 2022–2025 period, coinciding with increasing environmental regulatory pressures and shifting global investor preferences toward sustainable assets. Several companies, such as PT Bukit Asam Tbk and PT Indofood Sukses Makmur Tbk, have seen a decline in their Tobin's Q values amid increasing demands for ESG disclosures from regulators. This situation indicates a gap between market expectations regarding corporate sustainability performance and disclosure practices that remain inconsistent, thereby creating uncertainty that affects investors' assessments of corporate value (Prasetiyo & Annisa, 2025).

ESG disclosure generally refers to international standards such as the Global Reporting Initiative, which provide guidelines for corporate sustainability reporting. Through transparent ESG disclosure, companies are expected to be able to increase investor confidence, thereby boosting corporate value. A number of studies indicate that ESG disclosure has a positive impact on firm value by increasing transparency and reducing information asymmetry (Sedyasana & Wijaya, 2024).

However, the implementation of ESG in Indonesia still faces various challenges. Uneven levels of understanding and the quality of ESG disclosures mean that the information provided by companies does not fully reflect actual conditions. Additionally, instances of greenwashing persist—where companies engage in ESG disclosure solely as a public relations strategy without genuine implementation—which risks eroding investor trust and negatively impacting firm value (Aptasari et al., 2024). This indicates that the relationship between ESG disclosure and firm value remains inconsistent.

In addition to external factors such as ESG disclosure, firm value is also influenced by internal factors, one of which is green intellectual capital (GIC). GIC is an extension of intellectual capital that emphasizes the management of knowledge, innovation, and competencies based on environmental sustainability. Companies capable of effectively managing GIC tend to possess a competitive advantage and are able to create long-term value (Astuti & Ahmar, 2025). Thus, GIC is believed to play a significant role in enhancing firm value.

Although research findings regarding the influence of ESG disclosure and intellectual capital on firm value show mixed results. Some studies found positive and significant effects, while others showed insignificant or even negative results (Rachma et al., 2024). This inconsistency in results indicates that there are other factors that may influence the relationship between these variables and firm value.

One factor suspected to play a role is environmental risk. Environmental risk refers to potential losses arising from the impact of a company's activities on the environment, such as carbon emissions, pollution, and ecosystem damage. In this study, environmental risk is proxied using a company's carbon emission levels. High carbon emissions can increase pressure

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from regulators and stakeholders, as well as influence investors' perceptions of a company's sustainability (Rachma et al., 2024). Therefore, environmental risk is hypothesized to act as a moderating variable that strengthens or weakens the effects of ESG disclosure and green intellectual capital on firm value.

This study focuses on companies in the energy, basic materials, and non-cyclical consumer sectors listed on the Indonesia Stock Exchange for the period 2022–2025. These sectors were selected because they have high levels of environmental risk due to operational activities that have the potential to generate carbon emissions and significantly impact the environment (Adenina & Sudrajat, 2024). Additionally, these sectors are subject to strict regulatory pressure regarding ESG implementation, making them a relevant context for testing the relationship between ESG disclosure, green intellectual capital, and firm value.

Based on this, there are several research gaps that form the basis of this study. First, research findings regarding the impact of ESG disclosure on firm value remain inconsistent. Second, the impact of green intellectual capital on firm value has not yet yielded conclusive results. Third, research integrating ESG disclosure and green intellectual capital into a single model remains limited, particularly in Indonesia. Fourth, the use of environmental risk proxied through carbon emissions as a moderating variable is still rarely employed, even though this variable holds high relevance in industries with high environmental risk.

LITERATURE REVIEW

Stakeholder Theory

This theory,Freeman (2010) developed by , states that a company is not only accountable to shareholders but also to all stakeholders, such as employees, customers, the government, the community, and the environment. From this perspective, a company's success is not only measured by financial performance but also by its ability to meet the expectations of various parties involved in its business activities. This aligns with the Environmental, Social, and Governance (ESG) concept, which serves as a key indicator in assessing a company's non-financial performance.

Legitimacy Theory

Legitimacy is a state in which there is alignment between an organization's value system and the value system of the society in the environment where the organization operates (Lindblom, 1994). *Legitimacy* is the harmonious alignment of a company's values with existing social values (Dowling and Pfeffer, 1975). *Legitimacy* is defined as the recognition that a company's activities are desirable, appropriate, and consistent with the existing system of norms (Suchman, 1995).

Corporate Value

Corporate value is a central concept in corporate finance that reflects investors' perceptions of a company's performance, risk, and future prospects (Brigham & Houston, 2018). In the context of capital markets, corporate value serves as a key indicator because it reflects the level of investor confidence in a company's ability to generate long-term value. Corporate value represents not only the company's current financial condition but also investors' expectations regarding future cash flows and the company's ability to manage the risks it faces.

ESG Disclosure

ESG Disclosure refers to the disclosure of non-financial information that reflects a company's performance in environmental, social, and governance aspects. ESG Disclosure can be measured using several approaches, including content analysis based on GRI standards or

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global ESG indices such as the Bloomberg ESG Index, the Carbon Disclosure Project (CDP), MSCI ESG Ratings, and others (Laksmi & Narsa, 2021)

Green Intellectual Capital (GIC)

Green Intellectual Capital (GIC) is an extension of the intellectual capital concept that emphasizes the integration of knowledge, organizational capabilities, and environmental awareness in creating sustainable corporate value. This concept emerged in response to growing global pressure on companies to focus not only on profit but also on environmental sustainability and social responsibility. Intellectual capital was first introduced by Stewart (1997) and further developed by Edvinsson (1997), who explained that corporate value stems not only from physical assets but also from knowledge, innovation, and organizational capabilities.

Environmental Risk

Environmental risk can be understood as the likelihood of economic or non-economic losses caused by the negative impacts of a company's activities on the environment (Ananda et al., 2025). This risk not only affects a company's operational costs but can also influence stakeholders' perceptions of the company's legitimacy. The higher a company's environmental risk, the greater the pressure from regulators, investors, and the public to enhance transparency and environmental responsibility.

METHODOLOGY

This study employs a quantitative research method. It utilizes a moderation research design. The study uses secondary data of a *longitudinal* or panel nature, which combines *cross-sectional* and *time-series* data. Data were obtained from *annual reports* and *sustainability reports* of companies listed on the Indonesia Stock Exchange (IDX) for the period 2022–2025. This study employs a deductive approach, starting from Stakeholder and Legitimacy theories to formulate hypotheses that are empirically tested. The study population consists of all companies in the energy, basic materials, and consumer non-cyclical subsectors listed on the Indonesia Stock Exchange (IDX) for the 2022–2025 period. The sampling technique used is purposive sampling with the following criteria:

a) Listed on the IDX during the 2022–2025 period,
b) Consistently publishing annual and sustainability reports,
c) Disclosing ESG data based on GRI standards, and
d) Possessing the necessary data for all research variables.

The units of analysis are the Annual Reports and Sustainability Reports of companies in the energy, basic materials, and non-cyclical consumer subsectors. The population in this study consists of all companies listed on the Indonesia Stock Exchange (IDX) in the energy, basic materials, and non-cyclical consumer sectors during the 2022–2025 period. The sampling technique used in this study is purposive sampling. The criteria for purposive sampling established in determining the research sample are as follows:

a) Companies in the energy, basic materials, and non-cyclical consumer sectors listed on the IDX consecutively during the 2022–2025 period.
b) Companies that published complete annual reports and sustainability reports during the observation period.
c) Companies that fully disclose ESG data based on Global Reporting Initiative (GRI) standards during the 2022–2025 period.

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d) Companies that fully disclose data on the variables under study.

When conducting research using descriptive analysis and panel data regression models, the researcher must first select the appropriate method as the basis for determining the regression model: *Common Effect Model* (CEM), *Fixed Effect Model* (FEM), and *Random Effect Model* (REM). To determine which regression model is most appropriate to use, three tests must be conducted: the Chow Test, the Hausman Test, and the *Breusch-Pagan* Test (*Lagrange Multiplier*). Additionally, the Classical Assumptions Test, the Coefficient of Determination Test (R^2), the F-Test, and the T-Test are required. The analysis tool used in this study is EViews 9.0.

RESULTS AND DISCUSSION

Descriptive Statistics

Descriptive statistical tests present the results of descriptive statistical analysis of all research variables. The purpose of presenting descriptive statistics is to provide information on the average value (mean), median, standard deviation, minimum value, maximum value, and other statistical indicators that can help describe the characteristics of the data as a whole.

Table 1. Results of Descriptive Statistics

	TOBINS_Q	ESG	GIC	ENV_RISK	SIZE	ROA	LEV
Mean	2.207103	0.904167	1.019908	10.83631	31.21101	0.095639	0.419617
Maximum	11.27908	1.000000	1.424445	16.81971	33.45478	0.454542	0.866058
Minimum	0.359661	0.430556	0.876119	1.523389	30.02983	-0.036873	0.178578
Std. Dev.	2.425689	0.127106	0.098149	4.788594	0.751168	0.097613	0.167766
Observations	60	60	60	60	60	60	60

The Firm Value variable (TOBINS_Q) has an average value of 2.207103, indicating that, on average, the sample firms are valued higher by the market than their book value (Tobin's Q > 1). However, the high standard deviation of 2.425689 indicates significant variation among firms in terms of market valuation. The minimum value of 0.359661 indicates that there are companies that are undervalued by the market ( ), while the maximum value of 11.27908 reflects the existence of companies with very high market premiums.

The ESG Disclosure (ESG) variable has an average value of 0.904167, which is close to the maximum value of 1. This indicates that the sample companies have generally made fairly comprehensive ESG disclosures based on GRI standards. The low standard deviation of 0.127106 indicates that the level of ESG disclosure among the sample companies is relatively homogeneous. The minimum value of 0.430556 indicates that there are still companies with suboptimal ESG disclosure quality.

The Green Intellectual Capital (GIC) variable has a mean value of 1.019908, with a minimum of 0.876119 and a maximum of 1.424445. A GIC mean slightly above 1 indicates moderate efficiency of green intellectual capital. The relatively small standard deviation of 0.098149 suggests that companies' ability to manage GIC is fairly consistent within this study's sample.

The Environmental Risk (ENV_RISK) variable, proxied by carbon emission intensity, has a mean value of 10.83631 with a very wide range between a minimum value of 1.523389 and a maximum of 16.81971, as well as a standard deviation of 4.788594. This high level of variation reflects significant differences in carbon emission intensity across companies and sectors,

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consistent with the sectoral diversity in this study's sample.

The control variable Firm Size (SIZE), measured using the natural logarithm of total assets, has a mean value of 31.21101 with a standard deviation of 0.751168. The low variation in firm size indicates that this research sample is relatively homogeneous in terms of asset scale, which is understandable given that companies that publish sustainability reports are generally large firms. The profitability variable (ROA) shows an average of 0.095639, indicating an average return on assets of 9.56%. The presence of a negative minimum value (-0.036873) indicates that some companies incurred losses during a specific period. Meanwhile, the leverage (LEV) variable has a mean of 0.419617, meaning the average debt-to-total-assets ratio is approximately 42%, reflecting a moderate level of leverage in the study sample.

Selection of the Panel Data Regression Estimation Model

Before hypothesis testing, the most appropriate panel data regression estimation model was selected. Three estimation models were considered: the Common Effect Model (CEM), the Fixed Effect Model (FEM), and the Random Effect Model (REM). Model selection was conducted through a series of statistical tests, namely the Chow Test and the Hausman Test, as explained below.

Common Effect Model Estimation

The Common Effect Model is the simplest panel data regression model because it assumes no differences in characteristics between individuals and over time. The CEM estimation results are presented in Table 2 below.

Table 2. Common Effect Model Estimation Results

Dependent Variable: TOBINS_Q				
Method: Panel Least Squares				
Date: 02/06/26 Time: 20:25				
Sample: 2022–2025				
Periods included: 4				
Cross-sections included: 15				
Total panel (balanced) observations: 60				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	2.184903	0.256561	8.516117	0.0000
ESG	-0.329460	0.299312	-1.100724	0.2762
GIC	-1.716254	0.731516	-2.346162	0.0229
ENV_RISK	0.440462	0.317799	1.385975	0.1718
ESG*ENV_RISK	-0.097928	0.316677	-0.309236	0.7584
GIC*ENV_RISK	-0.163190	0.343223	-0.475465	0.6365
SIZE	0.134527	0.318495	0.422383	0.6745
ROA	2.266976	0.714402	3.173250	0.0026
LEV	0.910553	0.312713	2.911783	0.0053
R-squared	0.444805	Mean dependent variable		2.207103
Adjusted R-squared	0.357716	Standard deviation of dependent variable		2.425689
Standard error of regression	1.944012	Akaike information criterion		4.304865
Sum of squared residuals	192.7382	Schwarz criterion		4.619017
Log-likelihood	-120.1460	Hannan-Quinn criterion		4.427747

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F-statistic	5.107455	Durbin-Watson statistic	0.833913
Prob(F-statistic)	0.000107		

Based on the CEM estimation results in Table 2, the Adjusted R-squared value of 0.357716 indicates the model's moderate ability to explain the variation in the dependent variable. However, CEM ignores individual heterogeneity among firms, so its estimates may be inefficient. The Durbin-Watson value of 0.833913, which is well below 2, also indicates the potential for autocorrelation in this model .

Fixed Effects Model Estimation

The Fixed Effects Model accounts for individual heterogeneity across firms that remains constant over time through the use of dummy variables for each cross-sectional unit. The FEM estimation results are presented in Table 3.

Table 3. Fixed Effects Model Estimation Results

Dependent Variable: TOBINS_Q
Method: Panel Least Squares
Date: 02/06/26 Time: 20:25
Sample: 2022–2025
Periods included: 4
Cross-sections included: 15
Total panel (balanced) observations: 60

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.256845	0.130826	17.25075	0.0000
ESG	0.096859	0.301114	0.321669	0.7495
GIC	1.522140	2.064858	0.737165	0.4657
ENV_RISK	-0.050714	0.411063	-0.123372	0.9025
ESG*ENV_RISK	0.113335	0.247185	0.458504	0.6493
GIC*ENV_RISK	0.343522	0.265680	1.292988	0.2040
SIZE	-2.488872	0.660913	-3.765809	0.0006
ROA	-1.153467	2.095626	-0.550417	0.5853
LEV	-0.135207	0.480479	-0.281400	0.7800
Effects Specification				
Cross-section fixed (dummy variables)				
R-squared	0.902323	Mean of dependent variable		2.207103
Adjusted R-squared	0.844246	Standard deviation of the dependent variable		2.425689
Standard error of regression	0.957316	Akaike information criterion		3.033874
Sum of squared residuals	33.90882	Schwarz criterion		3.836706
Log-likelihood	-68.01623	Hannan-Quinn criterion		3.347906
F-statistic	15.53642	Durbin-Watson statistic		3.204079
Prob(F-statistic)	0.00			

Based on the FEM estimates, the Adjusted R-squared value increased significantly to 0.844246, largely due to the addition of dummy variables for each firm. The Firm Size (SIZE) variable was found to be significant at the 99% confidence level, with a negative coefficient

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indicating a negative relationship between firm size and the Tobin's Q value in this model.

Random Effect Model Estimation

The Random Effects Model assumes that inter-individual differences are reflected in the error term, not in the constant. The REM estimation results are presented in Table 4.

Table 4. Random Effects Model Estimation Results

Dependent Variable: TOBINS_Q
Method: Panel EGLS (Cross-section random effects)
Date: 02/06/26 Time: 20:25
Sample: 2022–2025
Periods included: 4
Cross-sections included: 15
Total panel (balanced) observations: 60
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.205470	0.530430	4.157889	0.0001
ESG	0.014345	0.258984	0.055390	0.9560
GIC	-1.318723	1.006379	-1.310364	0.1959
ENV_RISK	0.266070	0.340386	0.781671	0.4380
ESG*ENV_RISK	0.070443	0.226652	0.310797	0.7572
GIC*ENV_RISK	0.004195	0.228762	0.018338	0.9854
SIZE	-1.033570	0.445290	-2.321114	0.0243
ROA	1.479621	1.019257	1.451666	0.1527
LEV	0.406703	0.371799	1.093878	0.2791
Effect Specification				
			S.D.	Rho
Cross-section random			1.992771	0.8125
Idiosyncratic random			0.957316	0.1875
Weighted Statistics				
R-squared	0.216423	Mean dependent variable		0.515478
Adjusted R-squared	0.093509	Standard deviation of dependent variable		1.078760
Standard error of regression	1.027085	Sum of squared residuals		53.80007
F-statistic	1.760771	Durbin-Watson statistic		2.290676
Prob(F-statistic)	0.107000			
Unweighted Statistics				
R-squared	0.180279	Mean of dependent variable		2.207103
Sum of squared residuals	284.5695	Durbin-Watson statistic		0.43307

Based on the table above, it can be seen that the calculated t-probability values for the variables ESG Disclosure (ESG), Green Intellectual Capital (GIC), the interaction between ESG Disclosure and Environmental Risk (ESG* ENV_RISK), and the interaction between Green Intellectual Capital and Environmental Risk (GIC* ENV_RISK) are 0.9560, 0.1959, 0.7572, and 0.9854, respectively, while the calculated Prob. f value is 0.107000 and the adjusted R-squared value is 0.093509.

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Results of the Mode Selection Test l

Chow Test Results

The Chow test was conducted to determine the more appropriate model between the Common Effect Model (CEM) and the Fixed Effect Model (FEM). The results of the Chow test are presented in Table 5.

Table 5. Results of the Chow Test

Redundant Fixed Effects Tests
Equation: Untitled
Test of cross-sectional fixed effects

Effects Test	Statistic	d.f.	Prob.
Cross-section F	12.379182	(14.37)	0.0000
Cross-section Chi-square	104.259467	14	0.00

Based on Table 5, the probability value of the Cross-section F is 0.0000 < 0.05. Thus, H0 is rejected and it can be concluded that the Fixed Effect Model (FEM) is better than the Common Effect Model (CEM). The testing continued with the Hausman Test to choose between FEM and REM.

Hausman Test Results

The Hausman test was conducted to determine the more appropriate model between the Fixed Effect Model (FEM) and the Random Effect Model (REM). The results of the Hausman test are presented in Table 6.

Table 6. Hausman Test Results

Correlated Random Effects - Hausman Test
Equation: Untitled
Test of cross-sectional random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	15.704565	8	0.0468

Based on Table 6, the probability value for the cross-section random test is 0.0468 < 0.05. Thus, H0 is rejected, and it can be concluded that the Fixed Effect Model (FEM) is superior to the Random Effect Model (REM). Since both the Chow test and the Hausman test favor the FEM, the Lagrange Multiplier test is not necessary. The estimation model used in this study is the Fixed Effects Model (FEM).

Results of the Normality Test

The normality test aims to determine whether the residuals from the regression model are normally distributed. The normality test in this study was conducted using the Jarque-Bera test in EViews. Based on the results of the normality test, the Jarque-Bera probability value was 0.000000 < 0.05, indicating that the residuals are not statistically normally distributed.

The application of the Central Limit Theorem as a justification for normality in panel

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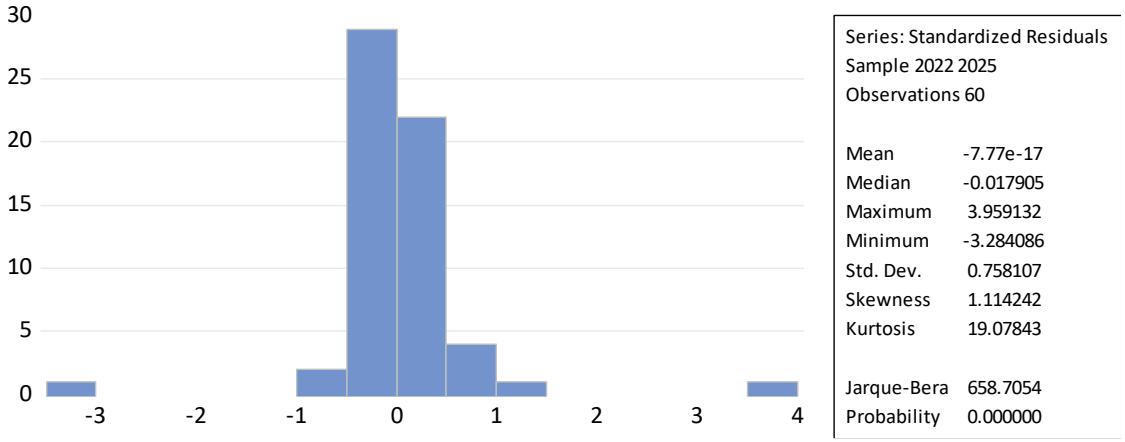
data with N = 60 has been widely used in similar studies.

Multicollinearity Test Results

The multicollinearity test aims to detect the presence or absence of strong linear relationships among independent variables in the regression model. Multicollinearity detection was performed using the Variance Inflation Factor (VIF). The results of the multicollinearity test are presented in Table 7.

Table 7. Results of the Multicollinearity Test



Based on the table above, it can be seen that the probability value of 0.000000 is less than 0.05; therefore, it can be concluded that the data are not normally distributed or do not pass the normality test. Based on *the Central Limit Theorem*, if N > 30, it can be assumed that the data meets the assumption of a normal distribution (Al-Refiay et al., 2025) (Singh et al., 2025) (Nair, 2025) (Abd-Elhaleim et al., 2025). The total number of data points in the study is 60 > 30, so it can be concluded that the data is normally distributed or passes the normality test.

Results of the Heteroscedasticity Test

The heteroscedasticity test aims to determine whether there is unequal variance in the residuals from one observation to another. The test was conducted using the Glejser method in EViews, by regressing the absolute values of the residuals against all independent variables. The results of the heteroscedasticity test are presented in Table 8.

Table 8. Heteroscedasticity Test Results (Glejser Test**)**

	Coefficient	Uncentered	Centered
Variable	Variance	VIF	VIF
C	0.065824	1.045045	NA
ESG	0.089588	1.398627	1.398627
GIC	0.535115	8.354142	8.354142
ENV_RISK	0.100996	1.576741	1.576741
ESG*ENV_RISK	0.100284	1.527870	1.526194
GIC*ENV_RISK	0.117802	1.887825	1.842600
SIZE	0.101439	1.583653	1.583653
ROA	0.510370	7.967823	7.967823
LEV	0.097790	1.526677	1.526677

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Based on the table above, it can be seen that all independent variables have Centered VIF values < 10.00, so it can be concluded that the model does not exhibit multicollinearity or passes the multicollinearity test .

Heteroscedasticity Test Results

The heteroscedasticity test aims to determine whether there is unequal variance in the residuals from one observation to another. The test was conducted using the Glejser method in EViews, by regressing the absolute values of the residuals against all independent variables. The results of the heteroscedasticity test are presented in Table 9.

Table 9. Heteroscedasticity Test Results (Glejser Test)

Dependent Variable: ABS(RESID)
Method: Panel Least Squares
Date: 02/06/26 Time: 20:29
Sample: 2022–2025
Periods included: 4
Cross-sections included: 15
Total panel (balanced) observations: 60

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.392073	0.047197	8.307192	0.0000
ESG	0.053146	0.108630	0.489237	0.6276
GIC	1.183957	0.744918	1.589378	0.1205
ENV_RISK	0.105026	0.148295	0.708225	0.4832
ESG*ENV_RISK	-0.006912	0.089174	-0.077506	0.9386
GIC*ENV_RISK	0.051313	0.095847	0.535363	0.5956
SIZE	-1.635971	0.238431	-6.861402	0.0000
ROA	-1.053720	0.756018	-1.393777	0.1717
LEV	0.092262	0.173338	0.532266	0.5977

Based on Table 9, all independent variables have probability values > 0.05, except for the Firm Size (SIZE) variable, which has a probability of 0.0000 < 0.05. This indicates that the regression equation model exhibits heteroscedasticity in the SIZE variable. The heteroscedasticity issue can be addressed by using the Cross-Section Weight approach in the Fixed Effects Model, ensuring that the estimation remains BLUE (Best Linear Unbiased Estimator) and the hypothesis testing remains valid .

Autocorrelation Test Results

An autocorrelation test was conducted to detect the presence of correlation between the residuals in one period and the previous period. The test was performed using the Durbin-Watson (DW) statistic. The results of the autocorrelation test are presented in Table 10.

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Table 10. Autocorrelation Test Results (Durbin-Watson)

R-squared	0.964263	Mean dependent var	5.310368
Adjusted R-squared	0.943014	Standard deviation of dependent variable	4.290576
Standard error of regression	0.839618	Sum of squared residuals	26.08348
F-statistic	45.37936	Durbin-Watson statistic	2.086727
Prob(F-statistic)	0.00		

Based on the table above, it can be seen that the Durbin-Watson value of 2.086727 falls between 1.5 and 2.5, so it can be concluded that the regression equation model does not exhibit autocorrelation or passes the autocorrelation test.

Panel Data Regression Analysis

Based on the results of the classical assumption tests, it was found that the regression equation model exhibits heteroscedasticity or fails the heteroscedasticity test. Therefore, hypothesis testing using the Fixed Effect Model becomes invalid. This issue can be addressed by using a Fixed Effects Model with a Cross-Section Weight approach, allowing heteroscedasticity to be ignored while ensuring that hypothesis testing using the Fixed Effects Model with Cross-Section Weights remains valid and unbiased ((Napitupulu et al., 2021) (Frances & Nworie, 2025) (Yaman et al., 2026) (Negara, 2024).

Table 11. Estimation Results of the Fixed Effects Model with Cross-Section Weights

Fixed Effects Model with Cross-Section Weights
Dependent Variable: TOBINS_Q
Method: Panel EGLS (Cross-section weights)
Date: 02/06/26 Time: 20:29
Sample: 2022–2025
Periods included: 4
Cross-sections included: 15
Total panel (balanced) observations: 60
Linear estimation after one-step weighting matrix

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.238710	0.032036	69.88214	0.0000
ESG	-0.054829	0.083787	-0.654390	0.5169
GIC	0.961799	0.783244	1.227968	0.2272
ENV_RISK	-0.052048	0.154802	-0.336226	0.7386
ESG*ENV_RISK	-0.006054	0.067355	-0.089874	0.9289
GIC*ENV_RISK	0.201993	0.095586	2.113208	0.0414
SIZE	-1.577646	0.523464	-3.013854	0.0046
ROA	-0.805901	0.781214	-1.031601	0.3090
LEV	-0.180726	0.165124	-1.094483	0.2808
Effects Specification				
Cross-section fixed (dummy variables)				
Weighted Statistics				
R-squared	0.964263	Mean of dependent		5.310368

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		variable	
Adjusted R-squared	0.943014	Standard deviation of dependent variable	4.290576
Standard error of regression	0.839618	Sum of squared residuals	26.08348
F-statistic	45.37936	Durbin-Watson statistic	2.086727
Prob(F-statistic)	0.000000		
	Unweighted Statistics		
R-squared	0.895995	Mean of dependent variable	2.207103
Sum of squared residuals	36.10593	Durbin-Watson statistic	3.321139

TOBINS_Qit = 2.238710 - 0.054829 ESGit + 0.961799 GICit - 0.052048 ENV_RISKit - 0.006054 ESG*ENV_RISKit + 0.201993 GIC*ENV_RISKit - 1.577646 SIZEit - 0.805901 ROAit - 0.180726 LEVit + eit

The interpretation of each coefficient in the above equation is as follows. The constant value of 2.238710 indicates that if all independent, moderating, and control variables are set to zero, the value of Tobin's Q will be 2.238710. The ESG coefficient of -0.054829 indicates that a 1-unit increase in ESG disclosure will decrease Tobin's Q by 0.054829, assuming all other variables remain constant. The GIC coefficient of 0.961799 indicates a positive relationship between GIC and Tobin's Q, meaning a one-unit increase in GIC will increase Tobin's Q by 0.961799. The positive and significant interaction coefficient of GIC*ENV_RISK, at 0.201993, indicates that an increase in environmental risk amplifies the positive effect of GIC on firm value. The control variable coefficient for SIZE of -1.577646 indicates that larger companies in this sample tend to have lower Tobin's Q, which can be attributed to the phenomenon of value deflation in large companies due to portfolio diversification.

Hypothesis Test Results

Results of the Coefficient of Determination Test (R^2)

Table 12. Results of the Coefficient of Determination Test (R^2)

R-squared	0.964263	Mean dependent variable	5.310368
Adjusted R-squared	0.943014	Standard deviation of dependent variable	4.290576
Standard error of regression	0.839618	Sum of squared residuals	26.08348
F-statistic	45.37936	Durbin-Watson statistic	2.086727
Prob(F-statistic)	0.000000		

Based on the table above, it can be seen that the Adjusted R-Square value is 0.943014 or 94.3014%. This coefficient of determination indicates that the independent variables, consisting of ESG Disclosure (ESG) and Green Intellectual Capital (GIC), moderated by Environmental Risk (ENV_RISK) and controlled for Firm Size (SIZE), Return on Assets (ROA), and Leverage

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(LEV), are able to explain the firm value variable (TOBINS_Q) by 94.3014%, while the remaining 5.6986% (100 – adjusted R-squared value) is explained by other variables not included in this research model.

A high adjusted R-squared value in a fixed-effects model does not necessarily indicate that the independent variables effectively explain the dependent variable; rather, it is because the model includes dummy variables to represent each individual unit (e.g., a company, a district, or a country). In a fixed-effects model, each individual unit is assigned a "specific effect" via a dummy variable. These dummy variables make the model highly flexible in accounting for the unobserved differences in each individual's characteristics. Because the dummy variables successfully account for a significant amount of variation, the R- -squared value automatically increases. This increase is called "mechanical" because it occurs due to the model structure adding many parameters, not because the causal relationship between the main variables has become stronger. In other words, the model appears to explain the data better, but part of this improvement stems from the dummy variables' ability to capture differences between individuals, not from the strength of the independent variables themselves.

F-Test Results

Table 13. F-Test Results

R-squared	0.964263	Mean dependent var	5.310368
Adjusted R-squared	0.943014	Standard deviation of dependent variable	4.290576
Standard error of regression	0.839618	Sum of squared residuals	26.08348
F-statistic	45.37936	Durbin-Watson statistic	2.086727
Prob(F-statistic)	0.00		

Based on the table above, it can be seen that the calculated F-statistic probability value is 0 < 0.05, so H0 is rejected and Ha is accepted, meaning that Environmental Risk moderates the influence of ESG Disclosure and Green Intellectual Capital on Firm Value.

t-Test Results

Table 14. t-Test Results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.238710	0.032036	69.88214	0.0000
ESG	-0.054829	0.083787	-0.654390	0.5169
GIC	0.961799	0.783244	1.227968	0.2272
ENV_RISK	-0.052048	0.154802	-0.336226	0.7386
ESG*ENV_RISK	-0.006054	0.067355	-0.089874	0.9289
GIC*ENV_RISK	0.201993	0.095586	2.113208	0.0414
SIZE	-1.577646	0.523464	-3.013854	0.0046
ROA	-0.805901	0.781214	-1.031601	0.3090
LEV	-0.180726	0.165124	-1.094483	0.2808

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The partial effect of the independent variables on the dependent variable is as follows: The calculated t-value for the ESG Disclosure (ESG) variable is 0.25845 (0.5169/2) > 0.05, so H1 is rejected, meaning that ESG Disclosure does not have a positive effect on Firm Value.

1. The calculated t-value for the Green Intellectual Capital (GIC) variable is 0.1136 (0.2272/2) > 0.05, so H2 is rejected, meaning that Green Intellectual Capital does not have a positive effect on Firm Value.
2. The calculated t-value for the interaction between ESG Disclosure and Environmental Risk (ESG* ENV_RISK) is 0.46445 (0.9289/2) > 0.05; therefore, H3 is rejected, meaning that Environmental Risk does not amplify the positive effect of ESG Disclosure on Firm Value.
3. The calculated t-value for the interaction between Green Intellectual Capital and Environmental Risk (GIC* ENV_RISK) is 0.0207 (0.0414/2) < 0.05, and the coefficient is positive at 0.201993; therefore, H4 is accepted, meaning that Environmental Risk reinforces the positive effect of Green Intellectual Capital on Firm Value.

DISCUSSIONS

The Effect of ESG Disclosure on Firm Value (H_1)

Based on the results of the regression test, $H_1$is rejected, meaning that ESG *Disclosure* does not have a positive effect on Firm Value. These results indicate that investors in the Indonesian capital market, particularly in the commodities and *high-impact* sectors, remain focused on short-term financial gains rather than sustainability-based investments. Furthermore, the prevalence of *greenwashing* issues has made investors skeptical, leading them to view *the costs* of preparing ESG reports as operational expenses that reduce profitability rather than as long-term investments. This finding aligns with research (Serly & Susanti, 2021) stating that non-financial disclosures fail to instantly boost market value in developing countries.

The Effect of Green Intellectual Capital on Firm Value (H_2)

The results of the statistical test indicate that $H_2$is rejected, meaning that GIC does not have a significant positive effect on Firm Value. Although the direction of the coefficient is positive, its impact is not statistically significant. This occurs because the efficiency of green intellectual capital management (through human, structural, and relational aspects) requires a long *time lag* to be converted into a competitive advantage recognized by the market. Given that the research sample is dominated by capital-intensive industries, investors still measure corporate value based on ownership of physical assets and movements in global commodity prices, rather than intangible assets. These results support the finding (Ichsan, 2020) that GIC has not yet become a primary component in investors' stock price calculations.

The Role of Environmental Risk in Moderating the Effect of ESG Disclosure on Firm Value (H_3)

The interaction test results indicate that $H_3$is rejected, meaning that Environmental Risk does not moderate the effect of ESG *Disclosure* on Firm Value. The failure of environmental risk (carbon emission intensity) to act as a moderating variable suggests that the level of emissions produced does not alter investors' perspective on a company's ESG reports. ESG disclosure in these high-risk sectors is viewed merely *as compliance* with regulatory formalities to avoid legal sanctions, rather than a reflection of management's actual strategy in mitigating climate transition risks .

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The Role of Environmental Risk in Moderating the Effect of Green Intellectual Capital on Firm Value (H_4)

The results of the fourth hypothesis test indicate that **$H_4$is accepted**, meaning that Environmental Risk strengthens the positive influence of *Green Intellectual Capital* on Firm Value. This finding strongly supports Legitimation Theory and Stakeholder Theory. When a company operates with high carbon emissions (environmental risk), the possession of green intellectual capital—such as employees competent in environmental issues and environmentally friendly operational systems —becomes a vital asset in the market.

Investors assign a premium valuation (an increase in Tobin's Q) because GIC is viewed as the company's actual capability to reduce *the legitimacy gap*, avoid environmental fines, and transform operational risks into business innovation opportunities. Conversely, for companies with low emissions, the urgency of managing GIC is not as pressing for investor valuation. These results align with Wardhana's (2024) argument that the effectiveness of environmental-based internal capital is highly dependent on the context of a company's external risk exposure.

CONCLUSION

Based on the results of panel data analysis using *the Fixed Effects Model* with *Cross-Section Weights*, the conclusions of this study are as follows: ESG *Disclosure* does not have a positive effect on Firm Value. Transparency of ESG information has not yet become a key indicator for Indonesian capital market investors in determining firm valuations, and tends to be viewed as an operational cost rather than a short-term value-enhancing instrument. *Green Intellectual Capital* does not have a positive effect on Firm Value in part**.** The management of environment-based intellectual capital takes a long time to impact stock market prices, particularly in capital-intensive industries where market valuation is still dominated by physical asset ownership. Environmental Risk does not moderate the relationship between ESG *Disclosure* and Firm Value**.** A company's carbon emissions level neither strengthens nor weakens the market's response to the quality of ESG disclosure, as disclosure is viewed merely as compliance with regulatory formalities. Environmental Risk strengthens the positive influence of *Green Intellectual Capital* on Firm Value**.** Environmental risk acts as a crucial *pure moderator*; that is, the management of green intellectual capital will be highly valued by investors and proven to significantly increase corporate value precisely when the company is in a high-environmental-risk operational condition (high carbon emissions.

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