

FINANCE | RESEARCH ARTICLE

Green Banking, Corporate Social Responsibility, and Firm Value: The Moderating Role of Non-Performing Loans

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ARTICLE HISTORY

Received: June 22, 2026
Revised: July 20, 2026
Accepted: July 20, 2026

DOI

<https://doi.org/10.52970/grfm.v6i2.2426>

ABSTRACT

This study examines whether green banking and corporate social responsibility (CSR) affect firm value and whether non-performing loans (NPLs) moderate these relationships. The study uses publicly available audited financial statements, annual reports, and sustainability reports of banking companies listed on the Indonesia Stock Exchange for the 2022–2024 period. Purposive sampling identified 24 eligible banks and 72 initial firm-year observations; after nine outlier observations were excluded, the final balanced panel comprised 21 banks and 63 observations. Green banking was measured using a green banking disclosure index, corporate social responsibility was measured using a CSR disclosure index, firm value was measured using Tobin's Q, and non-performing loans were measured using the NPL ratio. Panel-data moderated regression was estimated in EVIEWS 12. The Chow, Hausman, and Lagrange Multiplier tests supported the random effects model. Green banking ($\beta = -1.0361$; $p = 0.1126$) and CSR ($\beta = 0.0176$; $p = 0.9612$) had no significant direct effect on firm value. The green banking-NPL interaction was positive and significant ($\beta = 66.6937$; $p = 0.0056$), while the CSR-NPL interaction was not significant ($\beta = -11.0913$; $p = 0.4143$). These findings indicate that credit-risk conditions change the market relevance of green banking disclosure and underscore the need to integrate sustainability disclosure with disciplined credit-risk management.

Keywords: Green Banking, Corporate Social Responsibility, Firm Value, Non-Performing Loans, Banking

JEL Code: C23, G21, G32, M14, Q56

I. Introduction

Firm value represents the market's assessment of a company's current condition, future prospects, and capacity to create wealth for shareholders. For listed companies, stock prices and market-based valuation incorporate investor expectations regarding corporate fundamentals and continuity (Salama et al., 2019). A high valuation therefore reflects more than accumulated assets or current profitability; it also indicates the extent to which investors trust management's ability to manage risk and sustain performance (Galyani & Henny, 2022; Wulandari & Efendi, 2021). This assessment is especially sensitive in banking because banks operate as financial intermediaries whose valuation depends on public confidence, asset quality, regulatory discipline, and the credibility of information supplied to the market. The pursuit of firm value is increasingly connected with environmental and social sustainability. The Triple Bottom Line perspective emphasizes that corporate performance should combine economic outcomes with responsibility toward people and the

planet (Elkington, 1998). Environmental damage may weaken reputation and stakeholder confidence when companies fail to demonstrate responsibility for the consequences of their activities (Mardiana & Wuryani, 2019). At the macro level, the transition toward a green economy requires financial institutions to direct capital toward sustainable activities and incorporate ecological considerations into financing decisions (Kurniadi et al., 2023; Nugraha et al., 2024; Söderholm, 2020). This development expands the role of banks from conventional intermediaries into institutions that can influence the environmental orientation of investment and economic activity.

Green banking translates this broader sustainability agenda into banking operations, products, financing policies, risk assessment, and disclosure. It encourages environmentally responsible financing, digitalization, lower paper and energy use, and improved resource management (Aslam & Jawaid, 2023; Asyura et al., 2023; Rachmawati & Karim, 2024). Green banking disclosure may signal that a bank recognizes environmental risks and maintains a long-term strategic orientation (Khan et al., 2021). CSR broadens this orientation by expressing responsibility for economic, environmental, employee, community, and other stakeholder impacts (Kholis, 2020; Wati, 2019). Because the present study operationalizes both constructs through disclosure indices, it evaluates the market relevance of disclosed sustainability information rather than directly measuring the quality or outcomes of every underlying activity. Banks must simultaneously manage credit risk. NPLs measure the proportion of problematic loans relative to total loans and constitute an important indicator of asset quality (Anisa & Suryandari, 2021; Arfiyani & Sasongko, 2023). A high NPL ratio may reduce earnings capacity, increase provisioning pressure, constrain lending resources, and send a negative signal about credit management. Credit-risk conditions may therefore alter how investors interpret sustainability disclosure. Under relatively low credit-risk conditions, green banking and CSR disclosures may reinforce investors' perceptions of responsible management and long-term orientation. When credit risk is high, however, investors may assign greater weight to asset-quality concerns, thereby reducing the valuation relevance of sustainability disclosures (Iqbal & Nosheen, 2023; Khan et al., 2021). Nevertheless, green banking disclosure may remain informative, or even become more relevant, if it signals strategic commitment and responsiveness to environmental and financial risks (Tran & Ha, 2025). These competing interpretations justify examining NPLs as a contextual moderator of the relationships between green banking disclosure, CSR disclosure, and firm value, rather than viewing NPLs solely as an indicator of credit risk.

Empirical evidence remains inconsistent. Positive relationships between green banking and firm value have been reported by Khan et al. (2021), Murwaningsari and Rachmawati (2023), and Hilleri et al. (2025). In contrast, Romli and Zaputra (2021) and Tran and Ha (2025) identify negative relationships, whereas Arfiyani and Sasongko (2023), Galyani and Henny (2022), and Tiara and Jayanti (2022) find no significant effect. CSR findings are similarly mixed. Erlangga et al. (2021), Galyani and Henny (2022), Hilleri et al. (2025), and Machmuddah et al. (2020) report positive valuation effects, Afifah et al. (2021) report a negative effect, and Romli and Zaputra (2021) report no significant relationship. These differences indicate that the capital-market response to sustainability disclosure is not uniform and may depend on institutional, measurement, reporting, and financial-risk conditions. The moderating evidence is more limited and contradictory. Khan et al. (2021) conclude that NPLs weaken the relationship between green banking disclosure and firm value, whereas Tran and Ha (2025) find that NPLs strengthen it. Evidence concerning NPLs as a moderator of the CSR-firm value relationship is particularly scarce. Related studies generally reverse the direction of moderation: Yuniarti et al. (2022) examine CSR as a moderator of the NPL-firm value relationship, while Bijak et al. (2024) position CSR expenditure as a moderator of bank-health indicators, including NPLs, in explaining firm value. Iqbal and Nosheen (2023) also demonstrate that NPLs can condition the relationship between sustainability-oriented objectives and bank performance, but their dependent variable is financial performance rather than market valuation. Consequently, the role of NPLs in changing the market relevance of CSR disclosure remains unresolved.

The central research problem is therefore not merely whether green banking and CSR disclosure are associated with firm value, but whether credit-risk conditions change the strength and direction of those relationships. This study addresses three connected gaps: inconsistent direct effects of green banking and CSR, contradictory findings on the green banking-NPL interaction, and limited evidence on NPLs as a moderator of CSR and firm value in Indonesian listed banks. It contributes by testing both interaction terms within the same panel-data model, thereby allowing a direct comparison of whether credit risk changes the valuation relevance of environmental banking disclosure and broader CSR disclosure. Stakeholder, agency, and signalling perspectives are integrated to explain why disclosure may create value, be discounted as a cost or symbolic action, or become informative only under particular risk conditions. Accordingly, this study examines the effects of green banking and CSR on firm value and investigates whether NPLs moderate these relationships in banking companies listed on the Indonesia Stock Exchange during 2022–2024. The findings

are expected to advance the understanding of sustainability-related valuation in banking, assist bank management in integrating sustainability disclosure with credit-risk management, help investors evaluate sustainability information alongside asset quality, and provide a reference for future research.

II. Literature Review and Hypothesis Development

2.1. Stakeholder Theory

Stakeholder theory explains that a firm is not only responsible to shareholders, but also to all parties affected by corporate activities. Freeman (1984) introduced stakeholders as groups or individuals who can affect or be affected by the achievement of organizational objectives. In a broader institutional context, firms interact with several external parties through markets, regulation, communities, and social expectations (Khan et al., 2021). Therefore, corporate success should be assessed not only from financial performance but also from the firm's ability to create value for different stakeholder groups. In this study, stakeholder theory provides a foundation for explaining why green banking and CSR may influence firm value. Green banking addresses environmental stakeholders by integrating ecological considerations into banking activities. CSR addresses social stakeholders by reflecting corporate concern for employees, communities, and the environment. When these practices are disclosed transparently, stakeholders may perceive the bank as more legitimate, responsible, and sustainable. As stated by Machmuddah et al. (2020), companies are expected to provide added value to stakeholders, not only to internal owners. Consequently, stakeholder-oriented practices may improve reputation and generate a positive market response.

2.2. Agency Theory

Agency theory describes the relationship between principals, who own capital, and agents, who manage the firm on behalf of the principals. The theory assumes that both principals and agents act rationally to maximize their own interests, which may create agency conflict when managers pursue decisions that do not fully align with shareholders' interests (Lesmono & Siregar, 2021). Information asymmetry is central in this relationship because managers usually have more information about the firm's condition and future prospects than external investors or shareholders. In the context of this study, sustainability disclosure can reduce information asymmetry by providing additional information about how management responds to environmental, social, and credit-risk issues. However, sustainability activities may also be interpreted as agency costs if investors believe that managers allocate resources to reputation-building activities without clear economic benefits. Agency theory is therefore relevant in explaining why green banking or CSR may not always increase firm value. If investors perceive disclosure as symbolic rather than value-enhancing, the market response may be neutral. Conversely, if disclosure reduces uncertainty and strengthens accountability, it can support firm value.

2.3. Signalling Theory

Signalling theory explains that companies have incentives to disclose information to external parties in order to reduce information asymmetry. Internal management has more complete knowledge of company performance, risk, and prospects than investors and creditors. Because external parties do not directly observe all internal conditions, companies use disclosure to send signals about their quality and long-term prospects (Rochmah, 2017). In capital markets, credible signals can influence investor decisions and subsequently affect firm value. Green banking and CSR disclosure can be viewed as positive signals because they show that banks are committed to sustainability, stakeholder welfare, and long-term governance. Nevertheless, the strength of such signals depends on contextual financial conditions. NPLs, for example, can send a negative signal regarding credit risk. When NPLs are high, investors may be more cautious in interpreting sustainability disclosure. Thus, signalling theory supports the argument that NPLs may moderate the relationship between sustainability-related practices and firm value.

2.4. Green Banking and Firm Value

Green banking integrates environmental considerations into the intermediation function, internal operations, products, and financing decisions (Nugraha et al., 2024). It extends banking responsibility beyond

shareholder wealth maximization by incorporating environmental and social considerations into long-term activities (Rohman & Fathihani, 2025). Its scope may include environmental screening of financed projects, green products, paperless banking, energy efficiency, emission reduction, employee awareness, and disclosure of environmental policies. Bose et al. (2018) developed disclosure indicators covering these dimensions, which were subsequently applied by Khan et al. (2021) to examine the capital-market relevance of green banking. Such disclosure can reduce uncertainty about a bank's environmental orientation and indicate preparedness for sustainability-related risks.

Stakeholder theory predicts a positive effect because green banking responds to expectations that financial institutions should consider the environmental consequences of the activities they finance. A bank that demonstrates responsible financing may strengthen legitimacy among regulators, customers, communities, and investors. Signalling theory similarly predicts a positive market response when disclosure communicates strategic foresight, operational efficiency, and awareness of environmental risk. Green banking may also support economic benefits through digitalization, reduced resource use, fewer manual processes, and improved cost management (Rachmawati & Karim, 2024). Hastuti and Aprilia (2023) argue that green banking can generate value through bank efficiency, while Murwaningsari and Rachmawati (2023) show that environmental efficiency can condition its valuation effect. Empirical evidence provides support for this expectation, although it is not uniform. Khan et al. (2021), Hilleri et al. (2025), and Murwaningsari and Rachmawati (2023) identify favourable implications of green banking for firm value. Their findings suggest that environmental banking disclosure can strengthen reputation, efficiency, or investor confidence. On the basis of stakeholder and signalling arguments and the positive evidence in these studies, the first hypothesis is formulated as follows:

H1: Green banking has a positive effect on firm value.

2.5. Corporate Social Responsibility and Firm Value

CSR represents a continuing commitment to ethical conduct, economic contribution, employee welfare, community development, and accountability for broader social and environmental effects (Kholis, 2020; Wati, 2019). In this study, CSR is captured through a GRI 2021-based disclosure index. The breadth of the index reflects that banking responsibility is not limited to philanthropic programs but includes governance, employment, environmental, customer, and community topics. Public disclosure enables stakeholders to evaluate whether management acknowledges these responsibilities and incorporates them into corporate reporting. Stakeholder theory suggests that CSR can improve firm value by strengthening trust, legitimacy, and the relationships on which continued operations depend. Agency theory adds that transparent CSR reporting may reduce information asymmetry and limit managerial discretion by making non-financial commitments visible to shareholders. Signalling theory further suggests that consistent CSR disclosure can communicate governance quality and long-term orientation. When investors believe that CSR protects reputation, reduces stakeholder conflict, or contributes to sustainable performance, the information may support market valuation. Positive CSR-firm value relationships are documented by Erlangga et al. (2021), Galyani and Henny (2022), Hilleri et al. (2025), and Machmuddah et al. (2020). Although other studies report negative or insignificant results, the theoretical expectation remains positive because credible CSR disclosure may provide reputational and informational benefits. The second hypothesis is therefore stated as follows:

H2: Corporate social responsibility has a positive effect on firm value.

2.6. The Moderating Role of Non-Performing Loans in the Green Banking-Firm Value Relationship

NPLs represent the share of problematic loans in a bank's credit portfolio and are a central indicator of credit risk and asset quality (Anisa & Suryandari, 2021). Higher NPLs can reduce interest income, increase impairment and provisioning requirements, limit new lending, and weaken confidence in management's credit decisions. The negative information embedded in NPLs may influence the way investors evaluate non-financial disclosure because market participants assess sustainability commitments together with the bank's capacity to manage its core intermediation risks. Two competing moderation mechanisms are possible. First, high NPLs may weaken the green banking-firm value relationship. Credit deterioration can constrain financial resources and cause investors to prioritize loan recovery and capital protection over environmental initiatives. Under this interpretation, green banking disclosure may appear less credible or less economically relevant

when the bank's core asset quality is under pressure. Khan et al. (2021) support this mechanism by finding that NPLs weaken the valuation effect of green banking disclosure.

Second, high NPLs may strengthen the informational relevance of green banking disclosure. When adverse credit conditions already send a negative signal, continued disclosure of environmental screening, sustainable financing, and long-term policies may differentiate banks that retain strategic discipline from those that respond only to short-term pressure. Green banking may then function as a counter-signal of managerial commitment, stakeholder responsiveness, and forward-looking risk awareness. Tran and Ha (2025) report evidence consistent with this strengthening effect. The contradictory evidence means that the direction must be tested in the Indonesian setting. Based on the contextual importance of NPLs, the third hypothesis is formulated as follows:

H3: Non-performing loans moderate the effect of green banking on firm value.

2.7. The Moderating Role of Non-Performing Loans in the CSR-Firm Value Relationship

NPLs may also change the valuation relevance of CSR. Under stakeholder theory, CSR can preserve relationships with employees, customers, and communities when financial pressure increases. Continued social responsibility during periods of higher credit risk may demonstrate that management protects long-term stakeholder relationships instead of focusing exclusively on short-term financial outcomes. Signalling theory similarly suggests that credible CSR disclosure under adverse conditions could communicate resilience and continuity. These mechanisms imply that CSR may become more valuable when asset quality is under pressure. Agency theory provides an opposing interpretation. When NPLs rise, shareholders may expect management to concentrate resources on credit recovery, provisioning, governance, and risk control. CSR-related resource allocation or broad disclosure may then be viewed as discretionary, image-oriented, or insufficiently connected with urgent financial priorities. The signal can become ambiguous because investors cannot always distinguish substantive responsibility from reputational communication. Iqbal and Nosheen (2023) show that NPLs can moderate the relationship between sustainability objectives and bank performance, while Yuniarti et al. (2022) and Bijak et al. (2024) demonstrate that CSR and banking risk can interact in models of firm value. However, these studies use a different direction of moderation from the present model. Direct evidence on NPLs as a moderator of CSR disclosure and firm value remains limited. Because CSR may sustain stakeholder confidence but may also be discounted as an agency cost under credit stress, the empirical direction is uncertain. The study tests whether the interaction is statistically relevant through the following hypothesis:

H4: Non-performing loans moderate the effect of corporate social responsibility on firm value.

2.8. Conceptual Framework

The conceptual framework combines the two direct relationships and the two interaction relationships. Green banking and CSR are expected to affect firm value, while NPLs are positioned as a contextual variable that may change the strength or direction of each effect.

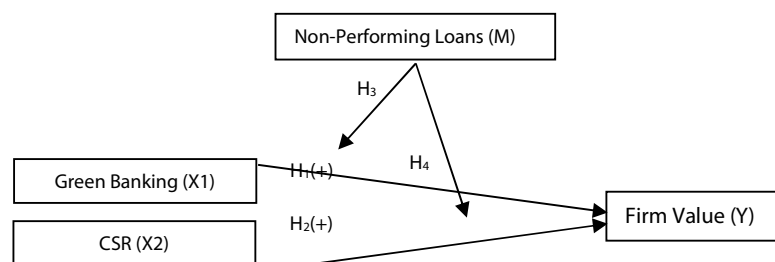


Figure 1. Conceptual Framework

III. Research Method

This study uses a quantitative research design with a descriptive approach. A descriptive quantitative design is used to describe and explain phenomena based on observed conditions without manipulating the variables (Putra et al., 2025). The dependent variable is firm value, the independent variables are green banking and CSR, and the moderating variable is NPLs. The unit of analysis is the bank-year. The population comprises 48 banking companies listed on the Indonesia Stock Exchange during 2022-2024. The observation period provides three annual observations for each bank that meets the sampling criteria. The data are secondary and publicly accessible. Audited financial statements and annual reports were obtained from the Indonesia Stock Exchange and the official websites of the sampled banks, while sustainability disclosures were collected from published sustainability reports. Documents were screened for the relevant financial year, bank identity, availability of the information required to calculate Tobin's Q and the NPL ratio, and consecutive availability of GRI 2021-based sustainability reporting. Data were tabulated and transformed into the study variables using Microsoft Excel 2021, after which the panel dataset was analyzed in EViews 12. The use of public archival documents makes the collection procedure reproducible, subject to continued accessibility of the issuers' reports.

3.1. Sampling Procedure and Data Screening

The sample was selected through non-probability purposive sampling because the disclosure indices require complete and comparable annual information that is not available for every listed bank. A bank was included when it: (1) was listed on the Indonesia Stock Exchange throughout 2022-2024; (2) was not delisted during the period; (3) issued audited financial statements and annual reports consecutively for all three years; and (4) issued sustainability reports using the GRI 2021 framework consecutively for all three years. The criteria yielded 24 eligible banks and 72 initial firm-year observations. Nine observations identified as outliers during the original data-screening process were removed, leaving a balanced final sample of 21 banks and 63 firm-year observations. The exclusion of banks without consecutive GRI-based reports improves measurement comparability but may limit generalizability to banks with less developed sustainability reporting.

Table 1. Sample Selection Procedure

No.	Criteria	Number of Companies
1	Banking companies listed on the Indonesia Stock Exchange during 2022-2024	48
2	Companies delisted during 2022-2024	(0)
3	Companies that did not publish audited financial statements and annual reports consecutively during 2022-2024	(0)
4	Companies that did not publish sustainability reports based on the GRI framework consecutively during 2022-2024	(24)
5	Number of companies selected as sample	24
6	Total firm-year observations during three years	72
7	Outlier observations	(9)
8	Final observations used in the study	63

3.2. Variable Measurement

Firm value is measured using Tobin's Q, calculated as the sum of the market value of equity and total liabilities divided by total assets (Lee et al., 2019). Tobin's Q combines market expectations with accounting information and therefore reflects how investors value the resources controlled by the bank. Green banking is measured using the 21-item Green Banking Disclosure Index developed by Bose et al. (2018) and applied by Khan et al. (2021). Each item receives a score of 1 when disclosed and 0 when not disclosed, and the index equals the number of disclosed items divided by 21. CSR is measured using a 117-item disclosure index developed from the GRI Standards 2021. Following the dichotomous disclosure-index approach used by Machmuddah et al. (2020), each item receives a score of 1 when disclosed and 0 when not disclosed, and the index equals the number of disclosed items divided by 117. NPLs are measured as non-performing loans divided by total loans (Khan et al., 2021). All variables are expressed as ratios.

Table 2. Operationalization of Variables

Variable	Measurement	Scale	Source
Firm Value (Y)	Tobin's Q = (Market Value of Equity + Debt) / Total Assets	Ratio	Lee et al. (2019)
Green Banking (X1)	GBDI = Total disclosed green banking items / Total expected green banking items	Ratio	Khan et al. (2021)
Corporate Social Responsibility (X2)	CSRDI = Total disclosed CSR items / Total expected CSR items	Ratio	Machmuddah et al. (2020)
Non-Performing Loans (M)	NPL Ratio = Non-performing loans / Total loans	Ratio	Khan et al. (2021)

3.3. Data Analysis Technique

The analysis begins with descriptive statistics to summarize the mean, median, maximum, minimum, standard deviation, and number of observations. Three panel-data specifications are then considered: the common effects model, fixed effects model, and random effects model. The Chow test compares the common and fixed effects models; a probability below 0.05 supports the fixed effects model. The Hausman test compares the fixed and random effects models; a probability above 0.05 supports the random effects model. The Lagrange Multiplier test compares the common and random effects models; a Breusch-Pagan probability below 0.05 supports the random effects model (Savitri et al., 2021). Selection is based on the combined evidence from the three tests rather than on one test in isolation. Before hypothesis testing, classical assumption tests were conducted, consisting of normality, multicollinearity, heteroscedasticity, and autocorrelation tests. Normality is evaluated using the Jarque-Bera probability, with $p > 0.05$ indicating that normality is not rejected (Sihombing, 2022). Multicollinearity is evaluated from the correlation matrix; absolute correlations not exceeding 0.80 indicate that no strong pairwise linear association is detected (Ghozali, 2018). Heteroskedasticity was examined using the Glejser test, with a Prob. Chi-Square value greater than 0.05 indicating the absence of heteroskedasticity (Ghozali, 2018). Autocorrelation was evaluated using the Durbin-Watson statistic. A Durbin-Watson value above +2 indicates negative autocorrelation, a value between -2 and +2 indicates the absence of autocorrelation, and a value below -2 indicates positive autocorrelation (Rochmah, 2017).

Moderated regression analysis is used to test whether NPLs change the relationships between green banking, CSR, and firm value (Rahadi & Farid, 2021). The estimated equation is:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 M + \beta_4 X_1 M + \beta_5 X_2 M + e$$

where Y represents firm value, X1 represents green banking, X2 represents corporate social responsibility, M represents non-performing loans, X1M represents the interaction between green banking and NPLs, X2M represents the interaction between CSR and NPLs, and epsilon represents the error term. The coefficient of determination was assessed using adjusted R-squared, while the F-test was used to evaluate model feasibility. The t-test was used to test the partial effect of each independent variable and interaction variable at a significance level of 5%. A variable is considered significant if its probability value is less than 0.05. Model explanatory power is assessed through adjusted R-squared, and model feasibility is evaluated using the F-statistic. Individual coefficients and interaction terms are evaluated with t-tests at the 5% significance level. A hypothesis is supported when the relevant coefficient has the expected direction and a probability below 0.05. EVIEWS 12 is used for descriptive statistics, panel-model selection, random effects estimation, residual diagnostics, and coefficient testing.

IV. Results and Discussion

4.1. Sample Characteristics and Descriptive Statistics

The final sample consists of 21 banks observed for three consecutive years, producing 63 firm-year observations. Descriptive statistics show that green banking disclosure averaged 0.733182, meaning that

sampled banks disclosed approximately 73.32% of the 21 green banking items. Its standard deviation of 0.102467 and values ranging from 0.476190 to 0.857143 indicate variation across the bank-year observations. CSR disclosure averaged 0.590015, or approximately 59.00% of the 117 GRI 2021 items. Its standard deviation of 0.150172 and range from 0.290598 to 0.923077 indicate wider variation than green banking disclosure. The NPL ratio averaged 0.022970, with a minimum of 0.004100 and a maximum of 0.047000. Firm value averaged 0.998544 and ranged from 0.435560 to 1.650695. These distributions show that the banks differed substantially in CSR disclosure and market valuation, while green banking disclosure was relatively more concentrated.

Table 3. Descriptive Statistics

Statistic	Green Banking (X1)	CSR (X2)	NPL (M)	Firm Value (Y)
Mean	0.733182	0.590015	0.022970	0.998544
Median	0.761905	0.589744	0.022200	0.962569
Maximum	0.857143	0.923077	0.047000	1.650695
Minimum	0.476190	0.290598	0.004100	0.435560
Std. Dev.	0.102467	0.150172	0.009054	0.234075
Observations	63	63	63	63

4.2. Panel-Data Model Selection

The model selection tests indicate that the random effects model is the most appropriate model for this study. The Chow test produced a cross-section F probability of 0.0000, so the fixed effects model was preferred to the common effects model. The Hausman test then produced a probability of 0.4557, which supported the random effects model rather than the fixed effects model. Finally, the Lagrange Multiplier test produced a Breusch-Pagan probability of 0.0000 for the combined effect, indicating that the random effects model was preferred to the common effects model. The Hausman and Lagrange Multiplier results therefore converge on the random effects specification, which was used for moderated regression estimation.

Table 4. Panel-Data Model Selection Results

Test	Model Comparison	Statistic	Probability	Selected Model
Chow	CEM vs. FEM	Cross-section F = 32.017944	0.0000	FEM
Hausman	FEM vs. REM	Cross-section random = 4.683338	0.4557	REM
Lagrange Multiplier	CEM vs. REM	Breusch-Pagan (both) = 49.124280	0.0000	REM

4.3. Classical Assumption Test

The classical assumption test results indicate that the regression model satisfies the assumptions examined in this study. The normality test produced a Jarque-Bera probability of 0.063354, which is greater than 0.05, indicating that the residuals are normally distributed. The multicollinearity test showed that the highest correlation among the variables was 0.448453, which is below the 0.80 threshold; therefore, multicollinearity was not detected. The heteroscedasticity test produced a chi-square probability of 0.5585, which is greater than 0.05, indicating no heteroscedasticity problem. The Durbin-Watson statistic was 1.341401, which falls within the acceptable range of -2 to +2, suggesting no autocorrelation problem.

Table 5. Classical Assumption Test Results

Diagnostic	Testing Method	Result	Interpretation
Normality	Jarque-Bera test	Probability = 0.063354	The residuals are normally distributed
Multicollinearity	Correlation matrix	Highest correlation = 0.448453	No multicollinearity was detected
Heteroskedasticity	Glejser test	Prob. Chi-Square(5) = 0.5585	No heteroscedasticity was detected

Residual dependence	Durbin-Watson test	Durbin-Watson statistic = 1.341401	No autocorrelation was detected
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4.4. Moderated Regression Results

The random effects moderated regression model is statistically feasible. The moderated regression analysis was conducted using the random effects model. The regression equation generated from the estimation is as follows:

$$Y = 1.880976 - 1.036065X_1 + 0.017625X_2 - 47.81583M + 66.69368X_1M - 11.09131X_2M + e$$

Green banking has a negative but statistically insignificant coefficient ($p = 0.1126$), so H1 is not supported. CSR has a positive but statistically insignificant coefficient ($p = 0.9612$), so H2 is not supported. The green banking-NPL interaction is positive and significant ($p = 0.0056$), supporting H3. The CSR-NPL interaction is negative but not significant ($p = 0.4143$), so H4 is not supported.

Table 6. Moderated Regression Analysis Results

Variable	Coefficient	Std. Error	t-Statistic	Probability	Decision
Constant	1.880976	0.440287	4.272158	0.0001	-
Green Banking (X1)	-1.036065	0.642970	-1.611373	0.1126	H1 rejected
CSR (X2)	0.017625	0.360550	0.048884	0.9612	H2 rejected
NPL (M)	-47.81583	16.61207	-2.878378	0.0056	-
Green Banking x NPL (X1M)	66.69368	23.16058	2.879620	0.0056	H3 accepted
CSR x NPL (X2M)	-11.09131	13.48686	-0.822379	0.4143	H4 rejected

Notes: $R\text{-squared} = 0.371188$; $\text{adjusted } R\text{-squared} = 0.316030$; $F\text{-statistic} = 6.729438$; $\text{Prob}(F\text{-statistic}) = 0.000054$. Source: EVIEWS 12 output processed by the authors (2026)

The overall feasibility and explanatory power of the regression model were evaluated using the F-test and the coefficient of determination. The F-statistic is 6.729438 with a probability of 0.000054, indicating that the explanatory variables and interaction terms are jointly associated with firm value. The R-squared value is 0.371188 and the adjusted R-squared value is 0.316030. Accordingly, the model explains 31.60% of the variation in Firm Value, while 68.40% is associated with factors outside the specification. This explanatory power is meaningful but also confirms that bank valuation depends on other financial, governance, and market variables not included in the model.

4.5. Discussion

a. Green Banking and Firm Value

The first hypothesis states that green banking has a positive effect on firm value. The regression results show that the coefficient of green banking is -1.036065 with a probability value of 0.1126. Since the probability value is greater than 0.05, green banking does not have a significant effect on firm value. Thus, H1 is rejected. Although the average green banking disclosure level is relatively high at 73.32%, the result indicates that disclosure alone has not been sufficient to create a significant market valuation response among listed banks in Indonesia during 2022-2024. From the perspective of stakeholder theory, green banking should create value because it shows that banks are responsive to environmental concerns. However, the insignificant result suggests that stakeholders and investors may not yet perceive green banking disclosure as a direct source of economic value. From signalling theory, green banking disclosure should function as a positive signal regarding long-term sustainability. Nevertheless, the signal may not be strong enough to influence investment decisions if investors prioritize profitability, credit risk, or other financial indicators. From agency theory, the result may imply that green banking disclosure has not functioned effectively as a monitoring mechanism. Investors may view green banking as reputation-oriented disclosure rather than a strategy that directly improves market value. This finding is consistent with Arfiyani and Sasongko (2023), Galyani and Henny (2022), and Tiara and Jayanti (2022), who found that green banking does not significantly

affect firm value. However, it differs from Hilleri et al. (2025), Khan et al. (2021), and Murwaningsari and Rachmawati (2023), who found a positive relationship.

b. Corporate Social Responsibility and Firm Value

The second hypothesis states that CSR has a positive effect on firm value. The regression results show that the coefficient of CSR is 0.017625 with a probability value of 0.9612. Since the probability value is greater than 0.05, CSR does not significantly affect firm value. Thus, H2 is rejected. The average CSR disclosure level is 59.00%, indicating that many banks have not disclosed CSR items comprehensively. This limited disclosure may reduce the ability of CSR to influence investor perception. Stakeholder theory suggests that CSR should strengthen stakeholder trust and legitimacy. However, the insignificant result indicates that CSR disclosure has not created a clear perception of value added among stakeholders. From the signalling theory perspective, CSR should be a positive signal of good governance and long-term orientation, but investors may not treat CSR disclosure as a priority signal in investment decisions. Investors may pay more attention to profitability, capital adequacy, asset quality, and credit risk. From the agency theory perspective, CSR may not reduce agency conflict if investors suspect that CSR activities are implemented mainly to improve image rather than to increase long-term firm value. This finding is consistent with Romli and Zaputra (2021), who found that CSR does not significantly affect firm value. However, it differs from Erlangga et al. (2021), Galyani and Henny (2022), Hilleri et al. (2025), and Machmuddah et al. (2020), who found a positive effect.

c. Moderating Role of NPLs in the Green Banking-Firm Value Relationship

The third hypothesis states that NPLs moderate the effect of green banking on firm value. The interaction between green banking and NPLs has a coefficient of 66.69368 with a probability value of 0.0056. Since the probability value is below 0.05, NPLs significantly moderate the relationship between green banking and firm value. The positive coefficient indicates that NPLs strengthen the effect of green banking on firm value. Thus, H3 is accepted. This finding can be interpreted through signalling theory. High NPLs usually send a negative signal to investors because they reflect credit-risk problems. However, when a bank with credit-risk pressure continues to disclose green banking practices, the market may interpret this as a signal that the bank still has a long-term sustainability strategy. From stakeholder theory, green banking disclosure under NPL pressure may function as a mechanism for restoring stakeholder confidence. The bank shows that it remains committed to sustainable banking despite challenges in loan quality. From agency theory, the result suggests that green banking disclosure may reduce information asymmetry when credit risk increases. The finding is consistent with Tran and Ha (2025), who concluded that NPLs strengthen the relationship between green banking and firm value. However, it differs from Khan et al. (2021), who found that NPLs weaken the effect of green banking disclosure on firm value.

d. Moderating Role of NPLs in the CSR-Firm Value Relationship

The fourth hypothesis states that NPLs moderate the effect of CSR on firm value. The interaction between CSR and NPLs has a coefficient of -11.09131 with a probability value of 0.4143. Since the probability value is greater than 0.05, NPLs do not moderate the relationship between CSR and firm value. Thus, H4 is rejected. This result indicates that credit-risk conditions do not significantly change the market response to CSR disclosure among Indonesian listed banks during the study period. Agency theory suggests that higher NPLs may increase investor skepticism toward CSR activities because management may be expected to prioritize credit recovery and risk control. Signalling theory suggests that CSR disclosure under credit stress may produce an ambiguous signal when investors cannot distinguish substantive responsibility from reputational communication. Stakeholder theory likewise indicates that CSR disclosure may be insufficient to maintain trust when asset quality becomes a primary concern. Related evidence remains limited. Yuniarti et al. (2022) found that CSR did not moderate the effect of NPLs on firm value, whereas Bijak et al. (2024) found that CSR significantly moderated the relationship between NPLs and firm value. Both studies, however, used the reverse direction of moderation from the present model.

V. Conclusion

This study examines the effect of green banking and CSR on firm value with NPLs as a moderating variable in banking companies listed on the Indonesia Stock Exchange during 2022-2024. Based on moderated regression analysis using the random effects model, the study concludes that green banking does not significantly affect firm value. Although banks disclose green banking practices at a relatively high level,

investors may not yet interpret such disclosure as a direct determinant of market value. CSR also does not significantly affect firm value, indicating that CSR disclosure has not yet become a decisive signal for investor valuation in the banking sector. The study also finds that NPLs significantly moderate and strengthen the relationship between green banking and firm value. This result suggests that green banking disclosure becomes more relevant for market valuation when banks face credit-risk pressure. Green banking may serve as a signal of long-term strategic commitment and sustainability orientation in situations where NPLs raise investor concern. In contrast, NPLs do not moderate the relationship between CSR and firm value. This indicates that CSR disclosure does not significantly alter investor perception of firm value under different NPL conditions. This distinction refines stakeholder, agency, and signalling explanations by showing that the market response to non-financial information is conditional rather than uniform.

The study contributes to sustainability and banking valuation literature in three ways. First, it tests environmental banking disclosure and broader CSR disclosure in one model, revealing that the two forms of disclosure do not respond identically to credit-risk conditions. Second, it extends the contextual moderation approach of Khan et al. (2021) and Tran and Ha (2025) by comparing both GB x NPL and CSR x NPL interactions in Indonesian listed banks. Third, it integrates stakeholder, agency, and signalling theories: sustainability disclosure addresses stakeholder expectations, its value may be discounted when agency concerns remain, and its market relevance depends on the interaction between favourable sustainability signals and adverse credit-risk signals. Bank management should not interpret the positive GB x NPL interaction as evidence that higher credit risk improves firm value. NPLs retain a significant negative direct coefficient. The practical priority is therefore twofold: preserve disciplined underwriting, monitoring, restructuring, recovery, and provisioning processes while making green banking disclosure more specific and decision-useful. Banks should connect environmental policies with financed-project screening, portfolio exposure, measurable green-financing targets, risk controls, operating efficiency, and verified outcomes. This integration can help investors distinguish substantive strategy from generic disclosure. CSR reporting should likewise move beyond a count of disclosed topics. Banks should explain objectives, beneficiaries, expenditures, performance indicators, progress against targets, and links with material banking risks. Investors should assess sustainability disclosure together with NPLs and other asset-quality indicators rather than treating disclosure scores as stand-alone evidence of value creation. Regulators can support comparability by encouraging clearer definitions, quantitative indicators, year-to-year consistency, and stronger links between sustainability reporting and risk-management information.

This study is subject to several limitations. First, the sample is limited to Indonesian banking companies listed on the Indonesia Stock Exchange that consistently published sustainability reports based on the GRI Standards 2021 during the observation period. Consequently, the findings may not be generalizable to unlisted banks or financial institutions that apply different sustainability-reporting frameworks. Second, the three-year observation period may be insufficient to capture the long-term effects of green banking and CSR disclosure on firm value. Third, the relatively small final sample and the use of purposive sampling may introduce selection bias, particularly because banks with more complete and developed reporting systems were more likely to meet the sampling criteria. Fourth, the disclosure indices were measured using dichotomous scoring; therefore, they capture the extent of disclosure rather than its quality, materiality, credibility, external assurance, or actual sustainability outcomes. Finally, the model does not incorporate other factors that may influence firm value, such as profitability, capital adequacy, liquidity, firm size, corporate governance, dividend policy, and macroeconomic conditions. The adjusted R-squared value of 0.316030 indicates that a substantial proportion of the variation in firm value remains unexplained by the variables included in the model. Future research should extend the observation period. Researchers can compare conventional, Islamic, digital, state-owned, private, and regional development banks; add financial and governance controls; and evaluate disclosure quality through weighted indices, content intensity, materiality, external assurance, or measurable sustainability outcomes. Further studies may also separate environmental, employee, community, and governance components of CSR to determine whether specific dimensions interact with credit risk differently.

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