

The Effect of Green Investment on Banking Risk in Indonesia: The Role of Profitability as a Mediating Variable

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ABSTRACT: This study analyzes the relationship between Green Investment and banking risk in Indonesia and evaluates the role of profitability as a mediating variable. Banking risk is measured using Non-Performing Loan (NPL) for credit risk and stock beta for market-based systematic risk, while profitability is determined through Return on Assets (ROA). This study uses a balanced panel dataset of 18 banks listed on the Indonesia Stock Exchange for 2021–2025, comprising 90 observations. Green Investment is measured based on the ratio of green financing to total credit, and the control variables used include Firm Size, CAR, and LDR. The analysis was conducted using panel data regression, with model selection through the Chow, Hausman, and Lagrange Multiplier tests, alongside robust standard error estimation. The mediation test employed the Baron and Kenny approach, the Sobel test, and a bootstrap with 1,000 replications. The results indicate that Green Investment has a negative but insignificant relationship with ROA, and a positive but insignificant relationship with NPL. In the stock beta model, Green Investment shows a positive and individually significant coefficient; however, the overall model is insignificant, and the robustness test using return volatility also yields insignificant results. ROA does not mediate the relationship between Green Investment and either NPL or stock beta, as the 95% bootstrap confidence intervals include zero. Overall, Green Investment has not yet been proven to reduce banking risk through increased profitability, while its relationship with market-based systematic risk remains sensitive to the proxies used.

KEYWORDS: Green Investment, Profitability, Non-Performing Loan, Stock Beta, Market-Based Systematic Risk

INTRODUCTION

The banking sector plays a central role in Indonesia's financial system as an intermediary connecting public funds with productive sectors. In carrying out their functions, banks are not only required to maintain profitability but are also obligated to implement effective risk management. Nowadays, risk management challenges are becoming increasingly complex due to global economic uncertainty and the emergence of climate risk, which manifests as physical risk and regulatory transition risk towards a low-carbon economy (Batten et al., 2021). This condition shifts the risk management paradigm from a conventional approach to one that integrates Environmental, Social, and Governance (ESG) factors. In response, the Financial Services Authority (OJK, 2021) has reinforced the implementation of sustainable finance through the Phase II Sustainability Roadmap (2021–2025), which encourages banks to allocate their credit portfolios towards environmentally friendly economic activities or Green Investment.

Empirical evidence in the field shows that the dynamics of banking risk and performance in Indonesia remain highly fluctuating. Data from five representative banks (BBRI, BMRI, BBCA, BBNI, and BNGA) for the period 2021–2025 indicate heterogeneous challenges. From the perspective of credit risk, BBRI's Non-Performing Loan (NPL) ratio fluctuated from 3.00% (2021) to 3.07% (2025), while BMRI managed to consistently suppress it to 1.13% in 2025. On the market risk side, stock sensitivity (beta) showed high volatility; for instance, BBRI's beta surged from 0.71 (2023) to 2.14 (2024), and BBNI even recorded negative betas (-1.73 in 2022 and -0.12 in 2025), indicating an uneven response to market shocks (Damodaran, 2012). This condition is accompanied by fluctuations in profitability (Return on Assets/ROA), such as BBCA, which once plummeted to 0.38% (2023) before recovering to 1.98% (2025). These fluctuations reflect that a bank's ability to manage assets to generate profits is heavily influenced by the effectiveness of risk management amidst economic dynamics (Altunbas et al., 2021).

Theoretically, Green Investment is expected to serve as a risk mitigation solution. Based on Modern Portfolio Theory, diversifying the portfolio into the green sector can reduce exposure concentration in high-carbon industries. Furthermore, Stakeholder Theory suggests that adopting green practices can enhance legitimacy and investor confidence, which in turn supports financial

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performance (Friede et al., 2015). Within this framework, profitability (ROA) is strongly suspected to play a role as a mediating variable. The logical flow is that Green Investment can improve long-term efficiency and revenue, thereby increasing ROA. Banks with high profitability have a greater capacity to build loan loss provisions and absorb shocks, which can indirectly suppress NPL and stabilize stock beta.

Although the urgency of this topic has been acknowledged, existing empirical literature still shows several significant research gaps. First, there is an inconsistency in empirical findings regarding the impact of Green Investment on bank risk. Some studies, such as Zhang et al. (2023), found that green financing significantly reduces bank risk through improved asset quality. However, other studies in developing countries, such as Nguyen et al. (2022), Wardhani (2020), and Setiawan et al. (2023), show inconsistent results, where implementation costs, data limitations, and technological risks potentially burden profitability and increase short-term risk profiles. Second, the majority of previous studies tend to assess banking risk from only one perspective, for example, focusing solely on NPL (Zhang et al., 2023) or general stock volatility; very few simultaneously test credit risk and market-based systematic risk (stock beta) within a single model. Third, the role of profitability in this literature is almost always positioned as a dependent variable (the outcome), as seen in the research by Wardhani (2020) and Setiawan et al. (2023). Research that positions profitability (ROA) as a mediating variable to explain the mechanism of how Green Investment affects banking risk is still very limited, particularly in the context of the Indonesian banking sector during the 2021–2025 period.

Based on these gaps, this research offers novelty by integrating two dimensions of banking risk (NPL and stock beta) within a single analytical framework, as well as testing the role of profitability as a mediating variable. The use of panel data on banking companies in Indonesia during the 2021–2025 period provides an up-to-date empirical context. Therefore, this study aims to: (1) Analyze the direct effect of Green Investment on credit risk (NPL) and market-based systematic risk (stock beta); (2) Analyze the effect of Green Investment on profitability (ROA); and (3) Test the role of profitability as a mediating variable in the relationship between Green Investment and banking risk, while controlling for Firm Size, Capital Adequacy Ratio (CAR), and Loan to Deposit Ratio (LDR).

LITERATURE REVIEW

Stakeholder Theory

Stakeholder Theory asserts that a company's success is measured not only by the maximization of shareholder profits but also by the company's ability to meet the interests of all stakeholders. In the context of the banking industry, the integration of Environmental, Social, and Governance (ESG) principles and sustainable finance is a tangible manifestation of the bank's responsibility to its stakeholders (Schoenmaker & Schramade, 2019). Through this perspective, Green Investment is viewed as a strategic commitment that can enhance reputation, legitimacy, and stakeholder trust, which ultimately has a positive impact on financial performance (Ulfa et al., 2025). Although the realization of economic benefits from green financing may be delayed due to initial implementation costs, Stakeholder Theory provides a conceptual foundation to assume a positive correlation between Green Investment and profitability (ROA), which will subsequently be tested empirically in this study.

Modern Portfolio Theory (MPT)

Modern Portfolio Theory (MPT) emphasizes that the formation of an optimal investment portfolio is achieved through a combination of assets with low correlation, so that specific risk can be minimized without sacrificing potential returns (Saunders & Allen, 2020). In the banking context, this diversification principle is applied to the financing portfolio to reduce risk concentration in certain sectors, allowing losses in one sector to be offset by the performance of others. Green Investment is viewed as a diversification strategy into environmentally friendly sectors—such as renewable energy and green infrastructure—which not only reduces dependence on high-carbon industries but also increases portfolio resilience to regulatory shocks and climate change (Schoenmaker & Schramade, 2019). Based on this perspective, fund allocation to green investments has the potential to improve portfolio efficiency, reduce credit risk due to sector concentration, and decrease stock sensitivity to market dynamics. Therefore, MPT is used as a conceptual foundation to assume that Green Investment has a negative correlation with banking risk (both NPL and stock beta), which will subsequently be tested empirically in this study.

Capital Asset Pricing Model (CAPM)

The Capital Asset Pricing Model (CAPM) is a theoretical framework that links the expected return of an asset to systematic risk measured through the beta coefficient (β), which is an indicator of stock return sensitivity to changes in market returns (Brealey et al., 2020). A beta greater than one indicates a higher stock return response to market movements, while a beta below one reflects relatively lower sensitivity. In the banking sector, this market-based systematic risk is influenced by external factors such as interest rate changes, inflation, monetary policy, and investor sentiment. Green Investment has the potential to influence investors' perceptions of the bank's prospects and resilience through portfolio quality improvements, sustainability strategies, and the reduction of transition risk exposure, which in turn can alter the sensitivity of stock returns to market movements. Therefore,

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CAPM is used as a conceptual foundation in this study to proxy market-based systematic risk through stock beta, as well as to empirically test whether Green Investment has a correlation with changes in the bank's stock sensitivity to market dynamics.

Risk Management Theory dan Basel Framework

Risk Management Theory asserts that a bank's sustainability is determined not only by profit but also by the institution's capacity to identify, measure, monitor, and control risk exposures (Harb et al., 2023). In recent developments, banks are also required to integrate financial risks arising from climate change—both physical risk and transition risk—into their risk management systems (Bringas-Fernández et al., 2025). In this perspective, Green Investment is viewed as a risk management strategy through the allocation of financing to business activities that consider environmental and social dimensions, thus potentially improving portfolio quality and reducing the bank's exposure to long-term risks. Its effectiveness, however, still depends on the quality of the underwriting process, credit monitoring, and the bank's ability to manage portfolio concentration. Empirical studies in the ASEAN region support this view: green credit is related to banking performance (Andaiyani et al., 2023), revenue diversification and business cycles affect capital buffers and bank risk (Sahputra et al., 2024), risk management is a key factor in maintaining a sustainable growth rate (Isnurhadi et al., 2022), and macroeconomic conditions such as inflation also shape the bank's risk profile (Andriana et al., 2023). Based on the framework of Risk Management Theory and the Basel Framework principles, Green Investment is expected to improve the quality of the financing portfolio through more selective and sustainability-oriented fund disbursement, thereby potentially reducing credit risk. Furthermore, the profitability generated from green financing strategies provides banks with broader financial capacity to build loan loss provisions and absorb potential shocks. Therefore, this theory is used as a conceptual foundation to assume that Green Investment has a negative correlation with banking risk (NPL and stock beta), with profitability (ROA) acting as a mechanism that strengthens this relationship, which will subsequently be tested empirically in this study.

Green Investment in the Banking Sector

Green Investment refers to the allocation of bank financing to economic activities that meet environmental sustainability criteria, which not only pursue financial profit but also consider long-term environmental and social impacts (Schoenmaker & Schramade, 2019). In practice, Green Investment is realized through green financing, namely the disbursement of funds to projects such as renewable energy, green buildings, and sustainable transportation that align with Environmental, Social, and Governance (ESG) principles (Friede et al., 2015). In Indonesia, this implementation is strengthened by the Indonesian Green Taxonomy issued by the OJK as a guideline for classifying economic activities based on their environmental impact. Although Green Investment offers benefits in the form of reputation enhancement, funding access, and long-term risk management, high initial costs and technological uncertainty mean that its impact on profitability and risk still requires empirical proof. In this study, Green Investment is positioned as an independent variable measured through the ratio of green financing to total credit disbursed by the bank, reflecting the bank's level of commitment to allocating financing to the sustainable sector.

Banking Profitability

Profitability is a fundamental indicator that measures a bank's ability to generate profit from the resources it manages, while also serving as a primary marker of bank health for regulators and investors. In this study, profitability is measured using Return on Assets (ROA), which describes the efficiency of the bank's productive assets in generating profit (Muchiri et al., 2025). Mathematically, ROA is formulated as the ratio of net profit to total assets expressed as a percentage. A high ROA value reflects the effectiveness of productive asset management, including credit, securities, and interbank placements. ROA is influenced by internal factors such as asset quality, operational efficiency, and capital adequacy, as well as external factors such as economic growth, inflation, and interest rates. In the framework of this study, ROA is positioned as a mediating variable expected to be the connecting mechanism between Green Investment and banking risk, where increased asset efficiency and portfolio quality from green financing can strengthen the bank's capacity to absorb losses and maintain financial stability (Riyanti et al., 2025).

Banking Risk

Banking risk refers to the possibility of losses occurring due to uncertainties in business activities stemming from both internal and external factors. This study measures banking risk through two complementary dimensions. First, credit risk is proxied by Non-Performing Loan (NPL), which is the ratio of problematic credit (less smooth, doubtful, and bad collectibility) to total credit disbursed. A high NPL indicates a decline in the quality of the credit portfolio, an increase in provisioning costs (loan loss provision), and pressure on bank profitability. Second, market-based systematic risk is proxied by stock beta (β), which is a measure of the sensitivity of a bank's stock return to changes in market returns (IHSG), calculated based on the covariance ratio between stock returns and market returns to the variance of market returns. A beta above one indicates higher sensitivity to market movements, while a beta below one reflects relatively lower systematic risk. The simultaneous use of both indicators provides a more comprehensive picture of risk, as NPL represents the internal risk dimension (asset quality), while stock beta represents the external risk dimension (market perception). In the context of this study, Green Investment is expected to be able to reduce both

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dimensions of risk through improvements in the quality of the financing portfolio and strengthening investors' perceptions of the bank's long-term resilience, which will subsequently be tested empirically using a panel data approach for the 2021–2025 period.

Research Conceptual Framework

This study's conceptual framework is built upon the integration of four complementary theoretical foundations, namely Stakeholder Theory, Modern Portfolio Theory (MPT), Capital Asset Pricing Model (CAPM), and Risk Management Theory along with the Basel Framework. In this framework, Green Investment is positioned as an independent variable reflecting the bank's commitment to sustainable financing, which directly or indirectly affects two dimensions of banking risk, namely credit risk (Non-Performing Loan/NPL) and market-based systematic risk (stock beta). Profitability (Return on Assets/ROA) is placed as a mediating variable that bridges the relationship between Green Investment and banking risk, with the assumption that green financing allocation can improve asset efficiency and the bank's financial capacity, thereby strengthening the bank's resilience in absorbing losses and suppressing risk exposure (Schoenmaker & Schramade, 2019; Saunders & Allen, 2020; Brealey et al., 2020; Harb et al., 2023). To isolate the influence of internal bank characteristics and improve estimation accuracy, the research model also includes control variables in the form of Firm Size, Capital Adequacy Ratio (CAR), and Loan to Deposit Ratio (LDR). Through a panel data approach on Indonesian banking companies for the 2021–2025 period, this framework allows for the testing of the direct relationship of Green Investment to banking risk, as well as the evaluation of the role of profitability as an indirect mechanism explaining how green financing strategies impact bank stability, both from the perspective of internal asset quality (NPL) and market sensitivity (stock beta).

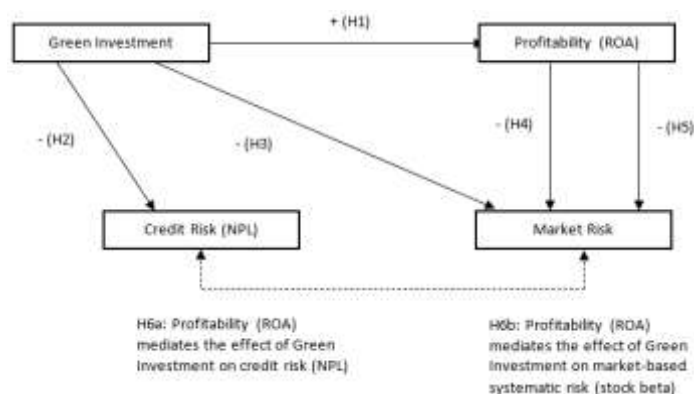


Figure 1. Research Conceptual Framework

Hypotheses

Based on Stakeholder Theory, Green Investment enhances legitimacy and stakeholder trust, which has the potential to expand funding access and improve the bank's operational efficiency and asset quality. Empirical support from Riyanti et al. (2025c), Muchiri et al. (2025), and Ulfa et al. (2025b) also confirms that green financing practices contribute positively to financial performance. Therefore, the first hypothesis is formulated:

H1: Green Investment has a positive effect on profitability (ROA)

Green Investment implements prudence principles and financing selection that are more resilient to environmental and transition risks, thereby having the potential to suppress default risk and reduce Non-Performing Loans (NPL). Empirical findings from Huang et al. (2024b) and Sun et al. (2025) support the view that green investment can reduce corporate financial and transition risks. Based on this, the second hypothesis is formulated:

H2: Green Investment harms credit risk (NPL)

From the perspective of the Capital Asset Pricing Model (CAPM), Green Investment can improve investors' positive perceptions of the bank's long-term prospects, thereby reducing uncertainty and stock price volatility. Studies by Carboni et al. (2024) and van den Berg et al. (2023) show that the implementation of sustainable finance and good environmental risk management can improve corporate financial stability. Therefore, the third hypothesis is formulated:

H3: Green Investment reduces market risk (stock beta)

High profitability reflects the bank's capacity to absorb losses, strengthen risk reserves, and improve credit portfolio quality, which ultimately suppresses the rate of non-performing loans. This is in line with the findings of Sutrisno et al. (2024), which state that increased profitability is closely related to a decrease in credit risk. Based on this description, the fourth hypothesis is formulated:

H4: Profitability (ROA) reduces credit risk (NPL)

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Based on Modern Portfolio Theory and CAPM, high profitability reflects strong financial fundamentals, thereby increasing investor confidence and reducing risk perceptions regarding the bank's stock sensitivity. This condition indicates that the higher the profitability, the lower the market-based systematic risk faced. Therefore, the fifth hypothesis is formulated:

H5: Profitability (ROA) reduces market risk (stock beta)

Theoretically, Green Investment increases stakeholder trust, which impacts financial performance improvements, where the resulting profitability subsequently strengthens the bank's capacity to mitigate both credit and market risks. Although Carboni et al. (2024) highlight the important role of profitability in this relationship, their empirical findings still show inconsistencies, making re-testing in the context of the Indonesian banking sector crucial. Based on this mechanism, the mediation hypotheses are formulated:

H6a: Profitability (ROA) mediates the effect of Green Investment on credit risk (NPL)

H6b: Profitability (ROA) mediates the effect of Green Investment on market-based systematic risk (stock beta)

RESEARCH METHODOLOGY

The population in this study consists of all banking sector companies listed on the Indonesia Stock Exchange (IDX) during the 2021–2025 period. The sample was selected using a purposive sampling technique, resulting in 18 banking companies with a total of 90 bank-year observations. Data were collected through secondary data documentation from annual financial reports, sustainability reports, and capital market databases. The analysis technique employed panel data regression with model selection through the Chow, Hausman, and Lagrange Multiplier tests, as well as mediation effect testing using the Sobel Test and Bootstrap Indirect Effect with 1,000 replications.

RESULT AND DISCUSSION

Descriptive Statistics of Research Variables

Table 1. Descriptive Statistics of Research Variables

Variable	Observations	Mean	Median	Std. Dev.	Minimum	Maximum
GI (%)	90	28,59	23,55	22,83	2,30	100,00
ROA (%)	90	2,63	1,98	2,42	-4,75	10,21
NPL (%)	90	2,87	2,46	1,75	1,12	10,25
BETA	90	1,09	0,87	2,06	-8,27	12,61
SIZE	90	32,76	32,91	1,60	29,11	35,34
CAR (%)	90	30,38	25,34	18,67	17,49	126,31
LDR (%)	90	88,37	84,23	44,56	23,28	373,61

The study utilized 90 observations from 18 banks during the 2021–2025 period. Green Investment (GI) showed relatively high variation with a standard deviation of 22.83%, which is close to the mean value of 28.59%, indicating heterogeneity in the implementation of green financing among banks. ROA varied from -4.75% to 10.21%, indicating significant differences in profitability performance. Stock beta had a very wide range (-8.27 to 12.61) with a standard deviation of 2.06, reflecting diverse sensitivities of stock returns to market movements.

Panel Data Regression Model Selection

Table 2. Panel Data Regression Model Selection Results

Dependent Model	Chow Test	Hausman Test	LM Test	Selected Model
ROA	0,0000*	0,0061*	-	FEM
NPL	0,0000*	0,0001*	-	FEM
BETA	0,9288	0,5360	0,0316*	REM

*Note: significant at $\alpha=0.05$

Based on the model selection results, the ROA and NPL equations use the Fixed Effects Model (FEM) because both tests (Chow and Hausman) showed significance. Meanwhile, the stock beta equation uses the Random Effects Model (REM) because the Chow and Hausman tests were not significant. However, the Lagrange Multiplier (LM) test showed significance at a probability of 0.0316, indicating the presence of random effects that need to be considered in the model.

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Final Model Estimation with Robust Standard Errors

Table 3. Final Model Estimation Results with Robust Standard Error

Variable	ROA (FEM)	NPL (FEM)	BETA (REM)
Konstanta	9,037871 (0,8984)	103,7399 (0,0041)*	15,23341 (0,0552)
GI	-0,062208 (0,2549)	0,025235 (0,1084)	0,017040 (0,0210)
ROA	-	0,186572 (0,1592)	0,000075 (0,9995)
SIZE	-0,190023 (0,9303)	-3,131689 (0,0044)	-0,420443 (0,0752)
CAR	0,092796 (0,0475)	0,022832 (0,2666)	-0,045014 (0,1978)
LDR	-0,013817 (0,3470)	-0,002040 (0,7286)	0,005755 (0,4903)
R ²	0,699351	0,807618	0,069188
Adj. R ²	0,606503	0,744448	0,013782
Prob. F	0,000000*	0,000000*	0,293889

*Note: significant at $\alpha=0.05$; values in parentheses are probabilities

The estimation results show that Green Investment (GI) has no significant effect on ROA (prob. 0.2549) or NPL (prob. 0.1084). However, GI shows a positive and significant effect on stock beta (coefficient 0.017040; prob. 0.0210), although the direction of this relationship is contrary to the hypothesis, which expected a negative effect. The control variable CAR has a significant positive effect on ROA (prob. 0.0475), while SIZE has a significant negative effect on NPL (prob. 0.0044). The stock beta model has a low explanatory power with an Adjusted R² of only 1.38% and is not simultaneously significant (Prob. F = 0.293889).

Hypothesis Testing

Table 4. Hypothesis Testing Results

Hypothesis	Relationship Path	Hypothesis Direction	Estimated Value	Test Statistic	Decision
H1	GI → ROA	+	-0,062208	Probability = 0,2549	Not Supported
H2	GI → NPL	-	0,025235	Probability = 0,1084	Not Supported
H3	GI → BETA	-	0,017040	Probability = 0,0210*	Not Supported
H4	ROA → NPL	-	0,186572	Probability = 0,1592	Not Supported
H5	ROA → BETA	-	0,000075	Probability = 0,9995	Not Supported
H6a	GI → ROA → NPL	-	-0,007398	95% CI: [-0,026301; 0,005750]	Not Supported
H6b	GI → ROA → BETA	-	0,000802	95% CI: [-0,012229; 0,013580]	Not Supported

*Note: GI = Green Investment; ROA = Profitability; NPL = Credit Risk; BETA = Market-Based Systematic Risk. () Statistically significant, but has a coefficient direction opposite to the hypothesis

The analysis results show:

Green Investment has no significant effect on profitability (ROA), so hypothesis (H1) is not supported. The negative but insignificant coefficient indicates that the financial benefits of green financing are not immediately reflected in the 2021–2025 observation period. This is caused by the heterogeneity of green financing implementation among banks and the long-term nature of green investments (lagged effect), where initial costs and technological adjustments still burden short-term performance. This finding is in line with Andaiyani et al. (2023), who stated that the impact of green credit is not necessarily immediately positive, but differs from Sutrisno et al. (2024). From the perspective of Stakeholder Theory, the increase in legitimacy and reputation requires time before having a tangible impact on financial performance.

Green Investment is not proven to reduce credit risk (NPL), so hypothesis (H2) is not supported. Credit quality is more determined by the underwriting process, the debtor's ability to pay, portfolio diversification, and economic conditions, rather than just the "green" label on a financing. This finding contradicts An et al. (2023) and Warninda & Widodo (2026), who found a decrease in risk. The perspective of Risk Management Theory and the Basel Framework emphasizes that green financing cannot replace strict risk management processes, while Modern Portfolio Theory reminds us that the benefits of diversification depend on the overall portfolio structure, not just the size of the green proportion.

Green Investment shows a positive and individually significant relationship with stock beta, but the overall model has a very low explanatory power (Adjusted R² 1.38%) and is not simultaneously significant, so hypothesis (H3) is not supported. This increase in beta is suspected to be due to transition costs, uncertainty of green projects, and information asymmetry in sustainability disclosures, which make the market not yet fully perceive it as a risk reducer. This finding is in line with Francisco & Couto (2026),

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who found that ESG performance can increase systematic risk. In addition, a robustness test using return volatility did not show a significant relationship, indicating that the beta results are highly sensitive to the risk proxy used.

Profitability (ROA) has no significant effect on the reduction of credit risk (NPL), so hypothesis (H4) is not supported. ROA measures general asset efficiency, while NPL measures credit portfolio quality. High profits do not automatically guarantee low non-performing loans due to the time lag between profit formation and the emergence of bad loans. This finding is consistent with Kalkan (2025), who also found an insignificant relationship, and reinforces the Basel Framework principle that credit risk management requires its own governance and does not rely solely on the level of profitability.

Profitability (ROA) has no significant effect on market-based systematic risk (stock beta), so hypothesis (H5) is not supported. Stock beta is largely driven by macroeconomic factors, monetary policy, and market sentiment that affect the entire industry simultaneously, rather than just the internal fundamental performance of a single bank. This is in line with Akhtaruzzaman et al. (2021), who stated that high profitability is not always identical to a decrease in systematic risk, as well as Nova et al. (2024), who emphasized that market responses to bank fundamentals vary greatly depending on the indicators used.

Profitability (ROA) is not proven to mediate the relationship between Green Investment and credit risk (NPL), so hypothesis (H6a) is not supported. The Bootstrap Indirect Effect results show that the 95% confidence interval includes zero. This indicates that the risk reduction mechanism of green financing relies more on the quality of underwriting and direct debtor monitoring, rather than through short-term profit increases. This finding differs from Huang et al. (2025), but is in line with Sutrisno et al. (2024), who mentioned that profit increases from green credit do not automatically translate into a decrease in bank risk.

Profitability (ROA) is not proven to mediate the relationship between Green Investment and market-based systematic risk (stock beta), so hypothesis (H6b) is not supported. The 95% bootstrap confidence interval includes zero, showing that market perception of systematic risk is more influenced by external factors (interest rates, investor sentiment, transition costs) than by the bank's internal profit performance. This result strengthens the findings of Pistolesi & Teti (2024), who stated that the relationship between sustainability activities and systematic risk is complex, non-linear, and does not always run through the profitability pathway.

CONCLUSION, LIMITATIONS, AND SUGGESTIONS

Based on the analysis of 18 banking companies in Indonesia during the 2021–2025 period, this study concludes that an increase in the proportion of Green Investment has not been statistically proven to improve profitability (ROA) or reduce credit risk (NPL). In the dimension of market-based systematic risk, Green Investment shows an indication of a positive relationship with stock beta individually; however, this finding must be interpreted with caution because the overall model is insignificant, has very low explanatory power, and is inconsistent when tested with an alternative proxy (return volatility). Furthermore, profitability has not been proven to act as a mediating variable that bridges the relationship between Green Investment and both dimensions of risk, as the bootstrap confidence intervals for both paths still include zero. Overall, the benefits of Green Investment to banking performance and risk are gradual and contextual, depending not only on the size of the green financing proportion but also on portfolio quality, internal bank characteristics, and market conditions.

This study has several limitations that need to be considered when interpreting its results. First, the relatively short observation period (five years with 90 observations) may not be sufficient to capture the medium- to long-term benefits of Green Investment (lagged effect). Second, the measurement of Green Investment, which relies on the green financing ratio based on each bank's sustainability report, is vulnerable to heterogeneity in classification and the level of disclosure detail across banks. Third, the empirical results proved to be sensitive to the risk proxies used, where the findings in the stock beta model were not entirely consistent when tested using an alternative proxy. Fourth, the research model has not included macroeconomic variables (such as interest rates and inflation) or time fixed effects that can simultaneously affect profitability and risk. Finally, the use of observational panel data opens the possibility of reverse causality and omitted variable bias, and the varying levels of stock liquidity among the sample banks can affect the stability of beta estimation.

Based on these findings and limitations, future research is suggested to extend the observation period and apply lag variables (e.g., Green Investment in year $t-1$ or $t-2$) to test for possible delayed impacts of green financing. The sample coverage can also be expanded to a regional level (ASEAN countries) or compared between bank groups (conventional vs. Islamic, or large vs. small banks) to observe variations in the level of sustainable finance maturity. To address potential endogeneity, future researchers are recommended to use stronger econometric approaches, such as the System Generalized Method of Moments (System GMM) or Instrumental Variables (IV). Additionally, it is important to include macroeconomic variables and market conditions to improve the explanatory power of market-based risk models. Finally, future research can explore alternative mediating variables (such as operational efficiency or ESG reputation) and use more diverse risk proxies (such as Z-score or downside beta) to gain a more comprehensive understanding of the mechanism of the relationship between sustainable finance and banking stability.

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