

Green innovation and firm value: The mediating role of financial performance in Indonesian Non-Financial Firms

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ABSTRACT

This study examined the effects of green process and green product innovation on firm value, with financial performance serving as a potential mediating mechanism. Financial performance was measured using Return on Assets (ROA) and Return on Equity (ROE), while firm value is assessed using Tobin's Q. Following financial-data revalidation and outlier treatment, the study utilized a balanced panel dataset of 273 non-financial companies listed on the Indonesia Stock Exchange during 2021–2024, comprising 1,092 firm-year observations. Panel-data regression and Sobel mediation tests are applied to evaluate the proposed relationships. The results indicated that neither green process nor green product significantly affects ROA. Green process showed a marginally significant negative effect on ROE at the 10 percent level, whereas green product has no significant effect on ROE. In terms of firm value, green process showed a significant negative effect, while green product showed a marginally significant negative effect. Furthermore, neither ROA nor ROE significantly influences firm value, and neither variable mediates the relationship between green innovation and firm value. The study integrated Signaling Theory, the Resource-Based View, and Legitimacy Theory to explain how green innovation may function as a non-financial signal, strategic capability, or legitimacy-related activity. The findings implied that environmental initiatives and disclosures are more likely to be valued by investors when they are accompanied by measurable economic outcomes.

Keywords: Financial performance, Firm value, Green innovation, Green process, Green product

JEL Classification: M14, G32, Q56

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1. Introduction

Investors place a high value on firm value. If a company has a high firm value, it indicates that investors have faith in its management skills, profitability, and capacity to stay in business (Hasibuan et al., 2023; Yanti & Darmayanti, 2019). As a financial signal that investors may utilize to evaluate a company's potential, profitability is an essential component of business valuation (Hapsari et al., 2025). It also shows how well management is able to make returns from the company's resources. According to several sources (Ghani et al., 2023; Sudiyatno & Puspitasari, 2010; Tharavanij, 2024), Tobin's Q is

a common metric for assessing a company's worth in the capital market. Sustainability concerns are receiving increased focus from corporations recently.

These days, stakeholders want businesses to do more than simply make a profit; they also need to show they can control their influence on the environment and satisfy their demands. As a result, businesses are now more likely to include ESG data in their annual and sustainability reports (Bae et al., 2018; Kurniawan & Nugroho, 2025). According to Listianingsih & Majidah (2025), carbon emissions are a crucial part of sustainability reporting in this context. It shows stakeholders how companies handle emissions, energy usage, climate risks, and strategies to reduce emissions. These issues are addressed by green innovation strategies. Companies may improve their goods, processes, culture, and innovation techniques through green innovation, which strives to reduce the negative environmental consequences of corporate operations.

Green method and green product are two ways in which green innovation may be shown. The term "green process" describes technologies that have the potential to be environmentally friendly. Some examples of green process modifications include making better use of water and energy, reducing waste, increasing the use of recycled materials, and using cleaner technology. According to Sari (2020), Tonay & Murwaningsari (2022), and Hidayah & Sibarani (2023), environmentally friendly goods aim to be safer, more energy efficient, or recyclable. Because of the strong relationship between non-financial organizations' operations and resource usage, production, energy consumption, emissions, waste, and environmental effect, these factors take on added significance for these types of businesses (Cahyaningtyas et al., 2022; Xie et al., 2022).

The notion of signaling states that investors may gauge a company's quality and risk level based on the information it shares. Managers and outsiders can bridge the knowledge gap using both financial and non-financial data (Connelly et al., 2011). The non-financial signals sent by a company's green operations and products demonstrate its dedication to sustainability, efficiency, and environmental challenges. According to Bae et al. (2018) and López-Santamaría et al. (2021), a company's market image and value can be enhanced through green innovation if investors perceive these signals favorably.

The different reactions of the market to environmentally friendly innovations might not be thoroughly explained by signaling theory on its own. In this view, "green" processes and products serve as non-financial signals that show investors that a company cares about the environment and is focused on sustainability. But these messages aren't always seen in a positive light. If green innovation is seen as expensive, meaningless, or not likely to provide tangible financial gains, investors can react unfavorably. This study integrates Legitimacy Theory and the Resource-Based View to offer a more thorough theoretical framework. The Resource-Based View sees green innovation as a strategic competency that can increase efficiency, cut down on resource waste, help differentiate products, and increase (Barney, 1991). In contrast, Legitimacy Theory suggests that environmental initiatives and disclosures may be viewed as compliance-driven activities or legitimacy costs rather than as value-creating strategies (Velte, 2023). This theoretical fusion provides the groundwork for investigating ROA and ROE, two measures of financial success, as a possible intermediary between green innovation and company value.

When looking at the connection between green innovation, financial success, and business value, previous studies have shown conflicting findings. Agustia et al. (2019), Asni & Agustia (2022), and Fathoni et al. (2025) are among the research that suggests green innovation increases business value. This is because ecologically focused processes and products may increase efficiency, reputation, and investor trust. By lowering operating costs, increasing resource efficiency, and allowing product differentiation, green processes and green product innovation may also help with financial performance. Xie et al.

(2022) and Velte (2023) found no evidence that green innovation had a positive or even negligible impact. This is especially true when environmental initiatives require significant investments in technology, certification, and product development before any monetary benefits can be realized. The impact of environmentally friendly innovations on company worth is still up for debate, according to these contradictory results. To fill this knowledge vacuum, the current study looks at the relationship between green process and green product innovation and firm value. Specifically, it asks if these factors affect value directly or if financial success, as shown by ROA and ROE, mediates the effect.

An additional metric for gauging the effect of green innovation on company value is financial performance. An important measure of a company's financial health is its profitability, which tells investors a lot about the company's worth and how well it uses its assets to make money (Nurhayati & Kristanti, 2023). The authors of this research (Nabila & Ismaulina, 2025) use ROA and ROE as metrics for evaluating financial success. According to Febbiliana et al. (2024), return on assets (ROA) and return on equity (ROE) are two ways to evaluate a company's profitability. Reducing waste and increasing efficiency are two benefits of using green processes and goods.

Using financial performance as a possible mediator, this study examines how green process and green product initiatives affect business value. Return on Assets (ROA) and Return on Equity (ROE) are financial performance metrics, whereas Tobin's Q is used to quantify firm value. Because of the tight relationship between the activities of these businesses and environmental effect, resource consumption, production emissions, and waste management, this research focuses on non-financial companies listed on the Indonesia Stock Exchange from 2021 to 2024. We use a quantitative approach, drawing on secondary data collected from sources such as financial statements, sustainability reports, annual reports, corporate websites, market data, and the Indonesia Stock Exchange. The number of outstanding shares, financial data, stock prices, sustainability disclosures, annual reports, and financial statistics are used in the purposive selection process to choose the sample. Data analysis is carried out through the use of mediation testing and panel data regression.

There are three main ways in which this study adds to the existing body of knowledge. To provide a theoretical framework for understanding the potential role of green innovation as a non-financial signal, strategic capacity, or legitimacy-related activity, it combines Signaling Theory, Resource-Based View, and Legitimacy Theory. This study presents accounting-relevant environmental information in the form of green process and green product disclosures. Sustainability reporting, environmental accounting, and ESG reporting are all connected since these disclosures show how companies tell the outside world about their environmental efforts, resource efficiency, waste management, and product-related environmental plans. By investigating the potential link between environmental efforts and financial performance and business value, the research adds to the body of knowledge on strategic investment appraisal. As a result, the research makes it clear if green innovation disclosures are only focused on sustainability or if they give investors economically relevant information. This study uses an Indonesian panel-data setting to methodologically differentiate between green process innovation and green product innovation, and to investigate ROA and ROE as possible mediating processes.

2. Theoretical Framework and Hypotheses Development

Signaling theory posits that firms reduce information asymmetry by communicating both financial and non-financial information to external stakeholders, particularly investors (Connelly et al., 2011). Within this framework, the terms "green process" and "green product" refer to non-financial signals that convey an organization's dedication to the environment, focus on operations, and plans for the future of sustainability. On the other hand, financial indications such as return on equity (ROE)

and return on assets (ROA) show how well a company can turn its equity and assets into profit. Thus, investors may assess the worth of a company by taking into account both financial and environmental indicators at the same time (Bae et al., 2018; López-Santamaría et al., 2021).

Green innovation signals are not always well-received by the market. Efficiency, product differentiation, cost reduction, and increased financial performance are some of the ways in which green processes and green products are seen as adding value. Conversely, investors may react negatively if green innovation is viewed as costly, symbolic, or incapable of generating measurable economic benefits. In this context, financial performance is critical, as ROA and ROE can either reinforce or undermine the credibility of green innovation signals. When green innovation leads to improved financial performance, the market is more likely to value the signal positively. Conversely, if financial performance does not improve, investors may consider the signal insufficient to enhance firm value (Velte, 2023; Xie et al., 2022).

To reinforce the theoretical framework, this study integrates the Resource-Based View and Legitimacy Theory. Enhanced efficiency, reduced resource waste, supported product differentiation, and strengthened competitiveness may be achieved through green processes and green products, according to the Resource-Based View (Barney, 1991). As a result, green innovation is anticipated to impact company value in two ways: how the market perceives it and its ability to provide financial results. This reasoning supports looking at return on assets (ROA) and return on equity (ROE) as a possible moderator in the connection between green innovation and company value.

Since investments in the environment may not immediately increase company value unless they produce quantifiable economic advantages, financial performance is thought of as a possible mediating factor. Profitability may be enhanced by green process efforts that reduce operational costs, maximize resource efficiency, decrease energy usage, and minimize waste. Product differentiation, more market acceptability, and new income sources are all ways in which green product strategies may increase profitability. These benefits, as stated by the Resource-Based View (Barney, 1991), come about when environmentally friendly innovation is transformed into a strategic competency that boosts productivity and rivalry. The effectiveness of green process and green product efforts in generating asset-based profitability and shareholder returns may be seen through appropriate financial measures such as Return on Assets (ROA) and Return on Equity (ROE). When green innovation leads to improvements in ROA and ROE, investors may interpret environmental initiatives as credible signals of value creation, which may strengthen firm value. Conversely, if green innovation does not enhance financial performance, investors may regard it as a cost rather than a source of economic value (Asni & Agustia, 2022; Velte, 2023).

According to Legitimacy Theory, firms may undertake environmental initiatives and disclosures to obtain or maintain social legitimacy. In this context, investors may not always interpret green innovation as a value-creating strategy, particularly when financial benefits are not readily measurable. If environmental initiatives are viewed primarily as compliance-driven activities or legitimacy costs, market responses may be weak or negative (Velte, 2023). Therefore, integrating Signalling Theory, Green innovation's impact on company value, financial performance as a mediator, and unfavorable investor reactions may be better understood with the help of the Resource-Based View and Legitimacy Theory.

The worth of a firm is a measure of the confidence investors have in its track record, projections for the future, and capacity to generate profits for its owners. An increase in a company's worth indicates that investors have increased confidence in its management, profitability, and resource utilization capabilities (Hasibuan et al., 2023; Yanti & Darmayanti, 2019). This study uses Tobin's Q, which is the market capitalization of equity plus the book value of liabilities divided by the book value of total assets,

as a measure of business worth. [Ghani et al. \(2023\)](#) and [Tharavanij \(2024\)](#) all agree that this ratio which may go from zero to infinity, reflects the market's perception of the firm.

According to [Agustia et al. \(2019\)](#), [Cahyaningtyas et al. \(2022\)](#), and [Teixeira \(2025\)](#), "green innovation" refers to innovations that aim to reduce the negative effects of businesses on the environment. These innovations may include process improvements, greener products, more eco-friendly technologies, or environmentally-oriented business practices. In this study, we classify green innovation along two dimensions: green process and green product. Energy and water efficiency, waste reduction, the use of recycled materials, and environmentally friendly technologies are all examples of operational improvements that can be characterized as green processes.

Green products can be interpreted as the development or modification of products that are safer, more energy efficient, recyclable, and have less environmental impact ([Hidayah & Sibarani, 2023](#); [Sari, 2020](#); [Tonay & Murwaningsari, 2022](#)). According to the signaling theory, the green process may make the signals become positive for investors as it indicates the company's efficiency and environmental friendly practices. Firms that employ the green process can reduce waste in production, utilize inputs more efficiently, and may promote their image, which would result in higher investor confidence and benefit the firm's value. Also, earlier researches also have demonstrated that green process innovation can impact firm value through the efficiency and green-oriented practices ([Agustia et al., 2019](#); [Hidayah & Sibarani, 2023](#)).

H₁: Green process and green product simultaneously influence firm value.

H₂: Green process has a positive effect on firm value.

Green products can increase a firm's value by helping products gain market acceptance, improving the company's reputation, on top of demonstrating its capacity to fulfill sustainability requirements. Green products show that a corporation cares about the environment and can change with the times, according to signaling theory. While the exact effect on firm value is contingent upon market reaction and implementation costs, prior research has indicated that green product innovation does increase firm value ([Fathoni et al., 2025](#); [Hidayah & Sibarani, 2023](#); [Xie et al., 2022](#)).

H₃: Green product has a positive effect on firm value.

The relationship between green innovation and business value is investigated in this study by analyzing financial performance with the use of Return on Assets (ROA) and Return on Equity (ROE) metrics. According to several studies ([Febbilia et al., 2024](#); [Mawardan & Pratiwi, 2025](#); [Nabila & Ismaulina, 2025](#)), return on assets (ROA) and return on equity (ROE) are two ways to quantify a company's profitability. Green processes have the potential to increase ROA and ROE when organizations use environmental management strategies that lead to cost reduction, operational efficiency gains, and increased productivity.

H₄: Green process has a positive effect on Return on Assets.

H₆: Green process has a positive effect on Return on Equity.

Green products can improve financial performance if environmentally friendly features help increase sales, expand market potential, and gain consumer acceptance. Innovation focused on sustainability can raise revenues and help assets and equity generate more profit. According to other studies ([Asni & Agustia, 2022](#); [Fathoni et al., 2025](#); [Wang & Ahmad, 2024](#)), environmentally friendly product innovations might impact the bottom line and the worth of a company.

H₅: Green product has a positive effect on Return on Assets.

H₇: Green product has a positive effect on Return on Equity.

Since both the Return on Assets and the Return on Equity are financial signals for investors, they can affect the value of a corporation. A high return on assets indicates that the firm is adequate at turning its assets into profit. In a similar vein, a high return on equity indicates that the business is profitable. According to [Asni & Agustia \(2022\)](#), [Febbilia et al. \(2024\)](#), and [Mawardan & Pratiwi \(2025\)](#), investors may view this robust financial performance as an indication of the company's future success, which can lead to a rise in firm value.

H₈: Return on Assets has a positive effect on firm value.

H₉: Return on Equity has a positive effect on firm value.

Since environmentally friendly procedures and goods may not have an immediate impact on a company's worth, return on assets (ROA) may potentially mediate the relationship between green innovation and ROA. Efficiency, cost-effectiveness, and profitability may all be enhanced via green innovation. Both investor trust and corporate value can benefit from increased profitability. According to earlier research ([Agustia et al., 2019](#); [Asni & Agustia, 2022](#); [Fathoni et al., 2025](#)), financial success has the potential to mediate the connection between green innovation and business value.

H₁₀: Return on Assets mediating the effect of green process on firm value.

H₁₁: Return on Assets mediating the effect of green product on firm value.

One such mechanism via which green innovation contributes to a company's value is return on equity. The bottom line and stockholder value can both benefit from environmentally friendly operations and products. As a result, such businesses are likely to receive a favorable reception from investors. Since return on equity (ROE) reveals the efficiency with which management turns business assets into profit, it can bolster the link between green innovation and firm value ([Asni & Agustia, 2022](#); [Mauliddah & Fajriah, 2021](#)). In this hypothesis, we find that ROE mediates the relationship between green processes and company value.

H₁₂: Return on Equity mediating the effect of green process on firm value.

H₁₃: Return on Equity mediating the effect of green product on firm value.

3. Methodology

Data

This study takes a look at the relationship between green innovation and business value, specifically looking at how financial success might play a mediating role. Green process and product are the yardsticks by which green innovation is evaluated. We estimate the worth of a company using Tobin's Q, and we measure the performance of its finances with Return on Assets (ROA) and Return on Equity (ROE).

This research makes use of a balanced panel dataset covering the years 2021–2024 that includes non-financial firms trading on the Indonesia Stock Exchange. Companies outside of the financial sector are preferred because of the environmental responsibility, resource use, energy consumption, waste, and output involved in their operations. Analysis of green process and green product innovations can benefit from these traits.

The sample selection procedure involved several sequential stages. First, companies in the financial sector were excluded because they have different asset structures, regulatory frameworks, and financial reporting practices compared to non-financial firms. Second, companies without complete annual reports for the 2021–2024 period were removed. Third, firms that did not provide sustainability reports or sustainability-related disclosures in their annual reports were also excluded because such information was required to assess green process and green product indicators. Fourth, companies with insufficient data for scoring green process and green product were excluded. Fifth, firms with incomplete financial data required to calculate Return on Assets (ROA), Return on Equity (ROE), and Tobin's Q, as well as firms without stock price or outstanding share data, were omitted. Missing observations were not estimated or imputed; instead, observations with unavailable data were excluded to preserve data reliability. Extreme values were verified against the original annual reports, financial statements, and market data. Values resulting from input or calculation errors were corrected, while valid extreme values were retained to reflect actual company conditions during the observation period.

Using these standards, we were able to narrow our sample down to 1,092 firm-year observations, which included 273 non-financial enterprises tracked across four years. Information is collected from a variety of sources, including annual reports, sustainability reports, financial statements, and statistics sourced from the Indonesia Stock Exchange and corporate websites.

Variable Measurement

As a measure of business worth, this research used Tobin's Q, which is determined by dividing total assets by the sum of market value of equity and book value of liabilities. Both "green procedure" and "green result" are seen as independent variables. The term "green process" describes innovations in processes that are environmentally conscious, while "green product" describes innovations in products that are similarly eco-conscious. Financial performance is represented by ROA and ROE. The raw accounting ratios were calculated before outlier treatment. For the empirical analysis, Tobin's Q was expressed as $\ln(TQ)$, ROA as $\ln(ROA)$, and ROE as $\ln(ROE)$. Consequently, the negative descriptive values of the transformed profitability variables reflect logarithmic scaling and should not be interpreted directly as average accounting losses.

Table 1. Green process and green product indicator assessment

Variable	Indicator Assessment
Green Process	- The company aims to reduce the use of resources, water, and energy and improve the efficiency of resource use.
	- The company uses recycled materials, recycling techniques, and environmental technology. The company prepares or conducts environmental campaigns.
	- The company uses or adapts equipment or technology to reduce energy, water, and waste.
Green Product	- The company uses safer and environmentally friendly raw materials.
	- The company designs energy-efficient or environmentally friendly products.
	- The company's products can be recycled or use waste-reduction technology.
	- The company reports green product innovation in annual reports or sustainability reports.

Green process and green product are evaluated with a scoring system. Companies get a score of 0 if they do not share information about the indicator. If they provide general or qualitative details, they receive a score of 1. A score of 2 is given when a company shares more complete information, either in detail or with numbers. The total score is divided by the number of indicators.

Table 2. Variable measurements

Variable	Abbreviation	Definition	Source
Firm Value	TQ	Market value of equity plus book value of liabilities divided by total assets Empirical measure = $\ln(\text{raw TQ})$	Annual reports
Green Process	GP	Total score of green process indicators divided by the number of indicators	Sustainability reports
Green product	GPR	Total score of green product indicators divided by the number of indicators	Sustainability reports
Return on Assets	ROA	Net income divided by total assets empirical measure = $\ln(\text{raw ROA})$	Annual reports

Model Specification

The direct and indirect effects of environmentally friendly processes and products on company value are examined in this study using panel data regression. Panel data regression is selected due to the inclusion of both time-series data from 2021–2024 and cross-sectional data from non-financial enterprises in the dataset.

In order to select the panel data model, the Chow, Hausman, and Lagrange Multiplier tests are used. When deciding between a Fixed Effect Model and a Common Effect Model, the Chow test is useful. When deciding between a Fixed Effect and a Random Effect model, the Hausman test is employed. One way to choose between the two models is to use the Lagrange Multiplier test. The regression models are specified as these equations (Eq. 1, Eq. 2, and Eq. 3).

$$ROA_{it} = \alpha + \beta_1 GP_{it} + \beta_2 GPR_{it} + \varepsilon_{it} \quad (\text{Eq. 1})$$

$$ROE_{it} = \alpha + \beta_1 GP_{it} + \beta_2 GPR_{it} + \varepsilon_{it} \quad (\text{Eq. 2})$$

$$TQ_{it} = \alpha + \beta_1 GP_{it} + \beta_2 GPR_{it} + \beta_3 ROA_{it} + \beta_4 ROE_{it} + \varepsilon_{it} \quad (\text{Eq. 3})$$

The modified firm-value measure is denoted by TQ, green process by GP, green product by GPR, return on assets by ROA, return on equity by ROE, company by *i*, year by *t*, constant by α , regression coefficient by β , and error term by ε . The altered measures discussed in the sections on variable measurement and data treatment are denoted by the symbols TQ, ROA, and ROE in the empirical equations.

The empirical model analyzes green process, green product, ROA, and ROE without adding any further control variables. Using this method, we may examine the main variables' direct and indirect interactions with one another. We acknowledge the restriction of the absence of control variables and suggest that future studies explore this avenue.

To determine if return on assets (ROA) and return on equity (ROE) play a mediating role between green process and green product and company value, the Sobel test is used. If the probability value is less than 0.05 or the Z-statistic is more than 1.96, then the mediation is significant.

4. Results

Descriptive Statistics

The study's variables and their descriptive statistics are shown in Table 4. The final balanced panel, after accounting for winning and revalidating financial data, includes 273 non-financial enterprises tracked from 2021–2024, for a total of 1,092 firm-year observations.

Table 3. Descriptive statistics

Variable	Obs	Mean	Median	Std.Dev	IQR	Min	Max
TQ	1.092	1.317	1.010	1.163	0.803	0.010	10.570
GP	1.092	1.527	1.750	0.423	0.500	0.250	2.000
GPR	1.092	0.866	0.750	0.481	0.750	0.250	2.000
ROA	1.092	0.479	0.028	13.940	1.813	-15.926	457.200
ROE	1.092	0.370	0.055	1.775	1.775	-75.584	458.240

The calculated values for TQ are 1.371 on average, 1.010 on the median, 1.163 on the standard deviation, and 0.803 on the interquartile range. Firm value varies significantly across the selected firms, as seen by these numbers. Several companies report far greater company value than the majority of observations, as shown by the right-skewed distribution and the fact that the mean value is higher than the median. The extreme number of 10.57, which is significantly higher than the median, also follows this trend.

The statistical distribution of green process is as follows: 1.527 for the mean, 1.750 for the median, 0.423 for the standard deviation, and 0.500 for the interquartile range. Even while there is still significant heterogeneity among businesses, these results show that green process ratings are largely consolidated across the sample. Since the median is greater than the mean, it indicates that a large percentage of organizations have relatively good ratings for implementing green processes. At the same time, the green product has a median value of 0.750, a standard deviation of 0.481, and an interquartile range of 0.750. The mean value is 0.866. A wider interquartile range for green product disclosure or implementation across enterprises is indicative of more dispersion than for green processes.

ROA ranges from an interquartile range of 1.813 to a standard deviation of 13.940, with a median of 0.028 and an average of 0.479. The same holds true for return on equity (ROE), which ranges from 1.775 in the interquartile range to 14.84488 in the standard deviation. The median return is 0.055. The significantly larger standard deviations as compared to the means and medians show that there is a lot of variation in the profitability of firms. Particularly for ROA and ROE, the large spread between the lowest and highest values indicates the existence of extreme profitability findings. Given the seemingly very scattered and right-skewed distributions of the profitability factors across the sample, it is imperative that their interpretation be approached with caution.

Panel Data Model Selection

Figure 5 shows the outcomes of the panel-data model selection process. While choosing between the Common Effect Model and the Fixed Effect Model, the Chow test was utilized. When choosing between the Fixed Effect Model and the Random Effect Model, the Hausman test was employed. When choosing between the Common Effect Model and the Random Effect Model, the Lagrange Multiplier test was utilized.

According to Structural Model 1A, the Fixed Effect Model is more supported by the Chow test than the Common Effect Model, although the Random Effect Model is supported by the Hausman and Lagrange Multiplier tests. So, the Random Effect Model is used to estimate Structural Model 1A. At the 5 percent significance level, the Random Effect Model is supported by the Hausman test probability of 0.056 for Structural Model 1B, and it is also favored by the Lagrange Multiplier test. The Fixed Effect Model is supported by both the Chow and Hausman tests for Structural Model 2. This means that for each structural equation, the chosen model is used in the regression analysis.

Table 4. Panel data model selection

Model	Dependent Variable	Chow Test	Hausman Test	Lagrange Multiplier Test	Selected Model
Structural 1a	ROA	0.000	0.464	0.000	Random Effect Model
Structural 1b	ROE	0.000	0.056	0.000	Random Effect Model
Structural 2	TQ	0.000	0.031	-	Fixed Effect Model

Regression Results

The findings of the panel-regression are displayed in Table 6. Green product and green process impact ROA, according to Structural Model 1A. They are assessed using Structural Model 1B in relation to ROE. Firm value is investigated in Structural Model 2 in relation to green process, green product, ROA, and ROE.

Table 5. Regression results

Variable	ROA	ROE	TQ
C	-3.276*** (-18.873)	-2.303*** (-10.781)	0.455*** (5.842)
GP	-0.000 (-0.005)	-0.217* (-1.672)	-0.130*** (-2.940)
GPR	-0.176 (-1.474)	-0.041 (-0.284)	-0.103* (-1.856)
ROA	-	-	0.026 (1.295)
ROE	-	-	0.012 (0.727)
R-squared	0.002	0.003	0.840
Adjusted R-squared	0.000	0.001	0.785
F-statistic	1.315	1.959	15.506

The t-statistics are shown in parenthesis. The ***, **, and * levels of significance correspond to the 1 percent, 5 percent, and 10 percent levels of significance, respectively. The revised empirical metrics outlined in the methodology section are TQ, ROA, and ROE.

According to Structural Model 1A, green process decreases ROA, although the effect is not statistically significant. With a probability of 0.995 and a t-statistic of -0.005, the coefficient is -0.000. With a coefficient so close to zero, it's clear that the converted asset-based profitability metric is unrelated to changes in the green process score.

The impact of green products on ROA is negative, although not statistically significant. The t-statistic is -1.474, the probability is 0.1406, and the coefficient is -0.176. Consequently, changes in the modified ROA metric during the observation period are not substantially explained by green product.

The adjusted R-squared value for Structural Model 1A is 0.000 and the R-squared value is 0.002. With a probability of 0.268, the F-statistic is 1.315. Based on these findings, it is clear that green process and green product do not have a statistically significant combined influence on ROA and only account for a negligible amount of the variance in ROA.

A t-statistic of -1.672, a probability value of 0.094, and a coefficient of -0.217 are all indicators of a green process in Structural Model 1B. Although the correlation is only slightly significant at the 10 percent level, it is not statistically significant at the 5 percent level. A negative correlation between green process and the converted ROE metric is thus very weakly supported by the data.

There is a negative and statistically negligible effect of green products on return on equity. Its probability is 0.776, t-statistic is -0.284, and coefficient is -0.041. As a result, the tested enterprises' equity-based financial performance was unaffected by green products.

The R-squared and adjusted R-squared values for Structural Model 1B are 0.003 and 0.001, respectively. With a probability of 0.141, the F-statistic is 1.959. Thus, at the 5 percent level of significance, green process and green product do not jointly affect ROE. ROA has a favorable impact on business value, although it is not statistically significant.

A negative and statistically significant influence of green process on company value is shown by Structural Model 2. A probability value of 0.003 and a t-statistic of -2.940 provide the coefficient -0.130. The results show that after accounting for other factors and company-specific fixed effects, a lower firm value is associated with better green process scores. Thus, the outcome proves the hypothesized beneficial impact of green processes on company value.

A t-statistic of -1.856 and a probability value of 0.063 are associated with the negative coefficient of -0.103 for the green product. Although the impact is marginally significant at the 10 percent level, it is not statistically significant at the 5 percent level. So, instead of a strong negative impact, the data points to a mild negative reaction from the market to green product initiatives.

Firm value is positively affected by ROA, although this impact is not statistically significant. The t-statistic is 1.295, the probability is 0.195, and the coefficient is 0.026. Firm value is not much explained by changes in the translated asset-based profitability metric, according to this finding.

Return on equity (ROE) has a favorable impact on business value, however it is not statistically significant. The t-statistic is 0.727 and the probability value is 0.466; the coefficient is 0.012. Therefore, during the observation period, the converted equity-based profitability metric had no meaningful impact on company value.

The R-squared and adjusted R-squared values for Structural Model 2 are 0.840 and 0.785, respectively. Incorporating firm fixed effects into this model allows us to see how well the independent variables and unobserved time-invariant corporate traits explain the data. All things considered, the Fixed Effect Model is statistically significant (F-statistic = 15.506; $p = 0.000$). Do not take this model-level test as proof that green processes and green products account for 78.6 percent of firm value on their own.

There is no statistically significant improvement in financial performance at the 5 percent level due to green process or green product. A strong negative correlation between green process and firm value exists, although a weak negative correlation between green product and firm value is only sustained at the 10 percent level. The value of a company is unaffected by ROA and ROE. Green innovation has not yet resulted in quantifiable financial gains that the market regularly rewards, according to these studies.

Mediating Test

The results of the Sobel test are displayed in Table 7. This study sets out to determine if return on assets (ROA) and return on equity (ROE) play a mediating role between green process and green product and company value.

Table 6. Mediation test results

Mediating Path	Test Statistic	p-value	Result
GP → ROA → TQ	-0.005	0.995	Not mediated
GPR → ROA → TQ	-0.973	0.330	Not mediated
GP → ROE → TQ	-0.667	0.504	Not mediated
GPR → ROE → TQ	-0.264	0.791	Not mediated

Every possible mediation route has a probability greater than 0.05, according to the Sobel test. Green process and green product have an impact on firm value, while ROA and ROE do not mediate this effect. This data suggests that between 2021 and 2024, green innovation (as measured by green processes and products) will not have any indirect effect on company value via financial performance.

5. Discussion

Taken together, the study's findings show that green processes and green products might affect a company's value. This indicates that the research model places a premium on financial success and green innovation as explanations of corporate value. The model fits the data well, as indicated by the corrected R-squared value. Unfortunately, not all factors have the predicted impact on company value.

There is a strong negative correlation between green process and corporate value. The original theory predicted a positive effect, therefore this is counterintuitive. When a business implements green practices, it should demonstrate to investors that it cares about the environment, is committed to sustainability, and prioritizes efficiency (Bae et al., 2018; Connelly et al., 2011). Green process may not immediately be perceived as a signal that increases value by the market, according to this study.

Because environmentally friendly process improvements frequently require substantial initial expenditures, the green process may have unintended consequences. Spending could go toward operational modifications, staff training, energy efficiency, new technology, or waste management. Prior to the appearance of any economic advantages, these expenditures might reduce short-term earnings. Investors may be wary of green process initiatives due to the potential for slow financial returns. This is in line with the findings of Xie et al. (2022), who discovered that when the costs of green innovation outweigh the benefits, it might reduce company value in the near run.

At the 10 percent level, there is a slightly negative correlation between green goods and company value. During the observation period, this finding indicates that developing environmentally friendly products does not always lead to a rise in market value. In theory, green products can strengthen firm value because they show a company's ability to meet sustainability demands and adapt to changing consumer preferences (Fathoni et al., 2025; Hidayah & Sibarani, 2023). However, this study suggests that green products may be seen as a cost burden if they do not lead to higher sales, better profitability, or broader market acceptance.

The negative effect of green products may be linked to research and development costs, using environmentally friendly materials, certification fees, product testing, and marketing expenses. In some industries, these products may also cost more, which can limit consumer acceptance. If green product innovation has not yet increased revenue or profits, investors may not see it as a strong sign of future firm value. This helps explain why green products have a significant but negative effect on firm value in this study.

From an accounting perspective, these findings indicate that green innovation disclosures should provide economically relevant information to be useful for investors. Green process and green

product disclosures should not only describe environmental activities but also explain how these initiatives relate to cost efficiency, resource utilization, profitability, and firm valuation. The negative effect of green process and green product on firm value suggests that investors may not fully value environmental disclosures when their economic consequences remain unclear. Therefore, sustainability reporting and ESG disclosure should be strengthened by including more measurable information, such as environmental cost savings, efficiency improvements, product-related environmental investment, and financial outcomes. This finding also has implications for strategic investment evaluation, as environmental initiatives should be assessed not only as sustainability programs but also as investments expected to generate measurable economic benefits. To strengthen the significance of green innovation for business value, the findings emphasize the necessity of combining accounting-based performance information with environmental disclosure.

There is no statistically significant relationship between green processes and ROA, according to the data. Even if the coefficient is almost zero and negative, the effect is not significant from a statistical standpoint. This means the company's capacity to turn its overall assets into profit has not been enhanced by environmentally oriented process innovation just yet.

Also, environmentally friendly items don't change ROA much. This indicates that innovation in environmentally friendly products has not yet increased asset-based profitability. It takes time and money to invest in new product development before you see a return on your investment. It could take some time for businesses to create, release, and get customers to embrace environmentally friendly items. As a result, eco-friendly items may not increase ROA in a direct way from 2021 to 2024. While previous research has shown a positive correlation between innovative green products and financial success, our results provide credence to the theory that price points, industry dynamics, and consumer reaction will determine whether or not green innovations provide a favorable financial return ([Asni & Agustia, 2022](#); [Xie et al., 2022](#)).

Returned on equity is unaffected by environmentally friendly processes and products. This proves that environmentally conscious innovations have not yet enabled businesses to boost their return on equity for shareholders. The return on equity (ROE) reveals the profitability of an investment for investors. Green process and green product may not be immediate drivers of equity-based profitability just yet, according to the lack of statistically meaningful outcomes. Meeting rules, reporting, and concentrating on long-term sustainability may still be more important to green innovation than giving shareholders instant gains.

Return on Assets (ROA) has little bearing on the value of a company. This disproves the hypothesis that asset-based profitability is the primary determinant of market value. Although return on assets (ROA) is one metric that investors use to evaluate a company's worth, other factors such as growth prospects, business risks, market trends, capital structure, and industry circumstances are also taken into consideration. This shows that efficient asset use does not necessarily result in increased company value if the market does not see it as an indication of robust future performance.

Return on equity (ROE) has a favorable impact on business value, however it is not statistically significant. During the observation period, this conclusion suggests that business value is not significantly explained by equity-based profitability. A number of factors, including growth prospects, risk capital structure, industry conditions, and the credibility of sustainability-related information, may be considered by investors when evaluating a firm's value, although return on equity (ROE) is often seen as a financial signal of shareholder return.

The mediation test proves ROA as an explanation for the relationship between green process and company value. This is due to the fact that neither green process nor ROA significantly affects company

value. A direct causal relationship between the mediator, the dependent variable, and the independent variable is required for mediation analysis. The relationship between green process and company value cannot be explained by ROA since these ties are insignificant.

There is no relationship between green product value and ROA. This suggests that the asset-based profitability of a company is unaffected by environmentally friendly products. There may be a lag time between green product invention and changes in sales, profitability, and market value. During the time frame considered, its advantages were insufficient to boost ROA or enhance company value. As a result, return on assets (ROA) is not a viable monetary metric for assessing the effect of green products on company value.

According to the results of the mediation test, return on equity (ROE) is not a mediator between green process and business value. Reason being, neither green process nor ROE has a discernible effect on business worth. In light of this, the necessary mediation pathway is not viable.

ROE is not a moderator between green products and company value. Therefore, the value of a company is unaffected by environmentally friendly products in terms of equity-based profitability. Despite the fact that green products demonstrate creativity and concern for the environment, the study found that these attributes did not result in a greater return on equity (ROE). The indirect relationship between green product and company value cannot be explained by ROE.

This study adds to signaling theory by showing that environmental signals do not always lead to positive market reactions. Investors value signals that are credible, measurable, and backed by financial results. In this study, green process and green product were not linked to better ROA or ROE. So, investors may not see green innovation as a strong sign of firm value.

In practice, the findings suggest that companies should not only disclose green innovation but also demonstrate its economic impact. Firms need to show how green process initiatives reduce costs, improve efficiency, and strengthen operational performance. Green product innovation should also be supported by market demand, appropriate pricing, and effective commercialization. For investors, green innovation should be evaluated together with financial performance, implementation costs, and the firm's ability to convert sustainability initiatives into economic value

6. Conclusion

In this study, we look at non-financial enterprises in Indonesia to see how green innovation relates to their financial performance and company value. Return on assets (ROA) and return on equity (ROE) are two measures of financial success, and the results demonstrate that neither green process nor green product really improves these metrics. There is a negative correlation between green process and company value that is statistically significant at the 10 percent level, but no such correlation between green product and firm value. According to these results, green innovation did not produce consistently claimed monetary gains during the observation period. Consequently, environmental activities alone might not be enough to boost business value if they don't come with measurable economic benefits. From an accounting standpoint, this discovery highlights the significance of combining financial performance data with environmental disclosures. When businesses can show that their green innovations save costs, increase profits, and create tangible economic value, investors are more inclined to support them.

It is important to note that there are certain restrictions. To start with, there is a possibility of omitted variable bias due to the fact that the empirical model does not include control factors such as company size, leverage, growth possibilities, and industry characteristics. Reverse causality or unknown firm-specific effects are two more possible sources of endogeneity. Thirdly, disclosure-based grading is

used to grade green processes and green products, but it might not be a good indicator of how well it was really implemented. Lastly, the results may not be consistent due to industry heterogeneity across non-financial enterprises.

To improve the robustness of the model and reduce bias, future studies should include appropriate control variables. Furthermore, it is advised to utilize sophisticated econometric approaches, such as GMM or dynamic panel models, to compensate for endogeneity. Carbon emissions, environmental expenses, and ESG performance indicators are detailed environmental accounting data that might be used in future research to expand the scope and improve the economic impact of green innovation.

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