



The Effect of Green Finance and Digital Transformation on Financial Performance with the Sustainability Disclosure Index as a Mediating in KBMI 3 and 4 Banks

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ABSTRACT

This research aims to analyze the effect of green finance and digital transformation on the financial performance of KBMI 3 and KBMI 4 banks during the 2019–2025 period, with the Sustainability Disclosure Index (SDI) as a mediating variable. The population of this study consists of all KBMI 3 and KBMI 4 banks, totaling 18 banks. After purposive sampling was conducted, the research sample obtained amounted to 13 banks. The research was analyzed using panel data regression. The results show that green finance has a significant positive effect on financial performance. Digital transformation has a significant negative effect on financial performance. SDI has a significant positive effect on financial performance. Green finance has a significant positive effect on SDI. Digital transformation has a significant positive effect on SDI. The mediation test shows that SDI does not mediate the effect of green finance on financial performance. SDI mediates the effect of digital transformation on financial performance.

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1. INTRODUCTION

The ROA of KBMI 3 and 4 banks in Indonesia shows a dynamic pattern over the 2019 to 2025 period, moving from a stable condition, a sharp decline caused by the COVID-19 pandemic, a recovery following the issuance of POJK No. 11/POJK.03/2020, to a profitability paradox in 2024–2025 when ROA declined despite rising commitments to green finance and digital transformation (**Figure 1**). Prior studies show inconsistent results regarding the effect of these two variables on ROA, with some finding a positive effect through operational efficiency and reputation, and others finding a negative effect due to high investment costs. This inconsistency suggests that the Sustainability Disclosure Index may act as a mediator, in line with Signaling Theory, by converting green and digital commitments into a credible signal to the market before translating into real profitability. Based on this gap, this study analyzes the effect of green finance and digital transformation on the financial performance of KBMI 3 and 4 banks, with the Sustainability Disclosure Index as a mediating variable.

Green finance, as an environmentally friendly banking practice covering both the credit and operational dimensions, shows inconsistent empirical results with respect to ROA. [Ulfa et al. \(2025\)](#), [Siswanti et al. \(2026\)](#), and [Ariefianto et al. \(2025\)](#) demonstrate a positive effect through strengthened reputation, customer loyalty, and regulatory compliance, whereas [Riyanti et al. \(2025\)](#) and [Siswanti et al. \(2024a\)](#) find a negative effect due to the high cost of green technology investment and operational burden.

A similar pattern is found for digital transformation, which has changed the role of banks into providers of technology-based financial services. [Siswanti et al. \(2024a, 2024b\)](#) demonstrate a positive effect on profitability through operational efficiency and the optimization of mobile services, whereas [Hasan et al. \(2025\)](#) and [Zhang \(2026\)](#) identify a productivity paradox, in which large technology investments not matched by adequate customer digital literacy actually suppress ROA.

The inconsistency found in both variables directs this study toward the Sustainability Disclosure Index as a possible mediator. Based on Signaling Theory, this index consolidates a bank's green commitment and digital capability into a credible signal to the market before it translates into real financial gains ([Cardillo & Basso, 2025](#)). However, findings on its role are similarly mixed, with [Cardillo and Basso \(2025\)](#) and [Zulkarnaini et al. \(2025\)](#) finding a positive effect on ROA, while [Nguyen \(2026\)](#) and [Gutiérrez-Ponce and Wibowo \(2023\)](#) find a negative effect due to high administrative costs.

Given the limited number of studies that simultaneously integrate green finance, digital transformation, and the Sustainability Disclosure Index as a mediator among systemically important KBMI 3 and 4 banks over the 2019–2025 period, this study tests the following seven hypotheses. **H1:** Green finance has a positive effect on financial performance. **H2:** Digital transformation has a positive effect on financial performance. **H3:** The Sustainability Disclosure Index has a positive effect on financial performance. **H4:** Green finance has a positive effect on the Sustainability Disclosure Index. **H5:** Digital transformation has a positive effect on the Sustainability Disclosure Index. **H6:** The Sustainability Disclosure Index mediates the effect of green finance on financial performance. **H7:** The Sustainability Disclosure Index mediates the effect of digital transformation on financial performance.



Figure 1. Return on Assets (ROA) Trends for KBMI 3 and KBMI 4 Banks, 2019–2025

2. METHODS

This section describes the methodological procedures used to test the seven hypotheses developed in the previous section. It begins with the overall research design, followed by the population and sampling procedure, the operationalization of the four research variables, and the panel data analysis technique, including the model selection tests and the mediation test used to examine the role of the Sustainability Disclosure Index.

2.1. Research Design

This study employs a quantitative approach with an associative-causal design, aiming to empirically test the effect of Green Finance and Digital Transformation on Financial Performance (proxied by ROA), with the Sustainability Disclosure Index positioned as a mediating variable. The data used are panel data combining cross-sectional and time-series dimensions, sourced from the official websites of the sample banks and the Financial Services Authority (OJK).

2.2 Population and Sample

The population of this study consists of all conventional commercial banks classified as KBMI 3 and KBMI 4 in Indonesia, totaling 18 banks as of 2025. Sampling was conducted through purposive sampling based on three tiered criteria: consistent classification as KBMI 3 or KBMI 4 throughout 2019–2025; publication of complete annual reports and sustainability reports for the 2019–2025 period; and availability of complete ESG data for the 2019–2025 period. This process narrowed the population from 18 banks to a final sample of 13 banks, yielding 91 bank-year observations (13 banks × 7 years).

2.3 Variable Measurement

This study involves four variables: one dependent variable (Financial Performance), two independent variables (Green Finance and Digital Transformation), and one mediating variable (Sustainability Disclosure Index), as summarized in **Table 1**.

Table 1. Operationalization of Research Variables

Variable	Measurement	Source
Financial Performance (ROA)	Profit After Tax / Average Total Assets × 100%	Annual Report
Green Finance (GF)	Total Green Financing / Total Loan Disbursement × 100%	Sustainability Report

Variable	Measurement	Source
Digital Transformation (DTI)	Available Digital Indicators / Total 21 Indicators × 100%	Annual Report
Sustainability Disclosure Index (SDI)	Disclosed GRI Items / Total 85 GRI Items × 100%	Sustainability Report

2.4. Data Analysis Technique

Data were analyzed using panel data regression with two models: Model 1 tests the effect of Green Finance (GF), the Digital Transformation Index (DTI), and the Sustainability Disclosure Index (SDI) on ROA, while Model 2 tests the effect of GF and DTI on SDI. The estimated models take the following general form: $ROA_{it} = \alpha_1 + \beta_1 GF_{it} + \beta_2 DTI_{it} + \beta_3 SDI_{it} + \varepsilon$ (Model 1), and $SDI_{it} = \alpha_2 + \beta_4 GF_{it} + \beta_5 DTI_{it} + \varepsilon$ (Model 2). The selection of the best estimation model among the Common Effect Model, Fixed Effect Model, and Random Effect Model was carried out through the Chow test, the Hausman test, and the Lagrange Multiplier test. Hypothesis testing was conducted using the t-test for partial effects and the F-test for simultaneous effects at a 5% significance level, while the mediating role of SDI was tested using the Sobel Test, with a Z-value greater than 1.96 indicating a statistically significant mediating effect.

2.5. RESULTS AND DISCUSSION

3.1. Descriptive Statistics

Table 2 presents the descriptive statistics of the four research variables based on 91 bank-year observations.

Table 2. Descriptive Statistics of Research Variables (Source: EViews 13 processed data, 2026)

Statistic	GF	DTI	SDI	ROA
Mean	0.2458	0.8972	0.6208	0.0212
Median	0.2310	0.9524	0.6471	0.0186
Maximum	0.6748	1.0000	0.9294	0.0486
Minimum	0.0000	0.4086	0.2000	0.0013
Std. Dev.	0.1540	0.1332	0.1746	0.0111

The mean GF of 24.58% is higher than the findings of [Ulfa et al. \(2025\)](#) and [Chen \(2025\)](#), which range from 15% to 20% in developing countries. The mean DTI of 89.72% indicates a nearly saturated level of digital adoption across the sample. The mean SDI of 62.08% shows that, on average, the sample banks disclosed more than half of the 85 GRI items. The mean ROA of 2.12% places the majority of observations (64.8%) in the “Very Healthy” category according to Bank Indonesia Circular Letter No. 13/24/DPNP of 2013.

3.2 Panel Data Regression Model Selection

The Random Effect Model (REM), selected as the best estimator based on the Chow, Hausman, and Lagrange Multiplier tests, was statistically fit for both equations, explaining 15.71% of the variation in ROA (Adjusted $R^2 = 0.1571$; $F = 6.594$; $p = 0.0004$) and 37.56% of the variation in SDI (Adjusted $R^2 = 0.3756$; $F = 28.076$; $p = 0.0000$).

3.3 Hypothesis Testing

Table 3 summarizes the Random Effect Model estimation results for the direct effects in both equations.

Table 3. Summary of Direct Effect Test Results, Random Effect Model
(Source: processed data, 2026)

Independent Variable	Coef.	Std. Error	t-Statistic	Prob.	Result
Model 1: Dependent Variable = Financial Performance (ROA)					
Green Finance	0.0133	0.0061	2.175	0.0323	H1 Accepted
Digital Transformation	-0.0124	0.0054	-2.278	0.0252	H2 Rejected
Sustainability Disclosure Index	0.0161	0.0046	3.483	0.0008	H3 Accepted
$R^2 = 0.1852$; $Adjusted\ R^2 = 0.1571$; $F\text{-statistic} = 6.594$; $Prob(F\text{-statistic}) = 0.0004$					
Model 2: Dependent Variable = Sustainability Disclosure Index (SDI)					
Green Finance	0.2558	0.1253	2.041	0.0443	H4 Accepted
Digital Transformation	0.6946	0.1034	6.717	0.0000	H5 Accepted
$R^2 = 0.3895$; $Adjusted\ R^2 = 0.3756$; $F\text{-statistic} = 28.076$; $Prob(F\text{-statistic}) = 0.0000$					

The results of the Sobel Test for the two indirect paths are presented in Table 4.

Table 4. Summary of Sobel Test (Mediation) Results
(Source: processed data, 2026)

Path	a (IV→M)	b (M→DV)	Direct Effect (c')	Indirect Effect (a×b)	Z-value	Result
Green Finance → SDI → Financial Performance	0.2558	0.0161	0.0133	0.0041	1.763	H6 Rejected
Digital Transformation → SDI → Financial Performance	0.6946	0.0161	-0.0124	0.0112	3.104	H7 Accepted

Note: a denotes the path coefficient from the independent variable to the mediator (SDI); b denotes the path coefficient from the mediator to financial performance (ROA); c' denotes the direct effect of the independent variable on ROA, controlling for SDI; the indirect effect is the product of a and b. A Z-value greater than 1.96 ($\alpha = 0.05$) indicates a statistically significant mediating effect.

3.4 Discussion

Green finance has a significant positive effect on bank financial performance. Stricter screening of green credit results in debtors with lower non-performing loan risk, while green commitment strengthens bank reputation and legitimacy (Stakeholder Theory and Legitimacy Theory), expands the low-cost funding base, and drives an increase in Net Interest Margin. This finding is consistent with [Siswanti et al. \(2026\)](#), [Ulfa et al. \(2025\)](#), and [Chen \(2025\)](#).

Digital transformation has a negative effect on financial performance, contrary to the initial hypothesis. The high and even level of digital adoption triggers saturation, in which digital features lose their element of rarity under the Resource-Based View framework, resulting only in competitive parity rather than competitive advantage. The burden of technology investment expenses on current-period profit also forms a J-curve effect pattern. This finding is in line with [Nguyen-Thi-Huong et al. \(2023\)](#) and [Zhang \(2026\)](#).

The Sustainability Disclosure Index has a positive effect on financial performance. In accordance with Signaling Theory, credible sustainability reporting reduces information asymmetry and risk premiums, thereby lowering the cost of capital, while in accordance with Legitimacy Theory it also strengthens the bank's social legitimacy. This finding is supported by [Cardillo and Basso \(2025\)](#) and [Ariefianto et al. \(2025\)](#).

Green finance has a significant positive effect on the Sustainability Disclosure Index. Sustainability reports serve as a channel through which external parties can verify the realization of green finance, while also functioning as a credible signal (Signaling Theory) and evidence of social compliance (Legitimacy Theory) in accordance with POJK No. 51/POJK.03/2017. This finding is consistent with [Sebastião et al. \(2024\)](#), [Yuan \(2025\)](#), and [Ulfa et al. \(2025\)](#).

Digital transformation has a positive effect on the Sustainability Disclosure Index. The maturity of digital infrastructure, through technologies such as AI, big data analytics, and cloud computing, supports the accurate and efficient collection and presentation of ESG data, strengthening the positive signal to investors (Signaling Theory) and the bank's legitimacy (Legitimacy Theory). This finding is supported by [Morea et al. \(2025\)](#) and [Mavlutova et al. \(2023\)](#).

The Sustainability Disclosure Index is found not to mediate the effect of green finance on financial performance, even though both direct paths are individually significant. The contribution of green finance is considered too small within holistic ESG reporting, while the decoupling phenomenon suggests that reporting is largely symbolic, aimed at meeting regulatory requirements rather than serving as a strategy to drive profitability. This finding is in line with [Cardillo and Basso \(2025\)](#) and [Cao et al. \(2024\)](#).

The Sustainability Disclosure Index is found to mediate the effect of digital transformation on financial performance, turning its negative direct effect into a positive one through the disclosure pathway. Digital capability that is leveraged to strengthen the quality of ESG reporting lowers the cost of capital through increased investor confidence, confirming SDI's role as a critical compensating mechanism. This finding is consistent with [Cardillo and Basso \(2025\)](#), [Siswanti et al. \(2024a\)](#), [Meraj et al. \(2026\)](#), and [Garg and Kumar \(2024\)](#).

4. CONCLUSION

This study demonstrates that green finance has a significant positive effect on financial performance (H1 accepted). Digital transformation has a significant negative effect on financial performance (H2 rejected), reflecting a saturation of digital capability that has become an industry-wide standard rather than a source of competitive advantage. The Sustainability Disclosure Index (SDI) has a significant positive effect on financial performance (H3 accepted). Green finance has a significant positive effect on SDI (H4 accepted), and digital transformation also has a significant positive effect on SDI (H5 accepted). SDI does not mediate the effect of green finance on financial performance (H6 rejected), but fully mediates the effect of digital transformation on financial performance (H7 accepted), reversing its negative direct effect into a positive indirect effect through the disclosure pathway.

Theoretically, this study extends Stakeholder Theory, Signaling Theory, and Legitimacy Theory by demonstrating that the value of disclosure as a credible signal to stakeholders is not uniform across antecedents: it is decisive for converting digital investment into profitability, but insufficient on its own to convert green financing into profitability. This finding confirms that meeting stakeholder expectations through the Sustainability Disclosure

Index does not function as an equally effective bridge across every relational pathway. Practically, bank management is encouraged to strengthen SDI reporting quality as a compensating channel for digital transformation costs, while regulators may consider incentive schemes that narrow the gap between green finance realization and its disclosure.

This study is subject to several limitations. The purposive sampling technique may introduce selection bias toward banks with stronger reporting capacity; control variables such as CAR, NPL, BOPO, bank size, and macroeconomic conditions were not included; the binary SDI measurement captures disclosure breadth but not depth or quality; and the cross-sectional sample of 91 observations may limit statistical power. Future research is encouraged to incorporate control variables, weighted digital transformation and SDI indices, and address potential reverse causality between financial performance and both green finance and digital transformation.

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6. AUTHORS' NOTE

The authors declare that there is no conflict of interest related to the publication of this article. The authors confirm that this article is free from plagiarism and is an original summary of the authors' own thesis research.

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