

The Effect of Sustainable Financial Policy Implementation on Banking Performance in Indonesia

Adilah Permananingrum^{1*}, Riskon Ginting¹, Ahmad Sutanto², Arif Santoso¹, Husnil Barry¹

¹Program Studi Administrasi Bisnis Terapan, Jurusan Administrasi Niaga, Politeknik Negeri Jakarta, Jl. Prof. DR. G.A. Siwabessy, Depok, Indonesia

²Program Studi Manajemen, Fakultas Ekonomi dan Bisnis, Universitas Nasional, Jl. Sawo Manila No. 61, Jakarta, Indonesia

*Corresponding Author(s) Email: adilah.permananingrum@lecturer.pnj.ac.id

Abstract

The implementation of sustainable finance has become an important policy instrument in encouraging the transformation of the financial sector toward sustainable economic development. In Indonesia, Peraturan OJK No.51/POJK.03/2017 was introduced to strengthen the integration of environmental, social, and governance principles within the financial services industry, particularly the banking sector. However, empirical evidence regarding the impact of this policy on banking performance in emerging economies remains limited. This study aims to examine the effect of sustainable finance policy implementation on banking performance in Indonesia and to identify the mechanisms through which the policy affects bank performance. This study employs a quantitative approach using the Difference-in-Differences method on a sample of BUKU 3 and BUKU 4 banks in Indonesia during the 2015–2024 period. Banking performance is measured using Net Interest Margin. In addition, this study investigates the mediating role of the green credit ratio and operational efficiency, proxied by the Operating Expense Ratio. The findings indicate that the implementation of sustainable finance policy has a positive and significant effect on banking performance. The results further show that the green credit ratio significantly mediates the relationship between policy implementation and bank performance. However, operational efficiency, as measured by OER, does not show a significant transmission mechanism. The study concludes that the implementation of sustainable finance policy positively contributes to banking intermediation performance, particularly through the expansion of green financing. These findings suggest that sustainable finance is not only a regulatory obligation but also a strategic opportunity to improve banking performance in Indonesia.

Keywords: Banking Performance; Green Credit Ratio; POJK; Sustainable Finance

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INTRODUCTION

The banking sector plays a strategic role in a country's economy because it is an intermediary institution that connects those with excess funds to those who need financing, enabling efficient resource allocation. The banking function is one of the main pillars supporting economic growth and the stability of the national financial system. The development of the modern financial system shows that the banking sector is not only required to maintain an increasingly complex global economy (Geissdoerfer et al., 2017; Wang & Wang, 2021). Therefore, banking can no longer be seen as a conventional intermediary institution but as one that must adapt to the demands of economic sustainability.

Paradigm shifts in the global financial system are driving banks to integrate environmental, social, and governance considerations in response to increasing pressure from regulators, investors, and the public. Financial institutions are now beginning to internalize the principle of sustainability in their business strategies to remain relevant and competitive amid shifting market preferences that increasingly prioritize sustainability (Saif-Alyousfi & Alshammari, 2025). This transformation also reflects a shift in orientation from short-term finance towards more sustainable long-term value creation. Thus, sustainability has become an integral part of the modern banking business strategy.

Climate change is one of the main factors driving such transformation, as rising global temperatures and the frequency of natural disasters have put pressure on economic activity and the stability of the financial system. The risks of transitioning to a low-carbon economy also affect production and investment structures, which ultimately impact the bank's financing portfolio (Zhang et al., 2021). The financial sector faces the challenge of adjusting its business strategies to remain viable amid increasing uncertainty. This condition underscores that adapting to environmental risks is a strategic imperative for the banking sector.

The banking sector plays a key role in supporting the transition to a sustainable economy by distributing financing across various economic sectors. The Bank can direct the flow of funds to sectors that support green development, such as renewable energy and sustainable infrastructure, thereby contributing to the achievement of long-term goals. The global sustainable finance market has grown significantly in recent years, creating new business opportunities for the banking sector (Lai et al., 2024). Therefore, the active involvement of banks in sustainable financing is not only a normative obligation but also a strategic opportunity to improve the bank's financial performance.

Changes in the preferences of investors and stakeholders have also accelerated the integration of sustainability principles in the banking sector. Institutional investors are increasingly considering ESG factors in investment decision-making, so companies committed to sustainability tend to gain greater market trust (Park & Kim, 2020). More transparent disclosure of sustainability information can also reduce costs and increase access to sources of financing (Khanchel & Lassoued, 2022). This condition shows that sustainability can provide banks with competitive advantages through improved reputation and funding efficiency.

Indonesia demonstrated a strong commitment to sustainable development through various national policies that support emission reduction efforts and accelerate the transition to a green economy. The government has set targets to reduce emissions and achieve net-zero by 2060 under the Nationally Determined Contribution (NDC), as part of a global commitment to address climate change. The financial sector is increasingly important in supporting the achievement of these targets by providing financing aligned with sustainability principles. Thus, strengthening governance in the financial services sector is a strategic step to encourage changes in financial institutions' behavior. In addition, the Financial Services Authority (OJK) has issued OJK Regulation No. 51/POJK.03/2017 (POJK 51/2017) as the foundation for the implementation of sustainable finance in Indonesia. POJK 51/2017 requires financial services institutions to integrate sustainability principles into their operations and to prepare sustainable finance action plans and periodic sustainability reports (OJK, 2017). Policy implementation is carried out in stages according to bank category, creating variations in each institution's readiness and response. Thus, this policy serves not only as a regulatory instrument but also as a driver of structural transformation in the banking industry. The implementation of sustainable financial policies encourages changes in banking business strategies, especially in the distribution of financing. Banks are beginning to increase credit allocation to sectors that support sustainability in preparation for regulations and market opportunities. Data released by the OJK show that green financing in Indonesia has increased, even though its contribution to total credit has remained limited in recent years. This indicates that the transition to sustainable finance is still underway and not yet fully optimal.

Sustainable financial policies can affect banking performance through various interrelated economic mechanisms. The development of sustainable financing enables banks to diversify their credit portfolios into sectors with long-term growth potential (Pham et al., 2021). The disclosure of sustainability information gives a positive signal to the market that can increase investor confidence (Spence, 1973). The increase in transparency can also reduce costs and reduce banks' interest margins (Khanchel & Lassoued, 2022). Thus, sustainable financial policy has the potential to improve intermediation performance through a combination of income and efficiency effects.

However, implementing sustainable financial policies also faces various challenges that can affect banking performance in the short term. Banks need to adjust their operational systems and increase manpower capacity to meet established sustainability standards. This process has the potential to increase operational costs and reduce financial performance in the early stages of implementation (Celestin & Sujatha, 2024). In addition, the complexity of sustainability finance projects can increase the need for more intensive analysis and monitoring. Therefore, the impact of policies on banking performance is not always direct and can vary.

Empirical research on the impact of implementing sustainable financial policies on banking performance continues to yield diverse findings and has not produced consistent conclusions. Most of the research was conducted in developed countries or large economies, so the results may not generalize to Indonesia, which has a different banking system. Research in Indonesia is also limited and has not specifically examined the relationship between policy implementation and banking intermediation performance. This condition indicates a research gap that warrants further study. This study aims to analyze the impact of implementing sustainable financial policies on banking performance in Indonesia.

LITERATURE REVIEW

Theoretical Framework: Sustainable Finance and Bank Performance

The sustainable finance literature frames the integration of environmental, social, and governance aspects as part of the transformation of the modern financial system, which aims to balance economic growth and long-term sustainability. Sustainable finance theory explains that capital allocation that considers ESG factors can improve investment quality and reduce exposure to systemic long-term risks (Geissdoerfer et al., 2017; Wang & Wang, 2021). In the context of banking, this approach is closely related to the intermediation function because credit decisions determine the direction of financing in the economy and affect the structure of the real sector (Lai et al., 2024).

In addition, Signaling Theory posits that the disclosure of sustainability information can serve as a positive signal to the market about the company's quality and prospects, thereby increasing investor confidence and lowering funding costs (Chen et al., 2023; Spence, 1973). A decrease in the cost of these funds could increase the interest margin banks earn. Thus, the combination of higher-quality credit allocation and reduced cost of funds forms a theoretical mechanism linking sustainable finance to the performance of banking intermediation.

Based on this theoretical framework, this study positions sustainable financial policy as an external factor that drives changes in banks' behavior in credit disbursement and fund management, ultimately affecting intermediation performance, as measured by Net Interest Margin (NIM). This framework emphasizes that policy influence occurs not through a single path but through a combination of income, reputation, and efficiency effects.

Empirical Evidence on Sustainable Finance and Bank Performance

The empirical literature shows that the relationship between sustainable finance and banking performance is still inconsistent. Some studies have found that integrating ESG and green finance can improve financial performance through credit portfolio diversification and enhanced reputation, thereby impacting investor confidence (Pham et al., 2021). Other studies show that better ESG disclosure correlates with reduced cost of capital and improved financial efficiency (Chen et al., 2023).

However, some studies have also found that early implementation of sustainable finance can increase operational costs and suppress short-term profitability due to the need for investment in systems and human resources (Celestin & Sujatha, 2024). These differences in results show that the impact of sustainable finance on bank performance is non-linear and highly dependent on the institutional context and stage of policy implementation.

Most previous studies have used aggregate profitability indicators such as ROA and ROE, and have not specifically captured changes in the bank's intermediation function. In addition, the literature examining the impact of regulation-based policies on banking performance in developing countries is still limited. Therefore, a more specific approach is needed to understand how sustainable financial policy affects banks' performance through intermediation mechanisms.

Sustainable Finance Policy and Banking Performance

The implementation of sustainable financial policies is an important instrument for encouraging changes in financial institutions' behavior to align with sustainable development goals. In the Indonesian context, the Financial Services Authority issues OJK Regulation No. 51/POJK.03/2017, which requires financial services institutions to integrate sustainability principles into their operations and reporting. This policy encourages banks to adjust their business strategies through increasing sustainable financing and strengthening transparency to stakeholders (OJK, 2017). The empirical literature suggests that sustainability-based policies can affect banking performance through changes in credit portfolio structures and funding costs (Pham et al., 2021).

From the perspective of intermediation performance, Net Interest Margin reflects the bank's ability to generate net interest income from productive assets, making it a sensitive indicator of changes in financing

composition and fund cost structure. Research shows that improving asset quality and operational efficiency can increase interest margins by better managing credit risk and reducing funding costs (Chen et al., 2023; Tan, 2014). Sustainable financial integration has the potential to strengthen both aspects by improving the quality of financing and the reputation of financial institutions. Therefore, the implementation of sustainable financial policies is expected to positively impact the performance of banking intermediation.

H₁: The implementation of sustainable financial policies has a positive effect on bank performance as measured using Net Interest Margin (NIM).

The Transmission Mechanism of Green Credit Ratio

The green credit ratio (GCR) represents the proportion of financing disbursed to sectors that support environmental sustainability and is an important indicator of sustainable finance implementation in the banking sector. The literature shows that increased green financing can improve credit portfolio diversification and reduce exposure to sectors with high environmental risks (Pham et al., 2021). In addition, green financing can enhance the bank's reputation among investors and customers, thereby strengthening its competitive position in the market (Park & Kim, 2020).

From a financial performance perspective, an increase in the green credit ratio can improve Net Interest Margin by enhancing asset quality and the stability of interest income over the long run. Financing directed at the sustainable sector tends to have more stable growth prospects, thereby improving intermediation efficiency and reducing costs associated with credit risk. Thus, green credit is not only an indicator of policy implementation but also a transmission mechanism linking policy to banking performance. Therefore, the green credit ratio is estimated to mediate the relationship between the implementation of sustainable finance policies and banks' performance.

H₂: The green credit ratio mediates the effect of sustainable financial policy implementation on bank performance, as measured by Net Interest Margin (NIM).

The Transmission Mechanism of Operational Efficiency Ratio (OER)

The implementation of sustainable financial policies also affects the bank's operating cost structure, as banks need to adjust internal systems, human resource development, capacity building, and risk management. The literature shows that operational efficiency is significantly related to banking performance, as lower operating costs enable banks to maintain higher interest margins (Tan, 2014). The integration of sustainability principles can improve efficiency in the long term through improved credit screening and monitoring processes and reduce the risk of non-performing loans (Chen et al., 2023).

However, the initial implementation of sustainable finance policies is often followed by increased operational costs due to the need to invest in more complex technologies and systems. Some studies show that the cost of such implementation can depress short-term financial performance before the efficiency benefits are realized (Celestin & Sujatha, 2024). This condition suggests that operational costs play an important role in explaining the relationship between policy and banking performance. Therefore, operating costs are estimated to mediate the effect of implementing sustainable financial policies on the bank's performance.

H₃: Operating costs mediate the effect of sustainable financial policy implementation on bank performance as measured using Net Interest Margin (NIM).

Conceptual Framework

The diagram in Figure 1 illustrates the conceptual framework, outlining the sequential steps undertaken in this research, from the literature review to managerial implications.

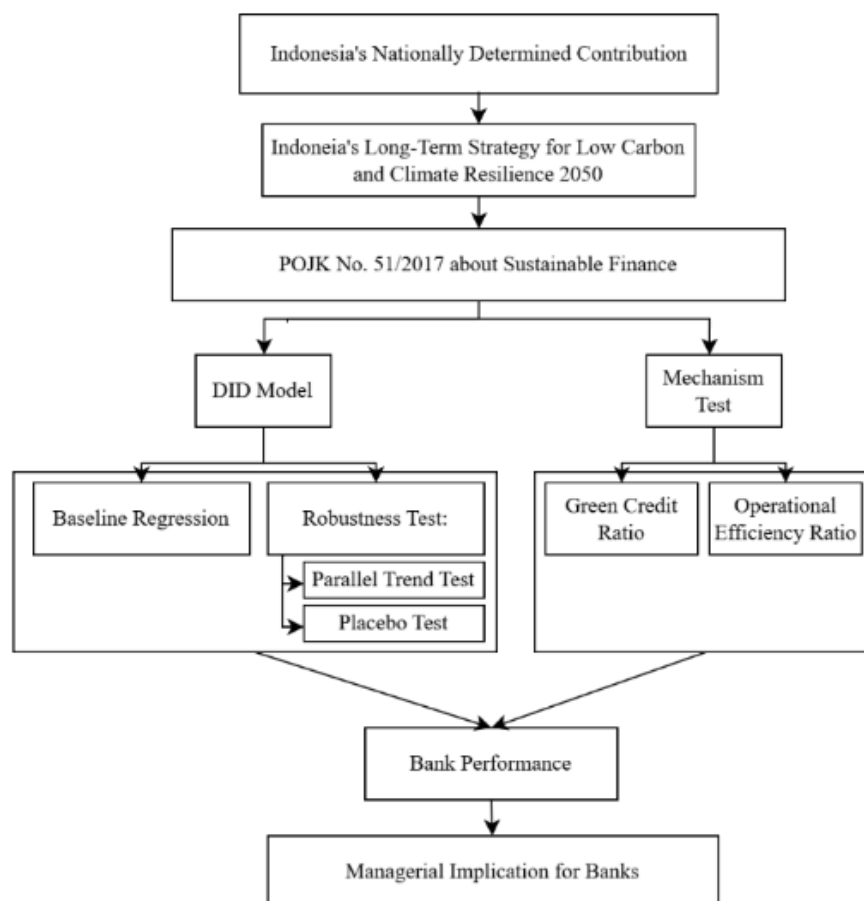


Figure 1. Conceptual Framework

METHOD

Research Design

This study uses a quantitative approach with a causal design based on Difference-in-Differences (DiD) to identify the influence of the implementation of sustainable financial policy on banking performance in Indonesia. This strategy uses variation in the level of interbank policy implementation following the enactment of OJK Regulation No.51/POJK.03/2017 in 2019 as a source of causal identification. Although the policy is mandatory for large-category banks, implementation varies significantly across banks in terms of green financing intensity and sustainability disclosures. This variation allows banks to be grouped into treatment and control groups based on the level of policy adoption, so that the DiD approach can still be applied in this context. Thus, the analysis captures not only the effects of the existence of policies but also the effectiveness of their implementation at the institutional level.

In this study, the treatment and control groups were defined as those that implemented the POJK 51/2017 policy after its enactment in 2019. The treatment group is a BUKU 3 and BUKU 4 bank that is proven to implement POJK 51/2017, as seen from whether the bank reports sustainable finance in accordance with the provisions and guidelines applicable to POJK 51/2017, while the control group is a bank that does not implement POJK 51/2017. This approach allows identification of policy impacts based on variations in implementation, not just on formal policies. Thus, the difference in performance changes between the two groups of banks after 2019 can be interpreted as a differential effect of implementing sustainable financial policies.

Data and Sample

This study uses secondary data from the annual financial reports of commercial banks in the BUKU 3 and BUKU 4 categories in Indonesia for the period 2015 to 2024. This observation period spans four years before policy implementation (2015–2018) and six years after implementation (2019–2024), providing adequate time to identify structural changes in banking performance.

The data are obtained from the regulator's official publications and the audited annual reports of each bank, making it highly reliable. The sample was selected using purposive sampling based on the availability of complete data throughout the study period. The data used were a balanced panel to maintain consistent estimates and reduce

potential bias from incomplete observations in certain periods. Of the 105 banks registered with the OJK in 2024, a sample of 22 banks was obtained: 18 treatment groups and 4 control groups. The 4 banks in the control group did not fully implement POJK 51/2017 in accordance with Technical Guidelines (*Pedoman Teknis POJK 51/2017*) for banks regarding the implementation of POJK 51/2017; for instance, their sustainability reports lacked a green credit portfolio, and they failed to submit the Rencana Aksi Keuangan Berkelanjutan (RKAB) as required by the regulation.

Operationalization and Measurement Variables

Table 1 summarizes the variable definition, indicators, and measurement scale used to ensure that all variables can be observed, measured, and analyzed consistently.

Table 1. Operational Definition and Measurement

Variables	Symbol	Definition	Measurement
Dependent:			
Bank Performance	NIM	The bank's ability to earn net interest income through effective management of productive assets.	$NIM = \frac{\text{Net Interest Income}}{\text{Average Earning Assets}}$
Independent:			
Implementations of POJK 51/2017	DID	Implementation Regulation of Otoritas Jasa Keuangan Number 51/POJK.03/2017	For a bank that implements the regulation, the value is 1; otherwise, it is 0
Mechanism:			
Green credit ratio	GCR	The percentage of credit financing distributed by banks to support environmental initiatives, compared to the total credit provided by banks.	$GCR = \frac{\text{Green credit total}}{\text{Credit Total}}$
Operational efficiency ratio	OER	The ratio of operating costs to income is used to assess a bank's operational efficiency.	$OER = \frac{\text{Operating Expense}}{\text{Total Revenue}}$
Control:			
Loan-to-Deposit Ratio	LDR	Comparison of the amount of credit disbursed to the total fund collected.	$LDR = \frac{\text{Total Loans}}{\text{Total Deposits}}$
Debt-to-Asset Ratio	DAR	The percentage of a bank's total liabilities compared to its total assets.	$DAR = \frac{\text{Total Debt}}{\text{Total Assets}}$
Revenue Growth Rate	RGR	The bank's ability to produce good financial performance and its long-term growth opportunities.	$RGR = \frac{\text{Revenue}_t - \text{Revenue}_{t-1}}{\text{Revenue}_{t-1}}$
Bank Size	Size	The size of a bank is determined by the total amount of assets it holds.	$\text{Size} = \log (\text{Total Assets})$
Equity Multiplier	EM	Financial leverage bank.	$EM = \frac{\text{Total Assets}}{\text{Shareholders Equity}}$

This section details the research implementation procedures, including the stages involved and how the researcher conducted the investigation. This description is particularly important in experimental research, which requires detailed explanations of the interventions used. This information can include explanations of the training required to implement new experimental learning methods and the types of instructions given to respondents when completing the survey. Furthermore, this section includes a realistic research implementation schedule for each phase of the study.

Analytical Method

To achieve the research objectives, this study employs the Difference-in-Differences (DiD) approach to estimate the causal effect of implementing sustainable finance policies on banking performance. This method is appropriate because the policy intervention was not random but introduced exogenously at a specific point in time, thereby creating conditions that resemble a natural experiment. The empirical strategy exploits both cross-sectional and time-series variation by comparing changes in performance between banks with higher and lower levels of policy implementation, before and after the policy came into effect in 2019. This approach allows the estimation to isolate the policy's net effect from general time trends affecting the entire banking sector. In this context, the DiD framework captures the differential impact of the policy by interacting the treatment indicator with the post-policy period, which serves as the main variable of interest.

This study focuses on BUKU 3 and BUKU 4 banks, which were required to implement the policy in the initial phase. However, consistent with empirical evidence, actual implementation varies across banks, particularly in compliance intensity and sustainability disclosure. Therefore, the treatment group comprises banks that provide verifiable evidence of sustainable finance implementation, such as sustainability reports and sustainable financial action plans. In contrast, the control group comprises banks that do not provide such evidence in the early phase of implementation. This classification enables a more precise identification of the policy effect by focusing on effective implementation rather than formal regulatory status. Based on this framework, the baseline DiD regression model is specified as follows:

$$NIM_{it} = \alpha + \beta DID_{it} + \gamma X_{it} + \mu_i + \lambda_t + \varepsilon_{it}$$

Where NIM_{it} presents the Net Interest Margin of bank i at time t , and DID_{it} is the interaction term between the treatment dummy and the post-policy dummy, capturing the effect of the implementation of POJK 51/2017. The vector X_{it} includes control variables that account for bank-specific characteristics, while μ_i and λ_t denote bank and time effects, respectively. The error term is represented by ε_{it} . Meanwhile, the β coefficient is the main parameter in the study, reflecting the average effect of the policy treatment on banking performance. A positive and statistically significant coefficient indicates that banks with higher levels of policy implementation experience greater improvements in Net Interest Margin after the policy period compared to banks with lower levels of implementation.

To further investigate the underlying mechanisms, this study extends the baseline model by incorporating the transmission mechanism, namely the green credit ratio and operational efficiency. Following a two-step regression framework, the first stage examines whether these variables transmit the policy effect to banking performance. This approach is consistent with prior studies that analyze transmission channels in sustainable systems.

RESULT

Descriptive Statistic

Table 2 presents descriptive statistics of all variables used in this study for the observation period in the full sample, before policy, and after policy. The research period covers 2015–2024, with 2019 as the starting point for the implementation of OJK Regulation No.51/POJK.03/2017. In general, descriptive statistics show changes in banking characteristics after policy implementation, especially in indicators of intermediation performance, green financing, funding structure, and operational efficiency.

Table 2. Descriptive Statistic

Variable	Period	N	Mean	Sd	Min	Max
DID	Full Sample	220	0.491	0.501	0.000	1.000
	Before Policy	88	0.000	0.000	0.000	0.000
	After Policy	132	0.818	0.387	0.000	1.000
NIM	Full Sample	220	0.047	0.019	0.005	0.120
	Before Policy	88	0.053	0.020	0.023	0.120
	After Policy	132	0.044	0.016	0.005	0.083
GC	Full Sample	220	0.097	0.143	0.000	0.614
	Before Policy	88	0.002	0.009	0.000	0.053
	After Policy	132	0.161	0.155	0.000	0.614
OER	Full Sample	220	0.837	0.218	0.417	2.262
	Before Policy	88	0.832	0.131	0.582	1.508
	After Policy	132	0.840	0.261	0.417	2.262
Ln_TA	Full Sample	220	33.036	1.764	30.191	39.446
	Before Policy	88	32.850	1.660	30.191	39.230
	After Policy	132	33.159	1.825	30.438	39.446
LDR	Full Sample	220	0.933	0.220	0.553	2.320
	Before Policy	88	0.986	0.241	0.553	2.320
	After Policy	132	0.897	0.198	0.586	1.630
RGR	Full Sample	220	0.171	1.818	-10.779	13.074
	Before Policy	88	0.431	2.123	-4.438	13.074
	After Policy	132	-0.003	1.566	-10.779	6.657
DAR	Full Sample	220	1.154	1.909	0.229	14.916
	Before Policy	88	1.402	2.671	0.229	14.916
	After Policy	132	0.990	1.133	0.590	10.259

The DID variable represents the interaction between the treatment group and the post-policy period and had an average value of 0.491 across the entire sample. This value shows that around 49.1% of observations are in the group of banks with a higher rate of policy implementation after the policy is implemented. As expected, the average DID in the period before the policy was zero because the policy had not yet been implemented. After the policy's implementation, the average DID increased to 0.818, indicating that most observations in the post-2019 period were from treatment-group banks. This condition indicates that the implementation of sustainable finance practices is increasingly widespread in the period following policy enactment.

Banking performance, measured by NIM, shows an average decline following policy implementation. Overall, the average NIM was 4.7%, with a minimum of 0.5% and a maximum of 12.0%, indicating variation in interbank intermediation capabilities in the study sample. Before the policy's implementation, the average NIM was 5.3%; after implementation, it decreased to 4.4%. This decline indicates pressure on banks' interest margins following the policy's implementation. These conditions can be related to changes in financing strategies, adjustments to funding structures, and increased compliance costs associated with implementing sustainable finance principles. However, these mean changes cannot be interpreted as causal relationships because further empirical testing using the Difference-in-Differences approach is still needed.

The average green financing ratio (GC) was 9.7%, with a maximum of 61.4%. Before the policy, the average green financing ratio was only 0.2%, whereas after its implementation, it increased significantly to 16.1%. The increase shows that the implementation of sustainable financial policies is followed by the expansion of financing into green and sustainable sectors. In addition, the increase in standard deviation after the policy reflects heterogeneity in interbank implementation, indicating that not all banks are adopting green financing with the same intensity.

The average OER increased from 0.832 in the pre-policy period to 0.840 after the policy was implemented. This increase indicates that banks faced increasing operating costs relative to operating income during the policy implementation period. Furthermore, the standard deviation of the OER increased significantly in the post-policy period, indicating that operational efficiency levels across banks became increasingly diverse. This condition may reflect differences in banks' capacity to adapt to the demands of implementing sustainable finance, including investments in reporting systems, strengthening governance, and developing sustainability infrastructure.

The bank size, measured by the natural logarithm of total assets ($\ln_TA$), increased from an average of 32,850 before the policy to 33,159 after the policy. This increase shows that the banks in the sample continued to experience asset growth during the study period. The maximum value of $\ln_TA$, 39.446, also indicates a considerable difference in business scale among banks in the research sample.

The Loan to Deposit Ratio (LDR) decreased from an average of 98.6% before the policy to 89.7% after its implementation. This decline indicates that banks tend to be more conservative in disbursing credit after the policy is in place. These conditions may reflect adjustments in financing strategies and increased prudence in liquidity management during the period of sustainable finance implementation.

The revenue growth ratio (RGR) shows a significant decrease from before to after the policy. Before the policy's implementation, the average RGR was 0.431; after implementation, it dropped to -0.003. This decline shows that bank revenue growth slowed in the post-policy period. In addition, the fairly extreme minimum value indicates the volatility of interbank revenue growth during the observation period. Changes can influence these conditions in business strategies, banking industry dynamics, and macroeconomic pressures in the period after policy implementation.

The Debt to Asset Ratio (DAR) variable decreased from an average of 1.402 before the policy to 0.990 after its implementation. This decline indicates a change in the bank's funding structure following the policy's enactment. Banks tend to reduce leverage relative to total assets in the post-policy period, which may reflect increased caution in managing capital structure and financial risk.

Overall, descriptive statistics show that the implementation of sustainable financial policy in Indonesia is accompanied by changes in various fundamental banking indicators, especially green financing, operational efficiency, liquidity, and intermediation profitability. These preliminary findings indicate that sustainable financial policy has the potential to influence bank behavior and performance; therefore, further empirical testing is needed to more accurately identify the causal effect of policies using the Difference-in-Differences approach.

Baseline Regression

Table 3 presents the main estimates of the effect of sustainable financial policy implementation on banking performance, as measured by NIM. Estimates were estimated using the DiD approach, including fixed effects at the bank level and time to control for unobserved heterogeneity across banks and changes in macroeconomic conditions throughout the study period.

Table 3. Baseline Regression

Variables	(1) NIM	(2) NIM
DID	0.00456* (0.00274)	0.00976*** (0.00256)
NPL		-0.0677*** (0.0205)
CAR		0.00188 (0.0148)
LDR		-0.0253*** (0.00354)
Ln_TA		-0.00389 (0.00261)
Constant	0.0524*** (0.00164)	0.207** (0.0866)
Fixed Time	Yes	Yes
Fixed Individual	Yes	Yes
Control Variable	No	Yes
Observations	220	220
R-squared	0.354	0.534
Number of id	22	22

Standard errors in parentheses : *** p<0.01, ** p<0.05, * p<0.1

Model (1) shows the estimation results without including the control variables, while Model (2) presents the estimation results by including the control variables in the form of NPL, CAR, LDR, and LnTA. In general, both models show that the DID variable has a positive and significant coefficient to NIM. In Model (1), the DID coefficient is 0.00456 and significant at the 10% level. After the control variable was entered in Model (2), the DID coefficient increased to 0.00976 and was significant at the level of 1%. The increase in coefficients and significance levels after adding control variables indicated that the estimation results were relatively robust and consistent.

The positive DID coefficient indicated that banks with higher levels of sustainable finance implementation experienced an increase in NIM after the implementation of OJK Regulation No.51/POJK.03/2017, relative to the comparison group. Economically, these results indicate that implementing sustainable financial policies can strengthen the banking intermediation function by improving the quality of financing and the efficiency of productive asset management. The findings also suggest that the integration of sustainability principles is not always a cost burden for banks, but can create economic benefits in the medium term through improving the quality of financing portfolios and strengthening institutional reputations.

These results support the study's first hypothesis that implementing sustainable financial policies positively affects banking performance. These findings are consistent with the perspectives of Stakeholder Theory and Signaling Theory, which suggest that implementing sustainability practices can increase institutional legitimacy and strengthen the market's positive perception of the bank's long-term prospects. Thus, banks that are more actively implementing sustainability principles are more likely to maintain intermediation profitability than banks with lower implementation rates. While the industry-wide average NIM declined from 5.3% to 4.4% post-policy, the treatment group's ability to maintain a significantly higher margin than the control group suggests the policy helped mitigate margin compression by improving asset quality and reputation.

In the control variable, the NPL ratio had a coefficient of -0.0677 and was significant at the 1% level. These results show that increased credit risk contributes to the decline in NIM. Economically, these conditions indicate that deteriorating asset quality will reduce banks' interest income due to increased non-performing loans and the formation of impairment loss reserves. These findings are consistent with banking intermediation theory, which holds that credit risk is a key factor affecting bank profitability.

The LDR variable also shows a negative and significant coefficient to NIM. A coefficient of -0.0253 indicates that a decrease follows the increase in the aggressiveness of credit disbursement relative to third-party funds in the net interest margin. These results suggest that excessively high credit expansion can increase liquidity pressures and funding costs, thereby reducing the efficiency of banking intermediation. These conditions may also reflect the trade-offs banks face between credit expansion and interest margin stability during the policy implementation period.

Meanwhile, the CAR variable showed a positive coefficient but was not statistically significant. These results indicate that capital adequacy has not directly influenced changes in NIM during the study period. Similarly, the bank size (LnTA) shows a negative but not significant coefficient. These findings suggest that the

scale of a bank's assets does not necessarily directly determine a bank's ability to generate a net interest margin during the period of sustainable financial policy implementation.

The R-squared value increased from 0.354 in Model (1) to 0.534 in Model (2), suggesting that the addition of control variables improved the model's ability to explain NIM variations. In addition, the use of fixed effects in both models strengthens the validity of the estimates by controlling for bank-specific factors and unobserved time effects. Overall, the results of the baseline regression indicate that implementing sustainable financial policies positively affects the performance of banking intermediation in Indonesia. These findings indicate that integrating sustainability principles is not only related to regulatory compliance but also has the potential to provide economic benefits to the banking industry by improving the quality of intermediation and strengthening medium-term profitability.

Robustness Test

To maintain the validity of the model run in this study, which uses the Difference-in-Differences approach, the study conducted parallel trend and placebo tests as part of the robustness checks. Both tests are important to ensure that the estimated impact of implementing POJK 51/2017 on banking performance accurately reflects the policy effect and is not influenced by prior trends or other random factors.

Parallel Trend Test

Figure 2 shows the results of a parallel-trend test assessing whether the treatment and control groups exhibited a relatively parallel trend prior to policy implementation in 2019. In the DiD approach, the assumption of parallel trends is the main prerequisite for interpreting the estimated coefficient as a causal effect of the policy.

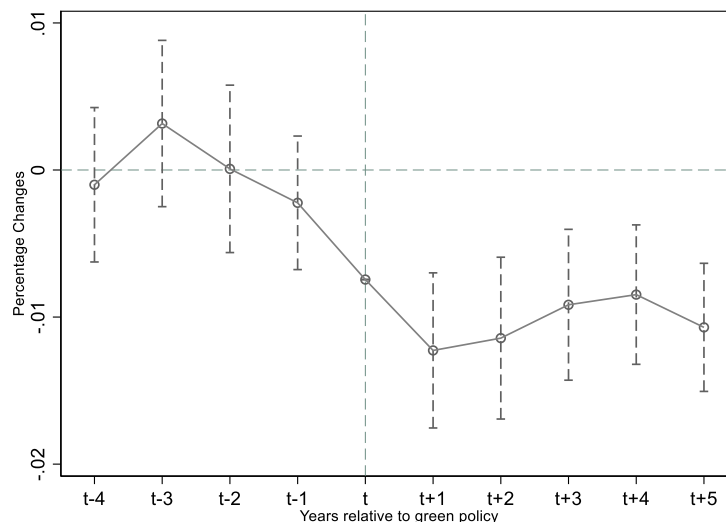


Figure 2. Parallel Trend Test Result

Based on the results of dynamic estimation, the coefficients in the period before policy implementation (t-4 to t-1) tended to be near zero. They showed no systematic difference between the treatment and control groups. In addition, the confidence interval for the pre-policy period still crossed the zero line, indicating no significant difference in trend before the policy was implemented. These findings indicate that the treatment and control groups exhibited a similar pattern of NIM development in the period prior to the policy's implementation. Hence, the assumption of parallel trends appears to be satisfied.

After the policy was implemented in 2019, the estimated coefficient showed a more pronounced change in direction, especially during the t+1 to t+5 period. This pattern shows a change in performance after the policy's implementation compared to the previous period. The decline in the coefficient in the post-policy period indicates that the policy's implementation led to changes in banking intermediation behavior that differed between the treatment and control groups. Thus, the results of the parallel trend test strengthen the validity of the DiD approach used in this study.

Placebo Test

Placebo testing is done to ensure that the main estimate does not appear to be due to chance (a spurious effect). Placebo testing was carried out by estimating the model using a randomized treatment assessment so that the resulting coefficient should be around zero if there were no pseudo-effects in the model.

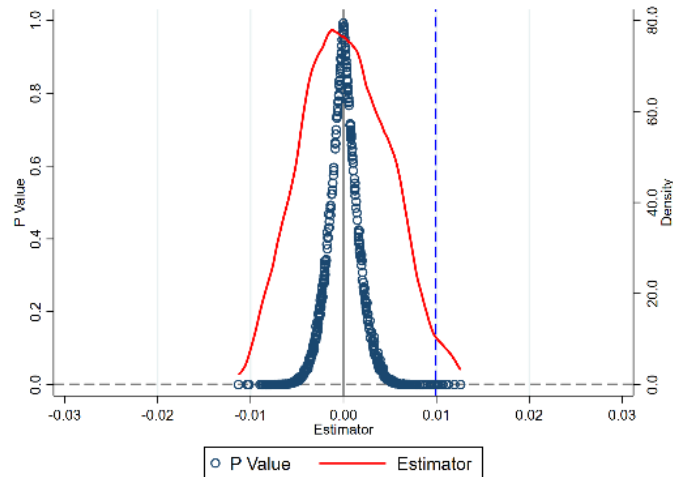


Figure 3. Placebo Test Result

Placebo estimation coefficient along with the distribution of its probability values. The test results showed that most of the placebo coefficients were centered around zero, with a relatively symmetric distribution. In addition, most p-values were at the significance level, suggesting that the policy effects observed in the main estimates were not random. The blue vertical line on the graph shows the estimated value of the main coefficient of the baseline model, which is well beyond the placebo estimated distribution. This condition indicates that the effect of sustainable financial policy implementation on NIM is very unlikely to be due to chance. Thus, the results of the placebo test provide additional evidence that the main estimates in this study have strong internal validity.

Mechanism Test

To examine the transmission mechanism by which sustainable financial policy implementation influences banking performance, this study conducted a mechanism test by examining the influence of the policy on mediation variables, namely the green credit ratio and operational efficiency, proxied by OER. This test aims to identify whether the implementation of OJK Regulation No.51/POJK.03/2017 affects the bank's performance through changes in green financing patterns or changes in operational efficiency ratio.

Table 4. Mechanism Test Result

Variables	(1) NIM	(2) GC RATIO	(3) OER
DID	0.00976*** (0.00256)	0.201*** (0.0309)	0.0166 (0.0514)
NPL	-0.0677*** (0.0205)	0.00554 (0.248)	1.493*** (0.411)
CAR	0.00188 (0.0148)	-0.334* (0.179)	-0.131 (0.297)
LDR	-0.0253*** (0.00354)	-0.0738* (0.0428)	0.226*** (0.0711)
LN_TA	-0.00389 (0.00261)	-0.0538* (0.0316)	-0.242*** (0.0525)
Constant	0.207** (0.0866)	1.897* (1.048)	8.506*** (1.742)
Fixed Time	Yes	Yes	Yes
Fixed Individual	Yes	Yes	Yes
Control Variable	Yes	Yes	Yes
Observations	220	220	220
R-squared	0.534	0.593	0.208
Number of id	22	22	22

Standard errors in parentheses : *** p<0.01, ** p<0.05, * p<0.1

Table 4 presents the results of the estimated policy transmission mechanism. Model (1) is a baseline regression showing that the DID variable has a positive coefficient of 0.00976 and is significant at the 1% level. These results reaffirm that implementing sustainable financial policies positively affects NIM. Thus, banks with

higher policy implementation rates tend to experience higher net interest margins than the comparison group after policy implementation.

Model (2) examines the influence of policy implementation on GER as the first transmission mechanism. The estimation results showed that the DID variable had a positive coefficient of 0.201 and was significant at the 1% level. These findings suggest that implementing sustainable financial policies significantly increases the share of green financing in banks' credit portfolios. Economically, these results indicate that the policy has succeeded in encouraging changes in banks' financing behavior towards sectors more oriented towards environmental sustainability.

The increase in GCR after the policy's implementation indicates that banks are beginning to integrate sustainability considerations into their credit distribution strategies. This supports the argument that sustainable financial policy is not only administrative or regulative, but is also capable of influencing the allocation of resources in the banking industry. These findings also strengthen the validity of GCR as an indicator of the actual implementation of sustainable finance policies at the institutional level.

Model (3) is run to test the influence of policy implementation on operational efficiency proxied using OER. The estimation results showed that the DID variable had a positive coefficient of 0.0166, but it was not statistically significant. These findings indicate that the implementation of sustainable financial policies has not led to significant changes in the bank's operational efficiency during the observation period. The insignificance of the relationship suggests that policy implementation may not have directly affected the bank's short-term operating cost structure. This can occur because the initial investments required to implement sustainability policies, such as developing reporting systems, governance adjustments, and internal capacity building, have not yet yielded measurable operational efficiencies during the study period. Thus, the influence of policies on banking performance seems to be transmitted more through changes in financing patterns than through increased operational cost efficiency.

The results of this mechanism test show that GCR plays a key role in explaining the relationship between the implementation of sustainable financial policy and improvements in banking performance. The findings support the study's second hypothesis that green finance mediates the effect of policy implementation on bank performance. In contrast, the third hypothesis that operational costs mediate the relationship has not received adequate empirical support.

Regarding the control variable, NPLs have a positive and significant influence on OER, indicating that higher credit risk tends to increase banks' operating costs. In addition, LDRs also show a positive and significant influence on OER, indicating that more aggressive credit expansion can increase operational cost pressures. In contrast, the size of LnTA banks has a negative and significant effect on OER, indicating the benefits of economies of scale in large banks.

Overall, the results of the mechanism testing showed that implementing sustainable financial policies in Indonesia was more effective at driving changes in the bank's financing structure than at improving operational efficiency. Thus, the increase in NIM post-implementation of the policy is explained more by the transformation of the credit portfolio towards green financing than by the decline in the bank's operating costs.

DISCUSSION

The results of the study show that the implementation of OJK Regulation No.51/POJK.03/2017 has a positive effect on banking NIM in Indonesia. These findings suggest that the integration of sustainable finance principles is not only related to regulatory compliance but can also provide economic benefits through improving the quality of banking intermediation. The increase in NIM in banks with higher levels of policy implementation indicates that a more sustainability-oriented financing strategy can strengthen banks' ability to generate net interest income from productive assets. These conditions show that the transformation towards sustainable banking practices can go hand in hand with increased profitability for banking intermediaries, especially as the banking industry adapts to the transition to a low-carbon economy. The policy impact is positive because treatment banks outperformed the control group, even though the sector as a whole faced pressure on interest margins due to increased compliance costs and adjustments to funding structures.

These findings are in line with Stakeholder Theory, which holds that companies that accommodate stakeholders' interests more broadly tend to gain greater legitimacy and market trust. Banks that actively implement sustainability principles generally have better governance quality, higher levels of transparency, and stronger risk management capabilities, thereby increasing positive perceptions among investors and customers of the company's long-term prospects (Freeman, 2010). In addition, the results of this study support the Signaling Theory, which holds that implementing sustainability policies can serve as a positive signal of institutional quality and the company's prospects (Spence, 1973). In the context of banking, disclosure of sustainable financial practices can improve a bank's reputation and strengthen market confidence in the stability of financial institutions.

Empirically, the results of this study are consistent with prior research indicating that implementing green finance and green banking can improve banking performance. Mirza et al. (2023) found that green financing positively influences banking profitability by improving the quality of financing portfolios and reducing exposure

to sectors with high environmental risks. Another study conducted by Yin (2021), shows that green credit expansion can improve intermediation efficiency and strengthen bank revenue stability through better financing diversification. Similar results were also found by Yan (2024), who explained that banks that are more actively engaged in distributing green financing tend to have better financial performance than banks with lower levels of sustainability implementation. Thus, the findings of this study strengthen the argument that sustainable finance can be a new source of growth for the banking industry.

The results of the mechanism test show that the green credit ratio is the primary channel explaining the relationship between the implementation of sustainable financial policies and improvements in banking performance. Policy implementation significantly increased the proportion of green financing in the bank's credit portfolio, indicating that banks are beginning to shift their financing strategies towards sectors that support environmental sustainability. This condition indicates that the influence of policy on bank performance does not occur directly, but is transmitted through changes in financing structure and credit allocation.

The findings support the view that green financing exhibits better long-term risk characteristics than conventional financing in sectors vulnerable to transition and environmental risks. Research by Zhang et al. (2021) shows that green credit tends to have lower default rates because it is primarily channeled to sectors with stronger sustainability prospects. In addition, Liu X.'s research found that banks that increase their share of green financing can improve asset quality and reduce revenue volatility in the long run (Liu et al., 2021). Thus, increasing the green credit ratio in this study can be understood as a mechanism that strengthens the quality of intermediation and supports the increase in banking NIM.

The results of this study are relevant to Indonesia's banking sector because the implementation of sustainable financial policies aims to transform the national financing structure towards a more productive and environmentally friendly one. The Financial Services Authority reported that the green financing portfolios of national banks have increased significantly following the implementation of POJK 51/2017, particularly in the renewable energy, natural resource management, and sustainable development sectors (OJK, 2023). The increase indicates that sustainability regulations are beginning to influence banks' intermediation behavior and to encourage a shift in financing strategies towards green sectors.

The findings of this study also indicate that the implementation of sustainable financial policies has not had a significant impact on operational efficiency as measured by OER. These findings show that integrating sustainability principles in the early stages of implementation still entails relatively large adjustment costs, so it has not yet directly generated operational cost efficiency. The implementation of sustainability policies requires investment in developing ESG reporting systems, strengthening governance, improving human resource quality, and developing sustainability risk management systems.

These findings are consistent with Cui et al.'s (2018) research, which finds that implementing green banking in the early stages often increases operational costs due to the need for institutional investment and considerable organizational adjustment. Buallay A.'s research also shows that the economic benefits of ESG implementation are generally evident only in the medium and long term, after the company has successfully passed the initial phase of institutional transformation (Buallay, 2019). Thus, the insignificance of OER in this study shows that the impact of policy implementation on operational efficiency may take longer to be empirically observed.

Other findings from the study's control variables indicate that banking fundamentals remain an important determinant of the profitability of bank intermediation. The NPL variable has a negative effect on NIM, indicating that higher credit risk will depress banks' ability to generate net interest income. These findings are consistent with banking intermediation theory, which posits that deteriorating asset quality increases reserve costs and reduces bank profitability (Athanasoglou et al., 2008). Meanwhile, the LDR variable also shows a negative influence on NIM, indicating that overly aggressive credit expansion can increase liquidity pressures and funding costs, thereby lowering banks' net interest margins.

From a policy perspective, the results of this study provide important implications for regulators and the banking industry in Indonesia. The findings that implementing sustainable financial policies can improve banking performance show that sustainability regulation is not only an instrument for environmental risk control but also has the potential to create economic benefits for the financial industry. Therefore, regulators need to continue strengthening the sustainable finance ecosystem by developing a green taxonomy, improving the quality of ESG disclosures, and strengthening green financing standards, so that policy implementation can run more effectively.

This study makes an empirical contribution to the sustainable finance literature in developing countries, particularly within the Indonesian banking industry. In contrast to most previous studies that have focused primarily on the risk and stability aspects of banking, this study shows that implementing sustainable financial policies also has implications for the profitability of banking intermediaries. The finding that the green credit ratio is the primary mechanism for increasing NIM indicates that the shift towards green financing can be a new source of growth for Indonesia's banking industry amid the transition to a sustainable economy.

CONCLUSION

This study aims to analyze the effect of implementing OJK Regulation No. 51/POJK.03/2017 on banking performance in Indonesia, using NIM as a proxy for bank performance. In addition, this study examines the transmission mechanism of policy influence through green credit ratios and the operational efficiency ratio, proxied by OER. Using the Difference-in-Differences (DiD) approach on the bank sample of the BUKU 3 and BUKU 4 categories for the 2015–2024 period, this study produced several key findings.

First, the main estimates show that implementing sustainable financial policies has a positive and significant effect on banking NIM. These findings show that banks with a higher rate of policy implementation tend to experience an increase in their net interest income after the policy is in place. These results indicate that implementing sustainable finance principles is not only related to regulatory compliance but can also provide economic benefits by strengthening the banking intermediation function and improving the quality of financing portfolios.

Second, the results of the mechanism test show that GCR is the primary channel explaining the relationship between the implementation of sustainable financial policies and improvements in banking performance. The implementation of the policy significantly increases the proportion of green financing in the bank's credit portfolio. These findings suggest that the transformation of financing structures towards more sustainability-oriented sectors is an important mechanism in increasing the profitability of banking intermediaries. Thus, green financing not only has an environmental dimension but also contributes to improving bank performance.

Third, this study found that the implementation of sustainable financial policies has not significantly affected banks' operational efficiency. These results show that the transformation towards sustainable banking practices still entails relatively large institutional adjustment costs, so the benefits of operational efficiency have not materialized in the short term. Therefore, the impact of policy implementation on bank performance is more transmitted through changes in financing patterns than through a reduction in operational costs.

Overall, this study shows that the implementation of sustainable finance policies in Indonesia has positive implications for the performance of banking intermediation, especially through increased green financing. These findings show that the transformation towards sustainable banking practices can be a new source of growth for the banking industry amid the increasing need for financing the transition to a sustainable economy.

The study limitation is that the post-policy observation period of 2019–2024 may be insufficient to capture the long-term operational efficiency benefits that typically take time to manifest after the initial phase of institutional transformation. Since the research focuses exclusively on BUKU 3 and BUKU 4 banks, the findings may not generalize to the broader Indonesian banking sector, particularly to smaller institutions in other categories. The sample imbalance between 18 treatment and 4 control reflects high policy adoption among large banks, but might limit the statistical power of comparative analysis. Furthermore, although the GCR is established as a key transmission mechanism, the study does not disaggregate the performance impact of specific green projects because the reporting data are aggregate.

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