International Journal of Financial Systems

Volume 4, Number 1 (2026)
January-June 2026
Page : 17-36
P-ISSN : 3025-8480
E-ISSN : 3025-8537
DOI : https://doi.org/10.61459/ijfs.v4i1.100

Article history
Received : January 16, 2026
Revised : June 8, 2026
Accepted : June 22, 2026
Available online : June 30, 2026

Green Loans and Bank Intermediary Costs: Evidence from Net Interest Margin and Loan Interest Spread in Indonesia

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ABSTRACT

Employing a unique dataset of green and non-green loans in Indonesia, we show that banks' loan allocation in environmentally and non-environmentally friendly activities are associated with bank intermediary costs. Our study utilizes green loan taxonomies released by the Indonesian Financial Services Authority to classify loans into green, transition, and unqualified categories. Using dynamic and static models, as well as GMM and fixed-effects estimators on bank-level panel data, we provide evidence that banks with larger green loan portfolios have lower intermediation costs, whereas banks with larger non-green loan portfolios have higher intermediation costs. We further confirm our findings by showing that green loans are associated with lower bank and loan interest spreads, implying that banks in a developing country consider environmental information in their lending decisions and perceive green loans as less risky. Our study contributes to the literature on net interest margins and green loan pricing in developing countries.

Keywords: Banks, Net interest margin, Green Loans, Indonesia, Loan risk

JEL Classification: G21, G28, Q51

1 Introduction

As banks increasingly consider their environmental impact through the composition of green and non-green loan portfolios (Degryse et al., 2023; Neagu et al., 2024; Wu et al., 2023), loan allocation across these activities may affect banks' intermediation costs, reflected in net interest margins. This issue is particularly relevant in the Indonesian banking industry, which has one of the highest net interest margins, despite of having robust, profitable, and lower loan risk among peer developing G20 countries (Appendix A). Prior studies similarly documented that Indonesian banks maintained relatively high margins compared to other East Asian countries (Demirgűc-Kunt & Huizinga, 1999; Trinugroho et al., 2014). Despite this evidence, little is known about how the composition of green and non-green lending associate with banks' intermediary costs.

To address this gap, this study examines how green and non-green loans link with banks' intermediation costs, drawing on the loan risk view of the net interest margin literature. Following Ho and Saunders (1981), interest margins capture intermediation and monitoring costs arising from information asymmetry, financial frictions, and risk. The loan risk view highlights loan heterogeneity: because loans differ in risk by type, sector, or industry, banks price higher-risk loans with higher margins. For example, agricultural, manufacturing, and construction loans in Uganda are positively associated with net interest margins (Beck & Hesse, 2009), whereas property loans in Indonesia are negatively associated with net interest margins (Trinugroho et al., 2014).

Given that loan composition shapes net interest margins, and prior studies showed that environmentally friendly activities had lower loan risk (Cui et al., 2018; Guan et al., 2017; Neagu et al., 2024; Wu et al., 2023), while lending to borrowers with environmental issues exposed banks to greater litigation risk (Aintablian et al., 2007; Balkenborg, 2002; Boyer & Laffont, 1997), green loans are expected to reduce banks' intermediation costs, whereas non-green loans are expected to increase them, as banks incorporate environmental risk premiums into their net interest margins.

However, the expectation that green loan portfolios decrease banks' intermediary cost is not without tension. Banks in developing countries that move their loan portfolio towards green activities may also increase their operational costs, including training and management expenses. The anecdotal evidence shows that big banks in Indonesia have created a new Environmental, Social, and Governance (ESG) division and committee to properly accommodate their new sustainable strategies (Bank Mandiri, 2022; Maulidin, 2025). As prior studies showed that banks' efficiency influences the net interest margin (Islam & Nishiyama, 2016; Maudos & De Guevara, 2004 ; Maudos & Solís, 2009), green loan portfolios may also increase banks' intermediary costs.[1]

This study employs a unique dataset of green, transition, and unqualified loan portfolios from the Indonesian banking industry. Based on the Indonesian Green Taxonomy, green loans finance activities directly classified as environmentally friendly,[2] transition loans cover activities that must meet specific criteria to qualify as green, and unqualified loans include environmentally harmful or unclassified activities. We admit that the green classification

1 Different from the theoretical foundation and empirical evidence that net interest margin captures banks' intermediary costs, Mirza et al. (2023) found that green loans increased net interest margin.

2 Green classification does no significant harm, applies minimum safeguard, provides positive impact to the environment, and aligns with the environmental objective of the taxonomy. Source: https://ojk.go.id/id/berita-dan-kegiatan/info-terkini/Documents/Pages/Taksonomi-Hijau-Indonesia-Edisi-1---2022/Taksonomi%20Hijau%20Edisi%201.0%20-%202022.pdf.

in this study has limitations as it is based on the Indonesian Green Taxonomy. However, prior studies similarly rely on country-specific definitions, for example, Cui et al. (2018) used the China Green Credit Policy classification, and Neagu et al. (2024) adopted the Romanian National Committee of Macroprudential Oversight's definition. Consistent with these approaches, our green category includes environmentally friendly agriculture, transport efficiency, circular economy, and climate change adaptation activities.

This study uses net interest margin and bank interest spread variables to capture banks' intermediary costs, following prior studies (Angbazo, 1997; Beck & Hesse, 2009; Ho & Saunders, 1981). To further confirm the loan-risk view that loan portfolios link with net interest margin and the role of borrowers' environmental issues on loan pricing (Alves & Meneses, 2024; Chava, 2014), this study observes the associations between green and non-green loan, and loan interest spread, captured by the difference between loan interest and market bond yield.[3]

Our results show that banks with a greater green loan portfolio have a lower net interest margin and bank interest spread. Transition loans also have the same link with a lesser degree, while unqualified loans are positively associated with a greater net interest margin and bank interest spread. Consistent with the loan risk-based view of bank loan portfolios (Beck & Hesse, 2009; Trinugroho et al., 2014), our results imply that green and non-green loans increase and decrease banks' intermediary costs, respectively.

The results of the loan interest spread confirm our main findings on banks' intermediary costs. It verifies banks' view that green activities have a lower risk than non-green activities and compensate for the additional risk premium associated with their borrowers' environmental issues in loan interest rates (Chava, 2014; Gu et al., 2023).

This study contributes to the literature of net interest margin and green loan pricing in developing countries. First, this study supports the theoretical model (Allen, 1988; Angbazo, 1997) and empirical evidence that loan portfolio heterogeneity influences banks' intermediary costs (Beck & Hesse, 2009; Trinugroho et al., 2014). Unlike Beck and Hesse (2009) who show that agricultural, manufacturing, and construction loans influence net interest margin, and Trinugroho et al. (2014) who show that property loans link with net interest margin in Indonesia, this paper provides evidence that green and non-green loan portfolios increase and decreased net interest margin, respectively.

Our study also differs from Mirza et al. (2023) in terms of both theoretical approach and results. As they used net interest margin to capture profitability, they found that banks with a higher proportion of green loans have higher net interest margins. Regarding banks' performance, our second findings suggest that green loans have lower risk and hence decrease banks' intermediation costs supports the evidence that green loans are negatively linked to default risk (Mirza et al., 2023) and market value (Tian et al., 2025).[4]

Next, this study adds to the green loan pricing literature by supporting the view that environmentally friendly activities have lower risk and therefore receive cheaper loans (Chava, 2014; Cui et al., 2018; Degryse et al., 2023; Giraudet et al., 2021; Neagu et al., 2024). Unlike those studies, we use bank-level data from Indonesia and show that banks' allocation to green and non-green loans influences banks' intermediation costs, which eventually affect green and non-green loan interest rates. Overall, our study supports the assumption that banks in Indonesia have already considered environmental risk in their

3 For example, Chandera and Setia-Atmaja (2020) uses the difference between loan interest in Indonesia and LIBOR.

4 Consistent with income diversification through loan portfolios increases efficiency (Nguyen and Pham, 2020).

lending decisions, as reflected in their loan interest rates.

The remainder of this study is as follows: Section 2 discusses the literature review, followed by Section 3: methodology. Next, Sections 4 and 5 present the analysis and conclusion, respectively.

2 Literature Review

2.1 Net Interest Margin

In the ideal setting where there is no financial friction, inefficiency, or risk, there is no interest margin or interest spread between deposits and loans. Hence, the interest margin indicates information asymmetry, intermediation, or monitoring costs. With this assumption, the seminal dealership model developed by Ho and Saunders (1981) assumes that the banks' intermediary function to link depositors and borrowers' faces uncertainty, which creates cost capture by interest margin. Their model suggests that market structure, bank risk preferences, transaction size, and the interest variance of loans and deposits determine the pure interest margin. Allen (1988) and Angbazo (1997) then extend the dealership model by incorporating loan heterogeneity and risk, respectively. Angbazo (1997) also shows that bank characteristics, including management efficiency, influence the net interest margin. Furthermore, the firm-theoretical model from Wong (1997) confirms that administrative costs influence bank margins.

Consistent with the theoretical models, prior empirical findings showed that loan heterogeneity and risk (Beck & Hesse, 2009; Trinugroho et al., 2014), bank-specific characteristics, including efficiency (Islam & Nishiyama, 2016; Maudos & De Guevara, 2004; Maudos & Solís, 2009), market structure, (Beck & Hesse, 2009; Maudos & De Guevara, 2004; Trinugroho et al., 2014), and macroeconomic conditions (Beck & Hesse, 2009; Brock & Suarez, 2000; Ho & Saunders, 1981; Saunders & Schumacher, 2000) influence net interest margins. Focusing on the Indonesian banking industry, Trinugroho et al. (2014) show that bank loan portfolios, bank-specific characteristics of efficiency and ownership, and the industry market structure influence net interest margin.

2.2 Green Loan

The studies of firm stakeholders' interest that lead to the stakeholder theory (Freeman, 1984; Freeman, 1999) explain that firms with more stakeholder focus have better reputations, risk management, and sustainability practices. Studies in this field support that environmentally friendly firms are considered to have lower reputation, regulation, and litigation risks (Stefan & Paul, 2008; Wu et al., 2023) while firms with environmental issues are burdened with higher costs of capital (Jung et al., 2018; Palea & Drogo, 2020; Tan et al., 2022).

On the bank side, as banks are considered liable for their borrowers' environmental problems (Aintablian et al., 2007; Balkenborg, 2002; Boyer & Laffont, 1997), they have more interest in their borrowers' environmental issues and hence adopted the Equator principle,[5] including recruiting more experts in this field (Stefan & Paul, 2008). Consequently, banks are moving their loan portfolios toward environmentally friendly borrowers (Xing et al., 2021) as they have a lower risk (Cui et al., 2018; Guan et al., 2017). Banks also avoid loans to environmentally unfriendly firms (Herbohn et al., 2019) or charge higher loan rates to those firms (Chava, 2014; Gu et al., 2023). As banks shift to

5 Financial institutions adopt the Equator Principles in order to ensure that the projects they finance and advise on are developed in a manner that is socially responsible and reflects sound environmental management practices.

more environmentally friendly loans and have lower risk, existing studies show that they have lower default risk and higher market value (Mirza et al., 2023a; Tian et al., 2025).

3 Methodology

3.1 Data

The main data of this study are the green, transition, and unqualified loan portfolios of each bank in Indonesia from 2012 to 2021. The final sample consists of 98 commercial banks with a share of 86.67% of the industry's total assets.[6] Since the Indonesian Green Taxonomy was issued in 2022,[7] we use ex-post identification and match activities classified in the taxonomy to banks' loan reports submitted to the Indonesian Financial Services Authority (Otoritas Jasa Keuangan, OJK).[8] The example of the matching process is in Appendix B. In addition to the loan portfolio yearly data, the other bank indicators are also from OJK, while the macroeconomic indicators are from Statistics Indonesia (Badan Pusat Statistik , BPS) and the Ministry of Finance of Indonesia.

3.2 Variables

3.2.1 Dependent Variables

Net interest margin

Our study follows Angbazo (1997) and calculates the net interest margin in Equation 1. $nim_{b,y}$ is the net interest margin of bank b in year y. *nint* is the net interest income, which is calculated from the difference between total interest revenues and total interest expenses. avassets is the average of total earnings assets.

$$nim_{b,y} = \frac{nint_{b,y}}{avassets_{b,y}} \tag{1}$$

Bank interest spread

Following Beck and Hesse (2009) we also employ bank interest spread calculated from the difference between the implicit interest rate of the loans and the implicit interest rate of the deposits to capture banks' intermediary costs. In Equation 2, $intsp_{b,y}$ is the interest spread of bank b in year y. *lrev* and *tloan* are the loan interest revenues and the total loans, respectively. *dexp* and *tdep* are the deposit interest expenses and the total deposits, respectively.

$$intsp_{b,y} = \frac{lrev_{b,y}}{tloan_{b,y}} - \frac{dexp_{b,y}}{tdep_{b,y}} \tag{2}$$

Loan interest spread

To confirm that our results are based on the loan risk view, we use the loan interest spread (loansp) calculated from the difference between the implicit interest rate of the

6 The final sample excludes Islamic banks, which do not use interest rates in their operations.

7 OJK has published a new Indonesian Sustainability Finance Taxonomy in 2024; however, the new taxonomy does not overrule the previous taxonomy as it only focuses on the energy sector.

8 Despite OJK issued the Indonesian Green Taxonomy in 2022, we assume that before the taxonomy, banks already considered environmental issues in their lending assessments, and the results of this study are consistent with our assumption. The similar ex-post identification strategy is used by Neagu et al. (2024). However, different from them, we identify the green loans reported the by banks and hence mitigate the selection bias of green loans identification by the banks.

loans and the risk-free interest rate in Indonesia indicated by the government bond 10-year yield (*sbn10yield*).

$$loansp_{b,y} = \frac{lrev_{b,y}}{tloan_{b,y}} - sbn10yield \tag{3}$$

3.2.2 Independent Variables

We use four groups of independent variables. The loan portfolios, bank specific characteristics, market structure, and macroeconomic indicators. The variable definition, expected sign, and supporting prior studies of all independent variables are available in Appendix C.

3.3 Empirical Model

This study uses a dynamic model in Equation 5 to examine the link between green and non-green loan portfolios and banks' intermediary costs. Equation 5 employs Generalized Method of Moment (GMM) estimator from Arellano and Bover (1995) and Blundell and Bond (1998), which is the further development of the GMM of Arellano and Bond (1991).[9]

$$\begin{aligned} nim_{b,y} = {} & \alpha_0 + \beta_1 nim_{b,y-1} + \beta_2 loanportfolio_{b,y} + \beta_3 rnpl_{b,y} + \beta_4 rcashbank_{b,y} \\ & + \beta_5 overhead_{b,y} + \beta_6 car_{b,y} + \beta_7 rloanta_{b,y} + \beta_8 govb_b + \beta_9 fob_b \\ & + \beta_{10} hhi_y + \beta_{11} cpi_y + \beta_{12} gdp_y + \beta_{13} vsbn10y_y + \beta_{14} cov19_y + \beta_{10} \varepsilon_{b,y} \end{aligned} \tag{4}$$

In Equation 5, $nim_{b,y}$ is the net interest margin in bank b and year y. $nim_{b,y-1}$ is the lagged variable of *nim*. Following Beck and Hesse (2009), this study also uses bank interest spread (*intsp*) as the dependent variable. To further confirm our results, we also use the loan interest spread (Chava, 2014) as the dependent variables. The variables of interest, loan-portfolios are green as the ratio of the green loans to total loans, transition as the ratio of the transition loans to total loans, and unqualified as the ratio of the unclassified loans to total loans. Next, *rnpl* is the non-performing ratio, and *rcashbank* is cash and bank to total assets. *overhead*, *car*, and *rloanta* are operational expenses to total assets, regulatory capital, and total loans to total assets, respectively. *govb* is a dummy variable, one for government banks and zero otherwise. *fob* is a dummy variable, one for foreign banks and zero otherwise. *hhi* is the Herfindahl-Hirschman index.[10] The macroeconomic indicators are consumer price index growth (*cpi*), GDP growth (*gdp*), the standard deviation of government bond 10-year yield in one year (*vsbn10y*), and a dummy variable of the Covid-19 outbreak (cov19).

4 Analysis

4.1 Descriptive Statistics

Table 1 shows that the average net interest margin is 0.049, with the bank interest spread of 0.065 and the loan interest spread of 0.039, indicating the high banks' intermediary costs in Indonesia. The observations show much lower green loans (green) of 0.014 compared to transition and unqualified loans that dominate the loan portfolio.

9 Particularly, we use the two-step system GMM. As discussed by Hadad et al. (2011), the estimations of the first step are more efficient, while the estimations of the second step are more robust.

10 The Herfindahl-Hirshman Index is the sum of squared market shares of banks in percentages with a value between zero and 10,000. The higher the value, the more concentrated the banking industry.

To the best of our knowledge, only prior studies using the banking industry in China published their green loan portion, which was around 0.03 (Cui et al., 2018). The loan risk in the Indonesian banking industry is maintained at a moderate level, captured by the average of the non-performing loan ratio (npl) of 0.026, with lower liquidity risk indicated by the cash and bank ratio to total assets (rcashbank) of 0.191. The Indonesian banking industry also has higher capital, as the averages of regulatory capital (car), 0.241, amid the loans comprise around 0.672 of the total assets (rloanta). Furthermore, the average hhi of 721 indicates that the banking industry in Indonesia is an unconcentrated industry. For the macroeconomic indicators, the average cpi and gdp growth were around the same level of 0.040 and 0.046, respectively, with the average of government bond 10-year yield standard deviation (vsbn10y) of 0.006.

Table 1. Descriptive Statistics

	Obs.	Mean	SD.	Min.	P25	P50	P75	Max.
nim	851	0.049	0.019	0.006	0.036	0.047	0.062	0.117
intsp	851	0.065	0.026	0.010	0.047	0.063	0.082	0.190
loansp	851	0.039	0.032	-0.046	0.022	0.040	0.056	0.138
green	851	0.014	0.020	0.000	0.002	0.008	0.018	0.108
transition	851	0.634	0.280	0.037	0.388	0.719	0.875	0.970
unqualified	851	0.351	0.285	0.013	0.110	0.260	0.594	0.963
rnpl	851	0.026	0.020	0	0.011	0.023	0.035	0.123
rcashbank	851	0.191	0.084	0.063	0.134	0.172	0.224	0.532
overhead	851	0.094	0.036	0.023	0.074	0.088	0.103	0.280
car	851	0.241	0.141	0.110	0.170	0.211	0.254	1.235
rloanta	851	0.672	0.110	0.357	0.608	0.677	0.743	0.937
hhi	851	721	56	657	670	700	772	816
cpi	851	0.040	0.023	0.017	0.026	0.034	0.037	0.084
gdp	851	0.046	0.021	-0.022	0.050	0.052	0.052	0.059
vsbn10y	851	0.006	0.003	0.002	0.004	0.005	0.007	0.013

The variable definitions are available in Appendix C

Source: Authors own work

The correlation matrix in Table 2 documents that there is a positive and high correlation among the net interest margin (nim), the bank interest spread (intsp), and the loan interest spread (loansp). The net interest margin, bank interest spread, and loan interest spread also have negative and positive correlations with transition and unqualified loans, respectively. There is also a positive and high correlation between transition and unqualified loans of 0.998. Hence, we do not use both variables concurrently in Equation 3. There are lower correlations among the other bank characteristic variables, while the concentration variable of hhi has negative correlations with all the macroeconomic indicators. Last but not least, inflation (cpi) has positive correlations with economic growth (gdp) and market interest rate volatility (vsbn10y).

Table 2. Correlation Matrix

	nim	intsp	loansp	rdepint	green	transition	unqualified	rnpl	rcashbank	overhead	car	rloanta	hhi	cpi	gdp	vsbn10y
nim	1															
intsp	0.811***	1														
loansp	0.633***	0.811***	1													
rdepint	0.004	0.014	0.437***	1												
green	-0.0697*	-0.053	-0.029	0.037	1											
transition	-0.620***	-0.573***	-0.474***	0.029	0.222***	1										
unqualified	0.614***	0.567***	0.468***	-0.031	-0.289***	-0.998***	1									
rnpl	-0.061	0.003	0.036	0.144***	-0.018	0.052	-0.050	1								
rcashbank	0.050	0.181***	0.118***	-0.111**	0.032	-0.039	0.036	-0.136***	1							
overhead	0.029	0.135***	0.216***	0.300***	-0.043	0.065	-0.060	0.271***	-0.105**	1						
car	-0.0718*	-0.193***	-0.192***	-0.183***	0.012	0.143***	-0.141***	-0.140***	0.275***	-0.0727*	1					
rloanta	0.0973**	-0.241***	-0.145***	0.155***	0.020	0.053	-0.053	-0.165***	-0.267***	-0.0922**	-0.242***	1				
hhi	-0.109**	-0.125***	-0.146***	-0.252***	-0.045	-0.020	0.022	0.162***	-0.190***	-0.0705*	0.219***	-0.287***	1			
cpi	0.031	0.061	-0.008	0.123***	0.0725*	0.015	-0.020	-0.166***	0.124***	0.032	-0.169***	0.280***	-0.679***	1		
gdp	0.0839*	0.0803*	0.023	0.0942**	0.011	0.009	-0.009	-0.065	0.149***	0.033	-0.107**	0.150***	-0.530***	0.358***	1	
vsbn10y	0.0735*	0.018	-0.154***	0.041	0.058	0.018	-0.022	-0.104**	0.004	0.024	-0.0943**	0.175***	-0.365***	0.430***	0.043	1

This table shows the correlation coefficient of all the main variables

The variable definitions are available in Appendix C. * $p < .10$, ** $p < .05$, *** $p < .01$

Source: Authors own work

4.2 Empirical Evidence Discussion

This study examines the association between green, transition, and unqualified loan portfolios and banks' intermediary costs captured by the net interest margin. First, we examine whether the green and non-green loan portfolios link with the net interest margin and bank interest spread. Next, to confirm that our results are consistent with the loan risk-based view, we investigate the association between influence of green, transition, and unqualified portfolios and loan interest spread.[11]

4.2.1 Net Interest Margin and Bank Interest Spread

Table 3 shows that the coefficient of the association between green and nim, and between transition and nim are negative and significant, while the association between unqualified and nim is positive and significant. Economically, one percent increase in green loan portfolio is associated with a 3.4 percent to 3.9 percent decrease in net interest margin. Regarding non-green loans, one percent increase in unqualified loan portfolio is associated with a 5 percent to 7 percent increase in net interest margin.

Consistent with the results in Table 3, the results in Table 4 show that the coefficient of the association between green and intsp, and between transition and intsp are negative and significant, while the association between unqualified and intsp is positive and significant. Economically, one percent increase in green loan portfolio is associated with a 11.3 percent to 12.6 percent decrease in bank interest spread. Regarding non-green loans, one percent increase in unqualified loan portfolio is associated with a 1.1 percent to 1.4 percent increase in bank interest spread.

Table 3. Net Interest Margin

Dependent Variable	(1) nim	(2) nim	(3) nim	(4) nim	(5) nim
	Green	Transition	Unqualified	Green & Transition	Green & Unqualified
nim (y-1)	0.715***	0.681***	0.689***	0.643***	0.672***
	(44.43)	(56.58)	(69.01)	(37.60)	(50.61)
green	-0.039***			-0.039***	-0.034**
	(-3.26)			(-2.83)	(-2.31)
transition		-0.007***		-0.006***	
		(-3.87)		(-3.85)	
unqualified			0.007***		0.005***
			(3.63)		(2.60)
rnpl	-0.017	0.010	0.003	-0.004	-0.005
	(-1.61)	(0.69)	(0.46)	(-0.31)	(-0.62)
rcashbank	-0.003**	-0.003*	-0.001	-0.003	-0.000
	(-2.39)	(-1.76)	(-0.23)	(-1.40)	(-0.23)
overhead	0.004	0.002	0.001	0.007	0.001
	(0.69)	(0.63)	(0.21)	(1.11)	(0.25)
car	0.009***	0.013***	0.012***	0.012***	0.011***

11 In Tables 3, 4, 5, and 6, columns 1, 2, and 3, we use only one of the variables of interest, green, transition, and unqualified loans, respectively. To mitigate the high correlation between transition and unqualified loans, we employ green loans concurrently with transition and unqualified loans, in the 4 and 5 columns, respectively.

Dependent Variable	(1) nim	(2) nim	(3) nim	(4) nim	(5) nim
	Green	Transition	Unqualified	Green & Transition	Green & Unqualified
	(17.06)	(14.92)	(15.36)	(11.98)	(11.51)
rloanta	0.025***	0.026***	0.026***	0.024***	0.025***
	(21.64)	(21.94)	(21.53)	(22.28)	(16.32)
govb	0.010***	0.007***	0.007***	0.009***	0.009***
	(9.52)	(5.24)	(5.15)	(7.91)	(8.30)
fob	-0.004*	0.000	0.002	-0.004	-0.002
	(-1.76)	(0.04)	(0.57)	(-1.33)	(-0.57)
hhi	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***
	(-27.94)	(-39.23)	(-33.50)	(-27.26)	(-34.08)
cpi	-0.174***	-0.178***	-0.182***	-0.176***	-0.180***
	(-33.54)	(-31.61)	(-26.50)	(-20.99)	(-28.58)
gdp	0.095***	0.089***	0.087***	0.083***	0.085***
	(24.45)	(24.70)	(27.13)	(22.44)	(41.43)
vsbn10y	0.537***	0.501***	0.499***	0.515***	0.516***
	(30.36)	(21.30)	(23.36)	(27.35)	(31.72)
cov19	0.006***	0.006***	0.006***	0.005***	0.005***
	(20.10)	(20.16)	(20.17)	(16.45)	(26.92)
constant	0.049***	0.056***	0.048***	0.057***	0.050***
	(18.06)	(20.54)	(19.62)	(24.55)	(16.02)
Wald Test	Chi2(14) 1150003***	Chi2(14) 122542.25***	Chi2(14) 114723.19***	Chi2(15) 259215.65***	Chi2(15) 202351.74***
Sargan Test	Chi (353) 82.91418	Chi2(353) 84.31209	Chi2(353) 85.63797	Chi2(405) 83.46868	Chi2(405) 85.15092
AR Test (1)	-4.2999 ***	-4.1471 ***	-4.1659***	-4.0952***	-4.1458***
Observations	741	741	741	741	741

This table shows the two-step GMM estimation system results of the net interest margin as the dependent variables, with green, transition, and unqualified loan portfolios as the main interest in the independent variables. The system GMM estimation is effective when the Sargan test and the Arrelano-Bond test AR (2) are not rejected

The variable definitions are available in Appendix C. * p < .10, ** p < .05, *** p < .01

Source: Authors own work

Table 4. Bank Interest Spread

Dependent Variable	(1) intsp	(2) intsp	(3) intsp	(4) intsp	(5) intsp
	Green	Transition	Unqualified	Green & Transition	Green & Unqualified
intsp (y-1)	0.412***	0.364***	0.355***	0.377***	0.375***
	(27.01)	(34.79)	(29.84)	(31.60)	(31.16)
green	-0.113***			-0.126***	-0.107***
	(-5.92)			(-7.29)	(-4.99)
transition		-0.012***		-0.010***	
		(-5.22)		(-2.64)	
unqualified			0.014***		0.011***
			(5.32)		(3.22)
rnpl	-0.089***	-0.053**	-0.060***	-0.089***	-0.100***
	(-8.10)	(-2.16)	(-3.57)	(-3.63)	(-6.56)
rcashbank	0.019***	0.019***	0.018***	0.020***	0.018***
	(10.02)	(7.91)	(8.38)	(7.15)	(5.73)
overhead	0.011	-0.010	-0.005	-0.002	0.001
	(1.34)	(-1.49)	(-0.57)	(-0.22)	(0.19)
car	-0.011***	-0.012***	-0.012***	-0.015***	-0.014***
	(-7.61)	(-10.13)	(-8.32)	(-13.33)	(-13.56)
rloanta	-0.052***	-0.052***	-0.052***	-0.054***	-0.054***
	(-26.70)	(-27.93)	(-40.77)	(-22.79)	(-32.23)
govb	0.010***	0.007***	0.005***	0.005**	0.005**
	(6.58)	(4.78)	(2.74)	(2.10)	(2.56)
fob	-0.023***	-0.016***	-0.021***	-0.026***	-0.027***
	(-5.29)	(-5.63)	(-6.23)	(-7.55)	(-7.44)
hhi	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***
	(-19.24)	(-21.28)	(-22.53)	(-15.07)	(-18.35)
cpi	-0.027***	-0.033***	-0.028***	-0.027***	-0.023***
	(-5.65)	(-7.75)	(-7.18)	(-4.50)	(-5.20)
gdp	0.052***	0.061***	0.060***	0.060***	0.062***
	(12.61)	(11.14)	(9.90)	(13.39)	(14.17)
vsbn10y	0.041	-0.016	-0.009	0.009	0.016
	(1.52)	(-0.64)	(-0.30)	(0.29)	(0.83)
cov19	0.005***	0.004***	0.004***	0.004***	0.004***
	(10.65)	(7.35)	(8.30)	(6.76)	(11.69)
constant	0.114***	0.127***	0.114***	0.129***	0.115***
	(30.37)	(28.20)	(44.23)	(28.64)	(31.98)
Wald Test	Chi2(14) 51723.07***	Chi2(14) 191671.08***	Chi2(14) 130260.00***	Chi2(15) 1114000***	Chi2(15) 438982.78***

Dependent Variable	(1) intsp	(2) intsp	(3) intsp	(4) intsp	(5) intsp
	Green	Transition	Unqualified	Green & Transition	Green & Unqualified
Sargan Test	Chi (353) 87.4944	Chi2(353) 90.59532	Chi2(353) 90.55514	Chi2(405) 88.50205	Chi2(405) 90.27998
AR Test (1)	-4.0934***	-3.7882***	-3.7494 ***	-3.8339***	-3.8373***
AR Test (2)	-0.87235	-0.88572	-0.91096	-0.88914	-0 .90077
Observations	741	741	741	741	741

This table shows the two-step GMM estimation system results of the bank interest spread as the dependent variables, with green, transition, and unqualified loan portfolios as the main interest in the independent variables. The system GMM estimation is effective when the Sargan test and the Arrelano-Bond test AR (2) are not rejected

The variable definitions are available in Appendix C. * p < .10, ** p < .05, *** p < .01

Source: Authors own work

The results from Tables 3 and 4 indicate that banks with greater green loans have lower intermediary costs, while banks with greater non-green loans linked with higher intermediary costs. These findings are consistent with the theoretical model and the risk-based view that the heterogeneity of bank loans matters for the net interest margin (Allen, 1988; Beck & Hesse, 2009; Trinugroho et al., 2014). Nevertheless, our results are different with Mirza et al. (2023), who find the positive association between green loan portfolios and net interest margin.

Regarding bank-specific characteristics, this study documents that bank capital increased intermediary costs as banks compensated for the cost of equity in their intermediary costs (Angbazo, 1997; Beck & Hesse, 2009; Brock & Suarez, 2000). Next, the results also showed that bank loans (rloanta) were positively associated with intermediary costs, which is consistent with the prior studies (Beck & Hesse, 2009; Demirgűc-Kunt & Huizinga, 1999; Maudos & Solís, 2009). Nevertheless, while our results show evidence of the negative and positive association between loan risk (rnpl), liquidity (rcashbank), and bank interest spread (intsp), the same associations do not exist with net interest margin.

Regarding the market structure, our results are consistent with Trinugroho et al. (2014), who found that government banks have higher net interest margins, while foreign banks are negatively associated with the interest spread. However, for the bank concentration, this study finds that a lower concentration level increased the net interest margin. The results could be influenced by the increasing trend of the hhi, as the number of banks tends to decline over the years because of mergers and acquisitions while the net interest margins tend to decrease.

The macroeconomic indicators also shape net interest margin and bank interest spread. Inflation is negatively associated with the net interest margin, whereas stronger economic growth is linked to higher net interest margin. In addition, both net interest margins and bank interest spreads increase with market interest rate volatility, consistent with theoretical predictions and prior evidence (Brock & Suarez, 2000; Maudos & De Guevara, 2004) Net interest margins also rose during the COVID-19 outbreak, aligning with heightened loan risk during the outbreak (Tumbelaka, 2023; Tumbelaka, 2025).

4.2.2 Loan Interest Spread

To further confirm the loan risk view that green loans carry lower risk and thus lower intermediation costs, we examine the effect of loan portfolios on loan interest spreads. Table 5 shows that green and transition loans are negatively and significantly associated with loan interest spread (loansp), while unqualified loans are positively and significantly associated with loansp. Economically, a one percent increase in the green loan portfolio is associated with a 6.9 to 8.7 percent decrease in loan interest spreads, whereas a one percent increase in unqualified loans is associated with a 0.9 to 1.3 percent increase in loan interest spread. These findings are consistent with Chava (2014) and Degryse et al. (2023), who document lower interest spread for environmentally friendly loans.

4.3 Additional Tests

Following Beck and Hesse (2009), Hadad et al. (2011), and Trinugroho et al. (2014), we confirm our results using static panel data regression with bank and year fixed effects, to account for unobserved, time-invariant bank characteristics and year effects not directly controlled in our main results. As reported in Table 6, the results are consistent with our main findings: green loans are associated with lower net interest margins, while the effects of transition and unqualified loans remain consistent with year fixed effect results, suggesting that our results are affected by invariant bank characteristics. In addition to the variables of interest, control variables, including regulatory capital (car), total loans (rloanta), and market structure indicators (govb, fob, and hhi), also exhibit signs and significance similar to those in the main results. In addition, the coefficients on market structure and macroeconomic variables support the results obtained from the dynamic models.

Table 5. Loan Interest Spread

Dependent Variable	(1) loansp	(2) Loansp	(3) loansp	(4) loansp	(5) loansp
	Green	Transition	Unqualified	Green & Transition	Green & Unqualified
loansp (y-1)	0.389***	0.367***	0.364***	0.380***	0.377***
	(29.42)	(26.45)	(24.95)	(29.07)	(26.53)
green	-0.069***			-0.087***	-0.068***
	(-3.58)			(-3.92)	(-3.42)
transition		-0.007***		-0.007***	
		(-2.66)		(-2.80)	
unqualified			0.013***		0.009***
			(4.38)		(3.14)
rnpl	-0.040*	-0.051***	-0.039***	-0.057***	-0.057***
	(-1.71)	(-3.92)	(-3.36)	(-3.31)	(-2.87)
rcashbank	-0.022***	-0.022***	-0.022***	-0.018***	-0.017***
	(-10.34)	(-6.81)	(-4.94)	(-6.73)	(-4.97)
overhead	0.025***	0.016**	0.019**	0.022***	0.034***
	(2.90)	(2.21)	(2.40)	(2.69)	(3.22)
car	-0.010***	-0.011***	-0.012***	-0.014***	-0.013***
	(-6.54)	(-7.65)	(-8.03)	(-8.86)	(-7.69)

Dependent Variable	(1) loansp	(2) Loansp	(3) loansp	(4) loansp	(5) loansp
	Green	Transition	Unqualified	Green & Transition	Green & Unqualified
rloanta	-0.064***	-0.066***	-0.065***	-0.063***	-0.061***
	(-29.95)	(-37.76)	(-21.05)	(-19.18)	(-20.53)
govb	0.002**	0.002	-0.001	-0.000	-0.001
	(2.38)	(1.55)	(-0.23)	(-0.15)	(-0.73)
fob	-0.045***	-0.034***	-0.037***	-0.041***	-0.039***
	(-11.84)	(-10.39)	(-8.67)	(-15.41)	(-9.51)
hhi	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***
	(-17.48)	(-26.52)	(-26.79)	(-20.50)	(-31.51)
cpi	0.051***	0.043***	0.041***	0.041***	0.041***
	(8.61)	(5.44)	(4.71)	(4.55)	(4.97)
gdp	-0.277***	-0.266***	-0.265***	-0.273***	-0.265***
	(-56.48)	(-44.05)	(-50.09)	(-45.31)	(-44.67)
vsbn10y	-2.552***	-2.543***	-2.487***	-2.543***	-2.484***
	(-45.58)	(-41.25)	(-50.06)	(-45.99)	(-47.90)
cov19	-0.014***	-0.014***	-0.014***	-0.014***	-0.014***
	(-39.44)	(-38.83)	(-35.68)	(-39.76)	(-37.39)
constant	0.151***	0.157***	0.147***	0.156***	0.143***
	(52.49)	(57.94)	(40.33)	(43.87)	(43.84)
Wald Test	Chi2(14) 27695.41***	Chi2(14) 108055.67 ***	Chi2(14) 87968.76 ***	Chi2(15) 69461.65 ***	Chi2(15) 66307.64 ***
Sargan Test	Chi (353) 91.08107	Chi2(353) 93.90475	Chi2(353) 93.0228	Chi2(405) 92.78061	Chi2(405) 92.99338
AR Test (1)	-4.3039***	-4.0989***	-4.053***	-4.1431 ***	-4.1522 ***
AR Test (2)	-2.6292	-2.7716	-2.7299	-2.6038	-2.7307
Observations	741	741	741	741	741

This table shows the two-step GMM estimation system results of the loan interest spread as the dependent variables, with green, transition, and unqualified loan portfolios as the main interest in the independent variables. The system GMM estimation is effective when the Sargan test and the Arrelano-Bond test AR (2) are not rejected

The variable definitions are available in Appendix C. * p < .10, ** p < .05, *** p < .01

Source: Authors own work

Table 6. Net Interest Margin: Static Panel Data Regression with Fixed Effects

Dependent Variable	(1) nim	(2) nim	(3) nim	(4) nim	(5) nim	(6) nim	(7) nim	(8) nim	(9) nim
	Green Loans	Transition Loans	Unclassified Loans	Green Loans	Transition Loans	Unclassified Loans	Green Loans	Transition Loans	Unclassified Loans
green	-0.092*			-0.073*			-0.087*		
	(-1.86)			(-1.79)			(-1.76)		
transition		-0.019			-0.024**			-0.020	
		(-1.28)			(-2.19)			(-1.32)	
unclassified			0.021			0.024**			0.021
			(1.46)			(2.31)			(1.50)
rnpl	0.022	0.030	0.029	0.005	0.014	0.013	0.018	0.025	0.023
	(0.56)	(0.76)	(0.72)	(0.14)	(0.33)	(0.30)	(0.43)	(0.57)	(0.54)
rcashbank	-0.001	-0.003	-0.003	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
	(-0.18)	(-0.38)	(-0.34)	(-0.20)	(-0.19)	(-0.14)	(-0.09)	(-0.17)	(-0.13)
overhead	0.031	0.030	0.030	0.043**	0.040*	0.040*	0.035	0.033	0.033
	(1.40)	(1.40)	(1.36)	(2.00)	(1.92)	(1.87)	(1.55)	(1.52)	(1.48)
car	0.012**	0.014***	0.014**	0.012**	0.014***	0.013**	0.012**	0.014**	0.013**
	(2.14)	(2.66)	(2.47)	(2.38)	(2.68)	(2.52)	(2.08)	(2.46)	(2.30)
rloanta	0.019**	0.018**	0.018**	0.019**	0.019**	0.020**	0.020**	0.019**	0.020**
	(2.05)	(1.96)	(2.02)	(2.42)	(2.47)	(2.51)	(2.15)	(2.10)	(2.16)
govb	0.024***	0.024***	0.025***	0.022***	0.011*	0.011*	0.024***	0.024***	0.025***
	(23.26)	(16.63)	(15.93)	(7.18)	(1.80)	(1.74)	(22.90)	(16.94)	(16.20)
fob	-0.022***	-0.017***	-0.016***	-0.017***	-0.015***	-0.015***	-0.022***	-0.017***	-0.016***
	(-11.04)	(-3.39)	(-3.25)	(-4.26)	(-4.49)	(-4.55)	(-9.59)	(-3.42)	(-3.28)
hhi	-0.000***	-0.000***	-0.000***	-0.000	0.000	0.000	-0.000	0.000	0.000
	(-2.99)	(-2.88)	(-2.79)	(-0.22)	(0.61)	(0.61)	(-0.15)	(0.49)	(0.53)
cpi	-0.086***	-0.088***	-0.087***	0.499***	0.580***	0.572***	0.500***	0.574***	0.570***
	(-4.65)	(-4.63)	(-4.61)	(4.13)	(4.28)	(4.28)	(3.90)	(3.93)	(3.98)

Dependent Variable	(1) nim	(2) nim	(3) nim	(4) nim	(5) nim	(6) nim	(7) nim	(8) nim	(9) nim
	Green Loans	Transition Loans	Unclassified Loans	Green Loans	Transition Loans	Unclassified Loans	Green Loans	Transition Loans	Unclassified Loans
gdp	0.041***	0.039***	0.039***	0.019	0.012	0.013	0.019	0.014	0.014
	(2.88)	(2.68)	(2.68)	(1.18)	(0.75)	(0.76)	(1.13)	(0.79)	(0.79)
vsbn10y	0.424***	0.415***	0.419***	0.409***	0.375***	0.377***	0.406***	0.377***	0.378***
	(7.38)	(7.43)	(7.52)	(3.14)	(2.99)	(3.02)	(2.93)	(2.84)	(2.85)
cov19	-0.003*	-0.004**	-0.004**	0.002	0.002	0.002	0.002	0.002	0.002
	(-1.72)	(-2.11)	(-2.11)	(1.18)	(1.05)	(1.04)	(1.09)	(0.98)	(0.97)
constant	0.057***	0.064***	0.044***	0.009	0.011	-0.013	0.014	0.012	-0.009
	(4.63)	(4.12)	(3.67)	(0.51)	(0.61)	(-0.70)	(0.77)	(0.65)	(-0.41)
Bank FE	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes
Year FE	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
R2.	0.838	0.839	0.840	0.396	0.472	0.468	0.843	0.845	0.846
Observations	851	851	851	851	851	851	851	851	851

This table shows the panel data regression results of the net interest margin as the dependent variables, with green, transition, and unqualified loan portfolios as the main interest in the independent variables. The results are with bank fixed effects (Columns 1, 2, & 3), year fixed effect (Columns 4, 5, & 6), and bank and year fixed effects, concurrently (Columns 7, 8, & 9). The standard errors are clustered at bank level

The variable definitions are available in Appendix C. * p < .10, ** p < .05, *** p < .01

Source: Authors own work

5 Conclusion

Employing a unique dataset of green and non-green loans in Indonesia, a developing country with a relatively high net interest margin and a lower ESG score, our study examines how green and non-green portfolios link with banks' intermediary costs.

Based on the theoretical model and prior empirical evidence that the net interest margin captures information asymmetry, intermediation, or monitoring costs, we provide evidence that banks with greater green loans have lower intermediary costs and vice versa. Our findings are consistent with the loan risk-based view that banks consider environmental information in their lending decisions and perceive green loans to have lower risk (Beck & Hesse, 2009; Trinugroho et al., 2014). We further confirm our results by showing that green loans are associated with banks' loan interest spread (Chava, 2014; Alves & Meneses, 2024).

Our study has two main policy implications. First, it supports the regulator's efforts to boost environmentally friendly lending, as it is perceived to have lower risk, which links to lower bank intermediation costs. Next, as transition loans dominate banks' loan portfolios, financial sector regulators can also provide more incentives to borrowers in transition activities so that they can move their businesses toward green activities.

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