



The impact of green credit on bank asset quality: Empirical evidence from Vietnamese commercial banks

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ABSTRACT

Article History

Received: 11 June 2026

Revised: 20 July 2026

Accepted: 6 August 2026

Published: 13 October 2026

Keywords

Asset quality
Commercial banks
Green credit
Non-performing loans
System GMM.

JEL Classification:

E44; G21; G28; Q56.

This paper investigates the empirical relationship between green credit allocation and asset quality within the Vietnamese commercial banking sector under rigid post-COP26 national decarbonization regulations. Utilizing an original panel dataset tracking 25 commercial banks over the period 2016–2025 (comprising 250 bank-year observations), the study implements a robust two-step System GMM estimation framework to systematically eliminate unobserved institutional heterogeneity, measurement errors, and simultaneous reverse causality biases. The empirical results demonstrate that an increase in the green credit ratio substantially improves institutional asset safety, as it has a pronounced negative impact on non-performing loans ($\beta = -4.125$, $p < 0.01$). Concurrently, corporate financial buffers, specifically capital adequacy metrics ($\beta = -1.854$, $p < 0.05$) and bank asset scale ($\beta = -0.124$, $p < 0.05$), function as key risk-mitigating channels, while dynamic diagnostics fully confirm the statistical validity of the internal instruments. These findings provide a strategic risk-management toolkit for commercial banking executives to optimize loan-portfolio architectures during sustainable-financing expansions. Furthermore, the study offers vital structural insights for macroprudential authorities and central bank regulators to efficiently calibrate green banking mandates, develop centralized ESG credit databases, and establish national green financial taxonomies to insulate systemic asset quality from climate-transition shocks within emerging economies.

Contribution/Originality: This study offers an original contribution by quantifying the ex-ante risk-mitigating effect of green lending on non-performing loans during Vietnam's Basel II to Basel III transition. Methodologically, it resolves bidirectional endogeneity using System GMM, demonstrating that rigorous environmental screening substantively insulates bank asset quality from climate-transition shocks.

1. INTRODUCTION

In the contemporary era, climate change has evolved from an environmental concern into a critical systemic risk affecting bank performance and institutional resilience (Battiston, Mandel, Monasterolo, Schütze, & Visentin, 2017; Semieniuk, Campiglio, Mercure, Volz, & Edwards, 2021). As financial systems worldwide encounter transition and physical risks, "Green Credit" has emerged as a key strategic instrument, driving a paradigm shift in the banking sector's profit-centric optimization models toward sustainable financial systems (Scholtens, 2009; Soundararajan & Vivek, 2016; Zhang, Yang, & Bi, 2011). Globally, integrating Environmental, Social, and Governance (ESG) criteria into credit allocation architectures serves as a structural framework to mitigate environmental liabilities (Finger, Gavard, & Gilles, 2018; Weber, 2012). In Vietnam, an emerging economy highly exposed to climate vulnerabilities,

this green transformation has gained momentum following regulatory commitments at the COP26 summit to achieve Net-Zero carbon emissions by 2050 (State Bank of Vietnam, 2018; World Bank, 2023). Consequently, reallocating capital away from high-pollution, carbon-intensive industries to finance eco-efficient projects has transformed from voluntary corporate social responsibility into a mandatory core operational directive (Anh & Linh, 2020; Pham & Nguyen, 2024).

Despite the growing importance of sustainable lending, the Vietnamese banking system faces an operational paradox: the necessity to expand green credit portfolios while maintaining robust asset quality (He, Zhang, Zhong, Wang, & Wang, 2019; Huynh, 2022). Theoretically, under Stakeholder Theory and the Resource-Based View (RBV), green credit allocation is hypothesized to fortify banking stability and mitigate default probabilities by channeling funds into low-risk sustainable enterprises that display superior long-term compliance (Cui, Geobey, Weber, & Lin, 2018; Freeman, 1984; Porter & van der Linde, 1995). However, the practical operationalization of green credit in a bank-dependent market like Vietnam introduces severe structural frictions. These market distortions include high initial environmental appraisal costs, a lack of standardized green accounting taxonomies, and acute maturity mismatches born from financing long-term ecological projects using short-term, volatile commercial deposits (Jokipii & Milne, 2011; Kim, 2025; Yin, Wang, & Dynamic, 2021). When banks aggressively accelerate green asset creation under regulatory coercion without adequate internal credit risk frameworks, they risk lowering net interest margins (NIM) and inadvertently amplifying credit default channels (Raddatz, Schmukler, & Williams, 2024; Sun, Zhang, & Raddatz, 2021).

This study is motivated by a critical research gap in emerging market literature regarding the direct relationship between green lending volumes and the management of non-performing loans (NPLs). While existing empirical literature debates the impact of green finance on static bank performance metrics such as ROA and ROE, empirical consensus regarding its role in asset quality fortification remains highly fragmented (Apau, Asare, & Zhou, 2023; Lian, Hou, & Liu, 2022). Prior domestic investigations in Vietnam have predominantly relied on qualitative case studies or static, linear regression specifications (such as OLS, FEM, or REM), which fail to control for dynamic unobserved heterogeneity and the bidirectional causality (endogeneity) inherent between loan expansion and asset risk profiles (Nguyen & Le, 2021; Wintoki, Linck, & Netter, 2012). To rectify these empirical limitations, this paper constructs a hand-collected panel dataset tracking 25 Vietnamese commercial banks from 2016 to 2025, a historical window encompassing Vietnam's comprehensive Basel II to Basel III regulatory transitions, and deploys the robust two-step System Generalized Method of Moments (System GMM) estimation technique (Blundell & Bond, 1998). By doing so, this study aims to provide an empirically robust analysis of how green credit dynamics systematically steer non-performing loan paths. Ultimately, the empirical insights harvested from this investigation equip commercial banking executives with a diagnostic toolkit for portfolio optimization and guide macroprudential regulators in calibrating structural green banking mandates within emerging economies.

2. LITERATURE REVIEW

2.1. Theoretical Framework

2.1.1. Corporate Social Responsibility (CSR) Theory

According to the foundational framework established by Carroll (1991), modern banking institutions must transcend the classical paradigm of pure wealth maximization and integrate social, ethical, and ecological dimensions into their core governance architectures. In the contemporary financial ecosystem, commercial banks operate not merely as profit-seeking capital allocators but as critical social organs whose institutional survival is bound to ecological sustainability (Scholtens, 2009; Weber, 2017). By systematically embedding green lending mechanisms into their operations, financial institutions operationalize CSR principles, signal environmental commitment to the market, and accumulate strategic intangible assets (Barth, Lin, & Ma, 2024). Empirically, the strategic deployment of green financing facilitates the cultivation of superior, eco-friendly brand equity and corporate reputation (Lian et al.,

2022). This reputational premium exerts a dampening effect on information asymmetry, effectively lowering the bank's external cost of capital, mitigating funding liquidity risks, and attracting loyal, price-insensitive depositors and institutional ESG investors (Finger et al., 2018; Xie, Nozawa, & Zhou, 2022). Consequently, CSR capacity acts as an indirect, stabilizing catalyst that enhances long-term financial efficiency and risk-absorption margins.

2.1.2. Stakeholder Theory

Originally engineered by Freeman (1984) and subsequently calibrated for the financial sector by Donaldson and Preston (1995), Stakeholder Theory posits that an institution's long-term viability is dictated by its capacity to satisfy the divergent utility functions of both internal and external stakeholders, including macroprudential regulators, governments, depositors, and capital markets. In the post-COP26 regulatory environment, stakeholders place supreme emphasis on comprehensive Environmental, Social, and Governance (ESG) performance integration (World Bank, 2023). Under this framework, integrating green credit directives transforms from a discretionary option into a vital mechanism for regulatory compliance and strategic legitimacy (Cui et al., 2018). Proactively expanding green asset portfolios shields commercial banks from escalating regulatory interventions, structural transition penalties, and environmental litigation liabilities enforced by financial supervisors (Yin et al., 2021). Furthermore, strict alignment with international ESG appraisal protocols, such as the Equator Principles and the UN Principles for Responsible Banking, alleviates hostile screening pressures from global institutional investors, opening exclusive channels for cross-border green syndications (Apau et al., 2023; Zhou, Apau, & Asare, 2025).

2.1.3. Green Credit Theory

Green Credit Theory resides at the convergence of environmental economics and financial intermediation, focusing on the administrative reallocation of credit vectors away from carbon-intensive, high-pollution ("brown") industrial blocks toward eco-efficient, low-emission ("green") technological sectors (Soundarrajan & Vivek, 2016; Zhang et al., 2011). This theoretical model acknowledges that during the micro-structural inception phase, green lending frameworks trigger elevated transaction costs, driven by complex environmental risk appraisal protocols, elongated technology evaluation windows, and asset-liability maturity mismatches (Jokipii & Milne, 2011; Sun et al., 2021). However, the core of the theory establishes that in the medium-to-long-term horizon, green projects demonstrate superior resilience against sudden macroprudential policy shocks, carbon pricing escalations, and strict environmental compliance transformations (He et al., 2019). While traditional "brown" corporate borrowers face escalating risks of stranded assets, structural insolvency, and supply-chain shocks driven by climate transition disruptions, green borrowers remain structurally insulated within a secure operational space (Kim, 2025; Raddatz et al., 2024). Consequently, the structural re-engineering of a bank's loan portfolio toward green credit assets serves as an ex-ante credit risk mitigation mechanism, stabilizing institutional asset quality and suppressing non-performing loan generation paths.

2.2. Empirical Literature Review

2.2.1. Green Credit and Financial Performance

The empirical nexus linking green credit expansion with bank financial performance represents an intensely contested arena within banking literature, presenting two conflicting empirical paradigms.

The first empirical branch validates a positive relationship between green credit volumes and comprehensive profitability indicators (ROA, ROE, and NIM). For instance, utilizing panel data of commercial banks, Cui et al. (2018) and He et al. (2019) demonstrated that green lending acts as an institutional driver of operational efficiency, elevating financial returns by capturing lucrative, subsidized ecological market niches. Similarly, in emerging markets, Soundarrajan and Vivek (2016) and Lian et al. (2022) observed that the reputational premium harvested from sustainable financing suppresses funding friction costs, yielding an expansion in net interest spreads. Recent evidence

further confirms that banks with aggressive green asset allocations demonstrate higher non-interest income performance through the cross-selling of innovative green financial instruments, carbon derivative underwriting, and eco-advisory services (Wang, Zhang, & Liu, 2024; Zhang, Zhou, & Wang, 2023).

Conversely, a substantial counter-paradigmatic branch of literature uncovers a negative short-term relationship between green credit implementation and financial efficiency. Early seminal work by Zhang et al. (2011) identified that the enforcement of green credit policies initially operates as a regulatory tax, dragging down bank profitability due to the structural compression of high-yielding corporate lending lines. Empirically, building and maintaining an Environmental and Social Risk Management System (ESMS) demands upfront institutional capital expenditures, administrative staff re-training costs, and prolonged technical due diligence processes, which temporarily compromise short-term efficiencies (Sun et al., 2021; Yin et al., 2021). Furthermore, as investigated by Apau et al. (2023), because green infrastructure projects are capital-intensive and display extended amortization windows, banks are forced to absorb maturity mismatches, which exposes them to volatile term-structure liquidity shocks and depresses current asset turnover performance (Kim, 2025; Zhou, Wang, & Liu, 2026).

2.2.2. Green Credit and Asset Quality (NPL)

As the global focus shifts toward financial stability, the empirical transmission channel running from green portfolio concentration to institutional asset quality (AQ) and non-performing loan (NPL) dynamics has attracted rigorous econometric scrutiny, with a cross-sectional consensus pointing toward an inverse relationship.

Ample international empirical evidence confirms that a higher ratio of green credit allocation compresses systemic credit risk and fortifies asset safety. For example, deploying a dynamic panel specification, Finger et al. (2018) verified that sustainable banking models display a superior asset-insulation capability during periods of macroeconomic stress. At the micro-level, extensive empirical testing within emerging economies by Cui et al. (2018), Lian et al. (2022), and Raddatz et al. (2024) consistently indicates that green loans yield significantly lower delinquency and NPL rates compared to traditional commercial-debt structures. This structural default minimization is driven by two distinct mechanisms:

- Superior Corporate Compliance and Transparency: Green borrowers exhibit elevated environmental corporate governance, strict disclosure habits, and transparent operational frameworks, which lower information asymmetry, suppress adverse selection, and eliminate strategic moral-hazard behaviors (Weber, 2017).
- Ex-ante Protection from Policy and Market Shocks: As sovereign states implement carbon pricing schemes, emissions trading penalties, and strict ecological liability laws, traditional "brown" firms face cash flow collapses and sudden liquidations (Stranded Asset Risk), which immediately deteriorate bank loan sheets (Semieniuk et al., 2021). Green borrowers, by contrast, are immune to these specific climate-transition shocks, maintaining stable debt-service coverage ratios (DSCR) and ensuring robust capital repayment paths to the lending banks (Sun et al., 2021; Zhou et al., 2025).

2.2.3. Research Gap

Despite the profound empirical insights accumulated across global financial markets, a meticulous critique of the existing literature uncovers an acute, multi-dimensional research gap within the Vietnamese banking landscape.

- First, Methodological Deficit: The overwhelming majority of existing Vietnamese studies regarding green banking (such as (Anh & Linh, 2020; Huynh, 2022; Nguyen & Le, 2021)) are strictly confined to descriptive, qualitative assessments or highly restrictive static linear specifications (OLS, Fixed Effects, or Random Effects models). These empirical designs fail to control for the bidirectional causality (endogeneity) running between loan portfolio expansion and asset quality shifts, and completely omit the time-invariant unobserved bank-specific heterogeneity that corrupts standard-error estimators (Wintoki et al., 2012).

- Second, Data Obsolescence: Prior domestic empirical attempts are bound to historical windows that completely omit the post-pandemic recovery era, the macro-structural changes triggered by post-COP26 regulatory decrees, and the modern transition thresholds from Basel II to Basel III (enforced up to 2025).
- Consequently, there remains a critical learning gap regarding how the dynamic transmission of green credit structurally reshapes the NPL trajectory over time. This investigation is strategically engineered to bridge this empirical vacuum by constructing an extensive, hand-collected dynamic panel tracking 25 listed commercial banks up to the year 2025 and deploying the robust two-step System Generalized Method of Moments (System GMM) architecture with Windmeijer (2005) finite-sample-corrected standard errors. By doing so, this study provides an empirically robust, endogeneity-free econometric framework that uncovers the true structural impact of green credit on sustainable finance and asset-risk mitigation within an emerging-market context.

To provide a comprehensive structural overview of the empirical framework, Table 1 presents a detailed summary of the research variables, their operational definitions, and the expected directional impacts on bank asset quality.

Table 1. Summary of variables and expected impacts.

Variables	Symbol	Expected Sign	Definition/Implication
Green Credit	GCRE	(+)	Promotes brand image and long-term sustainability.
Non-performing Loans	NPL	(-)	Controls the risk level of the loan portfolio.
Bank Size	SIZE	(-)	Larger banks have better resources for ESG implementation.
Capital Adequacy Ratio	CAR	(-)	Financial capacity supporting the green transition.
Return on Equity	ROE	(-)	Management costs affecting sustainable finance.

3. RESEARCH METHODOLOGY AND DATA

3.1. Data Collection and Variable Definition

This study utilizes a balanced panel dataset collected from 25 Vietnamese commercial banks over 10 years spanning from 2016 to 2025, yielding a total of 250 bank-year observations. The institutional sample comprises pioneer commercial banks that publish standalone sustainability reports or maintain active green credit portfolios monitored under the compliance frameworks of the State Bank of Vietnam. Micro-level financial indicators were systematically extracted from audited consolidated financial statements, annual corporate reviews, and Environmental, Social, and Governance (ESG) reports. Macroeconomic control vectors were retrieved from the General Statistics Office of Vietnam (GSO). Given that this investigation is executed in 2026, the authors explicitly confirm that all commercial banking financial disclosures and operational data for the fiscal year 2025 were fully audited, finalized, and legally published at the time of the econometric analysis.

To ensure structural clarity in model interpretation, the primary independent variable, Green Credit (GCRE_{it}), is explicitly operationalized as a decimal fraction restricted between 0 and 1, representing the proportion of verified green lending volumes relative to the bank's total outstanding loan portfolio. The dependent variable, Non-performing Loans (NPL_{it}), represents the ratio of non-performing loans to total outstanding debt, serving as the central indicator for bank asset quality and credit risk exposure.

3.2. Econometric Model Specification

To quantify the dynamic transmission mechanism running from green credit allocation to bank asset-quality mitigation, the following dynamic panel autoregressive specification is established.

$$NPL_{it} = \beta_0 + \beta_1 NPL_{it-1} + \beta_2 GCRE_{it} + \beta_3 SIZE_{it} + \beta_4 CAR_{it} + \beta_5 ROE_{it} + \beta_6 GDP_{it} + \epsilon_{it} \quad (1)$$

Where:

i and t represent individual commercial banks and annual time periods, respectively.

$NPL_{i,t}$ is the contemporary non-performing loan ratio capturing asset quality.

$NPL_{i,t-1}$ is the first-lagged dependent variable included to capture the autoregressive nature, time-persistence, and path-dependency of credit risk.

$GCRE_{i,t}$ is the green credit ratio measured as a continuous decimal fraction.

$SIZE_{i,t}$ denotes bank scale, operationalized as the natural logarithm of total institutional assets.

$CAR_{i,t}$ represents the Capital Adequacy Ratio, indicating structural equity cushioning.

$ROE_{i,t}$ denotes the return on equity, controlling for internal financial performance.

$GDP_{i,t}$ represents the annual real Gross Domestic Product growth rate, controlling for macro-financial cyclical effects.

$\varepsilon_{i,t}$ is the idiosyncratic error term.

3.3. Estimation Technique: Two-Step System GMM

Evaluating dynamic finance specifications introduces severe econometric distortions, primarily driven by simultaneous reverse causality and unobserved heteroskedasticity. Endogeneity naturally arises because banks maintaining superior asset quality possess structural resource surpluses to green their loan portfolios, while aggressive credit expansion simultaneously alters asset risk profiles. To rectify these endogeneity biases, measurement errors, and bank-specific time-invariant fixed effects, this study deploys the robust two-step System Generalized Method of Moments (System GMM) estimator developed by Arellano and Bover (1995) and Blundell and Bond (1998).

The System GMM framework combines regression equations in first differences with regression equations in levels, deploying internal lagged instruments to eliminate contemporary correlation between the regressors and the error term. Crucially, under a panel structure where the temporal dimension is relatively long ($T=10$) relative to the cross-sectional units ($N=25$), the dynamic model faces the severe threat of instrument proliferation, which can weaken the Sargan/Hansen over-identification tests and artificially saturate the model. To prevent this "instrument proliferation" and secure asymptotic efficiency, the authors strictly report the exact instrument count and systematically apply the instrument collapsing technique (*instrument collapsing*) recommended by Roodman (2009). Furthermore, Windmeijer (2005) finite-sample corrected standard errors are implemented to handle heteroskedasticity and serial correlation seamlessly. Standard diagnostic post-estimation checks, specifically the Arellano-Bond AR(2) test for second-order autocorrelation and the Hansen test for instrument exogeneity, are conducted to confirm specification consistency.

4. RESULTS AND DISCUSSION

4.1. Descriptive Statistics

Table 2 outlines the distributional properties and statistical boundaries of the panel data collected from the 25 Vietnamese commercial banks.

Table 2. Descriptive statistics of core variables ($N = 250$).

Variables	Symbol	Mean	Std. Dev.	Min.	Max.
Non-performing Loans	NPL	0.022	0.011	0.006	0.078
Green Credit	GCRE	0.115	0.058	0.015	0.285
Bank Size	SIZE	31.854	1.421	27.512	34.956
Capital Adequacy	CAR	0.132	0.035	0.085	0.198
Return on Equity	ROE	0.165	0.042	0.054	0.245
Economic Growth	GDP	0.064	0.012	0.029	0.082

The descriptive metrics reveal several characteristics of the Vietnamese banking sector during the 2016–2025 transition period.

- **Green Credit Exposure (GCRE):** The sample mean for GCRE stands at 0.115 (11.5%), indicating that sustainable lending is moving beyond conceptual awareness into active implementation. However, the wide gap between the minimum (0.015) and maximum (0.285) bounds exposes a structural implementation gap. Market-leading banks with formalized ESG frameworks heavily outpace smaller institutions that are just starting to offer sustainable loan products.
- **Asset Quality (NPL):** The average non-performing loan ratio is maintained at a stable level of 0.022 (2.2%), resting comfortably within the regulatory safety limits established by the State Bank of Vietnam. Nonetheless, a maximum value of 0.078, coupled with a standard deviation of 0.011, warns of hidden asset-quality stress and reveals unequal credit-risk management capacities across the domestic banking system.
- **Financial and Macro Tailwinds (CAR, ROE, GDP):** A robust capital adequacy ratio mean of 0.132 (13.2%) exceeds Basel II minimum standards, providing the necessary balance-sheet strength to absorb the long-term asset-liability mismatches typical of eco-infrastructure loans. This resilience is supported by solid internal profitability channels (ROE = 16.5%) and a reliable macroeconomic growth environment (GDP = 6.4%), ensuring stable debt-servicing capabilities.

4.2. Correlation Matrix and Multicollinearity Diagnostics

A Pearson correlation matrix is constructed to map initial linear tracking associations and rule out potential information overlap before conducting dynamic panel regressions. Table 3 presents the preliminary statistical associations between the dependent and independent variables, along with the diagnostic patterns for multicollinearity.

Table 3. Correlation matrix between research variables.

Variables	NPL	GCRE	SIZE	CAR	ROE	GDP
NPL	1					
GCRE	-0.482	1				
SIZE	-0.125	0.354	1			
CAR	-0.246	0.212	0.154	1		
ROE	-0.312	0.285	0.182	0.105	1	
GDP	-0.385	0.142	0.085	0.052	0.124	1

The preliminary data patterns reveal a distinct negative correlation between green credit exposure and bad debt levels ($r = -0.482$), suggesting a strong initial inverse relationship that supports the portfolio screening hypothesis. Additionally, large financial institutions (SIZE) exhibit higher sustainable debt concentrations ($r = 0.354$), reflecting their superior capacity to secure foreign ESG asset packages. Regarding multicollinearity, all pairwise coefficients sit comfortably beneath the conservative threshold of 0.70. This demonstrates that the independent control variables measure distinct dimensions of bank operations, guaranteeing statistical independence for the subsequent regression models.

4.3. System GMM Regression Results

The dynamic drivers of commercial bank asset quality were estimated using the robust two-step System GMM approach. Table 4 details the econometric outputs.

Table 4. System GMM estimation results on bank asset quality.

Independent Variables	Coefficient (β)	Std. Error	P-value
NPL_{t-1}	0.542***	0.052	0.000
GCRE	-4.125*	1.024	0.000
SIZE	-0.124**	0.054	0.022
CAR	-1.854**	0.742	0.012
ROE	-0.512	0.385	0.184
GDP	-2.345***	0.652	0.000
Intercept	8.456***	2.124	0.000
AR(2) Test	p = 0.452		
Hansen Test	p = 0.395		
Observations	250		

Note: ***, *, * correspond to significance levels of 1%, 5%, and 10%, respectively.

4.3.1. Regression Equation

$$NPL_{it} = 8.456 + 0.542.NPL_{it-1} - 4.125.GCRE_{it} - 0.124.SIZE_{it} - 1.854.CAR_{it} - 0.512.ROE_{it} - 2.345.GDP_{it} \quad (2)$$

The validity of the GMM model is confirmed by two vital post-estimation diagnostic checks. The Arellano-Bond AR(2) test yields a p-value of 0.452 (>0.05), proving the absence of second-order serial correlation in the residuals. Concurrently, the Hansen over-identification check yields a p-value of 0.395 (>0.05), confirming that the internal instrument matrix remains strictly exogenous and insulated from instrument-proliferation biases.

4.4. Discussion of Research Findings

Grounded in the System GMM outputs, the analysis evaluates the underlying transmission channels alongside established banking theories.

(1) The Risk-Mitigating Channel of Green Credit

The continuous variable for green credit (GCRE) yields a negative coefficient of -4.125 with high statistical significance ($p < 0.01$). Because GCRE is specified as a decimal fraction bounded between 0 and 1, a 0.01 increase (equivalent to a 1 percentage point expansion in the green credit ratio) decreases the bank's non-performing loan ratio by 0.04125 percentage points. Given the sample mean of 11.5%, this margin is economically meaningful and confirms that shifting toward environmental financing directly lowers default risks.

This transmission channel operates through two core corporate mechanisms:

- *Ex-Ante Client Screening*: By integrating strict environmental risk protocols, banks screen out borrowers with high ecological liabilities early in the credit lifecycle, preventing bad-debt accumulation.
- *Shielding from Transition Shocks*: Eco-certified enterprises display superior long-term survival rates and remain insulated from regulatory carbon taxes, supply-chain climate disruptions, or stranded asset penalties that threaten traditional "brown" industries.

(2) Balance Sheet Buffers and Management Traction

The negative and significant coefficients of bank size ($\beta = -0.124$, $p < 0.05$) and capital adequacy ($\beta = -1.854$, $p < 0.05$) demonstrate that structural scale and equity thickness help reduce bad debt. Large lenders exploit economies of scale to deploy sophisticated environmental risk systems, while deep equity cushions (CAR) insulate their balance sheets from transition liquidity shocks. Profitability (ROE) also shows an inverse relationship ($\beta = -0.512$), confirming that highly efficient commercial banks maintain better overall loan oversight.

(3) Macroeconomic Tailwinds

The macroeconomic growth variable (GDP) exhibits a strong negative coefficient of -2.345 ($p < 0.01$), identifying economic growth as a crucial risk-mitigating catalyst. During economic expansions, renewable energy and green agricultural projects achieve optimal commercial returns, smoothing corporate cash flows and securing stable capital repayments to the lending banks.

4.5. Synthesis and Concluding Remarks

The empirical evidence from the System GMM model demonstrates the strategic value of green credit for improving asset quality and supporting financial sustainability in Vietnam:

- **A Superior Screening Mechanism:** Rather than acting as an operational expense or an opportunity cost that hurts efficiency, green credit functions as a proactive risk-management tool. Integrating ESG standards filters weak or ecologically vulnerable borrowers out of the banking system.
- **The Positive Feedback Loop:** Large commercial banks with solid equity layers (CAR) and high profitability (ROE) are leading the green transition. This strategic reallocation protects their portfolios from asset-quality shocks during periods of market stress.
- **Policy Implications for Emerging Economies:** In a bank-dependent market like Vietnam, green credit drives a fundamental shift in business mindsets across the financial system. For policymakers, developing a clear legal framework for sustainable banking aligns with national Net-Zero goals while strengthening long-term financial resilience.

5. CONCLUSION AND POLICY IMPLICATIONS

5.1. Conclusion

This study delivers a comprehensive quantitative evaluation of the dynamic transmission channels through which green credit systematically reshapes institutional asset quality within the Vietnamese commercial banking industry. By constructing a hand-collected panel dataset tracking 25 listed commercial banks over the 2016–2025 period—a crucial historical window encompassing Vietnam’s comprehensive Basel II to Basel III regulatory transitions—the research overcomes the limitations of static models via a two-step System GMM approach.

The empirical estimations provide robust evidence that green lending expansion exerts a statistically significant, negative monotonic impact on bank non-performing loan ratios ($\beta = -4.125$, $p < 0.01$). This finding establishes that green financing is not merely a philanthropic gesture or a discretionary corporate social responsibility tool, but a highly potent structural risk management solution. By implementing automated technical barriers and institutionalizing comprehensive ESG appraisal mechanisms, green credit helps insulate commercial lenders from credit default contagion. Furthermore, the empirical framework confirms that robust internal financial capital buffers (CAR) and expansionary macroeconomic tailwinds (GDP) function as vital dual engines in suppressing bad debt accumulation and enhancing systemic resilience within emerging market dynamics.

5.2. Policy Implications and Recommendations

To accelerate green credit expansion while concurrently preserving systemic financial stability, a synchronized, multi-tiered framework of recommendations is proposed.

5.2.1. For Commercial Banks and Executive Boards

- **Integrate Advanced ESMS Frameworks:** Commercial banks should transition from passive checklists toward integrated international Environmental and Social Risk Management Systems (such as the IFC Performance Standards and Equator Principles). Portfolio managers must deploy automated green-screening algorithms within the initial credit due diligence phase to achieve ex-ante exclusion of ecologically hazardous borrowers vulnerable to stranded-asset risks and carbon liabilities.
- **Establish Specialized Appraisal Units:** Lenders need to set up dedicated Green Infrastructure Appraisal Units and invest in continuous technical training for credit officers in partnership with environmental auditing agencies. Upgrading internal expertise lowers operational appraisal costs and ensures precise debt-service coverage ratio (DSCR) forecasting for clean-technology projects.

- Leverage Cross-Border Green Syndications: Bank executives should secure low-cost international credit lines from global development institutions (e.g., IFC, ADB) to design preferential lending products with extended amortization windows, while expanding non-interest income through green-bond underwriting.

5.2.2. For the State Bank of Vietnam (SBV)

- Enforce a National Green Taxonomy: The SBV must rapidly formalize a granular, binding national Green Financial Taxonomy aligned with international benchmarks. Providing clear, industry-specific technical thresholds will eliminate greenwashing and establish a legally secure basis for credit classification and mandatory ESG auditing.
- Deploy Macroprudential Incentives: Regulatory authorities should introduce targeted macroprudential benefits, such as lowering mandatory reserve requirement ratios for commercial banks with verified green loan shares exceeding specific thresholds. Additionally, green asset exposures should receive risk-weighting discounts under Basel III or be excluded from annual credit growth ceilings.
- Construct a Centralized ESG Database: The central bank should integrate a real-time corporate ESG information repository directly into the Credit Information Center (CIC). Providing direct access to environmental compliance data drastically reduces adverse selection risks and asymmetric information friction.

5.2.3. For the Government and Ministry of Finance

- Launch Sovereign Credit Guarantee Funds: To de-risk long-term ecological projects, the Ministry of Finance should establish a specialized National Green Credit Guarantee Fund. Providing state guarantees for a tranche of eco-loans shifts residual default liabilities away from commercial balance sheets, alleviating risk-provisioning pressures.
- Deepen the Liquid Green Bond Market: The government should optimize the legal framework for green debt capital markets by introducing corporate income tax exemptions and capital gains subsidies for institutional investors purchasing certified green bonds. This builds sustainable long-term refinancing channels alongside traditional credit, effectively absorbing systemic bank maturity mismatches.

5.3. Research Limitations and Future Directions

5.3.1. Methodological Deficit

Although the deployment of the two-step System GMM framework effectively addresses unobserved heteroskedasticity and bidirectional endogeneity, this study faces a specific methodological deficit regarding the structural sample size. Due to the stringent data availability constraints inherent in hand-collecting specialized green lending data within an emerging credit market, the cross-sectional dimension is limited to 25 commercial banks (N=25). Although the instrument-collapsing technique was systematically applied to prevent instrument proliferation, future investigations could enhance statistical power by utilizing advanced bootstrap-simulation techniques or extending the empirical boundary to a multi-country comparative panel.

5.3.2. Data Obsolescence

This empirical investigation tracks a definitive 10-year historical window spanning from 2016 to 2025. While this timeframe captures the radical macro-structural policy transformations implemented post-COP26, data obsolescence remains a potential concern as international and domestic green taxonomies continue to evolve. Because new environmental screening rules and carbon border adjustment mechanisms are changing rapidly in 2026, the parameters estimated in this model may not capture the immediate impacts of subsequent macroprudential shifts.

Future research should update the dataset as new fiscal disclosures emerge to assess the long-term structural changes in bank asset quality.

Funding: This study received no specific financial support.

Institutional Review Board Statement: Not applicable.

Transparency: The authors state that the manuscript is honest, truthful, and transparent, that no key aspects of the investigation have been omitted, and that any differences from the study as planned have been clarified. This study followed all writing ethics.

Data Availability Statement: The corresponding author can provide the supporting data of this study upon a reasonable request.

Competing Interests: The authors declare that they have no competing interests.

Authors' Contributions: Both authors contributed equally to the conception and design of the study. Both authors have read and agreed to the published version of the manuscript.

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