Asian Journal of Innovative Research in Social Science
Vol 5, No.1, 2026
https://journal.das-institute.com/index.php/ajirss

GREEN MACROPRUDENTIAL BANKING STABILITY FRAMEWORK : A GLOBAL TRANSMISSION MECHANISM OF SUSTAINABLE FINANCE

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DOI: 10.53866/ajirss.v5i1.1270

Abstract

The increasing exposure of the financial system to climate-related risks has encouraged the evolution of macroprudential policy toward sustainability-oriented frameworks. This study develops the Green Macroprudential Banking Stability Framework (GMBSF) as an integrated analytical model explaining how sustainable finance instruments influence banking system resilience. Unlike conventional approaches that treat green finance as a complementary policy, this research positions it as a core macroprudential transmission channel affecting systemic stability. The study employs a panel dynamic approach using multi-institution banking data over the 2015–2024 period to examine both short-run adjustments and long-run equilibrium relationships between green financing, Environmental, Social, and Governance (ESG) performance, and banking stability. Stability is proxied by the Z-Score, while capital adequacy, profitability, credit risk, and institutional size are incorporated as control variables. The empirical findings indicate that sustainable finance exposure and stronger ESG governance significantly enhance banking stability by improving risk absorption capacity, strengthening capital buffers, and reducing credit volatility. Conversely, higher non-performing loans weaken systemic resilience. The results support the argument that green finance functions as a macroprudential shock absorber within climate-sensitive financial systems. This study contributes theoretically by introducing a globally applicable green macroprudential framework that integrates sustainability indicators into systemic risk management architecture. The proposed GMBSF provides strategic implications for central banks and financial regulators in designing climate-responsive macroprudential policies to maintain financial stability during the transition toward a low-carbon economy.
Keyword: Green Macroprudential; Sustainable Finance; ESG Governance; Banking Stability; Systemic Risk

Abstrak

Meningkatnya intensitas risiko keuangan terkait perubahan iklim telah mendorong transformasi kerangka kebijakan makroprudensial menuju pendekatan yang berorientasi pada keberlanjutan. Penelitian ini mengembangkan Green Macroprudential Banking Stability Framework (GMBSF) sebagai model analitis global yang menjelaskan mekanisme transmisi instrumen keuangan berkelanjutan dalam memperkuat ketahanan sistem perbankan. Berbeda dengan pendekatan konvensional yang memandang keuangan hijau sebagai kebijakan lingkungan pelengkap, penelitian ini memposisikannya sebagai kanal utama kebijakan makroprudensial yang memengaruhi stabilitas sistemik. Meningkatnya intensitas risiko keuangan terkait perubahan iklim telah mendorong transformasi kerangka kebijakan makroprudensial menuju pendekatan yang berorientasi pada keberlanjutan. Penelitian ini mengembangkan Green Macroprudential Banking Stability Framework (GMBSF) sebagai model analitis global yang menjelaskan mekanisme transmisi instrumen keuangan berkelanjutan dalam memperkuat ketahanan sistem perbankan. Berbeda dengan pendekatan konvensional yang memandang keuangan hijau sebagai kebijakan lingkungan pelengkap, penelitian ini memposisikannya sebagai kanal utama kebijakan makroprudensial yang memengaruhi stabilitas sistemik. Penelitian ini menggunakan pendekatan panel dinamis dengan data perbankan multi-institusi selama periode 2015–2024 untuk mengkaji hubungan jangka pendek dan jangka panjang antara eksposur pembiayaan hijau, kinerja Environmental, Social, and Governance (ESG), dan stabilitas perbankan. Stabilitas perbankan diukur menggunakan Z-Score, dengan variabel kontrol meliputi kecukupan modal, profitabilitas, risiko kredit, dan ukuran institusi. Hasil empiris menunjukkan bahwa eksposur keuangan berkelanjutan dan tata kelola ESG yang kuat secara

signifikan meningkatkan stabilitas perbankan melalui penguatan buffer modal, peningkatan kapasitas penyerapan risiko, serta penurunan volatilitas kredit. Sebaliknya, tingkat kredit bermasalah yang tinggi melemahkan ketahanan sistemik. Temuan ini menegaskan bahwa keuangan hijau berfungsi sebagai shock absorber makroprudensial dalam sistem keuangan yang sensitif terhadap risiko iklim. Penelitian ini berkontribusi secara teoretis dengan menawarkan kerangka makroprudensial hijau yang bersifat global dan mengintegrasikan indikator keberlanjutan ke dalam arsitektur manajemen risiko sistemik.
Kata Kunci: Makroprudensial hijau; Keuangan berkelanjutan; Tata kelola ESG; Stabilitas perbankan; Risiko sistemik

1. Introduction

Climate change has increasingly been recognized as a material source of financial risk, arising from both physical risks (e.g., extreme weather events) and transition risks (e.g., policy shifts, technological change, and carbon re-pricing) (Elderson, 2021). These risk drivers can translate into banking losses through conventional channels such as credit deterioration, market repricing, liquidity stress, and operational disruptions—thereby challenging standard assumptions in financial stability monitoring (Schinasi, 2004).

Reflecting this recognition, central banks and supervisors have expanded the conceptual boundary of macroprudential oversight toward climate-sensitive frameworks. A key implication is that climate risk cannot be treated as a niche environmental issue; instead, it interacts with systemic vulnerabilities and may amplify procyclicality and interconnectedness in the financial system. This view is strongly echoed in global policy discussions that emphasize the "radical uncertainty" and non-linear dynamics associated with climate-related financial instability (Bolton et al., 2020).

In parallel, sustainable finance and ESG governance have emerged as institutional mechanisms intended to internalize climate-related risks into financial decision-making (Dikau & Volz, 2021). Green credit allocation, sustainability-linked instruments, and stronger ESG governance can influence the risk profile of banking portfolios through improved screening, monitoring, and alignment with transition pathways (Campiglio, 2016). However, much of the literature still frames sustainable finance primarily as a development or environmental policy tool rather than as a macroprudential transmission channel with direct implications for systemic stability (Baicu, 2023).

Traditional macroprudential frameworks—designed mainly for credit cycles, leverage build-ups, and liquidity mismatches—have well-established toolkits such as countercyclical capital buffers, leverage ratios, and liquidity requirements (Galati & Moessner, 2011). Yet these instruments were not originally calibrated for long-horizon climate risks that may accumulate gradually but trigger discontinuous financial repricing. This creates a theoretical gap: how to integrate sustainability indicators into the architecture of systemic risk management without reducing them to a purely reputational or CSR domain (Kalaiarasi & Kirubahari, 2023).

To address this gap, the present study develops the Green Macroprudential Banking Stability Framework (GMBSF) as a globally applicable model that conceptualizes sustainable finance exposure and ESG governance as core macroprudential transmission mechanisms influencing banking stability (Aracil et al., 2021). The framework is designed to be institution-neutral and jurisdiction-agnostic, enabling cross-setting interpretation while maintaining methodological transparency. The aim is not to "localize" evidence, but to articulate a generalizable stability mechanism consistent with climate-sensitive prudential thinking (Nguyen, 2025).

Accordingly, this study contributes by (i) formalizing a green macroprudential transmission logic that links sustainable finance and ESG governance to resilience outcomes, (ii) empirically validating long-run and short-run dynamics using a dynamic panel strategy suitable for heterogeneous institutions, and (iii) deriving policy implications for climate-responsive macroprudential design relevant to central banks and supervisory authorities (Pesaran et al., 2001).

2. Research Methodology

This study employs a quantitative explanatory design to assess whether sustainable finance exposure and ESG governance operate as macroprudential stabilizers within a climate-sensitive financial system. Because banking stability typically exhibits persistence and institutional heterogeneity, a dynamic panel framework is adopted to capture both adjustment dynamics and equilibrium relationships. This choice aligns with standard econometric guidance for panel data where cross-sectional units may differ in short-run behavior but share long-run regularities (Palmaccio et al., 2023).

To model both short-run and long-run effects, the empirical strategy uses a Panel ARDL / Pooled Mean Group (PMG) approach. The PMG estimator constrains long-run coefficients to be common across institutions while allowing heterogeneous short-run dynamics and error variances—an appealing

compromise between full pooling and full heterogeneity. This is particularly relevant for stability analysis where structural long-run relationships may be similar, but short-run adjustments can differ due to balance-sheet structure and governance quality (Pesaran et al., 2001).

Banking stability is proxied by the Z-Score, a widely used insolvency-risk indicator that combines profitability, capitalization, and earnings volatility—interpretable as the "distance to default" in banking applications (Goel et al., 2017). The Z-Score has been extensively used in bank-risk and bank-performance research and remains a standard tool for comparative stability assessment.

The main explanatory variables are (i) Sustainable Finance Exposure (SFE)—capturing the relative emphasis of sustainability-aligned financing in the loan/investment portfolio—and (ii) ESG Governance Quality (ESGQ)—capturing governance strength and sustainability management practices derived from disclosures. The ESG literature provides robust evidence that governance quality is strongly associated with risk management capacity and long-term performance, supporting its inclusion as a stability-relevant determinant rather than a purely reputational metric (Damodar N. Gujarati, 2004).

Control variables follow standard prudential determinants of stability and credit risk: capital adequacy, profitability, credit risk (e.g., NPL ratio), and institution size. These controls reflect conventional channels in macroprudential monitoring, ensuring that the estimated effects of SFE and ESGQ are not confounded by baseline solvency, earnings capacity, or scale-related risk properties (Galati & Moessner, 2011). (Galati & Moessner, 2018; Baltagi, 2021).

The baseline PMG-ARDL specification can be expressed (conceptually) as:

$$\mathbf{Stability_{it} = f(SFE_{it}, ESGQ_{it}, Capital_{it}, Profitability_{it}, CreditRisk_{it}, Size_{it})},$$

with an error-correction representation used to interpret the speed of adjustment toward long-run equilibrium. This structure is consistent with macroprudential transmission thinking in which climate-related risks map into traditional risk categories, while green finance and governance can moderate the propagation of climate shocks through balance-sheet resilience (Palmaccio et al., 2023).

3. Results and Discussio

The long-run estimation results indicate that sustainable finance exposure is positively associated with banking stability. Interpreted through GMBSF, this finding is consistent with the proposition that climate-aligned portfolio shifts can improve risk composition and reduce vulnerability to transition shocks, thereby strengthening resilience over time. This logic aligns with policy-oriented evidence emphasizing that climate risk drivers materialize through standard banking risk channels, which can be mitigated by forward-looking portfolio strategies (The World Bank, 2021).

Similarly, the long-run effect of ESG governance quality on stability is positive, suggesting that stronger governance and sustainability management act as risk-control mechanisms. This is consistent with the broader ESG evidence base showing that ESG—especially governance—correlates with stronger risk management and long-term performance, which can translate into lower insolvency risk and more stable earnings (Masciandaro & Russo, 2024).

By contrast, credit risk (proxied by non-performing loans or comparable measures) exhibits a negative relationship with stability, consistent with the standard prudential view that impaired asset quality is a primary destabilizing factor. Within the GMBSF architecture, credit risk represents a key destabilizing transmission channel through which both macro shocks and climate-related exposures can amplify losses and weaken solvency buffers (Taneja et al., 2023).

The short-run dynamics show partial adjustments toward the long-run equilibrium, supporting the idea that the stabilizing effects of sustainable finance and governance accumulate over time rather than instantaneously (Bolton et al., 2020). This is consistent with the conceptual argument in climate-finance policy literature that climate risk management and transition alignment operate over longer horizons and under conditions of uncertainty, implying gradual transmission into observed stability outcomes (Ebrahimi Kahou & Lehar, 2017).

From a macroprudential policy perspective, the results support positioning green finance as a macroprudential shock absorber: by improving portfolio quality, strengthening capital resilience, and reducing volatility, sustainability-aligned exposures can dampen the propagation of climate-related shocks into systemic instability. This framing is coherent with the broader policy shift advocating climate-responsive supervisory approaches and prudential principles for managing climate-related financial risks (Punzi, 2024).

Taken together, the findings reinforce the central theoretical claim of GMBSF: sustainable finance and ESG governance are not merely "add-ons," but can be treated as core components of a climate-sensitive macroprudential transmission mechanism. This interpretation is consistent with the view that

financial stability frameworks must evolve to incorporate sustainability variables to remain adequate under climate transition conditions and associated systemic risk re-pricing (Akinci & Olmstead-Rumsey, 2018).

4. Conclusion

This study develops and validates the Green Macroprudential Banking Stability Framework (GMBSF) as a globally applicable model explaining how sustainable finance exposure and ESG governance transmit into banking stability. Empirical evidence from a dynamic panel specification indicates that sustainable finance and ESG governance strengthen stability in the long run, while credit risk remains the principal destabilizing force. These results support the argument that climate-sensitive prudential thinking should treat sustainability variables as stability-relevant drivers rather than solely ethical or reputational considerations (Borio, 2013).

Policy-wise, the GMBSF implies that regulators and supervisors can operationalize climate-sensitive macroprudential design by embedding sustainability indicators within prudential monitoring, governance expectations, and risk management standards. This direction is consistent with international supervisory guidance emphasizing the management and supervision of climate-related financial risks and the need to map climate drivers into conventional risk categories (Masciandaro & Russo, 2024).

(Luo & Kamarudin, 2024) Future research can strengthen the GMBSF agenda by extending robustness checks (alternative stability measures; alternative ESG proxies), addressing endogeneity with appropriate instruments or system estimators, and exploring cross-jurisdiction comparisons to test external validity. Such extensions would help translate the GMBSF logic into scalable policy toolkits for macroprudential authorities operating under climate transition uncertainty.

Bibliography

Akinci, O., & Olmstead-Rumsey, J. (2018). How effective are macroprudential policies? An empirical investigation. *Journal of Financial Intermediation*, *33*, 33–57. https://doi.org/10.1016/j.jfi.2017.04.001

Aracil, E., Nájera-Sánchez, J. J., & Forcadell, F. J. (2021). Sustainable banking: A literature review and integrative framework. *Finance Research Letters*, *42*. https://doi.org/10.1016/j.frl.2021.101932

Baicu, C. G. (2023). Green Finance-International Initiatives And Relevant Practices In Supporting Global Sustainable Goals 1. *Social Economic Debates*, *Volume 12*(Issue 1), 1–10. www.economic-debates.ro

Bolton, Patrick., Despres, Morgan., Pereira da Silva, L. Awazu., & Svartzman, Romain. (2020). *The green swan : central banking and financial stability in the age of climate change*. Bank for International Settlements.

Borio, C. (2013). *Macroprudential policy and the financial cycle: Some stylised facts and policy suggestions*.

Campiglio, E. (2016). Beyond carbon pricing: The role of banking and monetary policy in financing the transition to a low-carbon economy. *Ecological Economics*, *121*, 220–230. https://doi.org/10.1016/j.ecolecon.2015.03.020

Damodar N. Gujarati. (2004). *Basic Econometrics*.

Dikau, S., & Volz, U. (2021). Central bank mandates, sustainability objectives and the promotion of green finance. *Ecological Economics*, *184*. https://doi.org/10.1016/j.ecolecon.2021.107022

Ebrahimi Kahou, M., & Lehar, A. (2017). Macroprudential policy: A review. In *Journal of Financial Stability* (Vol. 29, pp. 92–105). Elsevier B.V. https://doi.org/10.1016/j.jfs.2016.12.005

Elderson, F. (2021). *NGFS ANNUAL REPORT 2021 2 Introductory messages*.

Galati, G., & Moessner, R. (2011). *BIS Working Papers Macroprudential policy-a literature review*. www.bis.org

Goel, A., Khatik, R. K., & Thakur, K. S. (2017). Green Banking: An Approach For Achieving Sustainable And Balanced Growth In New Millennium. In *Inspira-Journal of Modern Management & Entrepreneurship (JMME)* (Vol. 27, Number 04).

Kalaiarasi, H., & Kirubahari, S. (2023). Green Blockchain Technology for Sustainable Smart Cities Chapter 7-Green finance for sustainable development using blockchain technology. *Green Blockchain Technology for Sustainable Smart Cities*, 167–185. https://doi.org/./B----.-

Luo, H., & Kamarudin, F. (2024). Macroprudential policies and CO2 emissions: A comparative analysis of G7 and BRIC countries. *PLoS ONE*, *19*(1 January). https://doi.org/10.1371/journal.pone.0296363

Masciandaro, D., & Russo, R. (2024). Monetary and macroprudential policies: How to Be green? A political-economy approach. *Economic Modelling*, *141*.

https://doi.org/10.1016/j.econmod.2024.106931
Nguyen, Q. K. (2025). Green finance, climate risk and financial stability: Evidence from ASEAN+4 countries. *Environmental and Sustainability Indicators*, *28*. https://doi.org/10.1016/j.indic.2025.100922
Palmaccio, M., Galeone, G., Shini, M., & Campobasso, F. (2023). Green Finance: Past, Present And Future Studies. *Journal of Financial Management, Markets and Institutions*, *11*(2). https://doi.org/10.1142/S2282717X23500135
Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics*, *16*(3), 289–326. https://doi.org/10.1002/jae.616
Punzi, M. T. (2024). The role of macroprudential policies under carbon pricing. *International Review of Economics and Finance*, *93*, 858–875. https://doi.org/10.1016/j.iref.2024.03.044
Schinasi, G. J. (2004). *Defining Financial Stability*.
Taneja, S., Bhatnagar, M., & Ozen, E. (2023). *Greening the economy: Harnessing the power of sustainable finance*. https://doi.org/./B----.-
The World Bank. (2021). *Greening the Financial System and Developing a National Green Taxonomy*.