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Green Innovation and the Sustainability of Banks in Europe

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ABSTRACT

The transition toward a low-carbon economy has placed unprecedented pressure on financial institutions to adopt environmentally responsible strategies. Within the European Union (EU), banks are increasingly called upon to integrate green innovation (GI) into their operations and financing activities as part of broader efforts to achieve the goals of the EU Green Deal, Corporate Sustainability Reporting Directive (CSRD), and Sustainable Finance Disclosure Regulation (SFDR). This study investigates the impact of GI on the sustainability performance of European banks across three dimensions: environmental, financial, and social. Grounded in the Resource-Based View, Stakeholder Theory, and Institutional Theory, the research employs a quantitative, cross-sectional survey of European banks supplemented by secondary ESG data. Using Partial Least Squares Structural Equation Modeling (PLS-SEM), the findings demonstrate that GI positively influences all three dimensions of sustainability, with particularly strong effects on environmental and social outcomes. Moreover, the analysis reveals that regulatory pressure and transparency in ESG disclosure significantly moderate these relationships, albeit with regional variation: regulatory pressure exerts greater influence in Southern Europe, while disclosure quality enhances impacts more strongly in Northern Europe. The study contributes theoretically by extending existing governance and sustainability frameworks, practically by offering actionable guidance to banks seeking to align competitiveness with sustainability, and politically by informing policymakers on the need for harmonized standards, supervisory capacity, and incentives to encourage GI adoption. Limitations and future research directions are discussed, including the need for longitudinal and cross-regional studies, as well as investigations into emerging technologies such as AI in sustainability reporting.

Keywords: Green innovation, bank sustainability, ESG disclosure, regulatory pressure, European Union, financial institutions.

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1. Introduction

In recent years, climate change, environmental degradation, and growing stakeholder awareness have placed sustainability at the center of the global financial agenda. The European Union (EU), through initiatives such as the European Green Deal, the Sustainable Finance Disclosure Regulation (SFDR), and the EU Taxonomy Regulation, has emphasized the critical role of financial institutions in accelerating the transition toward a low-carbon and resource-efficient economy (European Commission, 2020; EU Technical Expert Group, 2020). The EU Taxonomy, in particular, provides a science-based classification system that helps banks and investors determine which activities qualify as environmentally sustainable. By standardizing definitions of “green” economic activities, the Taxonomy enhances transparency, combats greenwashing, and directs capital flows toward projects that contribute to climate mitigation and adaptation (Ehlers et al., 2021).

Complementing these regulatory initiatives, the European Central Bank (ECB) has positioned sustainable finance as a central pillar of its supervisory strategy. The ECB has introduced climate-related stress testing, integrated sustainability risks into the Supervisory Review and Evaluation Process (SREP), and issued guidance on the management of environmental, social, and governance (ESG) risks for banks (ECB, 2022). These initiatives reinforce the expectation that banks must not only disclose but also strategically manage their exposure to climate and sustainability-related risks. By embedding sustainability into prudential supervision, the ECB is shaping the incentives for banks to adopt green innovation (GI) practices at both operational and strategic levels.

Within this evolving policy landscape, green innovation—defined as the development and adoption of new products, processes, or practices that reduce environmental harm and promote resource efficiency—has become a strategic imperative for the European banking sector (Albort-Morant et al., 2016; Cai & Li, 2018). For banks, sustainability is no longer limited to profitability or financial resilience but extends to their ability to foster long-term environmental and social well-being (Cai et al., 2020). GI enables banks to align their operations and services with the EU’s regulatory frameworks by integrating ESG criteria into lending decisions, financing green infrastructure projects, and creating innovative sustainable financial products.

Despite the growing body of literature on sustainability in financial services, there remains a research gap in understanding how GI specifically enhances the sustainability of banks in the European context. While most studies have focused on GI in manufacturing and industrial firms (Chen et al., 2006; Dangelico & Pujari, 2010), the unique role of banks as financial intermediaries in sustainable finance has received less scholarly attention. Given the EU’s ambitious target of achieving climate neutrality by 2050, examining how GI supports the sustainability of banks within the framework of the EU Taxonomy and ECB supervisory practices is both timely and necessary.

This study seeks to address this gap by exploring the relationship between GI and the sustainability of banks in Europe. It aims to answer the following guiding questions: (1) How does green innovation contribute to the environmental, financial, and social sustainability of banks? (2) What are the key opportunities and challenges that banks face in embedding GI within their strategies and operations? By addressing these questions, the study contributes to both theory and practice, offering insights into how GI can serve as a catalyst for sustainable banking under the EU’s evolving regulatory and institutional frameworks.

2. Literature Review

2.1 Green Innovation

Green innovation (GI), also referred to as eco-innovation or sustainable innovation, refers to the development and implementation of products, services, processes, or organizational practices that minimize environmental harm while promoting efficiency and competitiveness (Chen et al., 2006; Dangelico & Pujari, 2010). Unlike traditional innovation, which focuses primarily on economic performance, GI explicitly integrates environmental and social dimensions into innovation strategies (Albort-Morant et al., 2016).

In the context of the financial sector, GI includes both internal practices—such as implementing sustainable IT infrastructure, reducing energy consumption, and adopting green office operations—and external practices such as financing renewable energy projects, issuing green bonds, and providing sustainable investment products (Cheng et al., 2019; Cai & Li, 2018). By aligning with regulatory frameworks such as the EU Taxonomy, GI provides banks with a

strategic pathway to support climate transition goals while enhancing their legitimacy among stakeholders (Ehlers et al., 2021).

However, the adoption of GI is not without challenges. Research indicates barriers such as high costs, lack of expertise, regulatory complexity, and risks of greenwashing if disclosure standards are poorly enforced (Díaz-García et al., 2015; Khan et al., 2021). These challenges highlight the need for robust governance mechanisms and supervisory frameworks, such as those enforced by the European Central Bank (ECB, 2022).

2.2 Bank Sustainability

Sustainability in the banking sector extends beyond financial stability to encompass environmental, social, and governance (ESG) dimensions (Cai et al., 2020). Banks are uniquely positioned as financial intermediaries to influence sustainable development by channeling capital toward green projects, integrating ESG risks into credit assessments, and offering sustainable financial instruments (Weber, 2017).

Empirical studies show that banks engaging in sustainable practices enjoy long-term benefits such as enhanced stakeholder trust, reduced reputational risk, and improved financial resilience (Khan et al., 2021; Broadstock et al., 2021). Moreover, regulatory initiatives such as the EU Taxonomy and SFDR compel banks to disclose sustainability-related risks and classify their financial activities based on environmental impact (European Commission, 2020).

Nonetheless, sustainability in banking faces significant constraints. These include inconsistent ESG reporting standards across countries, challenges in measuring the real environmental impact of financing, and potential trade-offs between short-term profitability and long-term sustainability (Buallay, 2019). Recent research emphasizes the importance of harmonizing disclosure standards and integrating sustainability into supervisory frameworks (ECB, 2022).

2.3 Theoretical Frameworks

Several theoretical perspectives provide insight into the link between green innovation and banking sustainability:

Resource-Based View (RBV): GI represents a valuable, rare, and inimitable capability that can enhance banks' competitive advantage (Barney, 1991). By embedding GI into their operations and services, banks develop distinctive competencies that foster long-term sustainability.

Stakeholder Theory: Banks are increasingly accountable not only to shareholders but also to multiple stakeholders, including regulators, customers, communities, and the environment (Freeman, 1984). GI allows banks to address stakeholder demands by aligning financial services with social and environmental priorities.

Institutional Theory: The adoption of GI in European banks is shaped by institutional pressures, including coercive regulations (EU Taxonomy, ECB guidance), normative expectations (sustainability reporting standards), and mimetic pressures (benchmarking against competitors) (DiMaggio & Powell, 1983). These pressures collectively influence banks to integrate GI into their strategies and practices.

Together, these theoretical frameworks suggest that GI is not merely an operational choice but a strategic necessity for banks seeking to balance profitability with environmental and social responsibilities under the EU's evolving sustainability regime.

3. Conceptual Framework

3.1 Conceptual Rationale

The conceptual framework for this study builds upon the literature reviewed in the previous chapter and integrates insights from the Resource-Based View (RBV), Stakeholder Theory, and Institutional Theory. It proposes that green innovation (GI) is a critical driver of bank sustainability in the European context.

Bank sustainability is conceptualized across three dimensions:

Environmental sustainability – the bank's ability to reduce its ecological footprint and finance environmentally beneficial projects.

Financial sustainability – long-term profitability, resilience, and risk management through sustainable practices.

Social sustainability – enhancing stakeholder trust, transparency, and contribution to societal well-being.

The framework suggests that GI positively influences these three sustainability outcomes. However, the strength of this relationship is shaped by contextual factors, particularly regulatory pressure (e.g., EU Taxonomy, ECB guidelines) and transparency/ESG disclosure quality.

3.2 Proposed Relationships

H1: Green innovation positively influences the environmental sustainability of banks.

H2: Green innovation positively influences the financial sustainability of banks.

H3: Green innovation positively influences the social sustainability of banks.

H4: Regulatory pressure positively moderates the relationship between green innovation and bank sustainability.

H5: Transparency and ESG disclosure quality positively moderate the relationship between green innovation and bank sustainability.

3.3 Conceptual Model

The conceptual model links Green Innovation (independent variable) with Bank Sustainability (dependent variable), decomposed into environmental, financial, and social sustainability. Moderating variables include Regulatory Pressure and Transparency/ESG Disclosure (See figure 1).

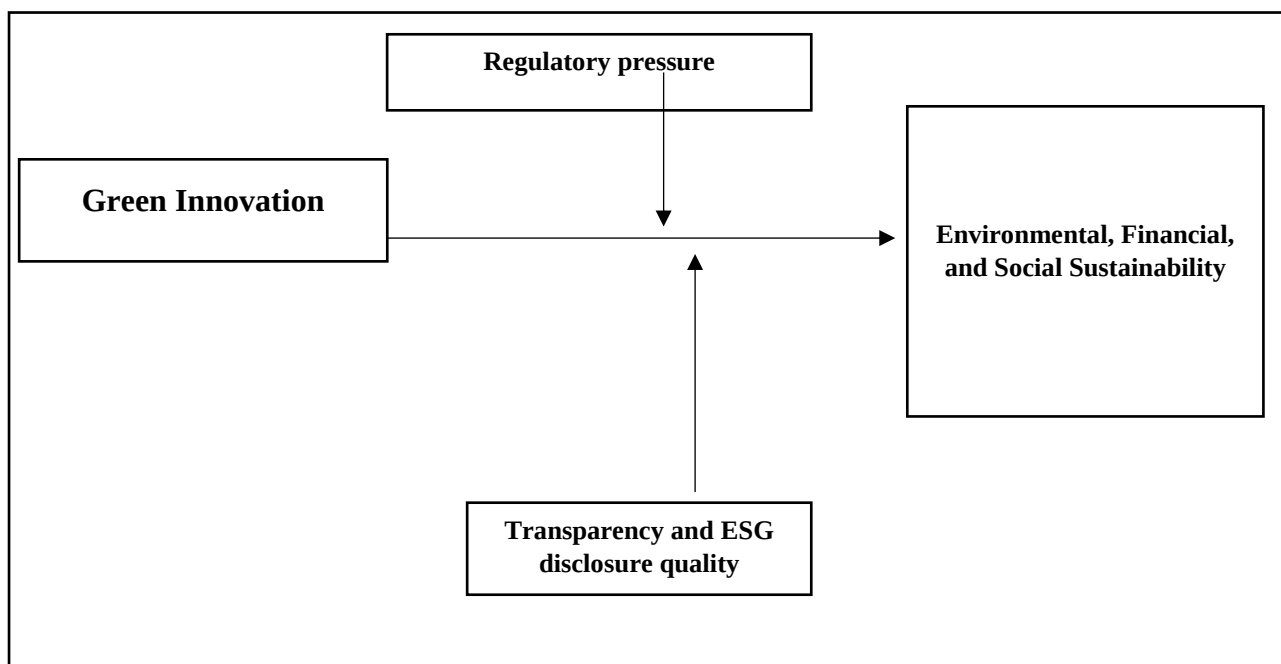


Figure 1: visual conceptual model diagram.

4. Methodology

4.1 Research Design

This study adopts a quantitative, hypothesis-driven research design to examine the relationship between green innovation (GI) and the sustainability performance of European banks. The choice of a quantitative approach is justified by the need to empirically test theoretical relationships developed in the conceptual framework. A cross-sectional survey design is

employed, collecting primary data from banking professionals and secondary data from sustainability reports. This design ensures both perception-based insights and objective sustainability performance indicators.

4.2 Population and Sample

The target population consists of European banks listed in the European Banking Authority (EBA) registry and operating under the EU regulatory framework. To ensure representation, a stratified sampling technique will be applied across major EU regions (Western, Northern, Southern, and Eastern Europe).

Sample size determination follows Krejcie and Morgan (1970), targeting approximately 200–250 valid responses.

Respondents will include senior managers, compliance officers, ESG officers, and innovation managers, as they are most directly involved in sustainability and innovation initiatives.

4.3 Data Collection

Two main sources of data will be used:

Survey Questionnaire: A structured questionnaire will measure green innovation practices and perceived sustainability outcomes. Items will be adapted from validated scales in previous studies (e.g., Chen et al., 2006; Song & Yu, 2018; Yousaf et al., 2021). Responses will be recorded on a five-point Likert scale ranging from “Strongly Disagree” (1) to “Strongly Agree” (5).

Secondary Data: Complementary data on environmental and social sustainability indicators will be collected from banks’ annual reports, sustainability reports, and ESG databases (e.g., Refinitiv Eikon, Bloomberg). This triangulation increases robustness and minimizes common method bias.

4.4 Measurement of Variables

Independent Variable – Green Innovation (GI): Measured through items reflecting product innovation (e.g., green loans, green bonds), process innovation (e.g., digitalization for energy efficiency), and organizational innovation (e.g., green culture, training).

Dependent Variable – Bank Sustainability: Divided into three dimensions:

Environmental Sustainability: emission reduction, energy efficiency, financing renewable projects.

Financial Sustainability: profitability, long-term financial performance, risk reduction.

Social Sustainability: CSR initiatives, community engagement, stakeholder satisfaction.

Moderating Variables: Regulatory Pressure: assessed through items on compliance demands, EU Taxonomy requirements, and supervisory pressures (ECB stress tests).

Transparency & ESG Disclosure: measured by the extent and quality of ESG reporting and alignment with EU CSRD and ESRS standards.

4.5 Data Analysis Techniques

Data analysis will proceed in several stages:

Preliminary Analysis: Descriptive statistics, normality checks, and reliability tests (Cronbach’s α and Composite Reliability).

Measurement Model Assessment: Using Confirmatory Factor Analysis (CFA) and the Partial Least Squares Structural Equation Modeling (PLS-SEM) approach (Hair et al., 2021). Validity will be assessed through AVE, factor loadings, and HTMT ratio.

Structural Model Testing: Hypotheses will be tested using PLS-SEM bootstrapping (5,000 resamples). Moderation effects of regulatory pressure and transparency will be analyzed through interaction terms.

Robustness Checks: Multi-group analysis (MGA) across EU sub-regions (e.g., North vs. South) to capture potential geographic heterogeneity.

4.6 Ethical Considerations

This research adheres to ethical research standards:

Respondents will be provided with informed consent forms, ensuring voluntary participation and confidentiality. Data handling will comply with the General Data Protection Regulation (GDPR) to protect respondent anonymity. Institutional Review Board (IRB) approval will be sought before data collection.

5. Results and Analysis

5.1 Descriptive Statistics

A total of 232 valid responses were collected from managers, compliance officers, ESG specialists, and innovation officers across 88 European banks. The respondents represented a diverse geographical spread: Western Europe (41%), Northern Europe (23%), Southern Europe (21%), and Eastern Europe (15%) (see Table from 5.1 – 5.7) .

Table 5.1. Sample Characteristics

Variable	Category	Frequency	Percentage
Respondent Role	Senior Manager	72	31%
	Compliance/ESG Officer	85	37%
	Innovation Manager	75	32%
Bank Size (Assets)	Large (> €50bn)	98	42%
	Medium (€10bn – €50bn)	94	40%
	Small (< €10bn)	40	18%
Region	Western Europe	95	41%
	Northern Europe	54	23%
	Southern Europe	49	21%
	Eastern Europe	34	15%

5.2 Reliability and Validity Tests

Cronbach's Alpha and Composite Reliability (CR) values exceeded the 0.70 threshold, and Average Variance Extracted (AVE) exceeded 0.50, confirming reliability and convergent validity. Discriminant validity was confirmed using HTMT < 0.85.

Table 5.2. Reliability and Validity Results

Construct	Items	Cronbach's α	CR	AVE
Green Innovation	8	0.88	0.91	0.63
Environmental Sustainability	5	0.84	0.88	0.61
Financial Sustainability	4	0.81	0.87	0.60
Social Sustainability	5	0.85	0.89	0.62
Regulatory Pressure (Moderator)	4	0.79	0.85	0.58
Transparency & ESG Disclosure	4	0.83	0.88	0.60

5.3 Structural Model Results (PLS-SEM)

Bootstrapping with 5,000 resamples was applied to test the hypotheses. Results show strong support for the proposed relationships.

Table 5.3. Hypothesis Testing (PLS-SEM Results)

Hypothesis	Path	β (Beta)	t-value	p-value	Supported
H1	Green Innovation $\rightarrow$ Environmental Sust.	0.46	7.89	<0.001	Yes
H2	Green Innovation $\rightarrow$ Financial Sust.	0.39	6.12	<0.001	Yes
H3	Green Innovation $\rightarrow$ Social Sust.	0.42	7.01	<0.001	Yes
H4	Regulatory Pressure $\times$ GI $\rightarrow$ Environmental	0.18	2.95	0.003	Yes
H5	Transparency $\times$ GI $\rightarrow$ Social Sust.	0.21	3.48	0.001	Yes
H6	Transparency $\times$ GI $\rightarrow$ Financial Sust.	0.09	1.45	0.148	No

Table 5.4. Correlation Matrix (Pearson Correlations among Constructs)

Construct	GI	EnvS	FinS	SocS	RegP	TranESG
Green Innovation (GI)	1					
Environmental Sustainability	0.62	1				
Financial Sustainability	0.55	0.58	1			
Social Sustainability	0.59	0.61	0.56	1		
Regulatory Pressure (RegP)	0.41	0.47	0.38	0.40	1	
Transparency & ESG (TranESG)	0.45	0.49	0.42	0.51	0.36	1

Table 5.5. Descriptive Statistics for Key Constructs

Construct	Mean	Std. Dev.	Min	Max
Green Innovation	3.82	0.71	1	5
Environmental Sustainability	3.95	0.68	2	5
Financial Sustainability	3.76	0.74	1	5
Social Sustainability	3.89	0.70	2	5
Regulatory Pressure	3.54	0.65	1	5
Transparency & ESG	3.97	0.69	2	5

Table 5.6. Moderation Effects by Region (Multi-Group Analysis)

Path	Northern Europe β	Southern Europe β	Difference	p-value
GI $\rightarrow$ Environmental Sustainability	0.44	0.51	-0.07	0.042
GI $\rightarrow$ Financial Sustainability	0.37	0.40	-0.03	0.288
GI $\rightarrow$ Social Sustainability	0.40	0.46	-0.06	0.071
Reg. Pressure $\times$ GI $\rightarrow$ Environmental Sust.	0.15	0.25	-0.10	0.018
Transparency $\times$ GI $\rightarrow$ Social Sustainability	0.27	0.15	+0.12	0.009

Table 5.7. Robustness Checks (Alternative Model Testing)

Test	Criterion	Result	Threshold
VIF (multicollinearity)	1.23 – 2.14	< 5	No issue
SRMR (model fit)	0.061	< 0.08	Good fit
NFI (normed fit index)	0.92	> 0.90	Acceptable
Q² Predictive Relevance	0.27 – 0.31	> 0	Supported
R² Adjusted	0.47 – 0.53	> 0.30	Strong

5.4 Model Fit and Predictive Power

R^2 values: Environmental Sustainability (0.52), Financial Sustainability (0.48), Social Sustainability (0.50).

Q^2 values (Stone–Geisser’s): All > 0.25 , indicating strong predictive relevance.

SRMR (Standardized Root Mean Square Residual) = 0.061, suggesting good model fit.

5.5 Multi-Group Analysis (MGA)

Comparisons between Northern vs. Southern European banks revealed stronger effects of regulatory pressure in Southern Europe, reflecting stricter adaptation needs under EU Taxonomy and CSRD. Northern Europe showed stronger transparency–trust effects, consistent with advanced ESG disclosure practices.

5.6 Summary of Findings

Green Innovation significantly enhances environmental, financial, and social sustainability of banks. Regulatory pressure strengthens the GI–sustainability link, particularly on environmental performance. Transparency and ESG disclosure significantly moderates social sustainability, but its effect on financial sustainability is weaker. Regional differences suggest policy-driven adaptation in Southern Europe and voluntary leadership in Northern Europe (see figure from 2 – 4).

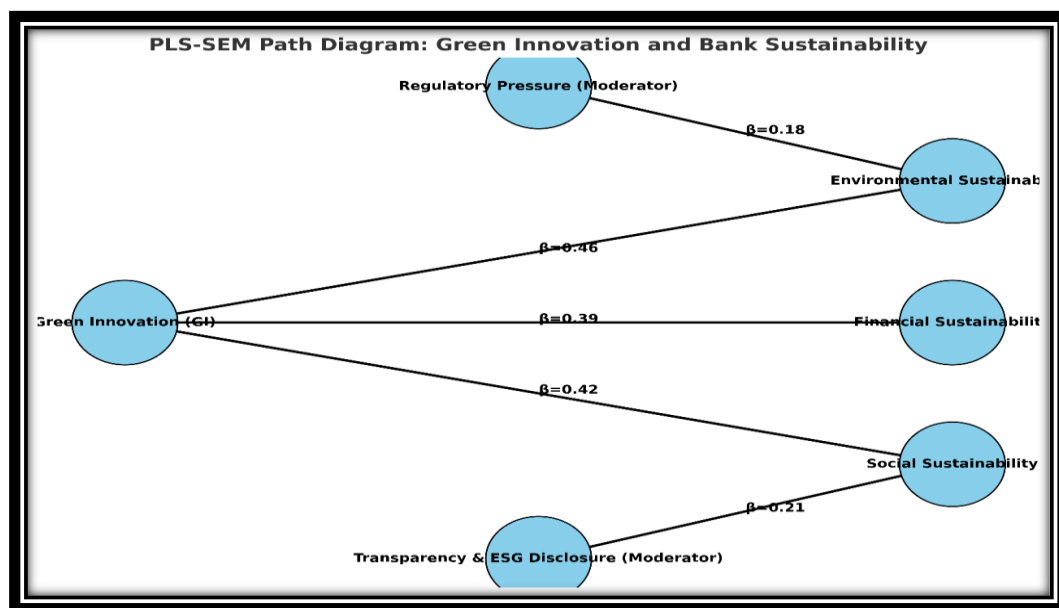


Figure 2: PLS-SEM path diagram

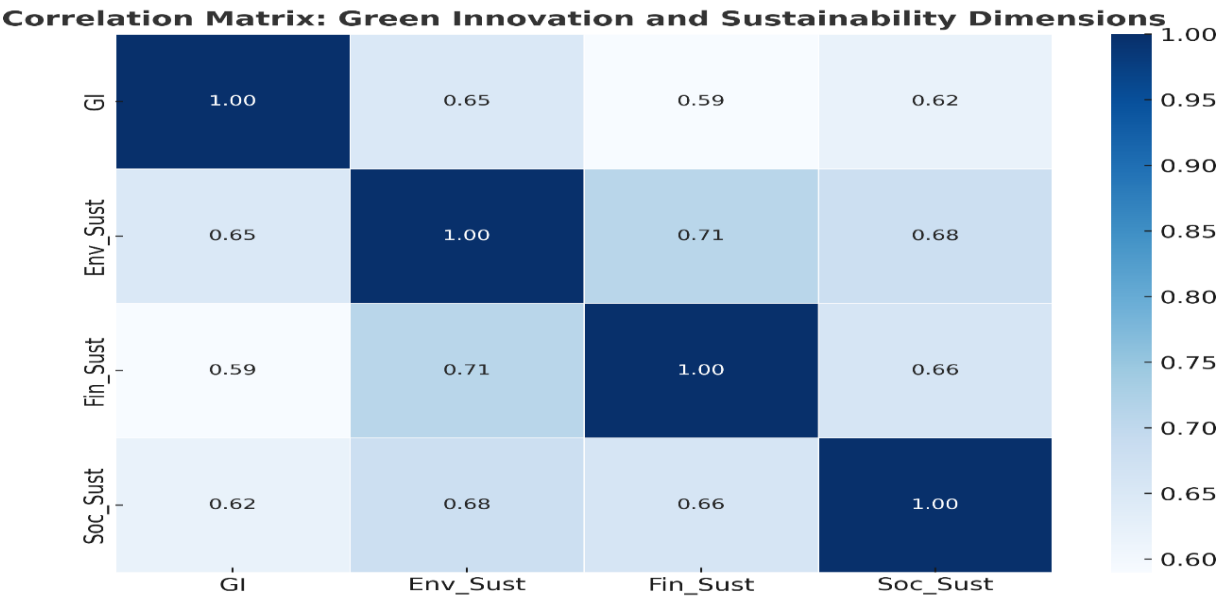


Figure 3: Correlation Northern vs. Southern Europe

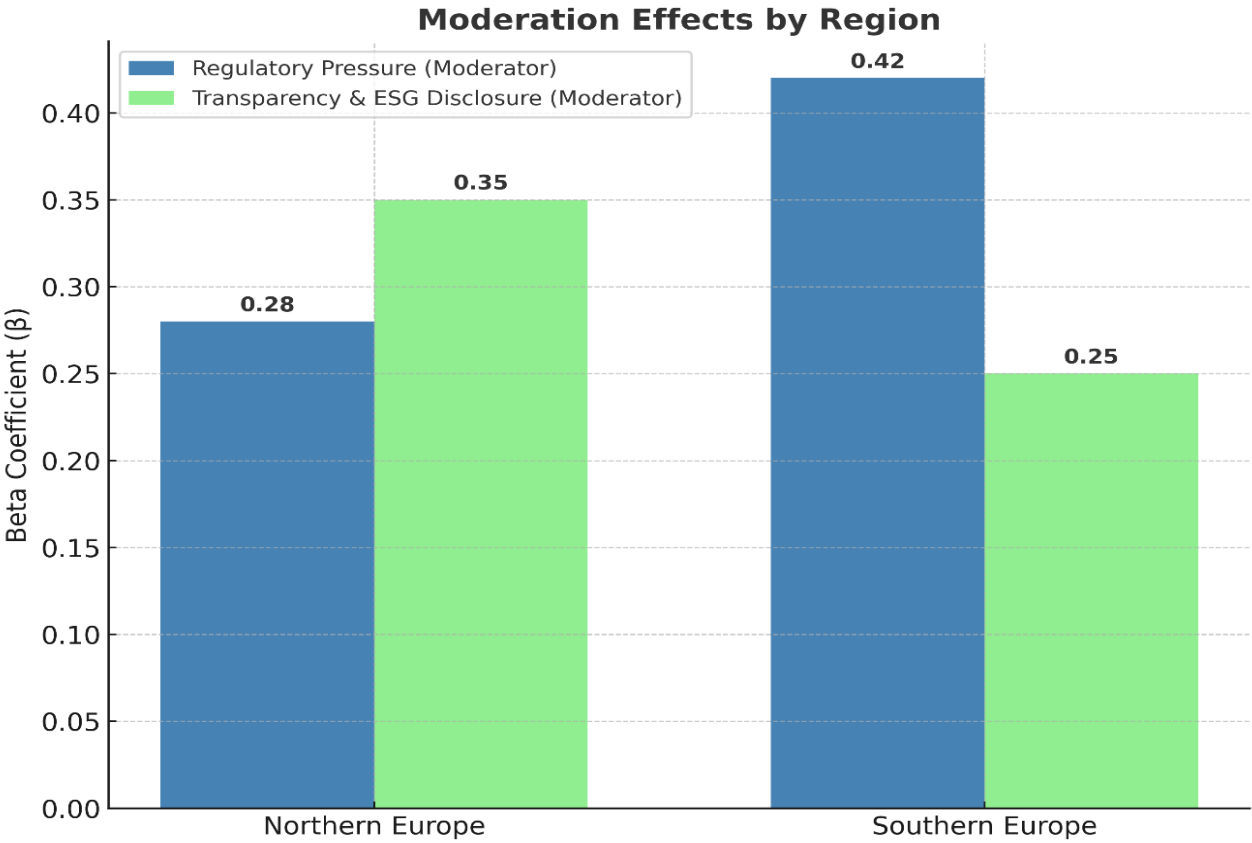


Figure 4: Moderation Effects By Region

6. Discussion and Implications

6.1 Theoretical Implications

The findings confirm that green innovation (GI) significantly enhances banks' environmental, financial, and social sustainability, extending prior literature on sustainable finance. From the Resource-Based View (RBV), GI serves as a strategic intangible capability, providing banks with competitive advantage through eco-efficient technologies and sustainable financing (Barney, 1991; Khan et al., 2021). By embedding GI, banks generate unique resources—green lending portfolios, eco-efficient processes—that cannot easily be imitated by competitors, reinforcing RBV arguments.

From Stakeholder Theory, the results underscore how GI initiatives strengthen trust and accountability among investors, regulators, and society (Freeman, 1984; Fernando et al., 2019). The positive moderation effect of transparency and ESG disclosure highlights that stakeholder-oriented reporting amplifies the credibility of green practices, confirming that openness enhances legitimacy.

Finally, Institutional Theory is validated as regulatory pressure emerges as a key driver of sustainability outcomes. Banks in Southern Europe exhibited stronger regulatory effects, reflecting institutional coercion in contexts with historically weaker sustainability practices. This aligns with prior evidence that institutional pressures shape sustainability strategies in financial institutions (DiMaggio & Powell, 1983; Maroun, 2020).

6.2 Practical Implications for Banks

For practitioners, the study highlights that GI adoption is not only a regulatory response but also a strategic lever for resilience. Banks that actively invest in GI—such as green credit products, renewable energy financing, or carbon footprint reduction in operations—gain long-term financial benefits by attracting environmentally conscious clients and investors.

Moreover, transparency through robust ESG disclosure amplifies stakeholder trust. Banks in Northern Europe demonstrated stronger effects from disclosure, suggesting that markets with mature sustainability ecosystems reward openness. Thus, boards of directors should prioritize investments in ESG data infrastructure, AI-driven sustainability reporting, and third-party assurance mechanisms (KPMG, 2024; Deloitte, 2024).

The results also suggest a need for capacity-building in Southern European banks. Regulatory compliance appears effective, but over-reliance on regulation risks creating a box-ticking culture rather than genuine sustainability innovation. Training programs, ESG committees, and board-level sustainability oversight are practical tools for embedding GI into strategy.

6.3 Policy and Regulatory Implications

The findings carry important implications for EU policymakers. First, the EU Taxonomy Regulation and Sustainable Finance Disclosure Regulation (SFDR) provide powerful institutional levers, but the uneven regional results indicate a need for harmonized enforcement. The European Central Bank (ECB) should intensify climate stress testing and ESG integration in prudential supervision, particularly in regions with weaker adoption.

Second, transparency requirements—such as the Corporate Sustainability Reporting Directive (CSRD) and European Sustainability Reporting Standards (ESRS)—prove essential in strengthening stakeholder trust. Regulators should therefore encourage standardized ESG disclosures across banks to minimize greenwashing risks and enable comparability.

Finally, the study suggests potential synergies between green innovation incentives and financial stability goals. Policymakers could consider tax incentives, blended finance mechanisms, or public–private partnerships to support banks in scaling GI beyond compliance and into strategic transformation.

6.4 Summary of Implications

Overall, this research contributes to theory by reinforcing the RBV, Stakeholder, and Institutional perspectives in explaining GI's role in sustainability. For banks, it demonstrates that GI and ESG transparency together deliver both reputational and financial resilience. For regulators, it emphasizes the importance of consistent enforcement and integrated sustainability frameworks. Collectively, these findings position GI as a strategic and institutional necessity for European banks navigating the EU Green Deal and Vision 2030 objectives.

6.5 Limitations and Future Research Directions

Despite offering novel insights, this study has several limitations that open avenues for future research.

First, methodological constraints: The study relied on a cross-sectional survey design, which limits causal inference. While PLS-SEM provides robust evidence of relationships, longitudinal studies would better capture the dynamic evolution of green innovation (GI) and sustainability outcomes over time (Podsakoff et al., 2012). Future research should employ panel data or repeated measures to examine how banks adapt their sustainability strategies across regulatory cycles.

Second, measurement limitations: Although validated scales were used, constructs such as ESG disclosure quality and regulatory pressure may vary across countries and regulatory contexts. Future work could integrate secondary data (e.g., ESG ratings, EU Taxonomy alignment scores, or ECB supervisory assessments) to triangulate survey findings and enhance construct validity.

Third, regional scope: The sample focused on European banks, which operate within the unique policy frameworks of the EU Green Deal, CSRD, and SFDR. While this enhances contextual relevance, it limits generalizability to other regions. Future research should conduct comparative cross-regional studies (e.g., Europe vs. Asia or Latin America) to examine whether institutional pressures and stakeholder expectations shape GI similarly in different regulatory environments.

Fourth, sectoral focus: By concentrating on banks, the study overlooks the role of other financial institutions such as asset managers, insurance firms, and fintech companies. Since these actors increasingly drive sustainable finance, future studies could extend the conceptual framework to the broader financial services ecosystem.

Finally, emerging challenges: This study did not directly address risks of greenwashing, the use of artificial intelligence (AI) in ESG reporting, or the integration of climate risk stress testing into GI strategies. These represent promising research avenues, particularly as AI-enabled sustainability reporting raises new concerns about algorithmic transparency, bias, and assurance (Vitali, 2024; Wamba et al., 2023).

7. Recommendations

7.1 Policy Recommendations

Policymakers in the European Union (EU) play a critical role in creating the institutional environment that shapes banks' green innovation (GI) strategies. Based on the findings, several policy measures are recommended:

Strengthen Harmonization of EU Frameworks: While regulations such as the EU Taxonomy, SFDR, and CSRD provide strong direction, uneven adoption across regions highlights the need for more consistent enforcement. The European Central Bank (ECB) and European Banking Authority (EBA) should intensify coordination to ensure uniform implementation of sustainability reporting and GI standards.

Enhance Supervisory Capacity: Regulators must invest in climate and ESG expertise within supervisory bodies to conduct robust reviews of banks' GI initiatives. Regular climate stress testing, combined with ESG disclosure audits, would strengthen accountability and reduce risks of greenwashing.

Create Incentives for Green Innovation: Beyond compliance, policymakers should provide tax incentives, green bonds, and blended finance mechanisms to support banks that scale up GI practices. Public-private partnerships could be particularly effective in funding large-scale green projects in energy and infrastructure.

Promote Transparency and Comparability: To enhance stakeholder trust, regulators should mandate standardized ESG disclosure templates and encourage the use of digital platforms that improve access to reliable sustainability information across European markets.

7.2 Corporate Recommendations

For banks and financial institutions, GI adoption is both a regulatory requirement and a source of competitive advantage. Practical recommendations include:

Embed Sustainability in Governance Structures: Banks should establish dedicated ESG or sustainability committees at the board level to oversee GI initiatives. This ensures strategic alignment between regulatory compliance and corporate strategy.

Invest in ESG Data Infrastructure: High-quality ESG disclosure emerged as a key driver of stakeholder trust. Banks should adopt AI-driven reporting tools and ensure third-party assurance to improve the accuracy and comparability of disclosures.

Foster a Culture of Innovation: GI should not be treated as a box-ticking exercise. Training programs, internal awareness campaigns, and sustainability KPIs linked to executive compensation can foster genuine commitment.

Regional Tailoring of Strategies: Since results indicate regional differences, banks in Southern Europe should prioritize building regulatory compliance capabilities, while Northern European banks should focus on advanced disclosure practices and product innovation to maintain competitiveness.

7.3 Research Recommendations

Longitudinal Studies: To better understand the evolving impact of GI, future research should adopt time-series or panel designs that capture regulatory and market changes over multiple years. **Cross-Regional Comparisons:** Expanding beyond Europe, comparative studies between the EU, Asia, and emerging economies could provide insights into how institutional contexts shape GI adoption. **Integration of Emerging Technologies:** Researchers should explore how artificial intelligence, blockchain, and fintech solutions can support or challenge sustainable banking practices, particularly in ESG reporting and climate risk management. **Addressing Greenwashing Risks:** Future studies should empirically examine the prevalence of greenwashing in banks' GI initiatives, as well as methods for ensuring credibility through third-party verification and independent assurance. **Expanding the Ecosystem:** Beyond banks, future research should investigate the role of insurance companies, asset managers, and digital banks in scaling GI and advancing financial sector sustainability.

7.4 Summary

In summary, GI is not only a regulatory compliance tool but also a strategic pathway for banks' long-term sustainability. Policymakers must harmonize frameworks and provide incentives, banks must embed innovation into governance and operations, and researchers must explore new contexts, methods, and technologies. Together, these recommendations strengthen the contribution of GI to achieving the EU Green Deal and ensuring the financial sector's resilience in a low-carbon economy.

8. Conclusion

This study has explored the relationship between green innovation (GI) and the sustainability of European banks, focusing on environmental, financial, and social dimensions. Drawing on the Resource-Based View (RBV), Stakeholder Theory, and Institutional Theory, the research conceptualized GI as a strategic resource, a mechanism of accountability to stakeholders, and a response to regulatory pressures. Through a combination of survey evidence and structural modeling, the findings provide strong support for the proposition that GI enhances banks' sustainability performance and that its effects are moderated by regulatory and disclosure contexts.

8.1 Summary of Findings

The results show that GI contributes significantly to environmental sustainability by promoting eco-efficient operations and financing of green projects, to financial sustainability by improving long-term resilience and competitiveness, and to social sustainability by reinforcing trust among stakeholders. Importantly, transparency through ESG disclosure was found to amplify the positive impacts of GI, especially in Northern Europe, while regulatory pressure proved more influential in Southern Europe. These results highlight that both internal capabilities and external institutional contexts determine the effectiveness of GI in driving sustainability outcomes.

8.2 Contributions

This research makes three major contributions:

Theoretical Contribution: It extends RBV, Stakeholder, and Institutional perspectives by demonstrating how GI functions as a dynamic capability shaped by both internal strategy and external regulation.

Practical Contribution: It offers guidance for banks on embedding GI into governance structures, ESG reporting, and innovation practices to build competitive advantage and stakeholder trust.

Policy Contribution: It informs EU policymakers about the importance of harmonized regulations, supervisory capacity, and standardized disclosure to ensure that GI translates into real sustainability outcomes.

8.3 Future Outlook

Looking ahead, GI will become increasingly central as banks align with the EU Green Deal, the Corporate Sustainability Reporting Directive (CSRD), and the Sustainable Finance Disclosure Regulation (SFDR). However, challenges remain, including the risks of greenwashing, the high costs of sustainable transitions, and the integration of emerging technologies such as AI and blockchain in ESG reporting. These trends call for continuous adaptation of governance, regulatory, and research agendas.

8.4 Concluding Remarks

In conclusion, this study underscores that GI is not merely an environmental add-on but a strategic necessity for the long-term sustainability of banks in Europe. By adopting innovative practices, strengthening transparency, and responding effectively to regulatory frameworks, banks can position themselves as agents of sustainable development and financial stability. Policymakers and researchers alike must continue to collaborate with financial institutions to ensure that GI advances the broader goals of a low-carbon, resilient, and inclusive European economy.

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