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Research Article

Collateral Greenwashing Practices Worldwide: Green or Sustainable Bonds to Finance Green Innovation

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Abstract

Amid accelerating climate risks, firms increasingly issue green bonds and the broader set of sustainable bonds to finance green innovation while signaling environmental credibility. This study examines whether these labeled debt instruments are associated with substantive environmental upgrading or primarily support symbolic narratives that may coexist with greenwashing. Using firm-year data from 2010 to 2022, we merge issuer information from the Luxembourg Green Exchange with ESG and financial indicators from LSEG Data and Analytics to test how green bonds and sustainable bonds relate to green product innovation, green process innovation, and a firm-level greenwashing index based on the substantive versus symbolic gap. Feasible GLS panel models with extensive controls and a matched-sample design via propensity score matching indicate that both green bonds and sustainable bonds are positively associated with green product innovation. Only sustainable bonds show a consistent positive association with green process innovation, aligning with the view that sustainability- and KPI-linked designs strengthen stakeholder and institutional pressures and translate them into operational change. Neither instrument is associated with an immediate reduction in greenwashing. Dynamic robustness analyses suggest that improvements emerge over medium to long horizons as verification cycles and organizational capabilities mature. Overall, the findings highlight that instrument design and time dynamics matter. Labeling alone is insufficient to curb opportunism, but well-governed sustainable finance can help scale innovation and, over time, reduce the space for greenwashing.

Keywords: Sustainable bonds; Green innovation; Greenwashing; Sustainable finance; Panel data

Highlights

- Green bonds and sustainable bonds are positively associated with green product innovation.
- Only sustainable bonds show a consistent positive association with green process innovation.
- No immediate greenwashing reduction is observed, with improvements emerging over medium to long horizons.

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1 Section 1- Introduction

Green finance has expanded rapidly, and corporate issuers increasingly rely on labelled debt to mobilize capital for climate-related investments. Among these instruments, green bonds are earmarked for environmental projects, while the broader set of sustainable bonds, including sustainability and sustainability-linked structures, can embed explicit performance targets, incentives, and reporting requirements (Flammer, 2021; Gianfrate & Peri, 2019; Cochelin et al., 2023). A central challenge is credibility: whether proceeds translate into verifiable improvements rather than marketing claims. Related research has examined issuer incentives and market outcomes around labeled debt, including pricing, yield, and issuer heterogeneity questions (Sheng et al., 2021; Tang & Zhang, 2020), as well as how ESG scoring and greenwashing risk can relate to green bond yields (Baldi & Pandimiglio, 2022). Policy and regulatory discussions also matter because market discipline, taxonomies, and disclosure rules can shape how these instruments operate in practice (Spielberger, 2024; Sudan, 2023; Zhang, C. et al., 2024).

Green innovation is a primary channel through which firms can convert external finance into environmental value. This study separates green innovation into green product innovation and green process innovation. Green products improve the footprint of goods and services, while green processes reduce resource use, emissions, and waste in operations and supply chains (Chen et al., 2006; de Jesus & Mendonça, 2018). Prior empirical work links green finance and innovation, but emphasizes that impacts can vary across institutions and issuer characteristics and may differ between product and process pathways (Dong et al., 2024; Zhang, J. et al., 2024). Corporate performance implications of going green have also been examined in specific contexts (Zhang, D. & Du, 2020).

At the same time, firms face incentives to communicate sustainability even when internal change is incomplete. Greenwashing refers to a misalignment between environmental claims and actual performance, often occurring when symbolic communication outpaces substantive action (Bruno & Greer, 1996; Delmas & Burbano, 2011; Lyon & Maxwell, 2011). Stakeholders respond to environmental communication and corporate credibility signals, which can shape reputational rewards and penalties (Musgrove et al., 2018; Torelli et al., 2020). When greenwashing is detected, firms may attempt legitimacy repair, including brand trust repair strategies (Guo et al., 2018). Research also distinguishes forms of greenwashing and highlights the role of information transparency in how corporate social responsibility narratives are interpreted (Wu et al., 2020). The broader debate includes whether different green bond types can be accused of greenwashing when examined over time and across causality patterns (Ghaemi Asl et al., 2024).

These tensions motivate the research question: How do green bonds and sustainable bonds affect firms' green innovation performance and their tendency to engage in greenwashing? To answer this question, the study integrates stakeholder theory, institutional theory, and agency theory. Stakeholder pressures shape incentives to adopt sustainability practices (Freeman, 1984). Institutional forces, coercive, normative, and mimetic, diffuse expectations and standards (DiMaggio & Powell, 1983), and institutional forces can condition environmental strategy when institutional settings are incomplete (Feng et al., 2022). Agency theory highlights information asymmetries and moral hazard in the use of labelled proceeds (Eisenhardt, 1989). The study contributes by comparing green bonds with the broader sustainable bond category, unpacking green innovation into product and process dimensions, and proposing a scalable firm-level greenwashing index that captures the substantive versus symbolic gap, aligning with measurement gaps emphasized in recent reviews (Bernini et al., 2024; Lublóy et al., 2025).

The analysis uses a firm-year panel and a matched-sample design to assess contemporaneous and dynamic relationships among issuance, innovation, and greenwashing.

2 Section 2

2.1 Defining Key Concepts

Green bonds are labelled debt instruments earmarked for environmental projects, whereas sustainable bonds encompass a wider umbrella, including sustainability and sustainability-linked structures that can embed targets, incentives, and reporting requirements (Flammer, 2021; Gianfrate & Peri, 2019). Green innovation is operationalized through two dimensions. Green product innovation captures product and service innovations that reduce environmental impacts, while green process innovation captures improvements in efficiency and pollution reduction across operations and supply chains (Chen et al., 2006; de Jesus & Mendonça, 2018).

Greenwashing is conceptualized as a misalignment between environmental claims and actual performance, consistent with classic accounts that emphasize selective disclosure, ambiguous claims, and strategic communication under imperfect monitoring and limited auditing (Bruno & Greer, 1996; Delmas & Burbano, 2011; Lyon & Maxwell, 2011). Stakeholder perceptions and reactions to environmental communication are relevant because credibility and reputational mechanisms influence how sustainability claims are received (Musgrove et al., 2018; Torelli et al., 2020). The concept also connects to transparency and the distinction between forms of greenwashing in relation to corporate social responsibility disclosure (Wu et al., 2020).

2.2 Existing Theories and Frameworks

Stakeholder and institutional pressures help explain why firms adopt labelled finance and disclose environmental information. Rising public sensitivity to environmental impacts increases the reputational value of sustainability initiatives and raises the cost of perceived inaction (Musgrove et al., 2018; Torelli et al., 2020). Institutional theory suggests that firms converge toward recognized practices and standards when regulators, investors, and peers legitimate specific disclosure and financing mechanisms (DiMaggio & Powell, 1983). Institutional pressures can also interact with the completeness of the institutional environment, shaping the translation of perceived institutional force into environmental strategy (Feng et al., 2022).

However, these same pressures can trigger symbolic compliance. Agency theory emphasizes that managers may use sustainability narratives to attract capital while retaining discretion over proceeds, especially when monitoring is imperfect (Eisenhardt, 1989). This framing aligns with greenwashing theories that highlight information asymmetries, selective disclosure, and strategic communication (Delmas & Burbano, 2011; Lyon & Maxwell, 2011). The credibility of sustainability narratives can also be linked to broader debates on corporate social responsibility and financial performance, which reinforces the idea that managers may pursue visible sustainability actions and communications (Flammer, 2015).

2.3 Knowledge Gaps and Research Opportunities

The sustainable finance literature includes both market-oriented and firm behavior questions. Studies examine whether labelled debt confers benefits to issuers or investors and how outcomes vary across issuers and settings (Sheng et al., 2021; Tang & Zhang, 2020). Others examine the convenience or

advantages of issuing green bonds (Gianfrate & Peri, 2019) and discuss alternative labelled instruments (Bongaerts & Schoenmaker, 2020). Policy and regulatory frameworks continue to evolve, influencing the governance environment for labelled instruments (Spielberger, 2024; Sudan, 2023; Zhang, C. et al., 2024). At the firm level, research also investigates drivers of enterprise green innovation performance, including leadership vision and stakeholder concerns (Wan et al., 2022), and examines how going green can impact corporate performance in specific contexts (Zhang, D. & Du, 2020).

Despite this growth, two limitations motivate this study. First, much work treats labelled finance as a single construct, whereas governance features can differ materially between green bonds and broader sustainable bond structures. Second, green innovation is often measured in aggregate, potentially obscuring differences between product- and process-upgrading pathways that may respond differently to instrument design (Dong et al., 2024; Zhang, J. et al., 2024). Third, greenwashing measurement remains challenging; recent reviews highlight the need for scalable firm-level tools that contrast symbolic narratives with substantive performance (Bernini et al., 2024; Lublóy et al., 2025). The possibility that green bonds may be accused of greenwashing, depending on time patterns and causality framing, further underscores the need for dynamic assessments rather than only contemporaneous tests (Ghaemi Asl et al., 2024).

2.4 Proposed Conceptual Model [1.1 Heading, Aptos, 14, Bold]

Issuing green bonds or sustainable bonds can increase resources for green innovation, but effects may differ across innovation types because the scope of the instruments and their governance features shape managerial discretion and internal prioritization. Labelled bonds can support green innovation by easing financing constraints and signalling environmental commitments that attract investors, partners, and policy support. Empirical work indicates that green bond issuance may be associated with higher innovation outputs, though effects depend on market institutions and issuer characteristics (Sheng et al., 2021; Zhang, J. et al., 2024; Dong et al., 2024). For product innovation, both instruments can finance project pipelines and be rewarded through stakeholder visibility. For process innovation, the prediction is more nuanced because bigger operational changes often require longer horizons and ongoing monitoring. Sustainable bond structures can embed measurable targets and monitoring, tightening the link between financing and operational performance (Bongaerts & Schoenmaker, 2020; Gianfrate & Peri, 2019).

- H1: Green financing has a positive impact on green product innovation.
- H1a: Green bonds leverage green product innovation.
- H1b: Sustainable bonds leverage green product innovation.
- H2: Green financing has a positive impact on green process innovation.
- H2a: Green bonds leverage green process innovation.
- H2b: Sustainable bonds leverage green process innovation.

Greenwashing arises when firms face incentives to appear sustainable but lag in investment relative to disclosures. Classic accounts emphasize selective disclosure, ambiguous claims, and strategic communication in the context of limited auditing (Delmas & Burbano, 2011; Lyon & Maxwell, 2011). Issuance may reduce greenwashing by increasing transparency requirements and third party review, raising reputational and financial costs of misallocation. Yet immediate reductions are not guaranteed

because issuance can act as a credibility signal while projects and verification cycles unfold over time, and legitimacy repair dynamics can complicate stakeholder responses to detected inconsistencies (Guo et al., 2018; Torelli et al., 2020). The broader literature also suggests that transparency and the nature of disclosure can shape how greenwashing is interpreted (Wu et al., 2020). Accordingly, the hypothesis is framed as a likely delayed effect.

- H3: Green financing can serve as a barrier to greenwashing.
- H3a: Green bonds can serve as a barrier to greenwashing.
- H3b: Sustainable bonds can serve as a barrier to greenwashing.

3 Methodology

Research design and data sources

The study uses a firm-level, cross-country panel design that combines labelled bond issuance data with ESG and financial indicators. Bond data are collected from the Luxembourg Green Exchange, which provides issuer- and bond-level information and a documented methodology (Spielberger, 2024; Sudan, 2023; LuxSE, 2025). ESG and accounting variables are obtained from LSEG Data and Analytics, formerly Refinitiv (LSEG, 2025). The merged dataset covers 2010 to 2022 and includes firms from all continents that report ESG.

The analysis proceeds in three steps. First, baseline panel models are estimated for each dependent variable using feasible generalized least squares, which is suitable for panels with heteroskedasticity and contemporaneous correlation, and are applied to relatively small issuer panels (Driscoll & Kraay, 1998). Second, propensity score matching is applied to construct comparable samples of issuers and non-issuers, and effects are re-estimated to mitigate selection bias. Third, robustness checks use dynamic specifications with system GMM and alternative variable constructions to assess persistence and reduce reverse causality concerns (Razzaq et al., 2021).

Variables and measurement

Dependent variables

Green product innovation is measured using the Environmental Innovation Score from LSEG, capturing product and service innovations that reduce environmental impacts. Green process innovation is constructed from the Resource Use Score and Emissions Score, capturing improvements in efficiency and reductions in pollution across operations and supply chains. For comparability, green innovation indicators are scaled to the unit interval.

Greenwashing index

Greenwashing is measured using an index grounded in the decoupling view, where greenwashing is higher when symbolic action exceeds substantive action. Following methodological reviews emphasizing scalable firm-level measures (Bernini et al., 2024; Lublóy et al., 2025), substantive action is operationalized with indicators of resource-intensive outcomes, and symbolic action is operationalized with indicators of commitments and controversies.

$$GW = \text{Substantive action (SuA)} - \text{Symbolic action (SyA)} \tag{1}$$

$$\text{SuA} = \text{Renewable Energy Use Ratio Score} + \text{Waste Recycled to Total Waste Score} + \text{Management Score} \tag{2}$$

$$SyA = CSR\ Strategy\ Score + Environmental\ Controversies\ Index \quad (3)$$

Core explanatory variables

Green bond issuance and sustainable bond issuance are measured as the annual amount issued by the firm, expressed in euros, and set to zero when no issuance occurs. Given skewness, issuance variables are scaled consistently with the estimation strategy to improve interpretability.

Control variables

Controls include firm size, proxied by total revenue; profitability and return on assets; research and development investment; firm age; governance indicators such as board size and tenure; sector classification; country context variables, including the Human Development Index and the Environmental Performance Index; technology-intensity controls; and year dummies.

Econometric strategy

For each outcome, green product innovation, green process innovation, and greenwashing, the fixed effects panel model estimates bond issuance effects conditional on the control set. Separate specifications are estimated for green bonds and sustainable bonds. Feasible generalized least squares inference is complemented by propensity score matching, and dynamic system GMM specifications are used as robustness checks to account for persistence and mitigate reverse causality concerns (Razzaq et al., 2021). The equations that represent all hypotheses are from 1a to 2c below.

Green bonds

$$GPTI_{it} = \beta_0 + \beta_1 GB_{it} + \beta_2' X_{it} + \beta_3' C_{it} + \beta_4' Z_{it} + \beta_5' Y_t + \beta_6' T_{it} + a_{it} + u_{it} \quad (1a)$$

$$GPSI_{it} = \beta_0 + \beta_1 GB_{it} + \beta_2' X_{it} + \beta_3' C_{it} + \beta_4' Z_{it} + \beta_5' Y_t + \beta_6' T_{it} + a_{it} + u_{it} \quad (1b)$$

$$GW_{it} = \beta_0 + \beta_1 GB_{it} + \beta_4' X_{it} + \beta_5' C_{it} + \beta_6' Z_{it} + \beta_7' Y_t + \beta_8' T_{it} + a_{it} + u_{it} \quad (1c)$$

Sustainable bonds

$$GPTI_{it} = \beta_0 + \beta_1 SB_{it} + \beta_2' X_{it} + \beta_3' C_{it} + \beta_4' Z_{it} + \beta_5' Y_t + \beta_6' T_{it} + a_{it} + u_{it} \quad (2a)$$

$$GPSI_{it} = \beta_0 + \beta_1 SB_{it} + \beta_2' X_{it} + \beta_3' C_{it} + \beta_4' Z_{it} + \beta_5' Y_t + \beta_6' T_{it} + a_{it} + u_{it} \quad (2b)$$

$$GW_{it} = \beta_0 + \beta_1 SB_{it} + \beta_4' X_{it} + \beta_5' C_{it} + \beta_6' Z_{it} + \beta_7' Y_t + \beta_8' T_{it} + a_{it} + u_{it} \quad (2c)$$

Where:

GPSI is the Green Process Innovation index for the company “*i*” in the year *t*

GPTI is the Green Product Innovation index for the company “*i*” in the year *t*

GW is the Greenwashing index for the company “*i*” in the year *t*

GB is the Green Bonds index for the company “*i*” in the year *t*

SB is the Sustainable Bonds index for the company “*i*” in the year *t*

X is the matrix for firm-level control variables for the company “*i*” in the year *t*

C is the matrix for country-level control variables for the company “*i*” in the year *t*

Z is the matrix for sectoral-related control variables for the company “*i*” in the year *t*

Y is the matrix for year-level control variables for year *t*

T is the matrix for tech-level control variables for the company “*i*” in the year *t*

a is the fixed effect for the company “*i*” in the year *t*

u is the random disturbance term for the company “*i*” in the year *t*

4 Results- Key Findings

Diagnostics and baseline estimates

Pre-estimation diagnostics support fixed effects specifications and robust panel estimators. Heteroskedasticity and potential cross-sectional dependence motivate feasible generalized least squares-based inference, and matching-based analyses address non-random selection into issuance.

Baseline coefficients show that both green bonds and sustainable bonds are positively associated with green product innovation, supporting H1a and H1b. For green process innovation, only sustainable bonds are statistically significant, supporting H2b but not H2a. For greenwashing, neither issuance measure is statistically significant in the contemporaneous specification, failing to support H3a or H3b in the short run.

Robustness analyses

Propensity score matching aligns issuers and non-issuers on observable determinants of issuance, including size, research and development effort, leverage, governance, sector, technology intensity, and country context. Matched sample results remain consistent with baseline directions, indicating that innovation results are not driven solely by observable differences.

Dynamic system GMM specifications confirm strong inertia in innovation outcomes. Once lagged outcomes are included, short-run issuance coefficients are smaller, but the qualitative pattern remains. Sustainable bonds are more consistently associated with process innovation than green bonds, and immediate greenwashing effects remain weak. Additional sensitivity tests, excluding outliers and using alternative proxy constructions, do not overturn the main conclusions.

5 Discussion

The positive associations between green bonds, sustainable bonds, and green product innovation suggest that labelled debt can help scale green product development by easing financing constraints and enhancing legitimacy. Product innovations are relatively visible to stakeholders and align with reputational incentives emphasized in stakeholder theory (Freeman, 1984). This visibility logic is consistent with the idea that stakeholders respond to environmental communication and credibility signals (Musgrove et al., 2018; Torelli et al., 2020), and it helps explain why firms may prioritize product innovations that can be readily observed and communicated.

The differentiated findings for green process innovation indicate that instrument design matters. Process innovation is operationally demanding and often less visible externally and therefore benefits from governance features that sustain monitoring and internal accountability. Sustainable bond structures can be broader in scope and may embed KPI linked terms, increasing the salience of ongoing performance and channelling institutional pressures into routine process change (Bongaerts & Schoenmaker, 2020; Gianfrate & Peri, 2019). Institutional perspectives also imply that firms may converge toward recognized practices when standards and expectations are legitimized by regulators, investors, and peers (DiMaggio & Powell, 1983), and the translation of such pressures into environmental strategy can depend on institutional conditions (Feng et al., 2022). These mechanisms help interpret why sustainable bonds, as a broader and potentially more governed category, show a more consistent association with process upgrading.

The absence of immediate greenwashing effects indicates that issuance labels alone do not eliminate information asymmetries or incentives for symbolic communication. This aligns with greenwashing theories emphasizing selective disclosure and strategic communication under imperfect monitoring (Delmas & Burbano, 2011; Lyon & Maxwell, 2011). Agency theory further explains why immediate reductions are unlikely: labelling can change perceptions faster than routines change, and managerial discretion persists until verification and learning cycles mature (Eisenhardt, 1989). The framing is also consistent with work discussing transparency and differentiated interpretations of greenwashing in relation to corporate social responsibility (Wu et al., 2020). In practice, when discrepancies are noticed, firms may attempt to repair legitimacy and trust, which can shape stakeholder reactions without necessarily reflecting immediate substantive change (Guo et al., 2018). The study's results also align with the view that accusations of greenwashing and their interpretation may depend on time dynamics and how causal patterns are evaluated (Ghaemi Asl et al., 2024).

6 Conclusions

By distinguishing green bonds from sustainable bonds and separating product from process innovation, the study shows that sustainable finance instruments relate differently to environmental upgrading pathways. Both instruments are associated with green product innovation, while only sustainable bonds show a consistent positive association with green process innovation. Neither instrument is associated with an immediate reduction in greenwashing, while dynamic analyses indicate that improvements can emerge over medium to long horizons as verification cycles and organizational capabilities mature.

The study contributes measurement infrastructure by operationalizing greenwashing as a substantive versus symbolic gap, consistent with calls for scalable firm-level tools (Bernini et al., 2024; Lublóy et al., 2025). The theoretical framing indicates that stakeholder and institutional pressures can translate into substantive innovation when financing instruments include governance features that sustain monitoring and accountability (Freeman, 1984; DiMaggio & Powell, 1983). At the same time, agency-based concerns imply that labels can serve as credibility signals, while discretion persists unless monitoring, reporting, and assurance routines strengthen over time (Eisenhardt, 1989; Delmas & Burbano, 2011).

Managerial and policy implications follow. Managers should align labelled debt choice with strategic intent. When the goal is to expand green product offerings, either green bonds or sustainable bonds can be appropriate. When the goal is to transform operations and supply chains, sustainable bond structures that embed measurable targets and verification routines are more consistent with process upgrading. For policymakers, exchanges, and standard setters, the findings reinforce the importance of credible taxonomies, assurance, and issuer-level transparency (LuxSE, 2025; Spielberger, 2024; Sudan, 2023). Stronger post-issuance reporting and harmonized verification can improve market discipline and help ensure that labelled instruments finance substantive change rather than purely symbolic communication. This emphasis is consistent with a broader policy interest in how green finance rules relate to ESG disclosure incentives (Zhang, C. et al., 2024) and how going green can shape corporate performance outcomes in particular contexts (Zhang, D. & Du, 2020).

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Data is unavailable since a significant portion is part of a private database named Refinitiv Eikon (LSEG Data & Analytics).

Conflicts of Interest

The authors declare no conflict of interest.

References

- Baldi, F., & Pandimiglio, A. (2022). The role of ESG scoring and greenwashing risk in explaining the yields of green bonds: A conceptual framework and an econometric analysis. *Global Finance Journal*, 52, 100711. <https://doi.org/10.1016/j.gfj.2022.100711>
- Bernini, F., Giuliani, M., & La Rosa, F. (2024). Measuring greenwashing: A systematic methodological literature review. *Business Ethics, the Environment and Responsibility*, 33(4), 649 to 667. <https://doi.org/10.1111/beer.12631>
- Bongaerts, D., & Schoenmaker, D. (2020). Green Certificates: A better version of green bonds. *Policy Contribution Bruegel*, 1(20), 1 to 11.
- Bruno, K., & Greer, J. (1996). *Greenwash: The reality behind corporate environmentalism* (1st ed.). Rowman & Littlefield Publishers.
- Chen, Y. S., Lai, S. B., & Wen, C. T. (2006). The influence of green innovation performance on corporate advantage in Taiwan. *Journal of Business Ethics*, 67(4), 331 to 339. <https://doi.org/10.1007/s10551-006-9025-5>
- Cochelin, P., Popoola, B., & Sugrue, D. (2023). Global Sustainable Bonds 2023 Issuance To Exceed \$900 Billion.
- de Jesus, A., & Mendonça, S. (2018). Lost in transition? Drivers and barriers in the eco innovation road to the circular economy. *Ecological Economics*, 145, 75 to 89. <https://doi.org/10.1016/j.ecolecon.2017.08.001>
- Delmas, M. A., & Burbano, V. C. (2011). The drivers of greenwashing. *California Management Review*, 54(1), 64 to 87. <https://doi.org/10.1525/cmr.2011.54.1.64>
- DiMaggio, P., & Powell, W. W. (1983). The iron cage revisited: Institutional isomorphism and collective rationality in organizational fields. *American Sociological Review*, 48(1), 147 to 160. <https://doi.org/10.17323/1726-3247-2010-1-34-56>
- Dong, H., Zhang, L., & Zheng, H. (2024). Green bonds: Fueling green innovation or just a fad? *Energy Economics*, 135. <https://doi.org/10.1016/j.eneco.2024.107660>
- Driscoll, J. C., & Kraay, A. C. (1998). Consistent covariance matrix estimation with spatially dependent panel data. *Review of Economics and Statistics*, 80(4), 549 to 560. <https://doi.org/10.1162/003465398557825>
- Eisenhardt, K. M. (1989). Agency theory: An assessment and review. *The Academy of Management Review*, 14(1), 57. <https://doi.org/10.2307/258191>
- Feng, T., Liu, S., & Zhang, Q. (2022). Linking perceived institutional force and environmental strategy: The moderating role of institutional incompleteness. *Baltic Journal of Management*, 17(3), 392 to 412. <https://doi.org/10.1108/BJM-06-2021-0221>
- Flammer, C. (2015). Does corporate social responsibility lead to superior financial performance? A regression discontinuity approach. *Management Science*, 61(11), 2549 to 2568. <https://doi.org/10.1287/mnsc.2014.2038>
- Flammer, C. (2021). Corporate green bonds. *Journal of Financial Economics*, 142(2), 499 to 516. <https://doi.org/10.1016/j.jfineco.2021.01.010>
- Freeman, R. E. (1984). *Strategic management: A stakeholder approach* (Vol. 1). Pittman.
- Ghaemi Asl, M., Smutka, L., Nasr Isfahani, M., Raza, S. A., & Vasa, L. (2024). Can multifarious types of green bonds be accused of greenwashing with a durative analysis? Insights from a permanent causality vs. temporary causality phenomenon. *Environment, Development and Sustainability*. <https://doi.org/10.1007/s10668-024-04501-z>
- Gianfrate, G., & Peri, M. (2019). The green advantage: Exploring the convenience of issuing green bonds. *Journal of Cleaner Production*, 219, 127 to 135. <https://doi.org/10.1016/j.jclepro.2019.02.022>
- Guo, R., Zhang, W., Wang, T., Li, C. B., & Tao, L. (2018). Timely or considered? Brand trust repair strategies and mechanism after greenwashing in China from a legitimacy perspective. *Industrial Marketing Management*, 72, 127 to 137. <https://doi.org/10.1016/j.indmarman.2018.04.001>

- LSEG. (2025). Refinitiv is now named LSEG Data & Analytics. Retrieved from <https://www.lseg.com/en/data-analytics>
- Lublóy, Á., Keresztúri, J. L., & Berlinger, E. (2025). Quantifying firm level greenwashing: A systematic literature review. *Journal of Environmental Management*, 373. <https://doi.org/10.1016/j.jenvman.2024.123399>
- LuxSE. (2025). Luxembourg Green Exchange DataHub Methodology.
- Lyon, T. P., & Maxwell, J. W. (2011). Greenwash: Corporate environmental disclosure under threat of audit. *Journal of Economics and Management Strategy*, 20(1), 3 to 41. <https://doi.org/10.1111/j.1530-9134.2010.00282.x>
- Musgrove, C. F., Choi, P., & Cox, K. C. (2018). Consumer perceptions of green marketing claims: An examination of the relationships with type of claim and corporate credibility. *Services Marketing Quarterly*, 39(4), 277 to 292. <https://doi.org/10.1080/15332969.2018.1514794>
- Razzaq, A., An, H., & Delpachitra, S. (2021). Does technology gap increase FDI spillovers on productivity growth? Evidence from Chinese outward FDI in Belt and Road host countries. *Technological Forecasting and Social Change*, 172(1), 1 to 16. <https://doi.org/10.1016/j.techfore.2021.121050>
- Sheng, Q., Zheng, X., & Zhong, N. (2021). Financing for sustainability: Empirical analysis of green bond premium and issuer heterogeneity. *Natural Hazards*, 107(3), 2641 to 2651. <https://doi.org/10.1007/s11069-021-04540-z>
- Spielberger, L. (2024). EIB policy entrepreneurship and the EU's regulation of green bonds. *Journal of Economic Policy Reform*. <https://doi.org/10.1080/17487870.2024.2356810>
- Sudan, F. K. (2023). Leveraging green bonds to address debt sustainability and economic recovery in South Asia: Lessons from EU and ASEAN countries. *Regional Economic Development Research*, 101 to 120. <https://doi.org/10.37256/redr.4220233543>
- Tang, D. Y., & Zhang, Y. (2020). Do shareholders benefit from green bonds? *Journal of Corporate Finance*, 61. <https://doi.org/10.1016/j.jcorpfin.2018.12.001>
- Torelli, R., Balluchi, F., & Lazzini, A. (2020). Greenwashing and environmental communication: Effects on stakeholders' perceptions. *Business Strategy and the Environment*, 29(2), 407 to 421. <https://doi.org/10.1002/bse.2373>
- Wan, X., Wang, Y., Qiu, L., Zhang, K., & Zuo, J. (2022). Executive green investment vision, stakeholders' green innovation concerns and enterprise green innovation performance. *Frontiers in Environmental Science*, 10. <https://doi.org/10.3389/fenvs.2022.997865>
- Wu, Y., Zhang, K., & Xie, J. (2020). Bad greenwashing, good greenwashing: Corporate social responsibility and information transparency. *Management Science*, 66(7), 3095 to 3112. <https://doi.org/10.1287/mnsc.2019.3340>
- Zhang, C., Zhang, S., Zhang, Y., Yang, Y., & Lan, K. (2024). Does green finance policy contribute to ESG disclosure of listed companies? A quasi natural experiment from China. *SAGE Open*, 14(1). <https://doi.org/10.1177/21582440241233376>
- Zhang, D., & Du, P. (2020). How China going green impacts corporate performance? *Journal of Cleaner Production*, 258. <https://doi.org/10.1016/j.jclepro.2020.120604>
- Zhang, J., Yang, G., Ding, X., & Qin, J. (2024). Can green bonds empower green technology innovation of enterprises? *Environmental Science and Pollution Research*, 31(7), 10032 to 10044. <https://doi.org/10.1007/s11356-022-23192-5>

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