Climate laws and green bond issuance

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Abstract

Using detailed deal-level data from 2008 to 2021, we examine how climate laws affect green bond issuance value across sixty-nine countries. To quantify the impact of climate legislation, we introduce an innovative Climate Law Index, which captures the date of climate law enactment, the years since mandatory and voluntary ESG disclosures, and the approach to ESG requirements—whether these disclosures are mandated simultaneously, enforced by government, or follow a comply-or-explain model. Our model includes both specific deal characteristics and country-level control variables. Results reveal a positive association between the Climate Law Index and green bond issuance values. This relationship is strengthened by factors such as higher deal ratings, robust underwriter networks, strict placement covenants, and comprehensive credit information, while inflation and country risk show weaker effects. Robustness is confirmed through endogeneity tests and various sensitivity analyses, identifying the length of climate law enactment and underwriter network strength as key drivers of green bond issuance volume. Additionally, policy-based channels—such as business disclosure level, corporate resource income tax, and entrepreneurial innovation—serve as critical pathways through which climate laws shape green bond markets.

Keywords

Climate laws; ESG disclosure rules; green bond issuance; sustainable finance; institutions; global.

JEL codes

G11, G28, K22, K32, Q56, Q58, M48

1. Introduction

With climate change emerging as a major societal challenge, there has been a rapid expansion in policy initiatives and related legal risks. Driven by the urgency of this issue, a growing number of countries are committing to net-zero emissions targets by mid-century (UNEP, 2020). To meet these goals, numerous climate-focused regulations and disclosure requirements—collectively termed "climate laws"—have been introduced at both national and international levels, albeit with varying rates of adoption. Consequently, climate-related litigation has surged to unprecedented levels (Setzer & Higham, 2021). Courts are increasingly enforcing these laws rigorously, holding governments to account and assigning emissions responsibility to the corporate sector (UNEP, 2023). Yet, despite this trend, how climate laws influence business decisions—especially within green finance—remains largely unexamined (Zhang *et al.*, 2019; Wu *et al.*, 2023).

Examining how climate laws shape green bond market growth is essential, as climate risks increasingly spill over into financial risks, particularly within the global bond sector (Bernstein *et al.*, 2019; Krueger *et al.*, 2020; Lamperti *et al.*, 2021; Painter, 2020). Among the various facets of climate risk—physical, technological, and operational—regulatory risk stands out as the most immediate for investors and financial stakeholders to manage (Krueger *et al.*, 2020; Stroebel & Wurgler, 2021). Despite the importance of climate laws, there is a notable gap in research regarding their specific role and impact on green bond markets. This paper seeks to bridge that gap by being the first study, to our knowledge, that empirically links climate laws directly to green bond issuance globally.

The impact of climate laws on financing decisions is multifaceted. Recognizing climate change as a global problem in need of global solutions, countries across the globe are developing regulatory frameworks to advance green finance, including the establishment of green bond standards to ensure transparency, accountability, and environmental effectiveness (Dikau & Volz, 2021; OECD, 2023; European Council, 2023). However, the costs of complying with environmental regulations can detrimentally affect corporate valuations (Karpoff et al., 2005; Ramelli et al., 2021; Shen et al., 2023) and limit firms' access to credit (Wu et al., 2023; Javadi & Al Masum, 2021). Companies and financial institutions may perceive climate laws as risks, especially if stringent penalties are imposed for noncompliance (Burby & Paterson, 1993). Additionally, varying regulatory practices across jurisdictions due to different legal traditions and institutions (La Porta et al., 1997, 1998; Leuz, 2010) and challenges in aligning financial policies with specific environmental outcomes (Demekas & Grippa, 2021) add to the complexity. Consistent and effective enforcement of climate laws is also essential in managing climate risk, as weak enforcement could lead firms to evade compliance, thus undermining the deterrent effect of national regulations (Dasgupta et al., 2000). The absence of standardized metrics for assessing the "greenness" and sustainability of financial products complicates comparative analysis and effectiveness evaluation (Delmas & Blass, 2010; Cowan, 2017). Challenges are further compounded by limited data availability and quality regarding the environmental impact of financial instruments and the outcomes of regulatory actions (OECD, 2021a). Moreover, broader market dynamics and economic conditions can obscure the specific effects of regulations, making it challenging to determine their direct impact on business finance. The evolving nature of sustainability considerations, with emerging priorities and issues, continually reshapes the objectives of green finance and the policies supporting it (Speck *et* *al.*, 2023). These diverse effects cloud the overall impact of climate laws on green finance. Addressing these uncertainties necessitates ongoing economic and institutional research, improved data collection and sharing, and collaborative efforts across sectors and disciplines. There is also a need for agility in updating and refining laws and regulations in response to new global environmental challenges and insights.

Despite numerous challenges, climate laws and environmental policies influence the global landscape of green bond issuance, affecting both supply and demand within financial markets (Bhutta *et al.*, 2022; Mertzanis, 2023b). These laws establish regulatory frameworks, offer market incentives, mitigate risks, and promote activity standardization. The interplay between environmental policies and green finance is dynamically evolving, with increasing recognition from private companies, national governments, and international organizations of green bonds as feasible green financing options (Lindner & Chung, 2023). Prominent initiatives like the European Union's Sustainable Finance Disclosure Regulation (SFDR) and the EU Taxonomy for sustainable activities exemplify this impact. These regulations set rigorous standards for defining sustainable economic activities and investments, shaping how green finance is structured and recognized across Europe (European Council, 2023; Sautner *et al.*, 2022). Such frameworks not only guide the issuance of green bonds but also enhance their credibility, ensuring that they truly contribute to environmental sustainability. This regulatory influence helps cultivate a robust market for green bonds, driving both investor interest and funding towards sustainable projects.

International cooperation significantly bolsters the advancement of climate risk mitigation policies. Key agreements such as the Paris Agreement, motivate countries to finance climate action and sustainable development initiatives (Seltzer et al., 2022). Driven by frameworks such as the Task Force on Climate-related Financial Disclosures (TCFD). mandatory climate risk disclosure for corporations has gained increasing attention. The TCFD, established by the Financial Stability Board (2023), has played a central role in setting the standards and shaping these disclosure requirements, underscoring the importance of transparency in corporate climate risk management.¹ Such disclosure mandates are increasingly becoming a fundamental component of financial reporting, aiding investors in making well-informed decisions by considering the environmental impacts associated with their investments. Governments are enhancing the attractiveness of green bonds and other sustainable finance instruments through various market incentives. These include tax benefits, reduced capital requirements for banks, and grants or subsidies for projects that contribute to environmental sustainability (Climate Bonds Initiative, 2023). These measures effectively reduce the costs associated with issuing and investing in green bonds, thereby facilitating a more favorable economic environment for sustainable finance (Degryse *et al.*, 2023). This strategic combination of policy, disclosure requirements, and financial incentives plays a crucial role in accelerating the transition towards a greener economy.

¹. Many governments have introduced mandates for climate risk disclosure (Krueger *et al.*, 2022), and recent regulatory advancements are reshaping the global business environment. In June 2023, the International Sustainability Standards Board unveiled two essential IFRS Sustainability Disclosure Standards: IFRS S1 and IFRS S2. IFRS S1 establishes overarching guidelines for reporting sustainability-related financial data, while IFRS S2 focuses specifically on climate-related disclosures. Furthermore, on March 6, 2024, the U.S. Securities and Exchange Commission implemented new rules requiring public companies to include detailed climate-related disclosures in their SEC filings, reinforcing the increasing priority of environmental transparency within the corporate world.

Governments worldwide are not merely adopting green finance regulatory policies; they are actively contributing to the market by issuing sovereign green bonds to finance environmental projects (Monasterolo & Raberto, 2018; Cheng *et al.*, 2022). This active involvement has significantly fueled the recent expansion of the global green bond market,² with an increasing share of these bonds being issued by governmental entities.³ These actions emphasize a strong commitment to environmental goals and contribute to strengthening the green bond market by establishing benchmarks for pricing and performance. As the market matures, Environmental, Social, and Governance (ESG) factors are becoming integral to investment decisions, moving beyond traditional financial metrics to incorporate assessments of environmental impact (OECD, 2017a; Bauer et al., 2021; Goldstein et al., 2022; Ilhan et al., 2023). This shift is indicative of a broader trend where investors are increasingly demanding that their investments reflect sustainable and ethical values. The demand for green finance products, such as green bonds and loans, has surged, driven by investors aiming to align their portfolios with environmental values (Tang & Zhang, 2020; Caramichael & Rapp, 2024). Emerging economies are rapidly joining the green finance movement, with countries like China, India, and Brazil implementing policies to promote the issuance of green bonds and other sustainable finance instruments (China Daily, 2016; Climate Bonds Initiative, 2019; Azhgaliyeva & Kapsalyamova, 2021; Dembele et al., 2021, among others). This trend stresses the growing importance of sustainability in financial markets, indicating a significant shift in how investment worthiness is evaluated.

By establishing formal and standardized definitions, disclosure obligations, and verification procedures for green bonds, climate laws play a key role in nurturing the growth of the green bond markets (European Council, 2023; Maragopoulos, 2023). The clarity and consistency provided by these laws enhance transparency, reduce information asymmetry, and bolster investor confidence, which in turn supports the expansion of green bond markets. Furthermore, climate regulatory risks are increasingly impacting corporate bond credit ratings and yield spreads, reflecting the financial sector's acknowledgment of climate risks as significant factors in financial evaluations (Seltzer *et al.*, 2022). This integration of climate considerations into the pricing mechanisms of bond markets underscores the substantial role of climate regulation in influencing both market dynamics and growth. Such regulatory frameworks not only incentivize investments in environmentally sustainable projects but also align financial market practices with broader reputational benefits and environmental objectives, facilitating a more sustainable economic development model (Sangiorgi & Schopohl, 2023).

Consequently, we investigate whether climate laws and regulations influence global green bond issuance using individual deal data across sixty-nine countries from 2008 to 2021. Drawing on Li *et al.* (2022) and Krueger *et al.* (2022), we introduce a novel 'Climate Law Index' metric to quantify the influence of climate laws, which encompasses several

² In 2023, green bond sales reached unprecedented levels, exceeding USD 1 trillion. By the close of Q3 2023, the Climate Bonds Initiative reported a cumulative issuance of USD 4.2 trillion in green, social, sustainability, and sustainability-linked bonds, alongside USD 12.7 billion in transition bonds, which remain unscreened. For more details, refer to the Climate Bonds Initiative's latest figures. See more details here - https://www.climatebonds.net/files/reports/cbi susdebtsum q32023 01e.pdf

³. In 2023, governments globally issued green bonds amounting to a substantial USD 190 billion, and sovereign green bonds now represent nearly 20% of the Bloomberg MSCI Green Bond Index (Mastouri *et al.*, 2023).

dimensions: the timing of climate law enactment, the period since the initiation of mandatory and voluntary ESG disclosures, and the specific methodologies adopted for ESG disclosure, including uniform mandates, government enforcement, or a comply-or-explain framework. By integrating individual deal attributes and wider country-specific institutional factors into our analysis, we assess the effects of both micro-level firm specific and macro-level national influences as well as mitigate endogeneity concerns. We use alternative techniques to check for endogeneity bias.

Our analysis reveals a positive correlation between the Climate Law Index and the value of green bond issuances. This association is strengthened by factors such as high credit ratings for individual deals, extensive underwriter networks, restrictive bond placement covenants, and comprehensive credit information at the country level. In contrast, inflation and sovereign risk have comparatively modest impacts. A series of sensitivity checks and endogeneity tests confirm the robustness and reliability of these results. In instrumental variable analysis, we use a country's *ratification* of international environmental agreements as our external instrument based on novel data provided by Bellelli *et al.* (2023), who used natural language processing techniques and survival analysis to identify multilateral environmental agreements across countries. Further, our dominance analysis identifies the length of time since climate laws implementation and the extensiveness of underwriter networks as the most influential determinants of green bond issuance activity. Furthermore, we uncover that the transparency of firm's disclosures, the structural aspects of corporate income taxation, and the levels of entrepreneurial innovation function as critical economic channels that mediate the effects of climate legislation on the green bond market.

Our analysis contributes to both theoretical and empirical research literature in several keyways: First, we have developed a quantifiable measure, the 'Climate Law Index', to assess the influence of climate-related regulatory environments on financial markets. This novel contribution adds a new dimension to the further future analysis of the impact of legislative and regulatory actions on various financial aspects, including asset pricing (Bolton & Kacperczyk, 2022), bank loans (Wu et al., 2023; Miguel et al., 2023), research and development expenditures (Brown et al., 2022), capital structure (Dang et al., 2023), and shareholders' investment decisions (Krueger et al., 2020). Drawing on Li et al. (2022) and Krueger et al. (2022), our 'Climate Law Index' encompasses data on both the enactment and maturity of climate laws and ESG disclosure regulations, exploring their effects on both corporate and sovereign green bond issuance. While the relatively scarce evidence on the financial consequences of climate-related policies appears to be inconclusive, our findings document a positive influence on financing decisions, demonstrating the potential for climate-related actions to enhance the attractiveness and viability of green investments. The 'Climate Law Index' provides researchers and practitioners with a new tool to assess and compare the regulatory landscape across countries, enabling more refined analyses of global green finance trends.

Secondly, by integrating a composite Climate Law Index into the study of green bond issuances, we contribute to understanding the association between legal and institutional factors and financial market outcomes (La Porta *et al.*, 1997, 1998; Cheffins, 2001; Leuz, 2010). This enriches the existing literature by clearly demonstrating how legislation, acting as an external shock and reflecting historical practices, can influence market behaviors and investment flows. We provide empirical evidence that can guide country-specific policy-making, highlighting which types of legal frameworks are most effective at promoting

sustainable investments in given circumstances. This analysis is particularly valuable for policymakers who are focused on refining and optimizing climate-related financial regulations in ways that effectively achieve sustainable business outcomes.

Thirdly, our study significantly broadens the scope of research in the Environmental, Social, and Governance (ESG) field. By incorporating ESG disclosure practices into our 'Climate Law Index,' we contribute to the rapidly expanding literature on the impact of ESG disclosures in finance (Al-Tuwaijri *et al.*, 2004; Dhaliwal *et al.*, 2011; She *et al.*, 2022; Krueger *et al.*, 2022; Tsang *et al.*, 2023, among others). Our analysis examines how both mandatory and voluntary ESG disclosures affect green bond issuance, illuminating the ways in which transparency and accountability practices can enhance the appeal of sustainable investment opportunities. While related to the work of Krueger *et al.* (2022), which investigates the impact of ESG disclosures on the equity markets, our study diverges by focusing specifically on the debt markets, particularly the green bond market. This distinction addresses a different segment of the financial market, providing insights into how ESG factors influence the behavior of debt investors and issuers.

Fourthly, our research provides insights into market dynamics and investor behavior concerning environmentally friendly debt instruments (Baker et al., 2018; Zerbib, 2019; Flammer, 2021). We find that the issuance of green bonds is significantly influenced by climate laws, resonating with existing studies that have observed corporate bond investors demanding higher interest rates from issuers with poor environmental performance (Seltzer et al., 2022) and that climate risk impacts municipal bonds (Painter, 2020). However, our approach distinguishes itself from that of Seltzer et al. (2022), who focus on the impact of climate regulatory risks on corporate bonds within the U.S. by evaluating corporate bond credit ratings and yield spreads. In contrast, our study expands the scope to a global perspective, considering the diversity of climate-related laws and ESG regulations and their effects across the global green bond market. This broader view allows us to capture the variances in how different regulatory environments influence market dynamics internationally. Furthermore, our findings align with those of Sangiorgi and Schopohl (2023), who suggest that issuers' primary motivation for issuing green bonds is their commitment to combating climate change. This supports the notion that green bonds are not only financial instruments decided upon their risk-return characteristics, but also reflect issuers' strategic responses to environmental challenges, thus attracting investors willing to fund sustainability through their investment portfolios, emphasizing its ethical dimension.

The paper is structured as follows: Section 2 offers a comprehensive review of the literature examining the interplay between climate laws and green bond issuance. Section 3 describes the data sources, variables, and empirical methods employed in our analysis. Section 4 presents the initial findings of our study. Section 5 conducts sensitivity analyses and addresses potential endogeneity concerns. Section 7 includes additional robustness tests. Section 8 discusses the primary economic channels through which climate laws influence green bond decisions. Finally, Section 9 concludes the paper.

2. Related literature and hypothesis development

The impact of climate laws on green bond issuance can be explained through legal constraint, agency, and institutional theories, highlighting how legislation and regulations influence debt securities' structure, timing, and attractiveness. These frameworks dictate capital

structure choices, address stakeholder conflicts, and shape market dynamics. Further, climate laws affect both the demand for and supply of green bonds. Demand is driven by environmental standards, financial incentives, market creation for green technologies, and heightened public awareness and risk management. Supply is encouraged through incentives for issuers, development of standards, public sector issuance, and efforts to increase market liquidity and education. Essentially, climate laws create a supportive ecosystem for green bonds, directing capital towards environmentally beneficial projects and facilitating a low-carbon economy transition by making green bonds an attractive financing option.

2.1 Theoretical foundations of law and debt finance

The influence of law on debt issuance can be elucidated through several theoretical frameworks. The law and finance theory emphasizes the role of institutional factors like legal origins, historical policy structures, regulatory bodies, and industry norms in influencing debt issuance behavior (Beck & Levine, 2005; Giombini *et al.*, 2018). Legal regulations mirror societal values around corporate governance, financial transparency, and investor protection, and changes in these frameworks significantly affect debt issuance practices and market dynamics. In this context, law and finance theory has been especially influential (La Porta et al., 1997, 1998). This approach emphasizes that high-quality legal systems. especially those protecting investors and enforcing laws effectively, are crucial for financial market development. Legal systems are categorized into common law and civil law families, with common law systems typically offering better investor protection and thus, more developed financial markets. These principles apply to green bond markets, where robust climate laws enhance market development by ensuring transparency, proper use of funds, and rigorous enforcement. Strong legal frameworks for green bonds boost investor confidence, potentially increasing their issuance value. Effective enforcement of these laws ensures issuer compliance with green standards, maintaining market integrity and attracting more investors and issuers. Internationally harmonized legal standards for green bonds could further promote their global acceptance and growth. Furthermore, agency theory focuses on the conflicts of interest among shareholders, creditors, and management, suggesting that legal regulations help mitigate these conflicts in green debt markets (Lemma et al., 2021). For example, bankruptcy laws that enforce accurate and timely disclosures can reduce information asymmetry and agency costs, enhancing the credibility of debt securities and reducing the risk of default (Armour et al., 2015). Moreover, the legal constraint theory posits that legal frameworks and regulations restrict debt issuance activities (Malmendier, 2009; Pistor, 2013). Regulations related to securities offerings, such as disclosure requirements and investor protection rules, dictate the structure, timing, size, and terms of debt securities. Laws regarding bankruptcy, creditor rights, and tax treatments of debt influence the relative attractiveness of debt versus equity financing, with strong creditor rights reducing the cost of debt capital for issuers. Overall, these theories illustrate how legal structures and regulations shape the activities related to debt issuance by influencing the terms, resolving conflicts, affecting market operations, guiding capital structure decisions, and reflecting the broader institutional context that shapes corporate behavior.

2.2 Climate laws and the demand for green bonds

Climate regulations can significantly influence green bond demand by enhancing nonfinancial information transparency, creating market liquidity, and establishing incentives alongside defined standards. Setting stringent criteria and certifications for "green" bonds is essential to building investor confidence, as clear standards ensure alignment with environmental goals (Ehlers & Packer, 2017; Lindner & Chung, 2023). Additionally, investor response to green bond issuances intensifies when third-party certifications are involved, resulting in a stronger market impact (Flammer, 2021). However, the lack of uniform definitions and standards can lead to increased heterogeneity and undermine the credibility of green bonds, thereby limiting the interest of ethical investors who are driven to invest in green initiatives (Cowan, 2017). Well-defined legal standards are essential to ensure that the capital raised through green bond issuances is directed towards projects with real environmental benefits, thus reducing the risk of "greenwashing" - where the environmental impacts are overstated or falsely represented (Suk et al., 2019). The urgency for comprehensive climate legislation to combat greenwashing is intensifying. For example, on January 17th, 2024, the European Parliament passed the Green Claims Directive, aimed specifically at curbing greenwashing by establishing precise standards for issuers to promote environmental claims to investors. Moreover, transparent and verifiable regulatory frameworks defining qualified green investments increase the appeal of green bonds to socially responsible investors who seek not only financial returns but also to make a positive impact on environmental sustainability. For instance, Caramichael and Rapp (2024) illustrate that, due to European Union (EU) unifying regulations since 2019, a noticeable 'greenium' has helped to reduce the cost of issuing green bonds.

Furthermore, climate laws can drive investments in green projects by providing tax incentives, subsidies, and other financial benefits to investors of green bonds (Martinsson *et al.*, 2024). These incentives enhance the risk-return profile of green bonds, making them more appealing compared to conventional bonds, which can further boost their demand (Moral & Bordier, 2012; Della *et al.*, 2011; Calabrese & Ely, 2016; Agliardi & Agliardi, 2019). Additionally, these financial benefits can significantly reduce the costs associated with issuing green bonds for firms or governments, thus greatly stimulating demand for green bonds (Climate Bonds Initiative, 2023). Moreover, when climate laws facilitate the allocation of public funds to green projects through the issuance of green bonds by government entities, this not only directly injects capital into the market but also signals strong governmental confidence in the viability and importance of green investments (Baldacci & Possamaï, 2022). This public endorsement of green initiatives often motivates further involvement from the private sector, enhancing the scope and impact of green finance.

In addition, climate laws and regulations that require corporate non-financial disclosure of environmental impacts help reduce information asymmetry, enhancing transparency and accountability in the investment world (Jeanne *et al.*, 2023; Weil *et al.*, 2013; Krueger *et al.*, 2021). These disclosures increase investor knowledge and interest in sustainable investment options, aiding in the reduction of environmental risk exposure. For instance, Ilhan *et al.* (2023) highlight the strong demand among institutional investors for climate risk disclosures to better shape their diversified portfolios. Similarly, She (2022) demonstrates the tangible effects of such disclosures by illustrating how, following the California Supply Chain Due Diligence Act in 2010, firms improved their supply chain due diligence, enhancing demand for suppliers' human rights performance, which helped improve these firms' financing conditions and economic performance. Additionally, mandatory disclosure of

climate-related non-financial information can help lower the overall costs associated with financial information processing thereby improving investor comprehensiveness of green finance instruments (Goldstein *et al.*, 2022). As societal norms shift towards sustainability-focused solutions, investors increasingly align their portfolios with these values, further fueling the demand for green bonds. Furthermore, by enhancing non-financial information, climate laws elevate market awareness and comprehension of the new financial risks posed by climate change, promoting strategic risk management and reevaluation (Krueger *et al.*, 2021; Li *et al.*, 2022). This understanding helps investors see green bonds as a viable tool to mitigate these risks, diversify their portfolios (Su *et al.*, 2023), and bolster the resilience of their assets against the adverse effects of climate change (Cepni *et al.*, 2022). Broader climate policies and public awareness campaigns also support this shift by underscoring environmental challenges and progressively modifying investor attitudes towards sustainable investments.

Lastly, climate laws that improve information about new risks can significantly boost liquidity in the green bond market, encouraging major institutional investors like pension funds and insurance companies to diversify their portfolios towards green investments (Della *et al.*, 2011; OECD, 2021a). Enhanced market liquidity makes green bonds more attractive, allowing issuers to sell their bonds more readily at fair prices. This increased liquidity can create a virtuous cycle, attracting more issuers and investors, which in turn deepens the market and facilitates its expansion. This dynamic supports a robust, sustainable financial market where green bonds play a pivotal role in funding environmentally beneficial projects.

2.3 Climate laws and the supply of green bonds

Climate laws can significantly influence green bond offerings by creating a conducive environment for their issuance, affecting credit conditions, providing issuance economic incentives, improving issuers' credibility, and improving sustainability-related technologies and services. Firstly, climate legislation significantly influences the sustainable finance landscape by directly impacting the issuance of green bonds across both public and private sectors (Lindner & Chung, 2023). These laws can mandate the financing of environmentally friendly projects or create favorable conditions that make green bonds an attractive financing option (Li et al., 2022; Agliardi & Agliardi, 2019). In response to climate regulations, companies are adapting their capital structures and financial practices (Dang *et* al., 2023), which drives their adoption of robust refinancing mechanisms where green bonds play a key role. As supportive regulatory requirements or incentives expand the portfolio of green investment projects, reliance on green bonds increases, underscoring their growing importance not only as financing tools but also as means for transitioning towards a sustainable economy (OECD, 2017, 2018, 2023). Legislative frameworks thus not only facilitate the direct issuance of green bonds by aligning competitive financial strategies with environmental goals but also signal a broader commitment to sustainable development, encouraging a diverse range of reputation-minded issuers to consider green bonds as a strategic financing resource.

Moreover, the impact of legal changes on bank lending behavior is well recognized (Haselmann *et al.*, 2010; Calomiris *et al.*, 2017). Climate regulations, in particular, can significantly influence the accessibility of bank loans for firms, as banks increasingly

consider a company's environmental record in their lending decisions. Compliance with mature and comprehensive climate laws might require substantial investments in innovative technologies, processes, or infrastructure by firms. This compliance could have mixed effects on their creditworthiness: on one hand, the increased risks and compliance costs associated with borrowers heavily reliant on carbon-intensive processes could deteriorate lenders' views of their future profitability and sustainability, potentially reducing credit availability. On the other hand, adherence to climate laws might enhance a firm's reputation and attract clients who prioritize sustainability, which could increase their creditworthiness. From the perspective of borrowing firms, climate laws can thus have both positive and negative effects on external credit conditions, influencing their decisions to issue green bonds. For instance, Wu et al. (2023) observed that stricter environmental law enforcement in China led to reduced access to bank loans for firms. Similarly, Miguel et al. (2023) noted that in Brazil, changes in capital requirements that require banks to consider environmental risks have prompted major banks to reduce lending to sectors more susceptible to environmental risks. These findings suggest that issuing green bonds may become a more attractive and feasible option, relative to bank loans, for financially constrained firms, presenting an alternative route to funding that aligns with evolving regulatory landscapes.

Furthermore, climate laws enhance the economic appeal of issuing green bonds by offering incentives such as tax breaks, subsidies, or other financial benefits designed to reduce issuance costs (Della et al., 2011; Calabrese & Ely, 2016; Agliardi & Agliardi, 2019; Azhgaliyeva & Kapsalyamova, 2021; Atalla & Mills, 2022; Climate Bonds Initiative, 2023). Such legislative measures establish a more financially attractive environment for green bonds relative to traditional financing methods by reducing both administrative and financial costs linked to their issuance. Additionally, climate legislation supports the implementation of risk mitigation strategies, which may include guarantees or insurance for projects financed through green bonds (OECD, 2021a; OECD, 2023b). For example, to enhance the risk/return profiles of projects and attract external investment, development banks might provide guarantees or cover first loss tranches of green bonds. These guarantees are particularly advantageous for funding environmentally friendly infrastructure projects that might otherwise have weak credit risk profiles. Such incentives effectively address the higher perceived risks often associated with green projects by providing a financial safety net, which improves the appeal of green bonds to issuers. By reducing financing costs and enhancing confidence in the green bond market, these legislative initiatives facilitate a smoother transition for organizations looking to finance sustainable projects.

In addition, climate laws enhance issuers' willingness to opt for green bond financing by boosting the credibility of the issuance process through increased transparency (UNEP, 2023, p. 16). Legislation usually requires strict enforcement of clear, comprehensive standards to identify a green bond (Ehlers & Packer, 2017; Lindner & Chung, 2023; UNEP, 2023, p. 16). The requirement for a recognized certification process serves as a seal of approval, affirming the environmental credentials of the projects financed by these bonds and reducing the likelihood of perceived abusive practices. This assurance of environmental integrity is vital for sustaining trust in the green bond market regarding the issuers' credibility (Pietsch & Salakhova, 2022). Such improved credibility and certainty motivate a

wider array of issuers to consider green bonds as a viable financing alternative, confident that their environmental sustainability efforts are verifiable and valued by investors.

Also, governments and public institutions have a distinctive role in setting precedents in the financial market through their active participation in green bond issuances to fund sustainable projects (OECD, 2021a, p. 22-23). This direct involvement not only increases the supply of green bonds but also acts as a strong endorsement of their viability as a financial instrument. It sends a clear signal of confidence in the green bond market's importance (Lehmann & Martins, 2023). This public sector trust and commitment are instrumental in encouraging private sector issuers to consider and adopt green bonds as a financing method for their own sustainable projects, thereby expanding the reach and impact of green finance.

Lastly, climate legislation can significantly drive the development and expansion of markets for green technologies and services (Wong, 2013; Nesta et al., 2014; Wang et al., 2021; Zhang et al., 2022; Xie et al., 2023). Effective environmental regulations can spur innovation in product quality and market positioning, leading to cost-effective compliance and potential net advantages for firms, such as cost savings, access to new markets, and enhanced reputations (Porter, 1991; Porter and van der Linde, 1995; Jaffe & Palmer, 1997; Ambec & Barla, 2002; André et al., 2009). By viewing climate regulation as an opportunity rather than a threat, firms can improve their competitive positions. Moreover, mature and comprehensive environmental standards and carbon emission reduction mandates across various sectors require financial solutions that enable compliance and support competitive business strategies (Zhang et al., 2021). As societal interest in and demand for green technologies and services increases, driven by legislative updates and a broader shift towards sustainability, there arises a significant need for substantial financing. Green bonds serve as a crucial financial instrument in this context, particularly for emerging technologies where initial costs are high but are compensated by long-term environmental and economic benefits. Consequently, climate laws promote the embracing of green practices while also enabling a wider array of sustainability-focused services to flourish within a competitive market framework.

2.4 Other determinants of green bond issuance.

Several other factors can influence green bond issuance, highlighting issuer-specific and country-level elements. Issuer-specific factors include credit ratings, which are critical in determining bond yields, spreads, and overall market decisions (Zerbib, 2019; Sangiorgi and Schopohl, 2023). Issuers with higher credit ratings generally face lower debt financing costs due to perceived lower risks (Sheng *et al.*, 2021; Li *et al.*, 2020; Bastida *et al.*, 2017; Wang *et al.*, 2020; Benito *et al.*, 2016). In the absence of credit ratings, evaluating an issuer's creditworthiness involves a thorough assessment of financial statements, market share, management quality, and industry trends. In the case of green bonds, assessing creditworthiness also encompasses scrutinizing ESG disclosures and the proper use of raised funds (Rusike and Alagidede, 2021). Moreover, underwriters play a crucial role in the issuance process. Their deep market knowledge and investor networks help structure offerings, appropriately price bonds, and ensure successful issuance by reaching a broad investor base (Liu, 2015; Siani, 2021; Ottonello *et al.*, 2023). Additionally, legal covenants in bond issues underscore the issuer's commitment to environmental goals, potentially

also introduce complexities and higher costs, especially in terms of additional placements and stringent environmental benchmarks, which may restrict issuer flexibility (Chiesa & Barua, 2019; Agliardi & Agliardi, 2019; Azhgaliyeva *et al.*, 2020; Reisel, 2014; Green, 2018).

Country-level factors also include monetary stability and credibility conditions. In particular, inflation could significantly impact green bond issuance. High inflation can erode national creditworthiness and reduce long-term financing availability, leading to higher borrowing costs and potentially stunting market expansion (Nickel *et al.*, 2011; Alexopoulou *et al.*, 2010; Presbitero *et al.*, 2016; Anh Tu *et al.*, 2020). Moreover, credit information frameworks enhance the attractiveness of green bonds by providing detailed risk assessments and signaling issuer transparency, which is crucial for attracting socially responsible investors (Benzoni *et al.*, 2023; Lin & Su, 2022). Finally, sovereign risk, reflected in a country's risk premium, directly affects borrowing costs and investor demand. Higher risk premiums might deter green bond issuance by increasing borrowing costs and reducing market liquidity, thereby impacting investor confidence and the country's ability to meet its environmental commitments (Bernoth *et al.*, 2012; Muzindutsi, 2020). Overall, these factors collectively influence the dynamics of green bond markets, affecting everything from issuance costs and investor appeal to market accessibility and regulatory compliance.

2.5 Research hypothesis.

Building on prior literature insights, this study hypothesizes that climate laws have a substantial impact on the value of individual green bond deals. This influence operates through a mixture of influences of both supply and demand, which in turn shape capital market trends, drive investor preferences, modify regulatory frameworks, and create incentives to participate in the green finance sector. The hypothesis considers both deal-specific and country-level as well as both economic and non-economic elements contributing to this complex interaction. The analysis emphasizes the impact of climate laws on green bonds across different countries, considering the duration since the first climate law was enacted, the years since the implementation of mandatory and voluntary ESG disclosures, and the specifics of these disclosures. This also includes examining whether disclosures of Environmental (E), Social (S), and Governance (G) components were mandated simultaneously, and whether the disclosure requirements were government-mandated or adopted on a voluntary basis with a comply-or-explain approach.

3. Data and identification strategy

3.1 Data and the outcome variable

We developed a unique panel dataset to explore the causal relationship between climate laws and green bond issuance, capturing individual green bond deals by both corporate and government entities from 2008 to 2021 covering sixty-nine countries. Using data from the Informa GM database (https://www.informagm.com/)-apremiersource of syndicated bond data and market intelligence—we focused exclusively on corporate and sovereign bonds, excluding issuances by international organizations and other non-corporate entities. Green bond issuance surged post-2013, coinciding with the release of the Green Bond Principles. The latter standardized issuance guidelines, building market confidence (Cheong and Choi,

2020). Global green bond deals rose from just three in 2008 to 101 in 2016 and reached 1,122 in 2021, totaling 2,729 deals. This reflects an impressive average annual growth rate of 70.5% during 2008-2021, far outpacing the global average growth rate of 6.1% for all corporate bonds during that period (Climate Bonds Initiative, 2022). To enrich our analysis, we integrated these corporate green bond issuance records with comprehensive country-level economic and institutional data from various reliable databases. This includes merging individual deal data with data from other national data sets. Specifically, issuer data were gathered from the IGM database, while country-level data came from the International Monetary Fund's Economic Outlook database and the World Bank's Doing Business database, among others. Our final dataset, created by compiling and integrating all available data, comprises 2,497 green bond transactions—both sovereign and corporate—across sixty-nine countries. To manage potential outliers effectively, we employed winsorization at the 1% and 99% thresholds and took logarithms of large level variables.

In our empirical analysis, the outcome variable is the logarithm of the individual green bond deal values per country, measured in U.S. dollars (expressed as GRBNDVAL). The growth of the green bond market is linked to the size of individual green bond deal values, though the strength of this association can fluctuate based on investor behavior, the nature of funded projects, and the surrounding economic and policy environment. However, we do not consider these dynamics.

Table 1 illustrates the distribution of our sample's key variables across countries. In our global sample, individual green bond deals average USD 0.687 billion annually—a substantial figure, yet notably lower than the average annual value of conventional bond deals (Climate Bonds Initiative, 2023b). France leads in average green bond deal size, reaching USD 20.96 billion, followed closely by Slovenia at USD 20.90 billion, Israel with USD 20.88 billion, and Saudi Arabia at USD 20.77 billion. Mid-tier issuers include Hong Kong and South Korea, both nearing USD 19.84 billion, alongside India at USD 19.87 billion. At the lower end, New Zealand averages USD 18.7 billion, followed by Sweden with USD 18.4 billion and Mauritius at USD 18.2 billion. While Europe has remained particularly initiative-taking in green bond issuance, numerous smaller and lower-income nations have joined this market, capitalizing on the growth potential despite various structural obstacles. These trends illustrate the expanding interest across regions, supported by reports from the Climate Bonds Initiative and other green finance sources (Nguyen *et al.*, 2021).

(About here insert Table 1)

3.2 Climate Law Index

In our study, the primary independent variable is the Climate Law index (denoted as CLIMLAW), which quantifies the implementation of climate laws across sixty-nine countries. This data is principally derived from the research of Li *et al.* (2022) and Krueger *et al.* (2022). Li *et al.* (2022) provided an extensive dataset covering national-level climate laws in 155 countries from 1989 to 2021, drawn from four major databases. The data's primary source, ECOLEX (https://www.ecolex.org/), is the result of collaboration among the Food and Agriculture Organization (FAO) of the United Nations, the International Union for Conservation of Nature (IUCN), and the United Nations Environment Programme (UNEP). Additional relevant data sources, used for data validation, include the Grantham Research

Institute's Climate Change Laws database (https://climate-laws.org/), the NewClimate Institute's Climate Policy database (https://newclimate.org/), and the World Bank's Carbon Pricing dashboard (https://carbonpricingdashboard.worldbank.org/). To ensure the accuracy of our data, we conducted selective manual verifications against these publicly available databases. The appendix in Li *et al.* (2022) lists specific law titles, facilitating easy verification and enhancing the transparency and accessibility of climate legislation research. This dataset focuses on laws critical for mitigating climate change, including regulations on greenhouse gas emissions, national climate strategies, and the creation of climate change oversight committees. The data also reveals significant variations in the time countries take to enact climate laws. Moreover, the effectiveness of these laws in reducing carbon emissions has been confirmed (Eskander & Fankhauser, 2023).

In addition, we incorporated data on ESG disclosure regulations across various countries, sourced from Krueger et al. (2023), who relied on information from the Sustainable Stock Exchanges (SSE), the Global Reporting Initiative (GRI), and primarily the Carrots & Sticks (C&S) project. The C&S project gathers comprehensive details on both mandatory and voluntary reporting requirements of ESG-related data worldwide, verifying its findings through government sources, exchanges, and media reports. This project has compiled a dataset that outlines country-specific legislation on ESG reporting obligations. By 2022, thirty-eight countries had implemented some form of mandatory ESG disclosure regulations. The regulatory approaches varied, with thirteen countries rolling out environmental (E), social (S), and governance (G) disclosures in stages, while twenty-five countries implemented comprehensive ESG disclosure regulations all at once. Our dataset includes information on voluntary ESG disclosure practices, highlighting instances where countries introduced more than one voluntary guideline, noting the year the first guidelines were implemented. Krueger et al. (2023) adopted a comprehensive approach to collect data on voluntary disclosures from initial listings of voluntary ESG disclosure regulations in various countries generated by AI systems, which were then cross-referenced with data from the C&S project and the regulations database of the Principles for Responsible Investment (PRI), supplemented by web searches. This methodology provided detailed information on the global landscape of ESG disclosure regulations, distinguishing between mandatory and voluntary practices and promoting transparency and accountability in ESG issues.

We constructed CLIMLAW as a composite indicator by employing principal component analysis (PCA) on six distinct dimensions for each country. These dimensions are: CLIMLAW1: Number of years since the first climate law initiative was introduced; CLIMLAW2: Number of years since the mandatory implementation of ESG disclosure regulations; CLIMLAW3: Number of years since the voluntary implementation of ESG disclosure practices; CLIMLAW4: A binary indicator (0 or 1) reflecting whether the mandatory disclosures of the Environmental (E), Social (S), and Governance (G) components were introduced simultaneously; CLIMLAW5: A binary indicator (0 or 1) denoting whether the mandatory ESG disclosure requirements were imposed by governmental authorities; CLIMLAW6: A binary indicator (0 or 1) indicating whether the mandatory ESG disclosure requirements were introduced on a comply-or-explain basis. This approach aggregates these varied dimensions into a single index, providing a detailed measure of each country's legislative engagement with climate and ESG issues.

Table 2 presents the PCA results. Panel A shows the pairwise correlations between the six dimensions of the Climate Law Index (CLIMLAW1-CLIMLAW6), capturing distinct

aspects of climate legislation and ESG disclosure. The strongest correlations are between CLIMLAW2 (years since mandatory ESG disclosure implementation) and both CLIMLAW6 (comply-or-explain disclosure basis) at 0.7030, and CLIMLAW5 (government-imposed ESG disclosure) at 0.6967, indicating that countries with longer-standing mandatory ESG regulations tend to also impose government-directed and comply-or-explain frameworks. Additionally, CLIMLAW4 (simultaneous ESG component introduction) has moderate correlations with CLIMLAW2 (0.6060) and CLIMLAW5 (0.6943), reflecting that countries implementing mandatory ESG disclosures often introduce all three components (environmental, social, and governance) at the same time. The lower correlations, such as between CLIMLAW1 (years since the first climate law) and CLIMLAW3 (years since voluntary ESG efforts do not always align with their mandatory regulations. The Bartlet test (χ^2 =377.5, p<0.01) confirms the overall suitability of these variables for principal component analysis by rejecting the null hypothesis that they are uncorrelated, validating the use of PCA in this context.

Panel B reports the results of the principal component analysis (PCA), which reduces the six dimensions of the Climate Law Index into key components. Factor 1 has an eigenvalue of 3.2432, explaining 54.05% of the total variance, making it the primary factor in capturing the legislative aspects of climate law, while Factor 2 adds another 14.41%, with the two factors together explaining 68.47% of the variance. The loadings on Factor 1 show that CLIMLAW2 (mandatory ESG implementation) and CLIMLAW5 (government-imposed ESG disclosure) have the highest loadings (0.8401 and 0.8374, respectively), indicating that the Climate Law Index is largely driven by mandatory, government-imposed ESG regulations. Other dimensions, such as CLIMLAW4 (simultaneous ESG introduction) and CLIMLAW6 (comply-or-explain basis), also contribute significantly to Factor 1, emphasizing the importance of structured ESG disclosure frameworks. The high uniqueness values of CLIMLAW1 (0.8008) and CLIMLAW3 (0.8218) suggest that these dimensions are more distinct and less captured by the principal components. Additionally, the Kaiser-Meyer-Olkin (KMO) test results in a value of 0.807, which indicates that the sampling adequacy is strong, further validating the use of PCA for constructing the Climate Law Index. These results imply that the index is primarily shaped by the strength of mandatory ESG disclosures, while voluntary and historical aspects play a secondary role.

Applying the traditional rule of selecting only components with eigenvalues above 1, we identify two main components that together account for about 69% of the total variance across variables. To create a single index that represents the combined variance of the six climate law components, we use the weighted rank-sum approach. This method assigns weights to each component based on their respective shares of explained variance, providing a ranked order of observations based on these weighted scores. This approach is advantageous as it considers contributions from all selected variables, unlike a single-factor approach that might miss significant positive impacts from variables strongly associated with the second component (Favero & Belfiore, 2019, Ch. 12). Since these dimensions show significant positive loadings, we interpret the CLIMLAW index as reflecting the maturity and comprehensiveness of a country's regulatory framework for climate and ESG issues. Essentially, higher scores would indicate a country with early adoption of climate laws, comprehensive and mandatory ESG disclosures, strong government involvement, and

flexible regulatory mechanisms. This would suggest a robust and initiative-taking approach to managing climate change and sustainability issues.

Table 1 shows the implementation of climate laws by our sample countries. Argentina and Australia both display low values for green bond issuance (USD 205 million and USD 535.79 million, respectively) and correspondingly low Climate Law Index scores (-1.47 and -1.49), indicating minimal legislative engagement and weak green bond markets. For countries with middle values, Colombia and South Korea represent moderate green bond issuance (USD 436.55 million and USD 459.90 million) and Climate Law Index values (1.15 and 1.62), reflecting growing but not fully developed green finance sectors supported by moderately strong climate regulations. At the high end, Italy and Finland stand out with high green bond issuance (USD 937.92 million and USD 403.53 million) and strong Climate Law Index values (3.17 and 3.08), signifying the positive influence of robust climate laws and mandatory ESG disclosures, which have contributed to more vibrant green bond markets. This pattern highlights that higher values in both green bond issuance and the Climate Law Index are intricately linked to more comprehensive climate legislation and regulatory support.

(About here insert Table 2)

3.3 Controls

To address the complexities of real-world conditions, we incorporate several control variables in our analysis. Our first control variable, labeled INDRATNG, represents the external credit rating of the green bond issuer. It is a binary indicator from the Informa GM database, showing whether the issuance is classified as investment grade (0/1). This rating assesses issuer creditworthiness, strongly shaping market perceptions and bond pricing decisions (Zerbib, 2019; Sangiorgi and Schopohl, 2023). Credit ratings have a substantial impact on green bond yields and spreads, with lower ratings often leading to increased financing costs due to heightened perceived risk regarding the issuer's capacity to meet financial obligations (Bastida *et al.*, 2017; Wang *et al.*, 2020; Benito *et al.*, 2016). In our analysis, green bonds are thus categorized into investment-grade and non-investment-grade to better analyze these dynamics (Capelle-Blancard *et al.*, 2019). Consequently, we anticipate that higher ratings will positively influence green bond issuance by making them more attractive to investors due to lower associated risk.

The next control variable UNDWRTNET represents the number of underwriters involved in a green bond issuance, which serves as an indicator of the strength and breadth of underwriter networks supporting these issuances. Data on UNDWRTNET is sourced from the Informa GM database, offering insight into how robust underwriter networks can influence the success and scale of green bond offerings. Underwriters bring capital market expertise, facilitating the structuring, pricing, and smooth issuance of green bonds, while their extensive investor networks help access a diverse base, enhancing bond visibility and reach (Liu, 2015; Siani, 2021; Ottonello *et al.*, 2023). We anticipate a positive relationship between UNDWRTNET and GRBNDVAL, as strong underwriter networks can lead to successful issuance and meeting funding goals.

Our third control variable, COVPLCMENT, is a binary indicator from the Informa GM database that signifies whether the green bond's covenants include provisions permitting

additional bond placements (0/1). Such covenants signal commitment to environmental objectives and ensure adherence to green standards (Chiesa & Barua, 2019; Agliardi & Agliardi, 2019; Azhgaliyeva *et al.*, 2020). This flexibility allows issuers to respond to market changes and attract a broader investor base, although it can also raise issuance costs due to monitoring and transparency requirements (Reisel, 2014). Given these mixed effects, we predict that COVPLCMENT could correlate positively or negatively with GRBNDVAL.

The inflation rate (INFLATION), drawn from the IMF's Economic Outlook database, is our fourth control variable. Inflation affects bond issuance costs and reflects macroeconomic stability, impacting creditworthiness (Nickel *et al.*, 2011). High inflation rates may disrupt long-term financing options, increase borrowing costs, and potentially constrain green bond issuance, particularly in OECD countries (Alexopoulou *et al.*, 2010; Anh Tu *et al.*, 2020). We expect INFLATION to have a negative effect on GRBNDVAL.

Our fifth variable, CRDINFO, measures the depth of credit information from the World Bank's Doing Business database. Transparent credit information aids green bond issuers by reducing default risk, boosting market confidence, and appealing to investors focused on sustainable projects (Benzoni *et al.*, 2023; Lin & Su, 2022). Comprehensive credit data signals transparency, essential for socially responsible investors, potentially lowering capital costs. We expect CRDINFO to positively influence GRBNDVAL.

The final control variable, CRISKPREM, represents the country's risk premium, with data drawn from Damodaran (2022). This variable influences borrowing costs, investor confidence, and capital flows. A higher risk premium typically elevates issuance costs, as it signals increased perceived risk, which can dampen investor interest (Bernoth *et al.*, 2012; Muzindutsi, 2020). Elevated risk premiums thus directly affect both the cost of capital and market attractiveness for green bond issuances, impacting overall investment influence of EU and OECD membership on green finance initiatives, as both organizations promote green bonds for sustainable projects (OECD, 2020; EU, 2022). We account for these policies using dummy variables indicating whether a country is an EU or OECD member. The appendix provides definitions of all variables.

Table 3 presents our variables' descriptive statistics, highlighting considerable variability. GRBNDVAL has a mean of 19.78 (SD=1.04), indicating that bond deals are concentrated around a relatively high average value with moderate variability. CLIMLAW shows a mean of 0.09 (SD=1.53), reflecting substantial variation across countries in their legislative engagement with climate laws, with values ranging from -2.49 to 3.17. This indicates that while some countries have strong climate laws, others are significantly behind. INDRATNG has a mean of 0.82 (SD=0.38), suggesting that most green bond issuers are financially stable with little variability in their ratings. In contrast, UNDWRTNET shows a mean of 4.57 (SD=3.54), indicating greater variability, as larger or more complex deals often involve more underwriters. INFLATION has a mean of 12.75% (SD=40.65), demonstrating substantial variation, which reflects economic instability in some countries. CRDINFO has a mean of 6.81 (SD=2.05), suggesting that better financial transparency in countries supports green bond issuance. These key variables indicate that stronger climate laws, higher credit ratings, and larger underwriter networks are associated with more active green bond markets across countries. In sum, these core variables indicate that countries with robust climate laws, high issuer credit ratings, and extensive underwriter networks are more likely to cultivate strong green bond markets. This combination strengthens market confidence, lowers issuance costs, and enhances investor appeal, thereby fostering green finance growth.

Table 4 highlights pairwise correlations among variables, offering insights into their relationships. The correlation between GRBNDVAL and CLIMLAW is positive at 0.11 (p<0.01), suggesting that stronger climate legislation is linked to higher green bond deal values, which supports the hypothesis that stringent climate laws boost green bond issuance. Additionally, GRBNDVAL has positive correlations with both INDRATNG (0.19, p<0.01) and UNDWRTNET (0.29, p<0.01), indicating that higher issuer ratings and larger underwriter networks are associated with more substantial green bond deals. Interestingly, CLIMLAW shows a slight positive correlation with INDRATNG (0.07, p<0.01) but a negative correlation with UNDWRTNET (-0.10, p<0.01), implying that countries with stricter climate laws may depend less on extensive underwriter networks. A Variance Inflation Factor (VIF) of 1.17 confirms that multicollinearity is not an issue within this model, as correlations among key variables remain low to moderate.

(About here insert Table 3 and Table 4)

3.4 Estimation model

Establishing a causal link between a country's climate laws and its green bond issuance presents inherent challenges, primarily due to potential unobserved factors that could influence both climate law adoption and decisions on the issuance value of green bonds. This complex relationship is likely shaped by intertwined economic, social, and political forces. For instance, growing market demand for green finance and rising interest in green bonds may drive the development of climate legislation that addresses these trends. Also, economic, and non-economic conditions that are not immediately apparent may significantly influence these decisions. If environmental sustainability gains greater importance in societal and governmental priorities, this might lead governments to integrate considerations of green finance into their legislative frameworks. These dynamics suggest that endogeneity could present a significant challenge in understanding these relationships (Greene, 2012). To manage the complexity of estimation, we apply alternative model specifications, beginning with a panel ordinary least squares (OLS) estimation model. While OLS offers a solid foundation for exploring data relationships, it does have limitations: it is sensitive to outliers, struggles with nonlinear relationships, lacks reliable extrapolation, and can suffer from attenuation bias, potentially inflating the values of the outcome variable. Despite certain limitations, OLS remains a widely preferred approach compared to nonlinear methods, which often suffer from incidental parameter bias (Angrist & Pischke, 2009).

Moreover, following Breuer & DeHaan (2024), we incorporate both individual deal fixed effects and joint country-sector fixed effects in our analysis. Including individual deal fixed effects allows us to control for specific characteristics of each bond issuance, such as the issuance terms, which are independent of broader national regulatory factors. Simultaneously, grouping country and sector fixed effects together enables us to account for unobserved differences that vary across countries and sectors but remain constant over time. This is critical because different sectors within a country may respond uniquely to climate laws due to factors like industry regulations, technological advancements, or established practices. Likewise, the same sector in different countries may face distinct regulatory, economic, or environmental conditions. By employing this joint approach, we ensure that our analysis centers on the interaction between climate laws at the national level and sector-specific reactions, while filtering out time-invariant, unobserved heterogeneity across country-sector combinations. For example, the energy sector may be more directly impacted by stringent climate policies than the services sector, and even within the energy sector, responses may vary significantly between countries. To enhance the robustness of our results, we conduct additional sensitivity analyses and assess potential endogeneity concerns.

Following Moulton's (1990) guidance on avoiding statistical bias when using aggregate policy variables to predict micro-level outcomes, in all regressions we cluster standard errors by country. This clustering approach adjusts for possible within-country error correlations, providing more reliable inferences and reducing the risk of underestimated standard errors that could otherwise result in false statistical significance. We adopt the following estimation model:

$$GRBNDVAL_{ijt} = a + CLIMLAW_j \beta_1 + X1_{ijt} \beta_2 + X2_{jt} \beta_3 + \kappa_j + \lambda_s + \varepsilon_{ijt}$$
(1)

The variables in equation (1) above are defined as follows: GRBNDVAL_{ijt} stands for the logarithmic value of each individual green bond *i* offered in country *j* during year *t*, being the outcome variable. CLIMLAW_{jt} denotes our Climate Law Index for country *j*, measuring the intensity and breadth of climate legislation. Vector X1_{ijt} includes deal-specific characteristics for each bond *i* in country *j* during year *t*, while vector X2_{jt} comprises country-level control variables for country *j* in year *t*. The sector-specific effects are captured by the error term λ_s , country-specific effects by κ_j , and the estimation error term ε_{ijt} is assumed to follow a normal distribution. Due to the difficulty of inferring causality from identified correlations, we read our results as suggestive of the intensity of association rather than causality. For clarity, we use "predict" to describe these relationships, mindful of this limitation.

4. Results

4.1 Baseline effects

Table 5 presents the baseline estimates. CLIMLAW exhibits a positive and significant relationship with green bond offering value across all models, confirming that stringent and longer climate laws bolster the green bond market. In Model (4), which includes both dealand country-sector fixed effects, the CLIMLAW coefficient is 0.465 (p<0.01), indicating that more stringent climate laws lead to higher green bond issuance. As additional fixed effects are incorporated, the coefficient strengthens, underscoring that controlling for country and sector heterogeneity enhances the robustness of this relationship. The results suggest that a more mature and comprehensive implementation of climate laws can improve the demand for green bonds by improving green finance standards and incentives, enhanced transparency and comparability of non-financial information, and market liquidity as well as the supply of green bonds by sustaining incentives for issuers, encouraging development of standards, public sector issuance, and efforts to increase market liquidity and education. Since green financing is crucial in assisting with the deployment of programs to mitigate climate change risks, our study uncovers a strong connection between the enactment of climate laws and the increase in funding for environmentally friendly projects in different nations.

The control variables also yield significant results. INDRATNG consistently shows a positive relationship with green bond issuance value, with a coefficient of 0.220 (p<0.01). This underscores the importance of issuer credibility, as higher-rated issuers tend to issue larger bonds. The relationship suggests that better credit ratings, which indicate lower financing costs and higher creditworthiness, encourage issuers to engage in green investments aimed at mitigating climate risks (Zerbib, 2019; Sangiorgi & Schopohl, 2023). Similarly, UNDWRTNET, reflecting the number of underwriters involved, remains positive and significant across all models, with a coefficient of 0.067 (p<0.1). This highlights that larger underwriter networks contribute to higher bond issuance values, likely due to their market reach and credibility. Underwriters, with their deep market knowledge, play a crucial role in guiding issuers through the complex green bond issuance process (Siani, 2021; Ottonello *et al.*, 2023).

In contrast, COVPLCMENT consistently displays a negative impact on bond issuance value. In Model (4), the coefficient is -0.759 (p<0.01), suggesting that deals with additional bond placement covenants tend to have lower bond values. This implies that restrictive covenants may discourage larger issuances, as they increase the complexity and operational challenges of issuing green bonds (Green, 2018). INFLATION shows a small but positive effect, with a coefficient of 0.002 (p<0.01), suggesting that inflation slightly increases bond issuance, possibly due to higher nominal issuance values in inflationary environments (Alexopoulou *et al.*, 2010; Presbitero *et al.*, 2016).

Additional controls such as CRDINFO and CRISKPREM provide further insights. The coefficient for CRDINFO is 0.176 (p<0.01), indicating a positive and statistically significant effect. This result suggests that countries with more advanced credit information systems tend to support higher levels of green bond issuance, likely due to improved credit transparency and reduced information asymmetry, which can increase investor confidence and market participation. Detailed and transparent credit information increases green bonds' attractiveness to investors by enhancing credibility and facilitating access to capital markets, particularly for socially responsible investors (Benzoni *et al.*, 2023). CRISKPREM, though less consistent, shows a positive coefficient of 22.271 (p<0.1), implying that higher country risk premiums may not fully deter bond issuance. This could reflect the fact that, while increased borrowing costs and constrained capital flows might negatively impact investors as a hedging tool against uncertainty. Green bonds serve as reliable safe havens against climate-related uncertainties, which suggests a nuanced interaction between risk factors and the attractiveness of green bonds (Cepni *et al.*, 2022),

Overall, these results provide robust evidence that stricter and longer implemented climate laws positively impact green bond issuance, especially when supported by strong financial market infrastructure, such as issuer credit ratings, underwriter networks, and transparent credit information systems. However, restrictive deal structures like additional placement covenants can hinder bond issuance, highlighting the complex interaction between deal-specific features and broader legislative frameworks in green bond markets.

(About here insert Table 5)

4.2 Indirect effects

Changes in climate legislation can influence both directly and indirectly the supply and demand of green bonds, shaping green bond issuer behavior. Indirectly, these laws influence green bond deals through their specific characteristics, such as issuance size, sector targeting, distribution strategies, and covenant choices. For example, legal support targeted at specific sectors may enhance the viability of green bond projects within those sectors, subtly directing issuers towards these opportunities (European Council, 2023). Additionally, changes in legislation can modify the risk profiles associated with green bond transactions, requiring issuers to adjust their project choices, designs, and financial conditions to stay compliant and attractive within the new legal framework (Spinaci, 2021). The complex interaction of policy incentives, investor demand, risk elements, and project traits reflects how climate regulations indirectly shape green bond market dynamics. By exploring how climate laws indirectly impact green bond deals via the Climate Law Index and specific deal characteristics, we uncover the varied effects of these laws. This insight is crucial for developing targeted policies and financial strategies, refining risk assessments for more accurate investment decisions, and offering essential guidance for policymakers aiming to adjust legal frameworks to effectively stimulate the market.

We utilize interaction terms between the Climate Law Index and individual deal characteristics in our dataset to assess indirect effects. The results, shown in Table 6, reveal that while climate laws have a significant direct impact on the value of individual green bond deals, they exert a negligible indirect effect through higher credit ratings (INDRATNG) (β =0.046; *p*-value>0.010). Similarly, climate laws significantly influence green bond deal values directly but have a minimal indirect effect through bond placement covenants (COVPLCMENT) (β =-0.031; *p*-value>0.010). In contrast, a notable and significant indirect influence of climate legislation on individual green bond deals is observed through the participation of underwriters (UNDWRTNET) (β =0.021; *p*-value=0.010). This suggests that legislators' deep understanding of underwriter distribution networks, coupled with the regulatory knowledge of underwriters, can be instrumental in organizing public offerings of green bonds, setting appropriate prices, and managing the challenges of the issuance process (Bayo et al., 2016). Thus, the findings suggest that a more thorough and comprehensive implementation of climate laws can enhance the issuance of green bonds by leveraging the underwriters' network, which in turn improves the structure and success of these financial instruments.

(About here insert Table 6)

5. Endogeneity

Endogeneity poses a frequent challenge in econometric models, occurring when an explanatory variable correlates with the regression model's error term, which can result in biased and inefficient estimates (Wooldridge, 2010). A source of potential endogeneity is reverse causation, where green bond issuance changes could impact climate law proxies, violating exogeneity assumptions. However, this risk appears minimal in our study, as national climate policies generally emerge from broader political processes that precede individual firm bond issuances. Our cross-country dataset also helps to reduce the likelihood

of reverse causation. Furthermore, measurement errors in key variables, such as green bond issuance values or climate law proxies, could further lead to unreliable and biased estimates if these errors align with the regression's error term, an issue that is pronounced in our cross-country data. To account for this, we employ alternative measures of core variables and adjust sample structures. Finally, to mitigate potential bias arising from omitted variables linked to both green bond issuance and climate law proxies or other control factors, we implement several strategies. We include fixed effects, various country-level controls, and group dummies to capture unobserved heterogeneity. For additional robustness, we apply instrumental variable (IV) estimation and conduct an Oster test to verify coefficient stability, further reinforcing the consistency of our findings.

5.1 Instrumental variable estimation

Using a 2SLS estimation approach, we incorporate an external instrument to address endogeneity concerns (Wooldridge, 2010). Specifically, we employ a country's *ratification* of international environmental agreements (RATIFCT) as our external IV instrument. Bellelli *et al.* (2023) provided this novel data, identifying 263 multilateral environmental agreements across 198 countries from 1950 to 2017 by applying natural language processing and survival analysis techniques. This data includes agreements directly connected with environmental issues, which explicitly mention their environmental scope either in the title or in the text of the treaty and were ratified by all countries that could potentially do so, and not those that were prevented from doing so because of the regional nature of the agreement. As a result, the data captures the countries true willingness to ratify international environmental treaties. By collecting data on the breadth and depth of these agreements, the authors produced a score that captures the extent to which a country has willingly ratified them.

The effective choice of a suitable instrument must satisfy two key conditions: relevance and exclusivity. Regarding the relevance condition, the IV must be correlated with the endogenous explanatory variable—in this case, the Climate Law Index. This means that the instrument should have a significant impact on the level of implementation or enactment of climate laws without being affected by other factors that would directly influence the dependent variable (green bond issuance value). We argue that countries that voluntarily ratify international environmental agreements are likely to take environmental issues seriously and hence are more likely to enact comprehensive domestic climate laws. This shows a probable strong correlation between the ratification of these agreements and the implementation of domestic climate laws.

Regarding the exclusivity condition, the instrument should affect the dependent variable only through its effect on climate laws, and not through any other channel. This means there should be no direct path from the instrument to the dependent variable except through the endogenous variable. We argue that the ratification of international environmental agreements should theoretically influence green bond issuance only by encouraging or mandating more comprehensive climate laws, which in turn might make a country more attractive for green bonds due to perceived lower environmental risks or alignment with investor sustainability goals. Ratification does not directly affect financial market conditions and investor sentiments independently of climate laws, or other factors related to green bond issuance. These international treaties involve country agreements to address global environmental issues, such as climate change, biodiversity loss, and pollution. Ratification signifies a country's legal commitment to adhere to the terms and implement the measures prescribed in these agreements (Mitchell, 2017). It often necessitates the creation, amendment, or reinforcement of domestic laws and policies to meet treaty obligations. Thus, ratification acts as a *commitment mechanism* that compels a nation to establish or strengthen its climate-related legal framework. Furthermore, ratification does not itself directly alter financial markets or economic conditions that affect green bond issuance. Instead, it influences these bonds by affecting the regulatory and legal environment following compliance with the agreements, acting as an *attraction mechanism* for green investments. Investors in green bonds are particularly sensitive to the regulatory environment as it affects the risk and return profile of environmentally-focused investments. Empirically, countries that have ratified such agreements are observed to have more comprehensive climate laws (Bernauer *et al.*, 2010).

If the relevance and exclusivity conditions are met, using the ratification of international environmental agreements as an IV in 2SLS analysis is appropriate and robust for investigating how climate laws affect green bond issuance. This approach helps control for endogeneity that might arise if, for example, countries with more green bond issuances are more likely to implement strict climate laws due to investor or public pressure, rather than the other way around. This endogeneity might also include omitted variable biases where unobserved factors affect both climate law enactment and green bond issuance, which the use of a valid IV helps to address.

We assess the relevance of our IV through a first-stage regression by regressing the allegedly endogenous explanatory variable (Climate Law Index) on the instrumental variable (ratification score) and any other control variables included in the model. Table 7 presents the results. Model (1) presents the 2SLS results. The coefficient of the IV in this first-stage regression is significant (β =1.624, *p*-value=0.001), which implies that changes in the IV are associated with changes in the allegedly endogenous variable. The F-statistic from the firststage regression is large (25.768) confirming the strength of the correlation. Moreover, after accounting for heteroskedasticity, the Kleibergen-Paap Wald F statistic (31.460) exceeds the Stock-Yogo weak instrument critical value (16.38) for a 10% maximum relative bias, confirming that the IV is sufficiently correlated with the endogenous explanatory variables to yield consistent and efficient parameter estimates in the second stage of the 2SLS. Further, the Kleibergen-Paap LM statistic is significant (21.244, *p*-value=0.001) indicating that our model is not under identified and there is enough information to uniquely identify the estimated parameters. To assess the exclusivity condition further, we performed a placebo test (Eggers et al., 2023). We use the same IV to predict an alternative outcome variable, which is unrelated to our theoretical model. If the IV significantly affects this unrelated outcome, it would suggest a violation of the exclusivity condition. We choose the Sukuk bond deal value as an unrelated outcome variable. The Informa GM database provides the data. Model (2) shows the results of the placebo test. While the IV predicts CLIMLAW, the new model does not exert a significant direct effect on the placebo outcome, thereby lending support to the contention that our IV affects green bond issuance value through the intended channel (climate laws).

To further address potential endogeneity, we apply the conditional mixed process (CMP) using the maximum likelihood estimator (Roodman, 2011). CMP enables us to estimate a

system of equations connected by endogenous interactions among dependent variables or by error term correlations, effectively capturing unobserved heterogeneity and managing diverse types of dependent variables. This approach supports various estimation algorithms, including seemingly unrelated regressions, mixed models, hierarchical models, and simultaneous equations. Within the CMP framework, we examine the Atanrho parameter, a transformed measure of the bounded correlation between the error terms in both the controlled and full estimation models, providing insight into the role of unobserved factors. For our instrument, we also use a country's ratification of international environmental agreements (RATIFCT). Atanrho measures the correlation between the error terms in assessing RATIFCT's effect on both CLIMLAW and GRBNDVAL. The findings, shown in Column (3) of Table 7, reveal a significant Chi2 statistic, indicating a well-specified model. Meanwhile, the Atanrho parameter (0.011, p<0.988) is small and statistically insignificant at the 10% level, suggesting a low probability that unobserved factors significantly impact both variables simultaneously, thereby reducing concerns of endogeneity.

Overall, The findings from both the 2SLS and CMP estimators demonstrate a significant, positive relationship between the Climate Law Index and individual green bond deal values. However, the magnitude of the CLIMLAW effect varies between models, with the influence of control variables also differing across estimation methods. Overall, our instrumental variable approach supports the validity of the Climate Law Index as a predictor of green bond issuance value across countries, reinforcing its relevance in assessing the impact of climate legislation on green finance markets.

5.2 The Oster test of coefficient stability

To reinforce the reliability of our estimates against endogeneity, we implement Oster's (2019) test. This test compares coefficients from a model with only observed variables (controlled model) to those from a hypothetical full model that accounts for both observed and unobserved variables. Oster's delta (δ) measures how much of the total variance could be explained if unobserved variables were included. A high delta value suggests that the observed variables capture most of the variance, reducing the risk of omitted variable bias. If the coefficient remains stable as delta approaches 1, the likelihood of omitted variables significantly influencing the results diminishes. Oster's framework also compares the beta (β) coefficients from the controlled model (β_{obs}) and the full model (β_{full}). A large shift between these coefficients indicates potential sensitivity to omitted variables, while stability suggests the model is robust. This method allows us to assess the stability of our findings and ensures that unobserved factors do not unduly influence the estimates. The results of the Oster test are displayed in Column (4) of Table 7. Since changes in climate laws cannot readily explain short-term variations in green bond deal value, we choose a moderate level of R_{max} (0.6) as an approximation of the regression's error. The substantial and positive δ parameter (0.439) indicates that unobserved factors are less influential than the observed predictors, suggesting that any omitted variables would minimally impact the potentially endogenous variable, CLIMLAW, thereby reducing the risk of endogeneity. Additionally, the strong and significant β coefficient (30.65, p<0.01) showing a significant estimated effect of the predictor variable on the outcome, after accounting for both observed and unobserved controls.

5.3 Propensity score matching

The choice of countries to adopt comprehensive climate laws (treatment) is likely influenced by unobserved factors that may also impact green bond issuance, making it difficult to separate the true effect of these laws. For instance, countries with initiative-taking environmental policies or heightened public awareness of climate issues are more inclined to enact strict climate laws. These same factors might independently boost green bond issuance, creating a challenge in isolating the specific impact of climate laws. Additionally, some countries might strengthen their climate laws in response to a growing green bond market, suggesting that the treatment could be endogenously driven. To address this selection bias, we apply propensity score matching (Rosenbaum and Rubin, 1983).

Column (5) of Table 7 displays the results from nearest-neighbor matching, where countries with a Climate Law Index above the global median form the treatment group (indicating advanced climate laws), while those below the median make up the control group (indicating less comprehensive laws). The treatment effect, shown by the TREATED variable coefficient, measures the impact of stronger climate laws on green bond issuance. The coefficient for TREATED is 0.077 (p<0.05), suggesting that countries with more robust climate laws issue more green bonds on average than those with weaker regulations. This statistically significant positive result indicates that strong climate legislation contributes to expanding green bond markets. Additionally, the mean bias statistic evaluates the average difference in covariates between the matched treatment and control groups. A mean bias below 10% suggests successful matching, and in this case, the bias of 6.322% confirms that propensity score matching effectively minimized observable differences, producing a balanced comparison. This low mean bias reinforces that the observed relationship between climate laws (TREATED) and green bond issuance is not driven by other observable characteristics, enhancing the credibility of the treatment effect.

(About here insert Table 7)

6. Robustness

6.1 Sensitivity analysis

To ensure the robustness of our baseline findings, we conducted sensitivity tests to evaluate how variations in data, assumptions, or methods might influence our conclusions. Table 8 presents these sensitivity test results. In the initial test, we applied an alternate measurement of the outcome variable (GRBNDVAL1), denominated in local issuer currency to account for foreign-exchange risk. This data is sourced from the Informa GM database. Assuming open markets, foreign exchange risk could significantly influence the impact of climate laws on green bond issuance, primarily because these bonds, often issued in the issuer's domestic currency, attract international investors who must then navigate currency fluctuations that could erode their returns. The necessity for investors to hedge against these fluctuations introduces additional costs, potentially dampening international interest in green bonds even when climate laws make such investments more appealing (Brown, 2001). The issuing country's currency strength also influences the appeal of green bonds to international investors. Countries with unstable or depreciating currencies may struggle to attract investment, while those with stable currencies have an advantage (Lessard & Lightstone, 1986). The findings in Column (1) show results using the alternative measurement. The updated estimates reveal a positive and significant relationship between the Climate Law Index and the green bond deal value, measured in local currency (β =0.430; p-value=0.010). These results suggest that the overall average effect of climate laws on green bond issuance remains largely unaffected by the currency denomination of the bonds.

In the second sensitivity test, we introduce a quadratic term of the key regressor (CLIMLAW2) to account for potential nonlinear effects. The effect of variations in climate laws on green bond issuance may exhibit nonlinearity due to a range of factors. Threshold effects suggest that climate laws may have to reach a certain level of maturity and comprehensiveness before significantly impacting green bond issuance, indicating a nonlinear response where the effect accelerates after surpassing specific legal criteria (Naranjo *et al.*, 2022). Conversely, saturation points may exist where more mature and comprehensive climate laws lead to diminishing or negative effects on issuance, as overly burdensome regulations could deter potential issuers. The interplay with investor sentiment and market capacity further contributes to nonlinear effects; initial regulatory changes may boost investor confidence and attract capital, but market growth might eventually hit capacity constraints, leading to diminishing returns (Cornaggia et al., 2022). Moreover, the nonlinear relationship is influenced by the interaction of climate laws with broader financial and economic variables, such as interest rates and economic policy, and by adaptive behaviors and innovation within the market, which can lead to periods of rapid issuance followed by slowdowns (Li et al., 2019). The findings from this alternative analysis are displayed in Column (2) of the results. While the direct effect remains significant, the quadratic effect is positive but insignificant. However, when we include in the regression only the quadratic effect (not shown in the Table), it turns positive and strongly significant. This provides weak evidence of a nonlinear positive effect of climate laws on green bond issuance. Thus, improvements in the maturity and comprehensiveness of climate laws might exert some weak intensifying effects on individual green bond issuance value.

For the third sensitivity test, we substitute our key regressor with an alternative measure: the climate-related financial policy index (CLMFINPOL), with data and rationale provided by D'Orazio & Thole (2022). The index measures the extent of countries' involvement in climate-related financial planning legislation, pinpointing areas where policy interventions are needed. It encompasses a range of policies designed to manage financial stability risks associated with climate change. These policies aim to mitigate systemic threats by promoting green lending and investment, directing credit allocation, and, in some cases, setting lending limits to prioritize climate-aligned projects. Additionally, CLMFINPOL includes policies that foster the development of green financial markets, mandate the public disclosure of climate-related financial risks, and facilitate green financing through instruments such as green bonds. Climate-related financial planning initiatives significantly affect green bond issuance by aligning financial strategies with environmental objectives, thereby facilitating the mobilization of capital for sustainable projects (OECD, 2021b, 2023). This legislative planning process involves assessing climate risks and opportunities, incorporating sustainability goals into financial decision-making, and identifying viable green projects that can be financed through bond issuances. Sound financial planning can significantly boost the appeal of green bonds for both issuers and investors. By demonstrating a strong commitment to sustainability, effective planning can enhance

investor confidence and potentially secure better issuance terms. This approach broadens participation in green bond markets, as it aligns with investors' growing interest in environmentally responsible financial products and encourages issuers to adopt clear, sustainable investment strategies. The findings from this alternative index are presented in Column (3) of the results. The new estimates confirm that implementing climate-related financial policy has a notable positive impact on the issuing of green bonds. This lends credence to the claim that sound financial planning can increase the appeal of green bonds to investors and issuers alike by showcasing a transparent dedication to sustainability. Such a commitment could potentially result in more favorable terms and greater market engagement.

The fourth and fifth sensitivity tests use alternative sample structures that exclude the largest average individual green bond deal issuer country (France) and the country with the more mature and comprehensive climate laws (Italy), respectively. Excluding boundary values from a sample is a widespread practice aimed at obtaining more accurate and reliable estimates, underpinned by the rationale that these outliers can skew the results, leading to misleading interpretations (Mertzanis & Tebourbi, 2023). Extreme values, which could also result from measurement errors, data entry mistakes, or genuine but rare variations, have a disproportionate impact on statistical inference. Columns (5) and (6) reveal the outcomes of these two sensitivity tests. In both tests, after the exclusion of these boundary cases, the effect of the Climate Law Index on individual green bond deal issuance value remains significant and positive, confirming the baseline results. All sensitivity tests consistently reinforce the baseline results, affirming both the significance and the direction of climate laws' impact on green bond issuance. Additional investigation and refinement of these effects could yield deeper insights into their underlying dynamics.

(About here insert Table 8)

6.2 New controls

The influence of climate laws on green bond issuance is multifaceted and subject to a variety of other factors. We identify geopolitical risk, social finance, and digital finance as key factors in this context. Geopolitical stability and consistent policies are crucial for the effectiveness of climate laws regarding green bond issuance. Political instability or shifts in priorities can dissuade investors due to the uncertain long-term returns (Mertzanis & Tebourbi, 2024). Additionally, economic actions that prioritize development, energy security over environmental objectives, or specific trade policies may undermine climate law enforcement or create less favorable conditions for green finance (Mertzanis, 2023b). Moreover, climate uncertainty heightens risks to green projects by increasing the unpredictability of transition risks associated with evolving toward a low-carbon economy, which can erode investor confidence and lead to policy inconsistencies (Cepni *et al.*, 2022; Tian *et al.*, 2022). These uncertainties and altered risk perceptions among investors may necessitate higher returns, thus raising the costs and diminishing the appeal of green bond financing.

Furthermore, social finance and societal environmental concerns can positively affect the issuance of green bonds. A robust social finance environment, fueled by trust, social norms, and community networks, can bolster cooperation and collective efforts towards environmental sustainability, enhancing the demand for green investments (Bhutta *et al.*, 2022). Additionally, strong societal concerns about environmental issues can intensify public and consumer pressure on corporations and governments to adopt sustainable finance practices (Mertzanis, 2023a). This pressure can support climate laws, promoting green bond issuance by creating a market environment conducive to financing green projects. Essentially, social capital and environmental concerns foster a supportive ecosystem that enhances the effectiveness of climate laws, driving a robust market for green bonds by aligning investor interests with environmental sustainability goals.

Moreover, digital finance can also influence the effectiveness of climate laws on green bond issuance. For instance, Fintech platforms provide innovative, efficient ways to link investors with green projects, enhancing the accessibility and transparency of green bond investments (Chen, 2023). This increased accessibility can draw a wider range of investors, including those traditionally less engaged in green finance. Blockchain technology improves the traceability and verification of the environmental impacts of green projects, boosting investor confidence in the authenticity of green bonds and the tangible outcomes of their investments. Digital platforms enable the utilization of big data to better evaluate environmental risks and returns, supporting more informed investment decisions (Dai, 2023). Additionally, digital commerce platforms can encourage sustainable consumer behaviors by offering green products and services, thereby increasing public awareness and demand for sustainability, which indirectly supports the green bond market. These digital advancements reinforce the impact of climate laws by ensuring that green projects are more visible, viable, and attractive to a global pool of investors.

Finally, institutions matter. The legal origins theory (La Porta *et al.*, 1997, 1998) distinguishes legal systems into common law and civil law based on their historical development and offers insights into the effectiveness of climate laws. Common law countries, known for their flexible legal frameworks, adapt quickly to financial innovations like green bonds and provide strong investor protection, enhancing market transparency and enforcement of commitments. This boosts investor confidence and supports a more developed financial market, conducive to higher green bond values. In contrast, civil law countries, with more rigid systems, may experience slower adaptation but benefit from uniform regulations, impacting the pace and scale of green finance. Thus, the theory explains how the foundational legal system of a country influences the regulatory environment and financial market development, ultimately affecting the appeal and value of green bond deals.

In our expanded analysis, we introduce new control variables to capture the potential effects of geopolitical risk, social finance, digital finance, and legal origins, on green bond issuance. These variables are grouped into distinct sets to minimize potential multicollinearity bias. In expanding Equation (1), we introduce four additional groups of controls as follows. Firstly, we consider the effect of geopolitical factors. We include the logarithmic values of the geopolitical risk index (GPRLOG) sourced from Caldara & Iacoviello (2022), which track geopolitical uncertainties that may influence investment climates and market conditions. We also include the climate risk uncertainty index (CRI), using data from the German Watch (https://www.germanwatch.org/en/cri) (Kreft *et al.*, 2015), which measures the global impacts of extreme environmental events in terms of human and economic losses. This index sheds light on how climate-related risks can impact the stability and appeal of green bond markets across different regions. Additionally, we examine the influence of social and environmental conditions, considering how these factors may interact with climate-related policies to shape green finance dynamics. We include the social capital

index values (SOCAP), which reflects a country's social infrastructure that comprises factors like life satisfaction, healthy life expectancy, nutrition, sanitation, and social support, sourced from the World Economic Forum's Global Competitiveness report. We further include the social-environmental performance index values (SEI), sourced from Rigal (2022), and measured on a [0,1] scale, which combines biophysical indicators such as CO₂ emissions, water usage, and ecological footprint with social indicators like income, education, and employment. Thirdly, we consider the effect of digital finance conditions. We include the aggregate Fintech finance per capita values (FINTECHCAP) sourced from Cornelli et al. (2023), which indicates the level of digital financial inclusion and the proliferation of digital financial services within a country. We further include the growth of trade in digital services value (DGTRADE), sourced by UNCTAD, which highlights the growth rates of trade in digital services, reflecting the expanding role of digital platforms and technologies in facilitating international trade and finance. Fourthly, in line with the legal origins theory, we consider the effect of legal origin proxies. We include dummies for U.K. (LEGORUK) and French (LEGORFR) legal origin sourced from La Porta *et al.* (1997), which capture the effects of key historical legal origin of countries.

The updated equation (1) results, presented in Table 9, reflect the impact of incorporating additional control groups on our analysis of green bond issuance value influenced by climate laws. Even with the inclusion of new control variables, the core relationship—showing a positive and significant impact of climate laws on green bond issuance-remains consistent across all models, underscoring the robustness of the baseline findings. The new controls are significant predictors. Interestingly, an increase in geopolitical risk correlates with higher deal values. This might suggest that in regions with higher geopolitical uncertainty, green bonds could be seen as relatively safer or more stable investments (Mertzanis & Tebourbi, 2024). Conversely, lower climate uncertainty, which reduces the unpredictability associated with climate-related economic impacts, is associated with higher issuance values. This indicates that more predictable climate conditions can bolster investor confidence in green projects. Contrary to expectations, stronger social infrastructure and heightened societal environmental concerns have shown a significant adverse effect on the issuance value of green bonds. This could potentially be due to more stringent environmental expectations or regulations that raise the threshold for what qualifies as a green bond, thereby possibly limiting issuance (Malmendier, 2009). Moreover, the adoption of digital finance mechanisms like Fintech platforms and digital commerce has positively influenced the issuance value of green bonds. These technologies are likely to enhance transparency, reduce transaction costs, and broaden market accessibility, thus encouraging more investments into green bonds. Finally, as anticipated, common-law countries are generally associated with a significant positive impact of climate mitigation laws on green bond issuance, supporting the legal origins theory. In contrast, civil law countries seem to have a negligible effect. This could be due to the inherent flexibility of common law systems, which, while encouraging financial innovation, may also allow for lower standards that enable greenwashing, potentially diminishing the environmental benefits of green bonds. On the other hand, the uniformity of civil law systems may promote stronger and more consistent environmental regulations, albeit at the cost of slower adaptation to new financial tools. Although this preliminary analysis is informative, it necessitates further examination to fully understand the intricate relationships between institutional, economic, social, and technological factors and their effects on the green bond

market. By incorporating these additional variables, our model not only upholds its foundational insights about climate laws but also uncovers wider dynamics shaping green finance.

(About here insert Table 9)

6.3 Dominance analysis

We use dominance analysis to identify the leading predictor's effect on the deal value of green bonds, examining the comprehensive influence of independent variables within the model rather than focusing solely on individual coefficients. Grounded in the Shapley value decomposition method from game theory, dominance analysis evaluates the relative influence of each predictor on the model's overall explanatory power (Azen and Budescu, 2006). Utilizing Luchman's (2021) recent analytical approach, we quantify the mean increase in overall model fit (R^2) achieved by individually adding each predictor. This method provides deeper insights into the predictive hierarchy of regressors for green bond issuance value.

Table 10 presents a dominance analysis of the Climate Law Index components and all regressors in predicting green bond issuance value. Part A focuses on the Climate Law Index components and reveals that CLIMLAW2 (years since mandatory ESG implementation) holds the highest dominance in developing countries, with a dominance statistic of 0.0224, highlighting its importance in driving green bond issuance. Similarly, CLIMLAW6 (comply-or-explain ESG disclosure basis) is also a strong predictor, particularly in developing nations, with a dominance statistic of 0.0234. This suggests that mandatory ESG regulations and frameworks with clear enforcement mechanisms are crucial for boosting green bond markets in these regions. Conversely, CLIMLAW1 (years since the first climate law initiative) shows relatively low dominance, indicating that historical climate laws are less influential on green bond issuance compared to more recent regulatory actions. The fit statistics, ranging from 0.0637 to 0.1073, indicate moderate model fit, with stronger relevance for developing countries, suggesting that recent regulatory measures are more effective in these markets.

Part B examines the relative importance of all regressors and finds that UNDWRTNET (underwriter network) consistently dominates across all models, with dominance statistics between 0.0713 and 0.0718, making it the strongest predictor of green bond issuance. This emphasizes the critical role of underwriters in facilitating larger bond deals, particularly in developed countries. CRDINFO (credit information) also plays a significant role, especially in developed markets, with a dominance statistic of 0.0514, highlighting the importance of transparent credit systems for green bond issuance. While CLIMLAW remains relevant with a dominance statistic of 0.0138, its influence is less pronounced compared to deal-specific factors. The fit statistics, which range from 0.2307 to 0.2393, suggest that incorporating deal-specific characteristics improves the model's explanatory power, underscoring the importance of financial market infrastructure in complementing climate laws to promote green bond markets globally.

(About here insert Table 10)

7. Economic channels of influence

We investigate the economic mechanisms through which climate law influences green bond issuance, focusing on three core economic policy variables that act as mediators. These mediators are: (a) business disclosure extent (BUSDISCL), rated from 1 to 10, and sourced from the World Bank's Doing Business database; (b) the natural resource component of taxes on business income, profits, and capital (TAXRES), measured as a percentage, and sourced from the UNU-WIDER's 2021 Government Revenue database; and (c) the degree of entrepreneurial innovation (ENTRINN), rated from 1 to 100, and sourced from the Global Entrepreneurship Monitor (GEM, https://www.gemconsortium.org/) database. We assess both these variables' direct and indirect effects on green bond issuance value.

These variables reflect specific policy choices which can be actively leveraged to influence green bond issuance. Through robust disclosure practices, companies enhance transparency, manage risks, and access capital effectively. The extent of disclosure by businesses, which includes information on their environmental performance and commitment to sustainability, plays a crucial role in mitigating the impact of climate laws on green bond issuance (Lebelle *et al.*, 2022). By providing investors with clear information about their environmental risks and opportunities, businesses can build trust and confidence, attracting investment for green bond offerings despite stricter regulatory environments. Moreover, strong disclosure practices enhance a company's credibility and reputation as a responsible corporate citizen, reducing financing costs and improving market reception (Flammer, 2021). Climate laws by directly affecting information disclosure will enable businesses to adjust their long-term sustainability strategies aligned with climate goals as well as reassure investors and sustain their interest in green bond issuance over time.

Furthermore, the natural resource component of taxes on income, profits, and capital refers to the portion of tax revenue collected by governments that is derived from the exploitation or utilization of natural resources. This channel serves as a critical tool in mitigating the impact of climate laws on green bond issuance. By legislating revenue generation from natural resource exploitation, governments can finance green initiatives and incentivize sustainable practices, aligning with climate mitigation goals. Taxes on resource-related business income and profits also internalize externalities, encouraging the adoption of cleaner technologies and processes while providing regulatory certainty for investors in the green bond market (Cheng *et al.*, 2024). This combination of revenue generation, incentivization of sustainability, and regulatory certainty fosters an environment conducive to green bond issuance, facilitating investments in climate-friendly projects and supporting the transition to a low-carbon economy.

Entrepreneurial innovation, defined as the development or adoption of new or significantly enhanced products, services, processes, or business models by individuals or organizations (GEM, ibid.), can moderate the effects of climate laws on green bond issuance value. By spearheading technological advancements, entrepreneurial ventures introduce novel solutions for climate change mitigation and adaptation, spanning renewable energy, resource efficiency, and sustainable practices (Aghion *et al.*, 2022). These innovations often drive down costs associated with green technologies and practices, making projects funded by green bonds financially viable and attractive to investors (Braga *et al.*, 2021). Moreover, entrepreneurial endeavors expand markets for sustainable products and services, aligning

with the objectives of climate legislation and creating new opportunities for green bond issuance. By helping businesses adapt to regulatory changes and mitigate risks, entrepreneurial innovation enhances the creditworthiness of green projects, thus fostering a climate law-supported environment for green bond investment and accelerating the transition to a low-carbon economy.

Table 11 presents the results of including these policy variables and their interaction terms with our Climate Law Index to capture both direct and indirect effects. In Model (1), CLIMLAW shows a positive and significant relationship with green bond issuance, with a coefficient of 3.181 (p<0.05), indicating that stronger climate laws significantly boost green bond activity. However, the interaction between CLIMLAW and BUSDISCL (business disclosure) is negative, with a coefficient of -0.287 (p<0.05), suggesting that while both climate laws and business disclosures contribute positively, their combined effect is less than expected. BUSDISCL alone positively impacts green bond issuance, with a coefficient of 0.534 (p<0.05), underscoring the critical role of business disclosures. The diminishing marginal impact of climate laws in countries with high disclosure rates implies that as disclosure levels increase, the incremental benefits from stricter climate laws decline. This could be due to market saturation with climate-related information or the standardization of sustainability reporting, which reduces the competitive advantage of firms adhering to stricter climate laws. Moreover, the quality and context of disclosures may interact with broader economic conditions and investor preferences, influencing the observed effects.

In Model (2), the interaction between CLIMLAW and TAXRES (natural resource taxes on business income) is examined. CLIMLAW continues to positively influence green bond issuance, with a coefficient of 0.537 (p<0.01). However, the interaction term CLIMLAW * TAXRES has a negative coefficient of -0.167 (p<0.05), indicating that the presence of tax incentives may diminish the marginal impact of climate laws on green bond issuance. Higher resource taxes are directly associated with increased green bond issuance, but at elevated tax levels, the positive impact of climate laws weakens. This could be because resource taxes impose higher costs on businesses, especially in sectors heavily reliant on natural resources, reducing their capacity to invest in green initiatives. Additionally, higher taxes might slow economic growth, dampening investor confidence and reducing long-term green bond investments. Businesses burdened with higher tax liabilities may prioritize short-term financial stability over green investments, limiting their participation in the green bond market.

In Model (3), the interaction between CLIMLAW and ENTRINN (entrepreneurial innovation) shows that CLIMLAW continues to positively influence green bond issuance, with a coefficient of 0.386 (p<0.01). The interaction term CLIMLAW * ENTRINN is also significant, with a positive coefficient of 0.006 (p<0.01), suggesting that entrepreneurial innovation amplifies the positive effects of climate laws. Although ENTRINN does not have a significant direct effect, it significantly enhances the impact of climate laws. As innovation grows, new cost-effective solutions for environmental challenges emerge, making green investments more financially viable. This, combined with regulatory support, boosts the attractiveness of green bonds, particularly in financing sustainable projects. Furthermore, increased innovation fosters the creation of new green industries, expanding the pool of green investment opportunities and enriching the green bond market.

The results from these three models indicate that while climate laws significantly boost green bond issuance, their effectiveness is shaped by interactions with other economic

factors. In countries with strong business disclosures or tax incentives, the marginal benefit of climate laws is lower. However, in more innovative economies, climate laws become even more effective. These findings highlight the need for a holistic approach to fostering green bond markets, where climate laws, financial transparency, tax policies, and innovation must be carefully balanced to maximize their collective impact.

(About here insert Table 11)

8. Conclusions

In this study, we examined how climate legislation impacts green bond issuance from 2008 to 2021 covering sixty-nine countries, utilizing detailed individual bond deal data. We introduced a novel metric to gauge the influence of climate-related laws, considering various dimensions such as the timing of enactment, the duration since mandatory and voluntary ESG disclosures began, and the specific enforcement methodologies employed for ESG disclosure. By integrating unique individual deal attributes and broader country-specific factors into our analysis, we could evaluate the effects of both firm-specific details and national influences while addressing concerns about endogeneity.

Our findings indicate a significant positive, though nonlinear, association between our Climate Law Index and the value of green bond issuances. This positive trend is reinforced by factors like high credit ratings, robust underwriter networks, stringent bond placement covenants, and detailed credit information availability. Conversely, the roles of inflation and country-wide risks appear relatively subdued. We confirmed the stability and reliability of these results through sensitivity analyses and endogeneity tests, including the Oster test for coefficient stability. Our dominance analysis revealed that the duration since climate law implementation and the breadth of underwriter networks are the most influential determinants of green bond issuance value. Additionally, we found that the transparency of business disclosures, corporate income taxation from natural resource income, and entrepreneurial innovation serve as critical economic channels that mediate the effects of climate legislation on the green bond market.

Our study reveals a positive, nonlinear connection between the Climate Law Index and green bond issuance value, deepening our understanding of market dynamics and investor responses to regulatory changes. This insight supports the development of theoretical models in sustainable finance and probes how legal and regulatory frameworks shape investment strategies. We identify mechanisms such as underwriter networks, corporate tax policies, and entrepreneurial innovation that influence the green bond market, highlighting economic pathways that either facilitate or obstruct capital flow towards sustainable projects. Our findings advocate for embedding climate considerations into financial decision-making and regulatory structures, thereby supporting the shift toward a more sustainable global economy. By examining how national policies influence corporate financial decisions, this approach reduces endogeneity concerns, thereby reinforcing the validity of our causal inferences.

Our study contributes to theoretical and empirical research literature by incorporating a composite Climate Law Index into the analysis of green finance decisions, bridging the gap between legal studies and financial market research. This multidisciplinary approach enriches the literature by demonstrating the tangible impacts of legislation on market behavior and investment flows, offering empirical evidence to inform policy-making and refine climate-related financial regulations. Moreover, our results provide a quantifiable measure of how regulatory environments influence financial markets, particularly in sustainable finance contexts, through the development of a composite Climate Law Index. This serves as an innovative tool for assessing and comparing regulatory landscapes globally, facilitating nuanced analyses of green finance trends. Furthermore, our study expands the scope of ESG research by examining the effects of both mandatory and voluntary disclosures on green bond issuances, shedding light on how transparency and accountability practices impact sustainable investment attractiveness. Lastly, our findings offer insights into investor behavior, contributing to the understanding of investor response to regulatory changes and economic pathways facilitating capital flow towards sustainable projects.

Despite the valuable contributions of our study, several limitations must be acknowledged. Data availability remains a challenge, as accessing consistent, high-quality information on green bond issuance across countries and time periods is difficult due to fragmented reporting standards and differences in financial transparency. Additionally, climate law heterogeneity complicates the analysis, as laws vary significantly in scope, enforcement, and effectiveness across nations, making it difficult to fully capture their complexities through the Climate Law Index alone. This variation highlights the need for future research to explore qualitative dimensions, such as enforcement differences through case studies. The dynamic nature of legislation further adds complexity, as climate laws evolve in response to new environmental challenges and market shifts, meaning that their impact on green bond markets may change over time. Given these challenges, our findings emphasize the importance of methodological rigor and contextual understanding in future research. Employing advanced econometric techniques and recognizing the broader economic, social, and political interactions that influence climate laws can offer deeper insights and more actionable outcomes for promoting green bond markets.

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Appendix. Definition of variables.

Variable code	Variable explanation and source
GRBNDVAL	The logarithm of the individual green bond deal values per country (in USD), sourced from the Informa GM database.
CLIMLAW	The Climate Law Index is a composite measure encompassing six dimensions: (a) the number of years since the introduction of the first climate law initiative; (b) the number of years since ESG disclosure regulations became mandatory; (c) the number of years since voluntary ESG disclosure practices began; (d) a binary indicator $(0/1)$ for whether mandatory disclosures of Environmental, Social, and Governance components were introduced simultaneously; (e) a binary indicator $(0/1)$ for whether mandatory ESG disclosure requirements were imposed by government; and (f) a binary indicator $(0/1)$ for whether these mandatory ESG disclosures follow a comply-or-explain model.
UNDWRTNET	The number of underwriters involved in supporting the green bond issuance, as recorded in the Informa GM database.
INDRATNG	A binary indicator $(0/1)$ indicating the green bond deal is assigned an investment grade rating $(0/1)$, sourced from the Informa GM database.
COVPLCMENT	A binary indicator $(0/1)$ indicating whether the green bond's covenants allow for additional bond placements, sourced from the Informa GM database.
INFLATION	The inflation rate, measured as the annual percentage change, obtained from the IMF's Economic Outlook database
CRDINFO	The Depth of Credit Information Index, ranging from 1 to 7 (highest), sourced from the World Bank's Doing Business report.
CRISKPREM	The country's risk premium, expressed as a percentage, sourced from Damodaran (2022)
RATIFCT	A binary indicator (0/1) representing whether a country has ratified international environmental agreements, based on data from Bellelli <i>et al.</i> (2023), used as an instrumental variable (IV).
SOCAP	The Social Capital Index values, ranging from 1 to 100 (highest), sourced from the World Economic Forum's Global Competitiveness Report
SEI	The Social-Environmental Performance Index values, ranging from 0 to 1 (highest), sourced from Rigal (2022)
FINTECHCAP	The country-level value of fintech finance per capita, sourced from Cornelli <i>et al</i> . (2023)
LEGORUK	A binary indicator $(0/1)$ signifying whether the country has a U.K. legal origin, based on data from La Porta <i>et al</i> . (1997)
LEGORFR	A binary indicator $(0/1)$ signifying whether the country has a French legal origin, based on data from La Porta <i>et al.</i> (1997)
BUSDISCL	The Extent of Business Disclosure Index, ranging from 1 to 10 (highest), provided by the World Bank's Doing Business report

TAXRES	The natural resource component of taxes on business income, profits, and capital as a percentage per country, sourced from the UNU-WIDER Government Revenue database
ENTRINN	The Entrepreneurial Innovation Index, ranging from 1 to 100 (highest), sourced from the Global Entrepreneurship Monitor (GEM) database

Country	Green bond deal value (USD bn)	Climate Law Index (value)	Country	Green bond deal value (USD bn)	Climate Law Index (value)
Andorra	601.87	-0.38	Malaysia	335.12	1.62
Argentina	205.00	-1.47	Mauritius	80.00	0.29
Australia	535.79	-1.49	Mexico	944.20	1.87
Austria	437.71	1.59	Netherlands	756.00	-0.67
Belgium	750.36	-1.38	New Zealand	166.91	0.19
Benin	590.88	0.15	Nigeria	163.99	0.51
Brazil	637.87	2.48	Norway	329.95	1.25
Canada	610.29	-1.84	Pakistan	500.00	-2.41
Chile	1009.91	0.69	Panama	262.66	-0.04
China	441.98	-1.18	Peru	587.39	-0.05
Colombia	436.55	1.15	Philippines	314.09	-0.08
Costa Rica	500.00	-0.14	Poland	687.86	-0.97
Czech Rep.	582.94	0.10	Portugal	595.39	1.31
Denmark	464.84	2.34	Qatar	600.00	1.31
Dominican Rep.	300.00	-0.24	Romania	514.43	1.34
Egypt	750.00	0.88	Russian Fed.	322.39	0.47
Estonia	364.30	0.29	Saudi Arabia	1191.82	0.88
Finland	403.53	3.08	Singapore	451.43	1.04
France	1256.24	-2.19	Slovakia	356.35	0.10
Georgia	500.00	-0.71	Slovenia	1191.20	-0.03
Germany	845.13	1.32	South Africa	363.03	-0.58
Greece	547.57	1.77	South Korea	459.90	1.62
Honduras	332.50	-0.19	Spain	840.21	-0.47
Hong Kong	523.14	2.13	Sweden	175.83	0.15
Hungary	505.54	-0.51	Switzerland	302.87	1.41
Iceland	354.63	-0.04	Taiwan	300.00	-0.64
India	462.39	0.03	Thailand	659.41	1.71
Indonesia	538.46	-1.97	Türkiye	482.78	-2.10
Ireland	918.78	-0.28	Ukraine	592.45	-0.24
Israel	1203.18	-0.09	United Arab E.	483.06	0.21
Italy	937.92	3.17	United Kingdom	679.27	-1.68
Japan	262.82	1.66	United States	663.32	0.77
Latvia	369.00	0.10	Venezuela	694.88	-0.09
Lithuania	346.03	-0.28	Vietnam	312.50	1.60
Luxembourg	411.36	0.29	Total average	614.42	0.09

Table 1. Climate laws and green bond issuance value (average country estimates)

Source: Authors' calculations.

Panel A. Correlation among the constituent variables								
	CLIMLAW1	CLIMLAW2	CLIMLAW3	CLIMLAW4	CLIMLAW5	CLIMLAW6		
CLIMLAW1	1							
CLIMLAW2	0.3603*	1						
CLIMLAW3	0.2194*	0.2758*	1					
CLIMLAW4	0.3401*	0.6060*	0.3161*	1				
CLIMLAW5	0.3461*	0.6967*	0.3497*	0.6943*	1			
CLIMLAW6	0.2798*	0.7030*	0.2316*	0.4033*	0.5883*	1		
Panel B. Princi	Panel B. Principal component analysis							
Component	Eigenvalue	Difference	Proportion	Cumulative				
Factor 1	3.2432	2.3786	0.5405	0.5405				
Factor 2	0.8647	0.0909	0.1441	0.6847				
Factor 3	0.7738	0.1698	0.1290	0.8136				
Factor 4	0.6040	0.3326	0.1007	0.9143				
Factor 5	0.2713	0.0284	0.0452	0.9595				
Factor 6	0.2430	-	0.0405	1.0000				
Variables		Factor1		Factor2		Uniqueness		
CLIMLAW1		0.4306		0.0897		0.8008		
CLIMLAW2		0.8401		-0.1629		0.2675		
CLIMLAW3		0.3850		0.1608		0.8218		
CLIMLAW4		0.7327		0.2335		0.4066		
CLIMLAW5		0.8374		0.0866		0.2900		
CLIMLAW6		0.7058		-0.2938		0.4153		

Table 2. Climate Law Index: principal component analysis

Notes. Bartlet test (χ^2): 377.5***; KMO test: 0.8070.

	COUNT	MEAN	SD	MIN	P25	P50	P75	MAX
GRBNDVAL	2497	19.78	1.04	13.14	19.34	20.03	20.39	23.34
CLIMLAW	2497	0.09	1.53	-2.49	-1.18	0.15	1.32	3.17
INDRATNG	2497	0.82	0.38	0.00	1.00	1.00	1.00	1.00
UNDWRTNET	2497	4.57	3.54	1.00	3.00	4.00	5.00	46.00
COVPLCMENT	2497	0.08	0.27	0.00	0.00	0.00	0.00	1.00
INFLATION	2497	12.75	40.65	-2.54	0.90	1.68	2.53	99.02
CRDINFO	2497	6.81	2.05	0.00	6.18	7.43	8.24	8.49
CRISKPREM	2497	0.01	0.01	0.00	0.01	0.01	0.01	0.19
OECD	2497	0.85	0.36	0.00	1.00	1.00	1.00	1.00
EU27	2497	0.51	0.50	0.00	0.00	1.00	1.00	1.00
Ν	2497							

Table 3. Summary statistics

Note. The table reports the summary statistics of variables.

Table 4. Correlation matrix

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
GRBNDVAL (1)	1									
CLIMLAW (2)	0.11***	1								
INDRATNG (3)	0.19***	0.07***	1							
UNDWRTNET (4)	0.29***	-0.10***	-0.03	1						
COVPLCMENT (5)	-0.23***	0.03	0.03	-0.14***	1					
INFLATION (6)	0.02	-0.02	0.01	-0.01	-0.01	1				
CRDINFO (7)	0.23***	0.01	-0.07***	0.23***	-0.35***	0.02	1			
CRISKPREM (8)	0.05***	0.13***	-0.15***	0.03	-0.02	0.46***	0.05**	1		
0ECD (9)	0.02	0.13***	0.30***	-0.39***	0.06***	-0.06***	-0.24***	-0.22***	1	
EU27 (10)	0.06***	0.03	0.11***	-0.12***	0.14***	-0.03	-0.46***	-0.04*	0.43***	1
VIF	1.17									

Notes. The table reports the pairwise correlations between all variables and the overall mean VIF value. * p < 0.1, ** p < 0.05, *** p < 0.01

Table 5. Baseline effects

	(1)	(2)	(3)	(4)
CLIMLAW	0.088*	0.081*	0.251*	0.465***
	(0.051)	(0.049)	(0.151)	(0.129)
INDRATNG	0.572***	0.257**	0.453***	0.220***
	(0.138)	(0.101)	(0.097)	(0.079)
UNDWRTNET	0.077^{*}	0.081^{*}	0.059**	0.067^{*}
	(0.040)	(0.042)	(0.029)	(0.034)
COVPLCMENT	-0.391*	-0.562***	-0.728***	-0.759***
	(0.227)	(0.151)	(0.109)	(0.107)
INFLATION	-0.001	0.001	0.002**	0.002***
	(0.001)	(0.001)	(0.001)	(0.001)
CRDINFO	0.127*	0.175**	0.090	0.176***
	(0.068)	(0.083)	(0.058)	(0.062)
CRISKPREM	12.181**	8.476*	19.736	22.271*
	(5.171)	(4.979)	(15.742)	(12.208)
adj. R ²	0.228	0.295	0.442	0.488
RMSE	0.913	0.872	0.776	0.744
F-test	38.494	41.057		
Deal FE	No	No	Yes	Yes
Country-sector FE	No	Yes	No	Yes
Dummies	Yes	Yes	Yes	Yes
Ν	2497	2497	2497	2497

Notes. The table reports the baseline effects of the Climate Law Index on the deal value of green bonds. Additional control variables include deal-specific characteristics and macroeconomic variables. The parentheses report country-robust standard errors. We use a pooled OLS model with various fixed effects. The sample period is 2008-2021. Model (1) includes random effects only. Model (2) includes joint country-sector effects only. Model (3) includes deal effects only. Model (4) includes both deal and country-sector effects. * p<0.1, ** p<0.05, *** p<0.01

Table 6. Indirect effects.

	(1)	(2)	(3)
CLIMLAW	0.459***	0.406***	0.465***
	(0.125)	(0.109)	(0.130)
INDRATNG	0.223***	0.211***	0.220***
	(0.072)	(0.079)	(0.079)
CLIMLAW * INDRATNG	0.046		
	(0.053)		
UNDWRTNET	0.067*	0.077***	0.067*
	(0.034)	(0.026)	(0.034)
CLIMLAW * UNDWRTNET		0.021*	
		(0.012)	
COVPLCMENT	-0.759***	-0.741***	-0.753***
	(0.108)	(0.106)	(0.116)
CLIMLAW * COVPLCMENT			-0.031
			(0.068)
INFLATION	0.002***	0.002***	0.002***
	(0.001)	(0.001)	(0.001)
CRDINFO	0.175***	0.174***	0.178^{***}
	(0.062)	(0.057)	(0.062)
CRISKPREM	21.343*	21.554*	22.277*
	(11.662)	(11.638)	(12.233)
adj. R ²	0.488	0.495	0.487
RMSE	0.743	0.739	0.744
Deal FE	Yes	Yes	Yes
Country-sector FE	Yes	Yes	Yes
Dummies	Yes	Yes	Yes
Ν	2497	2497	2497

Notes. The table reports the indirect effects of the Climate Law Index with the individual green bond deal characteristics. Additional control variables include deal-specific characteristics and macroeconomic variables. The parentheses report country-robust standard errors. We use a pooled OLS model with fixed effects. The sample period is 2008-2021. Model (1) includes the interaction effect with the deal's rating. Model (2) includes the interaction effect with the deal's underwriter network. Model (3) includes the interaction effect with the deal's placement covenants. * p<0.1, ** p<0.05, *** p<0.01

	2S	LS	СМР	OSTER	PSM
	(1)	(2)	(3)	(4)	(5)
CLIMLAW	0.828***	-5.680	0.465***	0.465***	
	(0.179)	(7.236)	(0.100)	(0.129)	
INDRATNG	0.025	-0.951	0.220***	0.220***	
	(0.105)	(1.875)	(0.046)	(0.079)	
UNDWRTNET	0.117***	-0.380	0.067***	0.067^{*}	
	(0.016)	(0.873)	(0.009)	(0.034)	
COVPLCMENT	-0.732***	-3.130	-0.759***	-0.759***	
	(0.129)	(3.988)	(0.079)	(0.107)	
INFLATION	0.235***	-0.391	0.001***	0.001***	
	(0.043)	(0.614)	(0.001)	(0.001)	
CRDINFO	0.044	1.490	0.176***	0.176***	
	(0.036)	(2.225)	(0.065)	(0.062)	
CRISKPREM	-69.107***	-25.669	22.271***	22.271*	
	(17.425)	(28.318)	(7.412)	(12.208)	
TREATED					0.077^{*}
					(0.042)
First-stage					
RATIFCT	1.624***	0.395*			
	(5.61)	(0.78)			
F stat	25.768	5.598			3.441
Kleibergen-Paap LM stat (pv)	21.244 (0.001)	0.638 (0.425)			
Kleibergen-Paap F stat	31.460	0.605			
Wald Chi ²			13634.123		
Atanrho (pv)			0.011 (0.988)		
Delta (δ)				0.439	
Beta (β)				30.658***	
Mean bias (%)					6.322
Dummies	Yes	Yes	Yes	Yes	
Deal FE	Yes	Yes	Yes	Yes	
Ν	2492	359	2492	2497	

Table 7. Endogeneity analysis

Notes. The table reports the results of the endogeneity analysis. The outcome is the green bond deal value. The key independent variable is the Climate Law Index. Control variables include deal characteristics and macroeconomic factors. The sample period is 2000-2021. Model (1) uses an IV model with the 2SLS estimator. Model (2) implements a placebo test using the IV model with the 2SLS estimator for an alternative outcome variable (Sukuk bond value). Model (3) uses an IV model with the conditional mixed process (CMP) maximum likelihood estimator. The external instrument used in models (1) to (3) is the extent of country ratification of international environmental agreements index (RATIFCT). Model (4) presents the results of the Oster test. Model (5) presents the results of propensity score matching. * p<0.01, ** p<0.05, *** p<0.01

Table 8. Sensitivity tests

	(1)	(2)	(3)	(4)	(5)
CLIMLAW	0.430*	0.334***		0.500***	0.466***
	(0.269)	(0.048)		(0.137)	(0.136)
CLIMLAW ²		0.981			
		(0.734)			
CLMFINPOL			0.012**		
			(0.005)		
INDRATNG	0.248*	0.220***	0.065	0.222**	0.208**
	(0.140)	(0.079)	(0.136)	(0.085)	(0.082)
UNDWRTNET	0.015	0.067*	0.087**	0.065*	0.066*
	(0.024)	(0.034)	(0.042)	(0.035)	(0.035)
COVPLCMENT	-0.746***	-0.759***	-0.659***	-0.774***	-0.757***
	(0.125)	(0.107)	(0.145)	(0.110)	(0.110)
INFLATION	0.001	0.001***	-0.030	0.001***	0.001***
	(0.001)	(0.001)	(0.028)	(0.001)	(0.001)
CRDINFO	0.034	0.176***	0.117	0.151**	0.173***
	(0.079)	(0.062)	(0.133)	(0.061)	(0.063)
CRISKPREM	19.660	22.271^{*}	32.028*	26.310**	22.689*
	(24.025)	(12.208)	(16.816)	(12.727)	(12.902)
adj. R ²	0.322	0.488	0.505	0.470	0.483
RMSE	0.812	0.744	0.768	0.745	0.749
Deal FE	Yes	Yes	Yes	Yes	Yes
Country-sector FE	Yes	Yes	Yes	Yes	Yes
Dummies	Yes	Yes	Yes	Yes	Yes
Ν	2497	2497	1431	2277	2414

Notes. The table reports the results of the sensitivity tests. The parentheses report country-robust standard errors. The pool sample period is 2008-2021. We use a pooled OLS model with fixed effects. Model (1) includes an alternative assessment of the outcome variable measured in local currency to capture foreign exchange risk (GRBNDVAL1). Model (2) includes an additional quadratic term of the key regressor to capture nonlinear effects (CLIMLAW²). Model (3) uses an alternative key policy regressor, which is the Climate-Related Financial Policy Index (CLMFINPOL). Model (4) excludes the country with the largest individual green bond deal value (France). Model (5) excludes the country with the strongest Climate Law Index value (Italy). * p < 0.1, ** p < 0.05, *** p < 0.01

Table 9. New controls

Variable	(1)	(2)	(3)	(4)
CLIMLAW	0.148**	0.978***	0.522***	0.465***
	(0.063)	(0.319)	(0.137)	(0.129)
INDRATNG	0.220***	0.264*	0.231***	0.220***
	(0.078)	(0.157)	(0.074)	(0.079)
UNDWRTNET	0.067*	0.088*	0.070**	0.067*
	(0.035)	(0.045)	(0.032)	(0.034)
COVPLCMENT	-0.762***	-0.567***	-0.745***	-0.759***
	(0.108)	(0.161)	(0.107)	(0.107)
INFLATION	0.001***	0.141*	0.005	0.001***
	(0.001)	(0.076)	(0.016)	(0.001)
CRDINFO	-0.031	0.203**	0.143*	0.176***
	(0.118)	(0.076)	(0.072)	(0.062)
CRISKPREM	31.340***	-9.441	15.483	22.271*
	(11.309)	(23.908)	(10.494)	(12.207)
GPRLOG	0.359**			
	(0.150)			
CRI	-0.056**			
	(0.022)			
SEI		-17.750***		
		(4.793)		
SOCAP		-74.035***		
		(25.580)		
FINTECHCAP			0.003**	
			(0.001)	
DGTRADE			0.009**	
			(0.003)	
LEGORUK				1.082***
				(0.143)
LEGORFR				-0.089
				(0.505)
adj. R ²	0.492	0.493	0.494	0.488
RMSE	0.742	0.778	0.741	0.744
Deal FE	Yes	Yes	Yes	Yes
Country-sector FE	Yes	Yes	Yes	Yes
Dummies	Yes	Yes	Yes	Yes
Ν	2480	554	2471	2495

Notes. The table reports the updated Climate Law Index effect on green bond deal value, after adding new country-level economic and institutional controls in separate groups into the baseline regression. The parentheses report country-robust standard errors. The pool sample period is 2008-2021. We use a pooled OLS model with fixed effects. Model (1) includes additional controls capturing geopolitical risk and uncertainty conditions (GPRLOG, CRI). Model (2) includes additional controls capturing social perceptions and infrastructure conditions (SEI, SOCAP). Model (3) includes additional controls capturing digital finance conditions (FINTECHCAP, DGTRADE). Model (4) includes additional controls capturing legal origin conditions (LEGORUK, LEGORFR).

* *p*<0.1, ** *p*<0.05, *** *p*<0.01

Part A. Climate Law Index components				Part B. All regressors			
VARIABLE	(1)	(2)	(3)	VARIABLE	(4)	(5)	(6)
CLIMLAW1	0.0204	0.0226	0.0045	CLIMLAW	0.0136	0.0138	0.0138
CLIMLAW2	0.0190	0.0173	0.0224	INDRATNG	0.0429	0.0484	0.0484
CLIMLAW3	0.0055	0.0061	0.0212	UNDWRTNET	0.0713	0.0718	0.0715
CLIMLAW4	0.0024	0.0023	0.0123	COVPLCMENT	0.0232	0.0225	0.0222
CLIMLAW5	0.0071	0.0070	0.0236	INFLATION	0.0024	0.0024	0.0023
CLIMLAW6	0.0093	0.0111	0.0234	CRDINFO	0.0492	0.0514	0.0511
				CRISKPREM	0.0057	0.0047	0.0045
Fit-stat	0.0637	0.0664	0.1073		0.2307	0.2393	0.2381
Ν	2516	2441	2374		2497	2423	2423

Table 10. Dominance analysis

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Notes. The table reports the relative importance of predictors after applying dominance analysis of the Climate Law Index components (Part A) and of all regressors (Part B). The outcome is the green bond value issued. Model (1) shows the dominant effect of each of the index's components for the whole sample. Model (2) shows the dominant effect of each of the index's components only for developed countries. Model (3) shows the dominant effect of each of the index's components only for developing countries. Model (4) shows the dominant effect of each of the baseline regression predictors for the whole sample. Model (5) shows the dominant effect of each of the baseline regression predictors for the developed countries only. Model (6) shows the dominant effect of each of the baseline regression predictors for the developing countries only. The dominance statistics show the relative importance of each predictor. The fit statistics show the overall contribution to model fit.

	(1)	(2)	(3)
CLIMLAW	3.181**	0.537***	0.386***
	(1.299)	(0.201)	(0.137)
BUSDISCL	0.534**		
	(0.264)		
CLIMLAW * BUSDISCL	-0.287**		
	(0.119)		
TAXRES		0.098*	
		(0.060)	
CLIMLAW * TAXRES		-0.167**	
		(0.066)	
ENTRINN			-0.006
			(0.006)
CLIMLAW * ENTRINN			0.006***
			(0.002)
INDRATNG	-0.039	0.224***	0.219***
	(0.162)	(0.078)	(0.080)
UNDWRTNET	0.092**	0.067*	0.068*
	(0.040)	(0.034)	(0.034)
COVPLCMENT	-0.679***	-0.758***	-0.762***
	(0.162)	(0.107)	(0.107)
INFLATION	-0.007	0.011	0.002***
	(0.033)	(0.019)	(0.001)
CRDINFO	0.187	0.160*	0.173***
	(0.223)	(0.089)	(0.056)
CRISKPREM	28.947	20.754*	23.994*
	(20.041)	(11.345)	(12.140)
adj. R ²	0.512	0.488	0.487
RMSE	0.747	0.745	0.745
Deal FE	Yes	Yes	Yes
Country-sector FE	Yes	Yes	Yes
Dummies	Yes	Yes	Yes
Ν	951	2487	2470

Table 11. Economic channels of influence.

Notes. The table reports the effects of key economic channels (policy controls) through which climate laws affect green bond deal value. The parentheses report country-robust standard errors. The sample period is 2008-2021. We use a pooled OLS model with fixed effects. Model (1) shows the effect of the extent of business disclosure (BUSDISCL) as a mitigation channel. Model (2) shows the effect of tax on the natural resource component of corporate income (TAXRES). Model (3) shows the effect of the extent of entrepreneurial innovation (ENTRINN) in the country as a mitigation channel. * p<0.1, ** p<0.05, *** p<0.01