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DOI:
10.1111/eufm.12484

Document Version
Publisher's PDF, also known as Version of record

Citation for published version (Harvard):
Mertzanis, C & Tebourbi, I 2024, 'Geopolitical risk and global green bond market growth', *European Financial Management*, pp. 1-46. https://doi.org/10.1111/eufm.12484

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ORIGINAL ARTICLE

EUROPEAN FINANCIAL MANAGEMENT WILEY

Geopolitical risk and global green bond market growth

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Abstract

Using individual transaction data, we investigate how geopolitical risk influences green bond issuance across 73 countries during 2008–2021. We consider deal characteristics, as well as economic and institutional factors. We find a positive association between geopolitical risk and green bond issuance. The effect shows nonlinearity and time delays. Our findings remain robust after conducting sensitivity and endogeneity analysis. After decomposing the geopolitical risk index, we discover that all its components have positive correlations with green bond issuance. Lastly, our study highlights the crucial role of the underwriters' network and specific geopolitical jurisdictions as drivers for global green bond market expansion.

KEYWORDS
geopolitical risk, global, Green bonds, institutions, sustainability

JEL CLASSIFICATION
G15, G32, Q56, F34, G18, F52

We would like to thank the editor (John A. Doukas) and an anonymous referee of the European Financial Management for aid and advice and very timely feedback.

1 | INTRODUCTION

Green bonds are specialised financial instruments created with the explicit purpose of funding projects that promote environmental sustainability, including initiatives related to renewable energy, energy conservation, eco-friendly transportation and sustainable agriculture. Since its inception in 2007, the green bond market has rapidly increased (Climate Bonds Initiative, 2021). Governments, international organizations, corporations and financial institutions worldwide have been issuing green bonds to raise capital for environmentally beneficial projects while providing investors with an opportunity to support sustainable initiatives. Green bonds belong to a category of labelled bonds, alongside other environmentally-friendly bond types like social bonds, sustainability bonds and sustainability-linked bonds (de Mariz & Ferreira Savoia, 2018).

The expansion of the green bond market is shaped by a multitude of both economic and noneconomic factors. The former include the cost of capital, shifts in investor demand, changes in regulatory policies and improvements in market infrastructure and standards. The cost of capital has a crucial role in green bond market growth (Agliardi & Agliardi, 2019; Zhang & Liu, 2021). If the cost of issuing green bonds is comparable to conventional bonds or lower, it incentivizes issuers to tap into the green bond market for financing environmentally friendly projects. The demand for green investment opportunities from institutional investors, asset managers and individual investors can drive the growth of the green bond market (OECD, 2020; Sangiorgi & Schopohl, 2021; Tang & Zhang, 2020). Investor interest in sustainable investments and environmental, social, and governance (ESG) factors have been rising in recent years, leading to increased demand for green bonds. Government policies and regulations that promote sustainable finance and provide incentives for green bond issuance encourage market growth (Saravade et al., 2022; Tolliver et al., 2019). Measures like tax incentives, subsidies and green finance guidelines can stimulate issuer interest and investor confidence in the market. The presence of a well-developed market infrastructure, including reliable certification and verification mechanisms, standardised reporting frameworks and transparent guidelines, can facilitate green bond market growth (Bachelet et al., 2019; Cheong & Choi, 2020; Li et al., 2020). Such infrastructure ensures credibility, transparency and comparability of green bond issuances, attracting both issuers and investors.

Important noneconomic factors include environmental awareness and commitment, sustainability-driven social changes, transparency reporting policies and market awareness. Increasing awareness of environmental issues and a commitment to sustainability among issuers, investors and the public can contribute to the growth of the green bond market (Flammer, 2021; Tolliver et al., 2020). Companies and organizations that prioritise environmental stewardship and have sustainability goals are more likely to issue green bonds. Public sentiment, social movements and political will can also influence green bond market growth (Deschryver & De Mariz, 2020; Tang & Zhang, 2020). Strong public demand for action on climate change, coupled with supportive government policies and international agreements like the Paris Agreement, can create a conducive environment for green bond market expansion. Moreover, the availability of reliable information on the environmental effect and performance of green bond projects is crucial. Transparent reporting on the use of proceeds, project outcomes and environmental benefits instills confidence among investors and promotes market growth (Rahman et al., 2020; Wang, 2017). Furthermore, educating market participants, including issuers, investors and intermediaries, about the benefits and mechanics of green bonds is important (Azhgaliyeva et al., 2020; Sangiorgi & Schopohl, 2023). Increasing awareness about green finance, sustainable investing and the positive effect of green bond issuances can foster market growth.

Geopolitical risk and uncertainty are broader and more complex risk factors which could potentially affect green bond market growth (Alsagr et al., 2023; Caramichael & Rapp, 2022). These risk factors include geopolitical tensions, economic disputes and conflicts and political instability, which can create an environment of unpredictability that undermines investor confidence. Furthermore, geopolitical events can induce market volatility and heighten uncertainty, effecting bond yields, pricing and overall market sentiment (Doğan et al., 2023; Dong et al., 2023; Sohag et al., 2022; Tang et al., 2023, 2022). Such risk factors can also affect how sovereign and country risks are perceived, particularly for emerging markets facing geopolitical challenges (Nguyen & Örsal, 2023). They also shape the regulatory landscape governing green bonds (Adger et al., 2018; Li, 2023) and introduce complexities in global financial stability (Catalán et al., 2023). Additionally, geopolitical dynamics can affect international cooperation and commitments aimed at addressing climate change and sustainability goals (Dalby, 2015).

However, these studies focus on the direct and indirect effects of geopolitical risks on secondary green bond market behaviour and often in a specific country setting. There are hardly any studies that analyze the role of geopolitical risks on primary bond markets and therefore on green bond market growth as a whole across countries. Our paper fills this gap in the literature. It is the first study that investigates the effects of geopolitical risk on the issuance value of green bonds and therefore on the global green bond market growth around the world. We use individual green bond deal value data to examine the relationship between geopolitical risk (Caldara & Iacoviello, 2022) and green bond issuance value in 73 countries from 2008 to 2021. We control for the individual deal characteristics as well as for various country-level economic and institutional factors. We find a positive relationship between geopolitical risk levels and values of green bond issuance across different countries. The overall effect remains robust even after conducting sensitivity tests and addressing endogeneity bias. We use several alternative methods to address endogeneity, including the use of the novel Oster (2019) test on coefficient stability. Our results also suggest that changes in geopolitical risk conditions may not have an immediate or linear effect on green bond market growth, implying delays in investor recognition of new opportunities resulting from risk changes, as well as variations in the types of risks materialising, the maturity of the green bond market and the influence of specific events such as natural disasters or public health crises. Additionally, we document the role of the underwriters' network as the dominant predictor of green bond market growth.

Our paper contributes to the literature in several ways: First, it sheds light on the dynamics and the influence of global uncertainty on the green bond market growth (Alsagr et al., 2023; Caramichael & Rapp, 2022), using individual deal information that better addresses potential endogeneity bias. It provides a broader perspective on how local and global uncertainty and its numerous causes can shape market conditions and green bond issuance strategies (Sharma et al., 2020). This understanding can assist in identifying geopolitical trends that shape primary green bond markets.

Second, the study elucidates the nuanced relationship between geopolitical uncertainties and their effects on the attitudes and behaviours of green bond investors. It emphasises how geopolitical events serve as significant determinants of risk and uncertainty, which in turn, sway investor confidence and their propensity to engage with the green finance market. By dissecting the intricate interplay between geopolitical tensions and the inclination of investors to allocate resources to green initiatives, our study illuminates not only the immediate repercussions of such risks on investment decisions (He, 2023), but also the enduring impact on the commitment to fund sustainable projects and emerging technologies (Brogaard et al., 2020). By offering a more detailed evaluation of how geopolitical challenges might affect the security and feasibility of long-term investments in sustainability, the study points to a pathway for enhancing the strategic planning and risk management practices within green finance (Jia &

Li, 2020). The study advocates for a shift towards more inclusive and comprehensive investment analysis models that consider the broad spectrum of geopolitical risks.

Third, the study offers insights into corporate finance, particularly enriching theories around investment decisions, risk management and asset valuation in uncertain environments. This analysis elucidates how companies balance the appeal of sustainable investments against geopolitical instabilities, refining strategies for capital allocation, portfolio diversification and risk-return trade-offs (Tang & Zhang, 2020). It also advances corporate finance theory by integrating ESG factors into valuation models, challenging traditional methods to account for nonfinancial considerations that influence investor perceptions and a firm's cost of capital. Moreover, the study contributes to the discourse on corporate social responsibility (CSR)'s impact on financial performance, providing evidence of how sustainability practices can mitigate geopolitical risks, enhance company resilience and attract investment (de Souza Barbosa et al., 2023). The analysis highlights the necessity for firms to develop robust strategies that mitigate risks and capitalise on sustainable investment opportunities, thus enriching corporate finance theory with a more comprehensive approach to strategic planning and decision-making under uncertainty.

Third, the study emphasises the essential role that geopolitical risk analysis plays in shaping and refining regulatory frameworks for sustainable finance (Adger et al., 2018). It underscores the imperative for regulatory policies to explicitly consider and address geopolitical risks to safeguard market stability and protect investors. This necessitates a strategic approach by policymakers to pinpoint the junctures at which geopolitical risks and green finance converge, thereby enabling the formulation of targeted strategies to counteract these risks. The insights gained from examining the interplay between geopolitical risk and the expansion of the green bond market equip regulators with the knowledge required for fostering market growth while simultaneously guarding against potential vulnerabilities. Such informed regulatory interventions not only support market development but also enhance its resilience and strategic flexibility, highlighting the critical need for adaptive and proactive regulatory frameworks in the face of geopolitical uncertainties (Andersen, 2023)

The paper is structured as follows: Section 2 overviews the literature on geopolitical risk and green bond market development. Section 3 details the sources of data and outlines the empirical strategy. Section 4 discusses the findings of the baseline analysis. Sections 5 and 6 conduct sensitivity tests; an analysis of endogeneity; and robustness cheques, respectively. Section 7 concludes the paper.

2 | RELATED LITERATURE

Caldara and Iacoviello (2022) identify geopolitical risk as the uncertainty stemming from international conflicts, terrorism and state tensions that disrupt the usual and peaceful flow of global relations. Carney (2016) places geopolitical risk in an 'uncertainty trinity', alongside economic and policy uncertainty, pointing to its capacity to precipitate considerable adverse economic effects. Further emphasising this concern, the European Central Bank in its Economic Bulletin of April 2017, and the International Monetary Fund in the World Economic Outlook of October 2017, both highlight geopolitical uncertainties as a paramount risk threatening the economic landscape. Dong et al. (2023), Jernnäs and Linnér (2019) and Criekemans (2018) elaborate on geopolitical risk as emanating from intricate economic, social and political interactions among countries, encompassing political unrest, trade conflicts,

policy shifts and other noteworthy events that profoundly impact global relations and stability. Geopolitical risk can take various forms: political instability, such as regime change, civil unrest and conflicts; trade conflicts involving tariffs, sanctions and protectionist measures; economic policies, currency fluctuations, sanctions and financial crises affecting global economic stability and financial markets; security threats like terrorism, military conflicts and territorial disputes with consequences for regional stability and global security; unforeseen changes in government policies, regulations, or political priorities effecting businesses, investments and international relations; and competition or conflicts over natural resources such as energy, water and minerals.

2.1 | Geopolitical risk and green bond markets

The effect of geopolitical risk and uncertainty on the green bond market is multifaceted and complex, and its nuances are not yet fully understood. First, geopolitical risk generates a climate of uncertainty that effects investor confidence (Adebayo et al., 2022; Rumokoy et al., 2023). This uncertainty can make investors more cautious and risk-averse, potentially diminishing the demand for bonds. Geopolitical events like political turmoil, conflicts or policy shifts introduce uncertainty and volatility in financial markets, complicating the prediction of investment returns. Negative geopolitical developments might foster a pessimistic outlook, leading investors to adopt a more risk-averse approach in anticipation of potential negative effects on the global economy and financial markets (He, 2023). The perception of risk is critical in investor decision-making, with increased geopolitical risk often shifting perceptions towards caution (Bhatia, 2019). Such circumstances can lead to volatility in the bond market, negatively affecting investor sentiment (Hailemariam et al., 2019; Lee et al., 2021; Yilanci & Kilci, 2021).

Geopolitical risk may have a more pronounced effect on green bonds compared to conventional bonds for several reasons related to the nature of green investments, the investor base and the global policy environment surrounding sustainability (Hachenberg & Schiereck, 2018). Indeed, green bonds are often more directly influenced by changes in environmental policy and regulation, which can be affected by geopolitical tensions (Doğan et al., 2023; Lee et al., 2021). Since many green projects are aligned with government targets for sustainability and climate change mitigation, any geopolitical instability that leads to changes in these policies can impact the perceived value and future cash flows of green investments, making green bonds more sensitive compared to conventional bonds. Further, green bonds attract a global pool of investors who are specifically interested in environmental sustainability (Ballouk et al., 2023; Banga, 2019). Geopolitical risks that threaten international cooperation or lead to economic sanctions can disrupt investment flows more severely for green bonds, as these risks may affect the willingness of international investors to engage with certain markets or projects deemed risky. Moreover, many green projects, such as renewable energy installations, rely on global supply chains and international collaboration for technology, expertise and materials. Geopolitical tensions that disrupt these supply chains or international collaborations can directly impact the viability of green projects and therefore their relative funding attractiveness.

However, green finance can offer more stable investment opportunities, often linked to long-term, sustainable projects (Li, Li, Huang, et al., 2023). In times of geopolitical uncertainty, this stability becomes particularly attractive from an investment perspective. Moreover,

geopolitical risks can encourage broader investment diversification towards sustainable and alternative investments, potentially mitigating the effect of geopolitical risks on a firm's risk-taking (Li & Cheng, 2023). Consequently, in the context of geopolitical risk, green bond markets might become an attractive investment option, particularly since bonds are usually seen as safe investments. Green bonds, in particular, are known for outperforming traditional bonds in environmental and social effect (Guo & Zhou, 2021; Naeem et al., 2021). According to signalling theory, both institutional and retail investors might prefer green securities due to the positive environmental signals they send to the market (Flammer, 2021; Pastor et al., 2021). Furthermore, Dong et al. (2023) suggest that green bonds are also considered an effective hedge against geopolitical risk.

Second, geopolitical risk significantly shapes the regulatory landscape for green finance (Doğan et al., 2023; Lee et al., 2021; Wang et al., 2020). Geopolitical events can precipitate regulatory shifts that influence investment dynamics. On one side, alterations in government policies or changes in political priorities can affect the support structures, subsidies and incentives for both conventional and green finance. Such regulatory uncertainty might deter issuers from entering the market or cause delays in issuance. Investors, wary of unpredictable policy changes, especially those affecting green investments, may hesitate to engage with the green bond market. The anticipation of regulatory instability can lead investors to take a more cautious approach, diminishing their risk appetite (Das et al., 2019). However, geopolitical tensions can also lead to more stringent regulations on carbon emissions and fossil fuels. This new regulatory climate encourages investments in green technologies and sustainable projects, as entities aim to align with emerging standards (Falcone, 2020). The implementation of carbon taxes or carbon trading systems by governments can raise the costs associated with pollution, thus incentivizing businesses to invest in green solutions and practices, fostering a green finance market (Abbas et al., 2023). Additionally, heightened disclosure requirements driven by uncertainty, which demand more transparency on corporate climate-related risks and sustainability practices, can improve overall transparency. This enhancement in transparency facilitates investor assessment of the environmental effect of their investments, thereby stimulating interest in green finance products (Xu et al., 2022). The positive effects of environmental regulation on green finance incentives typically follow a path-dependent process (Hafner et al., 2020).

Third, trade disputes, political conflicts and shifts in geopolitical alliances can create uncertainties, affecting international capital flows (Feng et al., 2023). These adjustments in capital flows, both within and between countries, can have significant implications for green finance. On one side, geopolitical developments can lead to fluctuations in currency values, thereby influencing the appeal of investments made in those currencies. The volatility of currencies can affect the direction and magnitude of international capital movements, as investors attempt to navigate exchange rate risks. Such dynamics can hinder the ability of issuers to tap into foreign markets and may limit the participation of international investors. As a result, this could potentially limit the growth prospects of the green bond market, particularly in emerging economies (Banga, 2019). Conversely, geopolitical uncertainties often prompt a 'flight to safety', wherein investors gravitate towards assets deemed less risky and more stable (Wang et al., 2020). This usually entails shifting capital towards safe-haven assets like government bonds from economically stable countries, from which green bonds would benefit (Ballouk et al., 2023). Geopolitical events can also influence exchange rates, leading investors to reevaluate the economic and political stability of various countries (Iyke et al., 2022). In such

situations, green bonds might be seen as a safer investment option because of their inherent stability and their enduring commitment to sustainability over the long term.

Fourth, geopolitical risk can significantly influence perceptions of sovereign and country risks, particularly in emerging markets and nations facing ongoing geopolitical challenges (Ramady, 2014; Su et al., 2019; Wang et al., 2021). Elevated geopolitical risk may result in a downgrading of credit ratings, implying an increased likelihood of default. Corporations and sovereign entities in regions with high geopolitical risk might encounter higher borrowing costs. This is because investors typically demand higher yields to offset the heightened perceived risk, which could dampen the demand for bonds, including green bonds. In evaluating the creditworthiness and dependability of green bond issuers, including governments, investors may take these increased costs into account (Mazarr, 2012). On the other hand, in times of geopolitical tension, there is often a noticeable shift in public opinion towards sustainability and environmental responsibility (Dell'Atti et al., 2022). This change can stimulate consumer and investor interest in green projects and sustainable practices. Furthermore, in response to geopolitical incidents, environmental activists and advocacy groups become critical in heightening awareness about climate change, sustainability issues and their economic implications (Hamman, 2016). Their intensified efforts during periods of widespread uncertainty can sway public opinion and influence public policy. This, in turn, amplifies pressure on governments and businesses to give precedence to green finance and sustainable development (Botetzagias & van Schuur, 2012). The combined effect of these factors can, therefore, have a notable effect on the green finance sector, both in terms of challenges and opportunities.

Fifth, geopolitical risk can significantly influence international collaboration and commitments towards addressing climate change and sustainability (Leonard et al., 2021; Wang et al., 2022). Global accords, like the Paris Agreement, promote collective international effort to confront environmental challenges. Such international commitments play a vital role in lessening the likelihood that geopolitical disputes lead countries to prioritise their own interests over common goals for global climate preservation (Khan et al., 2023). Geopolitical factors that impede cooperation or weaken multilateral initiatives can have repercussions on the green bond market. They potentially affect the general progression towards sustainable finance and climate action. These international partnerships are instrumental in propelling green finance forward, as they enable countries and international organizations to combine their resources and expertise in addressing environmental issues (Bowman & Minas, 2019). Additionally, international agreements help overcome the barrier of the substantial initial investments needed for green finance. They ensure that, in the long term, sustainable practices lead to significant cost savings, making them more financially viable and appealing. This aspect of international cooperation is crucial in both maintaining momentum towards sustainable practices and in fostering a supportive environment for green bond market development.

Finally, there is a notable indirect link between geopolitical risk and green bonds through the influence on energy prices. Geopolitical tensions often lead to a surge in energy prices, primarily due to growing apprehensions about disruptions in energy supply (Dutta et al., 2020; Lee et al., 2021; Liu et al., 2019; Reboredo et al., 2017). Such disruptions prompt nations to lessen their reliance on fossil fuels to mitigate environmental risks. Simultaneously, companies are incentivized to augment their investments in green technologies and renewable energy sources. This shift aims to reduce their dependency on carbon-intensive energy sources (Gong et al., 2020; Sohag et al., 2022). Therefore, geopolitical risk can function as a catalyst, encouraging both countries and companies to accelerate their transition towards clean energy

and their investment in green assets (Rasoulinezhad et al., 2020). This urgency can stimulate innovation and foster collaboration among nations, aiming to address energy security concerns and transition to cleaner energy sources. Such a shift in focus not only helps in mitigating the risks associated with geopolitical tensions but also promotes green bond market development. These investments in green assets are pivotal in facilitating this transition, underlining the intricate connection between geopolitical dynamics, energy markets and the development of sustainable finance.

In conclusion, the relationship between geopolitical risk and uncertainty with green investments and the green bond markets could be either positive or negative. On the positive side, such risks can instill a sense of urgency, motivating countries and investors to pivot towards safe and sustainable investments and renewable energy sources. This shift can potentially stimulate the growth of green bonds, which are often viewed as a secure and diversified investment option during turbulent times. Conversely, geopolitical risks might negatively affect green investments by introducing market uncertainty and instability, potentially hindering the progress and appeal of green finance initiatives. We expect that, considering all relevant factors, the ongoing course of geopolitical developments will most likely result in a stronger shift towards green finance. Hence our key hypothesis is:

Hypothesis 1: Geopolitical risk most likely increases green bond issuance.

2.2 | Economic factors and green bond markets

Economic and financial conditions wield substantial influence over the trajectory of the green bond market. One key factor is the cost of capital, a critical determinant in the growth dynamics of the green bond market (Agliardi & Agliardi, 2019; Zhang & Liu, 2021). The cost associated with issuing green bonds plays a significant role in shaping the decision-making of issuers and, by extension, the attractiveness of the green bond market for financing environmentally friendly initiatives. When the cost of issuing green bonds is on par with or lower than that of conventional bonds, it creates a powerful incentive for issuers to leverage the green bond market as a viable avenue for funding sustainable projects and otherwise (Hachenberg & Schiereck, 2018). This economic incentive aligns with the growing emphasis on ESG considerations in the financial landscape. The prospect of comparable or reduced costs not only encourages issuers to choose green bonds but also amplifies the appeal of sustainable investments for a broader spectrum of market participants, including institutional investors and environmentally conscious individuals. Moreover, a favourable cost of capital for green bonds reflects a market that recognises and rewards sustainable practices (Maltais & Nykvist, 2020). As investors increasingly integrate ESG criteria into their decision-making processes, the cost dynamics become intertwined with the broader movement toward sustainable investing. This positive feedback loop contributes to green bond market development by fostering an environment where financial instruments aligned with environmental objectives are both economically feasible and socially and ethically compelling.

However, failing to adhere to ESG commitments specified in the bond covenants could primarily result in reputational repercussions for issuers, without any tangible effects on the bond's characteristics, debt acceleration, or financial sanctions. Thus, if the proceeds from green bonds are not entirely used for green initiatives, the bond itself remains unaffected in terms of its financial structure. Therefore, whether a bond's green designation inherently offers

additional security to investors needs to be qualified (MacAskill et al., 2021; Nanayakkara & Colombage, 2019). In certain instances, the 'green' label might not provide a sufficiently robust guarantee to investors, indicating that the perceived value of the green label can vary and may not always align with investor expectations for stringent ESG compliance.

Nevertheless, green corporate bonds offer small borrowing cost advantages. Caramichael and Rapp (2022) observe that green bonds typically offer a yield spread lower than that of conventional bonds, highlighting a cost benefit or 'greenium' that has become apparent since 2019, coinciding with the growth of the sustainable asset management industry following European Union regulations. Their research suggests that this greenium is driven by demand pressures, as indicated by factors such as bond oversubscription and inclusion in bond indices. While the governance practices associated with green bonds contribute to the greenium, the actual credibility of the projects financed by these bonds does not have a notable impact. The advantage of the greenium is mainly seen among large, investment-grade issuers, particularly within the banking sector and developed economies. This finding shows the critical role of green bonds in fostering global green investments, though it also highlights an uneven distribution of benefits among issuers.

The cost of issuing green bonds extends beyond the straightforward payment of coupons to investors. This process encompasses the managerial time and effort required to develop a comprehensive sustainability strategy and to establish a 'green finance framework' that outlines how the proceeds will be used for environmentally sustainable projects. Additionally, there is a significant cost involved in securing a second party opinion (SPO), which is an independent assessment verifying the environmental benefits and integrity of the green bond's framework (Ghitti et al., 2023). This SPO is crucial for ensuring the bond's credibility in the market and for meeting investor expectations for transparency and environmental impact. Consequently, the overall cost of issuing green bonds reflects a combination of financial expenses and the substantial resources devoted to aligning the bond issuance with environmental sustainability objectives, thereby ensuring that these financial instruments genuinely contribute to green initiatives.

Managerial incentives and constraints significantly influence the engagement of firms in green finance projects. Daubanes et al. (2021) propose a model highlighting how managerial incentives can amplify the effectiveness of carbon penalties in driving green finance projects. This suggests that incentives for managers, which may include reputational benefits, financial rewards, or a personal commitment to environmental sustainability, are crucial for enhancing the impact of regulatory measures aimed at promoting eco-friendly corporate actions. Additionally, Schaltenbrand et al. (2018) emphasise the complexity of green bonds, pointing out that a thorough understanding of environmental sustainability, finance and regulatory compliance is essential. A deficiency in these areas can obstruct the formulation of a robust green finance framework and the efficient allocation of funds to green initiatives. Furthermore, Ghitti et al. (2023) highlight the managerial burdens associated with issuing green bonds, such as creating a green finance framework, securing second-party opinions and maintaining transparent reporting. These additional costs present considerable challenges, particularly for smaller entities or those operating under financial constraints, potentially deterring their participation in green financing.

Furthermore, green bond market development is significantly influenced by an increased demand for green investment opportunities, emanating from both institutional and retail investors (Gyura, 2020; Nanayakkara & Colombage, 2019; Pham, 2016; Sangiorgi & Schopohl, 2021). The significant shift in investor preferences towards sustainable investments

and heightened consideration of ESG factors has emerged as a decisive driver, amplifying the allure of the green bond market. In recent times, there has been a discernible uptick in investor awareness and interest regarding sustainable finance. Institutional investors, such as pension funds, asset managers and insurance companies, are increasingly recognising the importance of integrating ESG criteria into their investment decisions. This growing acknowledgement stems from a dual perspective—the pursuit of financial returns and the commitment to fostering positive environmental and social effects. As a result, institutional investors are seeking avenues that align with their ESG principles, and green bonds, as instruments earmarked for financing environmentally beneficial projects, stand out as a compelling option.

Moreover, government policies and regulations play a crucial role in fostering green bond market development (Saravade et al., 2022; Tolliver et al., 2019; Wang, 2017). By actively supporting and incentivizing sustainable finance through targeted measures, governments create an environment conducive to the issuance and uptake of green bonds. By offering tax benefits to issuers of green bonds, governments provide a financial advantage that makes green financing more attractive (Baldacci & Possamaï, 2022). This can include tax deductions, credits or exemptions for expenses related to green projects, effectively lowering the cost of issuance for entities raising funds for environmentally beneficial initiatives. Subsidies are another tool in the government's arsenal to stimulate interest in green bonds (Zeng et al., 2023). Subsidies effectively lower the financial burden on issuers, making green financing a more economically viable and attractive option. On the other hand, where regulatory and reporting standards are more stringent, the administrative burden and associated costs of issuing green bonds may deter some potential issuers. It is important to note that labelled bond issuance is driven not solely by domestic regulations but also by the influence of foreign regulations, with European regulations wielding a particularly significant global influence (Redondo Alamillos & de Mariz, 2022). The ramifications of global regulations play a key role in fostering the adoption of green bonds, highlighting the interconnectedness of regulatory frameworks across borders, and underscoring the importance of international cooperation in promoting sustainable finance initiatives.

Moreover, the International Capital Markets Association (ICMA) published the 'Green Bond Principles' (ICMA, 2017), which serve as a comprehensive framework for guiding the issuance of green bonds, offering guidelines and best practices to issuers, investors and underwriters. These principles signify a concerted effort by the financial community to standardise and promote transparency in green bond issuance, thereby bolstering investor confidence and facilitating the integration of environmental considerations into investment decisions.

In addition, the presence of a well-developed market infrastructure, including reliable rating, certification and verification mechanisms, standardised reporting frameworks and transparent guidelines, can facilitate the growth (Bachelet et al., 2019; Cheong & Choi, 2020; Li et al., 2020). This robust infrastructure encompasses various components, including reliable rating systems, certification and verification mechanisms, standardised reporting frameworks and transparent guidelines. The synergy of these elements ensures credibility, transparency and comparability of green bond issuances, fostering an environment that appeals to both issuers and investors.

Finally, economic and financial development can significantly influence green bond market development (Dan & Tiron-Tudor, 2021; Tolliver et al., 2020). Economic and financial development contribute to the size and maturity of the financial market. Developed economies with well-established financial systems tend to have larger and more sophisticated capital

markets. These markets provide a conducive environment for the issuance of green bonds, with greater availability of investors, financial institutions and infrastructure to support the issuance process. Economic and financial development can shape the investor base and demand for green bonds. However, economic and financial development may have adverse effects. In advanced financial markets, established investment instruments and conventional bonds may dominate investor preferences (Sangiorgi & Schopohl, 2021; Su et al., 2022). Green bonds, being a relatively newer asset class, may face competition and struggle to attract attention from investors who are more accustomed to traditional investment options. This could limit the demand for green bonds, particularly if investors are not well-informed or familiar with sustainable investment concepts. Economic and financial development does not automatically guarantee widespread investor awareness and understanding of green bonds. Investors may lack knowledge about the environmental benefits and potential returns associated with green investments. This lack of awareness can lead to lower demand and liquidity for green bonds, making it more challenging for issuers to attract investors and issue green bonds. Likewise, the challenge of attracting attention extends to issuers as well. For many issuers, navigating the decision-making and governance processes inherent in adopting the 'green' format can be complex (Partridge & Medda, 2020). Factors such as the timeframe of funding needs, coupled with existing governance mechanisms, present significant hurdles. Issuers must carefully weigh the requirements and commitments associated with green bonds against their own operational and financial priorities. This complexity underscores the importance of support and guidance to issuers as they navigate the transition towards sustainable finance, ensuring that the adoption of green bonds is feasible and aligned with their broader business objectives. More generally, green bonds serve as a multifaceted financial instrument that transcends the scope of climate change and carbon reduction efforts. Beyond addressing these crucial environmental concerns, they also encompass initiatives related to water conservation, often referred to as 'blue bonds' (Bosman & de Mariz, 2023). Moreover, green bonds encompass a broader spectrum of environmental financing considerations that are aligned with the objectives outlined in Sustainable Development Goal No. 14 and therefore their issuance could be affected by various economic and non-economic factors. Based on these conjectures, our second testing hypothesis is stated as follows:

Hypothesis 2: Economic and financial factors influence green bond issuance.

2.3 | Individual deal characteristics and green bond markets

The individual deal characteristics critically influence green bond issuance. First, the characteristics of the issuer and of the project to be financed with the green bond proceeds are crucial (Agliardi & Agliardi, 2019; Barua & Chiesa, 2019). Green bonds typically fund projects that have clear environmental benefits, such as renewable energy installations, energy-efficient buildings, sustainable transportation infrastructure and water conservation initiatives. Aligning the project with recognised environmental standards and criteria is essential for attracting investors and ensuring the credibility of green bonds. Moreover, different issuers, whether private or public entities, have distinct incentives to issue green bonds related to such factors as enhancing their corporate image and reputation (Bachelet et al., 2019; Maltais & Nykvist, 2020 Tan et al., 2022). By demonstrating a commitment to sustainability and environmental responsibility, companies can improve their brand perception and attract

socially conscious investors. Green bonds provide a platform for issuers to showcase their environmental efforts and align their activities with sustainable development goals (Bhutta et al., 2022; Prakash & Sethi, 2021; Sinha et al., 2021; Tolliver et al., 2019). Further, both private and public issuers may be incentivized to access capital from investors specifically interested in green and sustainable investments (Sangiorgi & Schopohl, 2021; Tang & Zhang, 2020).

Green bonds can tap into a growing pool of investors who have dedicated funds or mandates for environmentally focused projects. By issuing green bonds, issuers can diversify their funding sources and potentially access capital at favourable terms, such as lower interest rates or a longer term. Further, public issuers, including government entities or public institutions, may issue green bonds to comply with environmental regulations or policy goals set by governing bodies (Saravade et al., 2022; Tolliver et al., 2019; Wang, 2017). Governments often establish frameworks that incentivize green finance, offering tax benefits, subsidies, or other incentives for issuers who invest in environmentally friendly projects. Green bond issuance can help public entities meet these requirements and access associated benefits. The specific incentives for issuing green bonds can vary depending on the issuer's sector, geographical location, regulatory environment and stakeholder expectations. Private issuers often emphasise market positioning, while public issuers may focus on policy compliance and meeting sustainability targets. Overall, green bond issuance offers a range of potential benefits for both private and public issuers, addressing reputational concerns, accessing capital, complying with regulations, managing risks and appealing to investor demand.

Secondly, the risk profile of the project and the issuer influence green bond issuance (Barua & Chiesa, 2019; Ferrer et al., 2021; Lichtenberger et al., 2022; Reboredo et al., 2020). Investors evaluate both the creditworthiness and sustainability performance of issuers, alongside specific investment risks. Issuers boasting a robust record, effective environmental management practices and proficient risk mitigation strategies are poised to attract greater investor interest. Additionally, considerations such as pricing and potential returns significantly influence investor decisions. Green bonds may exhibit distinct pricing dynamics compared to traditional bonds. Nevertheless, all bond investors scrutinise factors like coupon rates, yields and risk-return profiles. Therefore, competitive pricing of green bonds that aligns with investor expectations and offers reasonable returns can foster green bond issuance on par with conventional bonds. Furthermore, green bond issuance can serve as a risk mitigation strategy. Private issuers may acknowledge the long-term risks associated with climate change, resource scarcity, and evolving environmental regulations. By investing in green projects and issuing green bonds, issuers can mitigate reputational risks, adapt to shifting demand and align their business strategies with a low-carbon and sustainable future.

Third, clearly defining how the bond proceeds will be utilized is crucial for green bond issuance (Banga, 2019; Baulkaran, 2019; Ehlers & Packer, 2017; Löffler et al., 2021). Investors are interested in knowing how the funds will be allocated to support specific environmental projects. Transparency and accountability regarding the use of proceeds are important to gain investor trust and confidence. The potential environmental effect of the financed projects is therefore a significant consideration. Investors are interested in the expected outcomes, such as carbon emissions reduction, energy savings, or water conservation. Demonstrating a clear and measurable environmental effect can attract investors who are seeking to support projects that contribute to sustainability goals.

By considering these individual deal characteristics, issuers can effectively structure green bonds that align with investor expectations, meet environmental goals and enhance the attractiveness of the offering. It is crucial to ensure transparency, credibility and alignment

with recognised standards to foster investor confidence in the green bond market. Thus, our third testing hypothesis is stated as follows:

Hypothesis 3: Individual deal characteristics influence green bonds issuance.

3 | IDENTIFICATION STRATEGY

3.1 | Data

To establish a causal link between geopolitical risk and the issuance of green bonds, we created a distinctive panel data set encompassing both government and corporate green bond offerings from 73 countries, during the period of 2008–2021. Our green bond data is sourced from the Informa GM database. Our analysis specifically focuses on sovereign and corporate bond issues and excludes any issues by international organizations. A significant volume of green bond issuances took place following 2013, aligning with the introduction of the Green Bond Principles by major global investment banks. These principles helped standardise issuance requirements, thereby enhancing market confidence (Cheong & Choi, 2020). Examining the data, we find that there were three global green bond issues in 2008, which increased to 69 issues in 2015 and to 1122 issues in 2021. This represents an average increase of 70.5% during the 2008–2021 period, which is higher than the average 6.1% increase observed in all corporate bond types issued worldwide during the same period. To encompass a wide range of economic and institutional factors, we merged data on corporate green bond issuances with country-level data obtained from multiple sources. Our baseline data set consists of 2491 sovereign and corporate green bond deals from 73 countries. To mitigate the influence of potential outliers, we employ logarithmic transformations for variables with exceptionally high or low values.

3.2 | Key variables

Our primary research focus centers on explaining the individual green bond issuance values per country, denoted as GRNBND, which serves as our primary outcome variable. Table 1 provides an overview of the average logarithmic values of green bonds for all countries included in our sample. In our study, the global average value of green bonds stands at USD 0.686 billion. While this figure falls below the average issuance value of conventional bonds, it remains a substantial amount. Among the countries issuing green bonds, France leads with an average individual value of USD 1.26 billion, followed closely by Israel (USD 1.20 billion) and Saudi Arabia (USD 1.19 billion). In the mid-range, we find Romania (USD 0.514 billion), Hungary (USD 0.506 billion) and Costa Rica (USD 0.500 billion). At the lower end of the spectrum, we have Nigeria (USD 0.164 billion), Bermuda (USD 0.125 billion) and Mauritius (USD 0.080 billion). Notably, European countries have actively participated in green bond issuance. Moreover, smaller, and lower-income countries have also ventured into the market, driven by growth opportunities, despite facing challenges on both the demand and supply sides (Nguyen et al., 2021).

Our key independent variable is the composite measure of geopolitical risk (denoted as GPR) developed by Caldara and Iacoviello (2022). This GPR index provides a comprehensive

TABLE 1 Geopolitical risk and green bond issuance (average country values in billion USD).

Country	Green bond issuance	Geopolitical risk	Country	Green bond issuance	Geopolitical risk
Andorra	0.602	5.35	Mauritius	0.080	5.08
Argentina	0.205	4.80	Mexico	0.944	5.15
Australia	0.536	5.17	Netherlands	0.756	5.09
Austria	0.438	5.20	New Zealand	0.167	5.22
Belgium	0.750	5.24	Nigeria	0.164	5.26
Benin	0.591	5.35	Norway	0.330	5.20
Bermuda	0.125	5.08	Pakistan	0.500	5.35
Brazil	0.638	5.21	Panama	0.263	5.26
Canada	0.610	5.15	Peru	0.587	5.15
Chile	1.010	5.27	Philippines	0.314	5.17
China	0.442	5.20	Poland	0.688	5.17
Colombia	0.437	5.35	Portugal	0.595	5.28
Costa Rica	0.500	5.14	Qatar	0.600	5.26
Czech Republic	0.583	5.33	Romania	0.514	5.26
Denmark	0.465	5.17	Russia	0.322	5.28
Dominican Rep.	0.300	5.35	Saudi Arabia	1.190	5.26
Egypt	0.750	5.26	Serbia	1.180	5.35
Estonia	0.364	5.35	Singapore	0.451	5.29
Finland	0.404	5.12	Slovakia	0.356	5.35
France	1.260	5.14	Slovenia	1.190	5.35
Georgia	0.500	5.35	South Africa	0.363	5.35
Germany	0.845	5.16	South Korea	0.460	5.21
Greece	0.548	5.34	Spain	0.840	5.15
Honduras	0.332	5.28	Sweden	0.176	5.11
Hong Kong	0.523	5.15	Switzerland	0.303	5.21
Hungary	0.506	5.28	Taiwan	0.300	4.44
Iceland	0.355	5.33	Thailand	0.659	5.26
India	0.462	5.13	Togo	0.631	5.35
Indonesia	0.538	5.26	Turkey	0.483	5.23
Ireland	0.919	5.28	Ukraine	0.592	5.22
Israel	1.200	5.35	United Arab Em	0.483	5.15

TABLE 1 (Continued)

Country	Green bond issuance	Geopolitical risk	Country	Green bond issuance	Geopolitical risk
Italy	0.938	5.24	United Kingdom	0.679	5.23
Japan	0.263	5.19	United States	0.663	5.23
Latvia	0.369	5.35	Uzbekistan	0.235	5.35
Lithuania	0.346	4.92	Venezuela	0.695	5.21
Luxembourg	0.411	4.97	Vietnam	0.313	5.35
Malaysia	0.335	5.24	Total average	0.686	5.17

assessment of adverse geopolitical events and associated risks by analyzing global newspaper articles that cover geopolitical tensions. The index has tracked the evolution of geopolitical risk and its economic implications since 1900. To calculate the index, the researchers tally the number of articles related to adverse geopolitical events in each newspaper per month. This count is then expressed as a share of the total number of news articles. The search is structured into eight categories: war threats, peace threats, military buildups, nuclear threats, terror threats, beginning of war, escalation of war and terror acts. Historically, the GPR index notably spikes during the two world wars, the onset of the Korean War, the Cuban Missile Crisis, and following 9/11. Heightened geopolitical risk tends to coincide with decreased investment, stock prices and employment levels. It is also associated with an increased probability of economic disasters and poses larger downside risks to the global economy. However, this geopolitical risk might also be positively related to green investments and green bonds growth as companies and countries try to reduce their dependency on oil, which price could rise in times of heightened uncertainty and political risks. Furthermore, investors perceived green bonds as a safe haven pushing their demand and the overall growth of green bonds markets. We will empirically explore the association between GRP and the outcome variable GRNBND.

3.3 | Controls

Our study incorporates control variables to capture the influence of micro characteristics of individual deals and issuers as well as of country-level economic and institutional factors. The first control variable is a binary variable, denoted as CRPUTIL, which equals one if the green bond issuer is a corporate utility. It is common for corporate utility companies to regularly issue green bonds to fund projects and initiatives aimed at advancing environmental sustainability (Azhgaliyeva et al., 2020; Good, 2021; Sangiorgi & Schopohl, 2021). By issuing green bonds, they demonstrate their commitment to sustainable practices and environmental stewardship. It allows them to align their financing activities with broader environmental objectives, highlighting their dedication to addressing climate change and promoting renewable energy. Furthermore, issuing green bonds provides corporate utility companies with access to a specific pool of investors who are interested in supporting environmentally sustainable projects. These investors may include institutional investors, green funds and socially responsible investors who actively seek investment opportunities aligned with their environmental and ethical

values. Issuing green bonds enables utility companies to tap into this investor base and diversify their sources of funding. On the other hand, while green bonds offer opportunities for companies to raise capital for environmentally sustainable projects, utilities may face unique challenges and considerations that make them less inclined to issue such bonds compared to other industries. Green bonds often come with additional reporting and compliance requirements, which may increase the administrative and compliance costs for the utility, making green bonds less attractive. Regulatory frameworks for utilities are more complex and therefore may not provide sufficient incentives or mandates for investment in green projects or issue green bonds. Based on the balance of views, we expect either a positive or negative association between CRPUTIL and GRNBND.

Our second control variable is a binary variable, denoted as SOVERG, which equals one if the green bond issuer is a sovereign state. Sovereign states have several reasons for issuing green bonds, which reflect their commitment to sustainable development and addressing environmental challenges (Dell'Atti et al., 2022; Tsonkova, 2019). Green bonds serve as a financing mechanism for sovereign states to support their efforts to mitigate climate change. By issuing green bonds, governments can raise funds specifically dedicated to projects aimed at reducing greenhouse gas emissions, promoting renewable energy, improving energy efficiency and supporting other environmentally friendly initiatives. This allows sovereign states to demonstrate their dedication to environmental leadership and sustainability. It highlights their commitment to transitioning towards low-carbon economies, addressing the effects of climate change and contributing to global environmental objectives, such as those outlined in international agreements like the Paris Agreement. Issuing green bonds provides sovereign states with access to a specialised pool of investors who are specifically interested in financing environmentally sustainable projects. These investors, including green funds, institutional investors and socially responsible investors, actively seek investment opportunities aligned with their environmental and ethical values. By issuing green bonds, sovereign states can attract these investors and diversify their sources of capital. We anticipate a positive association between SOVERG and GRNBND.

Our third variable of interest is denoted as PLCMNAD, a binary indicator that takes a value of one when the green bond's issuance covenants include provisions for an additional amount of placement. These covenants are pivotal in the green bond issuance framework as they highlight the commitment of issuers to environmental goals and principles linked with green bonds (Agliardi & Agliardi, 2019; Azhgaliyeva et al., 2020; Barua & Chiesa, 2019). Acting as binding agreements, these covenants obligate issuers to follow certain environmental guidelines, offering investors and stakeholders further assurance. By ensuring issuers align their practices and operations with the green bond's environmental objectives, these covenants guarantee that the funds are channelled into qualified green projects and adherence to established environmental criteria is maintained.

The permission for additional placement amounts through green bond issuance covenants brings both benefits and drawbacks. On the positive side, such flexibility allows issuers to adeptly adjust to changing market conditions and investor preferences (Reisel, 2014). It widens the green bond's appeal, drawing a varied pool of investors. The opportunity for subsequent placements can attract investors who might have been reluctant to engage in the initial offering, thus improving the bonds' liquidity and attractiveness in the secondary market. This adaptability also permits issuers to refine their capital allocation strategies, enabling phased fundraising that aligns with project timelines or market windows. Moreover, the capacity for additional placements signals investor confidence, enhancing the issuer's standing in the green

finance sector. Clear communication about the use of proceeds and plans for any additional funds further elevates the trustworthiness of green bonds among investors. On the negative side, the inclusion of covenants for additional placements can introduce challenges, potentially diminishing the allure of green bonds for issuers, especially when associated with lower credit ratings (Green, 2018). Such covenants introduce additional complexity and administrative demands in the bond issuance process. They may necessitate that issuers meet specific environmental performance benchmarks, fund designated green projects, or reach certain sustainability goals. Fulfilling these requirements can escalate monitoring, reporting and verification costs, adding to the overall burden and expense for issuers. Additionally, by dictating stricter usage of the proceeds, these covenants can restrict issuers' flexibility. Also, while enhanced reporting and transparency measures boost a bond's credibility and appeal to those seeking authentic green investments, they impose extra responsibilities on issuers. We project that PLCMNAD could have either a positive or negative correlation with GRNBND, reflecting these mixed implications.

Our fourth control variable is the number of underwriters involved in supporting the green bond issue, denoted as UNDRWRTR. The network of underwriters plays a crucial role in green bond issuance, offering several significant benefits and contributions (Ottonello et al., 2022; Siani, 2019). Underwriters possess extensive knowledge of capital markets, investor preferences and regulatory requirements. They can assist issuers in structuring the green bond offering, appropriately pricing the bonds and navigating the complexities of the issuance process. With their deep understanding of the market, underwriters can provide valuable insights to guide smooth and successful green bond issuance. Furthermore, underwriters have established client networks and relationships with various investors, including institutional investors and asset managers. Leveraging these connections, underwriters can help issuers access a broad investor base and effectively distribute the green bonds. By utilizing their distribution capabilities, underwriters enhance the visibility and market reach of the green bond offering, increasing the chances of successful issuance and achieving the desired funding objectives. We anticipate a positive association between UNDRWRTR and GRNBND.

Our fifth control variable is the external rating of the green bond issuer, denoted as RATING. Credit ratings assess an issuer's creditworthiness and hold considerable influence over bond market decisions (Prajapati et al., 2021). Furthermore, credit ratings play a key role in determining the yields and spreads of green bonds (Li et al., 2020; Sheng et al., 2021). Lower credit ratings tend to signal higher financing costs because they reflect the perceived issuers' ability to fulfil debt obligations and access capital markets (Bastida et al., 2017; Benito et al., 2016; Wang et al., 2020). Changes in sovereign ratings could also affect equity and debt markets, with adverse changes having a particularly significant effect on both domestic and foreign markets (Rusike & Alagidede, 2021). At the absence of ratings, evaluating the creditworthiness of a green bond issuer entails analyzing the issuer's financial statements to assess profitability and liquidity, examining its competitive advantages and market share, evaluating the expertise and adaptability of its management team, and considering industry trends and regulatory dynamics. In the context of green bonds, this assessment also involves scrutinising ESG practices and commitments, evaluating the quality and impact of projects, engaging with stakeholders and seeking third-party assessments and certifications. In this study, we employ Moody's sovereign debt ratings, which are grouped into investment-grade and noninvestment-grade to capture these dynamics (Capelle-Blancard et al., 2019). We anticipate that higher ratings will have a positive effect on green bond issuance, signifying enhanced creditworthiness and potentially lower financing costs for the issuer.

Our sixth control variable in the analysis is the country's risk premium, denoted as RISKPREM, based on data provided by Damodaran (2022). The country's risk premium affects the cost of borrowing, investor demand and capital flows (Aidar & Braga, 2020; Bernoth et al., 2012). The risk premium represents the additional return that investors require to compensate for the perceived risk associated with investing in a specific country. When issuing green bonds, the country's risk premium directly influences the interest rate or yield at which the bonds are priced. Higher risk premiums translate into higher borrowing costs for the country, potentially making green bond issuance less attractive or feasible. A higher risk premium indicates a greater perceived risk and uncertainty regarding the country's economic, political and/or financial stability. This can affect investor perceptions and confidence in the country's ability to fulfil its obligations, including honouring the environmental commitments associated with the green bonds. Furthermore, the risk premium effects the market acceptance and liquidity of green bonds. A higher risk premium can discourage investors, leading to a narrower investor base and reduced secondary market activity. We anticipate a positive association between RISKPREM and GRNBND.

Our seventh control variable in the analysis is the inflation rate, denoted as INFLTN, sourced from the International Monetary Fund (IMF) outlook database. This variable has a significant effect on the nominal cost associated with bond issuance and offers valuable insights into the effectiveness of macroeconomic management, along with its influence on the issuers' default risk. High inflation rates can trigger economic instability, thereby eroding a nation's creditworthiness (Nickel et al., 2011). Moreover, inflation has the potential to decrease the availability of long-term financing (Alexopoulou et al., 2010). When inflation is running high, both governments and companies encounter hurdles when trying to issue bonds, leading to heightened borrowing costs (Presbitero et al., 2016). Research even suggests that elevated inflation in OECD countries could function as a hindrance to the expansion of the green bond market (Anh Tu et al., 2020). Our expectation is to observe a negative relationship between INFLTN and GRNBND.

Our eighth control variable, denoted as GDPCAPLL, stands for the log value of Gross Domestic Product (GDP) per capita in current USD. This data is obtained from the World Development Indicators database. Economic development could influence green bond issuance in several ways (Liu et al., 2022; Tolliver et al., 2020). Countries with a higher GDP per capita typically possess a larger economic base and greater resources available for investment in environmental and sustainable projects. Such countries are more likely to have the financial capacity to fund green initiatives and repay the bonds. Consequently, higher GDP per capita increases the likelihood of countries issuing green bonds to finance their environmental projects. Higher GDP per capita is often associated with economic stability, wealth and stronger creditworthiness. These factors enhance investor confidence, making green bonds issued by such countries more attractive. However, economic development could also adversely affect green bond issuance. As countries experience economic growth, there could be a tendency to prioritise economic objectives over environmental concerns. Resources may be allocated to sectors that drive economic growth, such as infrastructure development and industrial expansion, rather than investing in green projects. This shift in focus reduces the availability of funds and incentives for green bond issuance. Furthermore, economic development often entails increased industrialisation and resource consumption, leading to environmental trade-offs. The pursuit of economic growth may deplete natural resources, increase pollution or result in habitat destruction. In such cases, governments may face criticism or resistance from environmental activists or communities, making it challenging to issue green bonds and

demonstrate a genuine commitment to sustainability. We thus anticipate either a positive or a negative association between GDPCAPLL and GRNBND.

The ninth control variable is the depth of financial markets, denoted as FMDPTH, obtained from data provided by the IMF. The depth of financial markets plays a significant role in influencing bonds issuance (Black & Munro, 2010; Mizen & Tsoukas, 2014; Tendulkar & Hancock, 2014). Deep and well-developed financial markets provide issuers with greater access to capital. When financial markets are advanced and liquid, there is a larger pool of investors who are willing to invest in diverse types of securities, including green bonds. The presence of a diverse investor base increases the likelihood of successful green bond issuance and attracts a wider range of investors. Furthermore, deep financial markets are often associated with higher investor demand for securities, including green bonds. When markets are liquid, investors have more options to allocate their capital. This increased demand for green bonds can lead to favourable pricing, lower borrowing costs and a higher probability of successful issuance for issuers seeking to finance their environmental projects. Thus, we anticipate a positive association between FMDPTH and GRNBND.

It is crucial to acknowledge the concerted efforts made by international organizations, including the G20 and the OECD, in advocating for the adoption of green bonds (see, e.g., The Organization of Economic Cooperation and Development [OECD], 2020). The OECD recognises the significance of green finance in attaining sustainable development objectives and has encouraged its member countries to foster the use of green bonds as a means to finance sustainable projects. Likewise, the G20 group consists of 19 nations and the European Union, collectively representing 80% of world GDP. Furthermore, the Organization of Islamic Cooperation (OIC) has recently demonstrated an increasing commitment to assisting its member states in promoting sustainable finance and the issuance of green bonds. Therefore, in our analysis, we incorporate dummy variables to indicate whether a country is a member of these organizations.

Table 2 provides descriptive statistics for the variables, emphasising significant national variations. The average logarithmic value of green bond issuance stands at 19.78, with a

TABLE 2 Summary statistics.

	Count	Mean	SD	Min	P25	P50	P75	Max
GRNBND	2491	19.78	1.04	13.14	19.33	20.03	20.39	23.34
GPRLOG	2491	5.17	0.24	3.98	5.08	5.26	5.35	5.35
CRPUTIL	2491	0.47	0.50	0.00	0.00	0.00	1.00	1.00
SOVERG	2491	0.29	0.45	0.00	0.00	0.00	1.00	1.00
RATING	2491	0.82	0.38	0.00	1.00	1.00	1.00	1.00
UNDRWRTR	2491	4.56	3.55	1.00	3.00	4.00	5.00	46.00
PLCMNAD	2491	0.08	0.27	0.00	0.00	0.00	0.00	1.00
RISKPREM	2491	0.01	0.01	0.00	0.01	0.01	0.01	0.07
INFLTN	2491	1.87	2.66	−1.98	0.88	1.37	2.13	32.30
GDPCAPL	2491	10.57	0.78	7.37	10.46	10.75	11.00	11.80
FMDPTH	2491	0.79	0.19	0.03	0.68	0.82	0.96	1.02

standard deviation of 1.04 and a maximum value of 23.34, indicating considerable cross-country disparities. However, the median and mean values are relatively close, indicating a distribution within the sample that approximates normality. As expected, the logged GPR displays substantial cross-country variability, with an average value of 5.17, a standard deviation of 0.24 and a maximum value of 5.35. Additionally, the financial and economic controls exhibit noticeable dispersion, reflecting differences in countries' promises to sustainability and their objectives concerning corporate social responsibility and socially responsible investment.

Moreover, Table 3 presents the pairwise correlations among the key and control variables utilized in our primary regression analysis. The table reveals that there is a correlation between the value of green bond issuance and the variables representing geopolitical risk, providing initial evidence that there may be a potential causal relationship between these factors. Additionally, the table displays modest correlations among the other predictors, and the overall Variance Inflation Factor (VIF) value is low, indicating a reduced probability of collinearity among these variables.

3.4 | Estimation model

Establishing a causal link between a country's geopolitical risk and the issuance of green bonds is a challenging task because it involves the possibility of unobservable factors that are interconnected with both geopolitical risk and the choice to issue green bonds. We address this challenge by adopting alternative model specifications. Initially, we employ a pooled ordinary least squares (OLS) model that includes fixed effects for both countries and years. These fixed effects assist in adjusting for factors that remain constant over time, such as cultural norms, policy frameworks and geographical attributes, as well as factors that change over time, such as shifts in economic policies, alterations in political landscapes, technological progress and external disruptions.

Nonetheless, it is essential to acknowledge that OLS linear estimation has its limitations. It may not adequately capture nonlinear relationships, exhibits poor extrapolation capabilities, is sensitive to outliers, and can be prone to attenuation bias, which results in underestimating the values of the outcome variable. Despite these drawbacks, OLS estimation offers advantages in our particular context when compared to nonlinear estimation, which may be vulnerable to incidental parameter bias (Angrist & Pischke, 2009). Incorporating fixed effects into our analysis aids in alleviating the bias linked to OLS estimation. To further ensure the reliability of our results, we conduct supplementary sensitivity and diversified endogeneity analyses. Our approach involves using solely nonmissing observations and clustering the standard errors at the country level. We employ the following estimation model:

$$\mathrm{GRNBND}_{\mathrm{jt}} = a + \mathrm{GPR}_{\mathrm{jt}}\,\beta_1 + \mathrm{X1}_{\mathrm{it}}\,\beta_2 + \mathrm{X2}_{\mathrm{jt}}\,\beta_3 + \sigma_{\mathrm{jt}}. \quad (1)$$

The variables included in Equation (1) are, from the left-hand side: $\mathrm{GRNBND}_{\mathrm{ijt}}$ which represents the value of green bond i issued in country j in year t; and from the right-hand size, $\mathrm{GPR}_{\mathrm{jt}}$ which captures the geopolitical risk conditions of country j in year t; $\mathrm{X1}_{\mathrm{it}}$ which is a vector of individual deal i characteristics in year t; and $X2_{\mathrm{jt}}$ which is a vector of financial and economic controls for country j in year t. The composite error term σ_{jt} consists of three components: κ_j, which captures year-fixed effects, along with λ_t, which accounts for country-fixed effects, and finally $\varepsilon_{\mathrm{jt}}$, representing the regression's error parameter. We assume εjt follows

TABLE 3 Correlation matrix.

The table reports the pairwise correlations between the variables. It also provides the overall VIF mean value. *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
GRNBND (1)	1										
GPRLOG (2)	0.09***	1									
CRPUTIL (3)	−0.19***	0.16***	1								
SOVERG (4)	0.14***	−0.21***	−0.62***	1							
RATING (5)	0.19***	−0.12***	−0.37***	0.29***	1						
UNDRWRTR (6)	0.29***	0.14***	0.10***	−0.22***	−0.03	1					
PLCMNAD (7)	−0.23***	−0.07***	−0.12***	0.25***	0.03	−0.14***	1				
RISKPREM (8)	0.05***	−0.01	0.01	0.02	−0.15***	0.03	−0.02	1			
INFLTN (9)	0.09***	−0.10***	0.03	−0.02	−0.05**	−0.02	−0.02	0.24***	1		
GDPCAPL (10)	−0.09***	−0.06***	−0.08***	0.17***	0.28***	−0.36***	0.16***	−0.42***	−0.13***	1	
FMDPTH (11)	−0.05**	0.02	0.08***	−0.08***	0.17***	−0.12***	−0.07***	−0.33***	−0.07***	0.49***	1
VIF	1.74										

a normal distribution and varies across both years and countries. Acknowledging the difficulties tied to establishing causal effects solely based on observed correlations, we interpret our results as indicators of association rather than causation. To simplify our explanation, we use the term 'predict' to describe these associations.

4 | BASELINE RESULTS

The results presented in Table 4 demonstrate consistent findings across all models, with a statistically significant and positive coefficient for GPR. This indicates that higher levels of geopolitical risk are linked to increased values of green bond issuance across different countries, confirming hypothesis H1. It appears that green finance offers stable investment opportunities linked to sustainable projects, which become attractive during times of geopolitical uncertainty (see Li et al., 2023). Geopolitical risks could encourage diversification into sustainable investments, reducing overall risk for firms (in line with Li & Cheng, 2023). Green bonds, known for their positive environmental and social impact, appear to be appealing choices in such contexts (see Guo & Zhou, 2021). Additionally, uncertainty-driven heightened environmental regulations and disclosure requirements encourage green investments and transparency, further boosting the green finance market (Falcone, 2020). It may also be the case that geopolitical tensions lead to an investor 'flight to safety', favoring assets like government green bonds due to their stability (see also Wang et al., 2020). Further, geopolitical tensions can prompt a shift in public opinion towards sustainability, increasing interest in green projects (in line with Dell'Atti et al., 2022). Environmental activists and advocacy groups can accordingly play a role in raising awareness and pressuring governments and businesses to prioritise green finance (see Botetzagias & van Schuur, 2012). Moreover, international partnerships are crucial in advancing green finance, as they combine resources and expertise to address environmental issues (Bowman & Minas, 2019). They also help overcome initial investment barriers and promote long-term cost savings. Geopolitical risk can function as a catalyst for countries and companies to transition towards clean energy and green assets, fostering innovation and collaboration. This transition is vital in mitigating geopolitical risks and supporting green bond market development, emphasising the interconnectedness of geopolitics, energy markets and sustainable finance development (see also Rasoulinezhad et al., 2020).

The control variables exhibit significant associations with green bond issuance. Our results show that individual deal characteristics are associated with green bonds issuance, broadly confirming hypothesis H2. Being a utility issuer shows an adverse relationship with green bond issuance, while as anticipated, being a sovereign issuer is positively associated with green bonds. It appears that utilities may face complex regulatory challenges as well as compliance and other policy considerations that make them less inclined to issue such bonds compared to other industries. It also appears that sovereign states are dedicated to meeting environmental targets outlined in international agreements like the Paris Agreement, making green bond issuance a means to mobilise capital for projects aligned with these goals. A higher individual issuer rating, a robust underwriter network, and a higher country risk premium are all positively linked to green bond issuance. It seems that enhanced external credit ratings underscore the creditworthiness of green bond issuers in meeting obligations. Better ratings signal reduced issuance costs and improved yields, influencing decisions regarding bond purchases. Additionally, extensive client networks maintained by underwriters can facilitate seamless and successful placement of green bonds. This aids green bond issuers in accessing a

TABLE 4 Baseline effects.

The table reports the initial effect of the geopolitical risk index on the value of green bond issuance, along with other control variables that encompass bond-specific characteristics and macroeconomic factors. The standard errors, which are robust to country-level clustering, are enclosed in parentheses. The analysis covers the period from 2007 to 2021 using a pooled OLS model with fixed effects. Model (1) incorporates random effects, while Model (2) includes only year fixed effects. Model (3) includes only country-fixed effects, and Model (4) incorporates both country and year-fixed effects. *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$.

	(1)	(2)	(3)	(4)
GPRLOG	0.456***	0.949***	0.535***	0.972***
	(0.099)	(0.131)	(0.079)	(0.119)
CRPUTIL	−0.306***	−0.305**	−0.285***	−0.278***
	(0.112)	(0.116)	(0.097)	(0.096)
SOVERG	0.320***	0.309***	0.282***	0.280***
	(0.082)	(0.084)	(0.075)	(0.074)
RATING	0.304**	0.322***	0.246***	0.263***
	(0.123)	(0.119)	(0.074)	(0.072)
UNDRWRTR	0.091**	0.091**	0.071**	0.072**
	(0.042)	(0.041)	(0.033)	(0.032)
PLCMNAD	−0.737***	−0.739***	−0.762***	−0.755***
	(0.118)	(0.116)	(0.107)	(0.106)
RISKPREM	9.615	8.570	32.729***	24.529**
	(9.992)	(9.604)	(10.990)	(12.152)
INFLTN	0.044*	0.046*	−0.004	−0.007
	(0.025)	(0.023)	(0.004)	(0.004)
GDPCAPLL	−0.047	−0.059	−0.377	−1.071**
	(0.136)	(0.135)	(0.294)	(0.531)
FMDPTH	−0.589	−0.594	−2.137***	−2.898***
	(0.543)	(0.527)	(0.602)	(0.779)
adj. R^2	0.279	0.283	0.486	0.489
RMSE	0.885	0.882	0.747	0.745
F-test	33.358	.	.	.
Country FE	No	No	Yes	Yes
Year FE	No	Yes	No	Yes
Dummies	Yes	Yes	Yes	Yes
N	2491	2491	2491	2491

wide investor base and efficiently distributing the bonds. Moreover, the presence of covenants in green bond issuance, allowing for additional placement amounts, offers flexibility. This flexibility enables issuers to react effectively to changing market conditions and investor demand, optimise their capital deployment strategies, and attract a more varied investor pool. Conversely, if covenants allow for additional placement amount could adversely affect green bond issuance. Such an allowance could deter issuers by adding complexity, administrative burdens, and costs due to stringent environmental benchmarks, designated project funding and sustainability goals. This would necessitate comprehensive monitoring, reporting and verification, alongside restricting their flexibility in using the proceeds.

Finally, country-specific factors are crucial in influencing the issuance of green bonds. As anticipated, higher inflation rates tend to correlate with a decrease in green bond issuance. This relationship can be attributed to the erosive effect of inflation on investment value, increasing the cost of borrowing and potentially deterring issuers from entering the market. On the other hand, the impact of economic development on green bond issuance is not as clear-cut. While one might expect that more developed economies would issue more green bonds due to greater environmental awareness and financial capacity, this relationship is less direct and more complex, influenced by several factors such as government policies, market demand, and the maturity of the environmental finance sector. Moreover, the robustness of a country's financial market significantly influences green bond issuance positively. A deeper financial market, characterised by a wide array of financial instruments, mature regulatory frameworks and an elevated level of market participation, provides a conducive environment for green bond issuance. It not only offers issuers a broad investor base but also facilitates better terms and conditions for green bonds. Such markets typically have better mechanisms for assessing and pricing the risks associated with green investments, making them more attractive for issuers aiming to finance environmentally beneficial projects. The positive correlation between financial market depth and green bond issuance aligns with expectations, highlighting the importance of a strong financial infrastructure in green finance. Overall, hypothesis H3 is only partially confirmed. The high value of the F statistic and the relatively low values of RMSE suggest that the fixed effects are significant.

5 | SENSITIVITY AND ENDOGENEITY ANALYSIS

The estimation analysis encounters significant challenges related to endogeneity (Angrist & Pischke, 2009; Wooldridge, 2010). Endogeneity, characterised by the correlation between independent variables and the error term, poses a risk to the assumption of exogeneity, potentially resulting in biased and inefficient parameter estimates. Key sources of endogeneity in panel data analysis, such as omitted variable bias and measurement error, warrant careful consideration, particularly when examining the interplay between green bond issuance and the index of geopolitical risk. The risk of omitted variable bias is pertinent in this context. If crucial variables influencing both green bond issuance and the GPR are omitted from the model, the estimation may yield biased results. Such an omission could render the effect of geopolitical risk conditions endogenous to considerations related to green bond issuance. Simultaneity, or reverse causality, is another potential source of endogeneity. This arises when the values of green bond issuance and the geopolitical risk measure mutually determine each other. However, in this specific analysis, we argue that the issue of simultaneity is largely alleviated. It is improbable that the issuance decisions of individual governments or firms would

significantly influence a country's geopolitical risk conditions. Usually, geopolitical risk indicators are formulated well ahead of measuring the dependent variables. Additionally, the inclusion of a wide array of countries in the analysis reduces the likelihood of reverse causality. To tackle these potential challenges, we implement a multifaceted approach. First, we integrate various country-level controls, fixed effects and group dummies to bolster the robustness of our model. Moreover, we conduct sensitivity tests using different estimation techniques and variable measures to evaluate the resilience of our results. Additionally, we conduct endogeneity assessments, utilizing instrumental variable (IV) methods and the Oster test for assessing coefficient stability. This comprehensive approach is designed to enhance the credibility and validity of our estimation results considering potential endogeneity issues.

5.1 | Sensitivity analysis

The aim of sensitivity analysis is to evaluate the strength and dependability of the fundamental statistical findings by scrutinising how alterations in assumptions, data, or methodologies can affect the results. Table 5 provides the results. In our initial sensitivity test, we incorporate a 1-year lagged value of the primary regressor (referred to as GPR_{-1}) to account for delayed effects. The influence of geopolitical risk on green bond issuance may not manifest immediately and might require some time to become evident. Mitsas et al. (2022) argue that geopolitical risk triggers an adverse lagged effect on commodities returns, specifically, returns of crude oil, gold, platinum and silver; while Tang et al. (2023) document a positive relationship between geopolitical threats and green bonds returns over the long run. This lag can occur because the decision to issue green bonds involves careful consideration and evaluation by issuers, who need to assess the market conditions, investor sentiment and the potential risks and returns associated with the issuance. Consequently, it is possible that the complete consequences of energy policies on green bond issuance may not be immediately evident and may only become noticeable after a certain time has passed (Mertzanis, 2023). The findings in Table 5, Column (1), confirm this notion. The results demonstrate that geopolitical risk, with a 1-year lag, has a positive and statistically significant effect, albeit with a somewhat reduced magnitude. This additional insight underscores the time-dependent nature of the effect of geopolitical risk. However, it does not alter the fundamental qualitative findings of the baseline results in terms of their significance and direction.

In our second sensitivity test, we introduce the squared value of the primary regressor (referred to as GPR^2) to account for potential nonlinear effects. There might be a threshold level of geopolitical risk beyond which the effect on investments becomes more pronounced (Mensi et al., 2016). Below the threshold, the effect may be minimal or insignificant, but once the threshold is crossed, the effect becomes stronger. Hence, there is a possibility that the influence of geopolitical risk on green bond issuance weakens as the level of risk intensifies. In other words, the effect may be more prominent at lower levels of risk, but as the risk increases, the incremental effect becomes smaller. Lastly, the connection between geopolitical risk and green bond issuance may encounter complexities or yield different outcomes at varying levels of risk. The results in Table 5, Column (2), report these results. Specifically, the quadratic effect is statistically significant and positive. This implies that the association between geopolitical risk and green bond issuance follows a nonlinear pattern. These additional insights offer fresh perspectives on the implications of geopolitical risk and emphasise their dependence on time.

TABLE 5 Sensitivity analysis.

The table reports the results of the sensitivity tests conducted to examine the effects of the geopolitical risk index on the value of green bonds. In addition to the control variables capturing loan-specific characteristics and macroeconomic factors, the analysis incorporates various adjustments. The standard errors, which account for country-level clustering, are reported in parentheses. The sample period for the analysis spans from 2007 to 2021, and an OLS model with country-year fixed effects is utilized. Model (1) introduces a 1-year lagged value of the main regressor, while Model (2) includes an additional quadratic term for the main regressor. Model (3) substitutes the main regressor with an alternative geopolitical uncertainty variable, the World Uncertainty Index (WUI). Model (4) focuses solely on publicly traded issues, and Model (5) excludes the largest issuer (China) from the analysis. *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$.

	(1)	(2)	(3)	(4)	(5)
$GPR_{\_1}$	0.010***				
	(0.001)				
GPR^2		0.102***			
		(0.012)			
WUI			0.236*		
			(0.126)		
GPRLOG				0.791***	0.781***
				(0.106)	(0.125)
CRPUTIL	−0.278***	−0.278***	−0.286***	−0.216*	−0.348***
	(0.096)	(0.096)	(0.097)	(0.125)	(0.104)
SOVERG	0.280***	0.280***	0.288***	0.308***	0.274***
	(0.074)	(0.074)	(0.074)	(0.096)	(0.083)
RATING	0.263***	0.263***	0.287***	0.386***	0.323***
	(0.072)	(0.072)	(0.071)	(0.067)	(0.066)
UNDRWRTR	0.072**	0.072**	0.064**	0.072**	0.133***
	(0.032)	(0.032)	(0.029)	(0.032)	(0.024)
PLCMNAD	−0.755***	−0.755***	−0.754***	−0.742***	−0.718***
	(0.106)	(0.106)	(0.146)	(0.114)	(0.107)
RISKPREM	24.529**	24.529**	19.516*	21.684**	20.031
	(12.152)	(12.152)	(10.629)	(9.547)	(11.994)
INFLTN	−0.007	−0.007	−0.008*	−0.007*	−0.006
	(0.004)	(0.004)	(0.005)	(0.004)	(0.006)
GDPCAPLL	−1.071**	−1.071**	−1.200**	−0.104	−0.292
	(0.531)	(0.531)	(0.539)	(0.513)	(0.878)
FMDPTH	−2.898***	−2.898***	−2.203***	−1.550*	−2.204**
	(0.779)	(0.779)	(0.759)	(0.839)	(1.081)

TABLE 5 (Continued)

	(1)	(2)	(3)	(4)	(5)
adj. R^2	0.489	0.489	0.504	0.518	0.536
RMSE	0.745	0.745	0.727	0.695	0.722
Country FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Dummies	Yes	Yes	Yes	Yes	Yes
N	2491	2491	2325	1925	2284

Nonetheless, it is important to note that they do not fundamentally change the baseline results in terms of their significance and direction.

In the third sensitivity test, we utilize an alternative assessment of geopolitical uncertainty: the World Uncertainty Index (WUI) (data source at https://worlduncertaintyindex.com/). This is an economic indicator that measures the level of uncertainty in the global economy. It quantifies the extent to which economic and political uncertainty, as reflected in news media reports, is affecting economic activity and decision-making worldwide. Like the GPR index, the WUI is based on textual analysis of media coverage, specifically news articles from major newspapers in different countries. Column (3) of Table 5 presents the results of the new estimation, indicating that the new world uncertainty measure positively affects green bond issuance. This finding corroborates the baseline results, indicating that global uncertainty affects green bond market development.

In the fourth sensitivity test, we modify the sample structure to examine the effect of geopolitical risk specifically on publicly listed green bonds. This is because geopolitical risk might have a more pronounced effect on the issuance of publicly listed green bonds (Gao et al., 2021; Lee et al., 2021). Publicly listed bonds are subject to greater investor scrutiny, making them more sensitive to external factors. Investors of publicly listed bonds may be more cautious and risk-averse during periods of heightened geopolitical uncertainty, which could affect the demand for and pricing of these bonds. On the other hand, nonlisted green bonds, such as those issued through private placements or directly to institutional investors, may have a different risk profile and investor base. The terms and conditions of nonlisted bonds may be negotiated on a case-by-case basis, potentially allowing issuers and investors to account for and mitigate geopolitical risk in their agreements. Nonlisted bonds may also be less influenced by short-term market fluctuations driven by geopolitical events. Column (4) of Table displays the results, which reveal that the effect of geopolitical risk on publicly listed green bonds remains statistically significant and positive, with a stronger effect. As a result, these updated estimates do not fundamentally change the essential qualitative characteristics of our initial findings.

Lastly, to explore the potential effect of a bias associated with large-sized data points, we perform an additional sensitivity test by excluding China, which is the largest issuer of green bonds in our sample. This approach enables us to investigate whether the presence of an outlier or a particularly influential data point has an effect on the results. The findings in Column (5) of Table 5 demonstrate that geopolitical risk maintains a positive and statistically significant effect, with an even greater magnitude. Like the earlier findings, these updated estimates do not fundamentally change the qualitative characteristics of our baseline results.

5.2 | IV estimation

To address potential endogeneity concerns in our estimation, we utilize IV methods (Greene, 2012). We use the e-participation index (EPART) as an external IV to predict geopolitical risk conditions. The United Nations e-Government knowledge group provides the data (https://publicadministration.un.org/en/eparticipation). The e-participation index assesses the extent to which governments and public institutions use digital technologies to engage and involve citizens in decision-making processes. It considers the availability of online platforms and tools for citizen participation, the use of social media and other digital channels for communication between governments and citizens, and the overall accessibility and inclusiveness of digital technologies for public engagement. As a first approximation of the instrument's exogeneity, we observe that EPART correlates well with GPR (0.581) and little with the outcome, GRNBND (0.016). It also makes sense. E-participation can influence a country's geopolitical risk by enhancing transparency, empowering citizens, and preventing conflicts. E-participation platforms and digital tools can enhance transparency by providing access to information on government policies, and decision-making processes. Having more access to information and actively participating in governance, citizens can help reduce the opacity and perceived risks associated with government actions, potentially lowering geopolitical risk (Le Blanc, 2020). When actively involved, with a sense of ownership in decision-making, citizens can achieve greater political stability and social cohesion, which can mitigate geopolitical risk (Åström et al., 2012). Further, by providing a platform for open discussions and engaging citizens, e-participation can help prevent conflicts and promote the peaceful resolution of disputes (The European Parliament EP, 2015).

To obtain unbiased estimates, we employ three different methods: two-stage least squares (2SLS), the two-step generalised method of moments (GMM) and the conditional mixed process (CMP) utilizing the maximum likelihood estimator. These estimators enable us to address the issue of endogeneity and generate dependable estimates of the connection between geopolitical risk conditions and green bond issuance. Table 6 presents the results of these estimations. In Column (1), we provide the outcomes derived from the 2SLS estimator. This estimator initially regresses geopolitical risk on the e-participation index, which assesses the validity of the IV. The substantial Kleibergen-Paap *F* statistic serves as an indicator of the IV instrument's validity and the reliability of the 2SLS estimator. The Hansen *J* statistic evaluates the null hypothesis that the instruments are valid, meaning that they are uncorrelated with the error term. Since the associated *p*-value is statistically small, we cannot reject the null hypothesis at the 10% level, indicating that the instrument may be valid. The results of the 2SLS estimator indicate that GPR remains statistically significant and positive Additionally, in Column (2), we display the results derived from the two-step GMM estimator, which utilizes the lagged first differences of the dependent variable as an IV (Arellano & Bover, 1995). The outcomes are consistent with the findings of the 2SLS estimator, and there is no substantial evidence of second-order autocorrelation detected. The relationship between GPR and green bond issuance remains statistically significant and positive. Lastly, in Column (3), we present the results obtained from the conditional mixed process (CMP) method. This method estimates separate equations as a system to accommodate unobservable influences in the analysis (Roodman, 2011). The substantial Chi^2 statistic suggests a well-specified model, while the lack of significance in the Atanhrho12 correlation parameter indicates a low likelihood of endogeneity at the 10% significance level. Furthermore, the results obtained from the CMP estimator also reveal a statistically significant and positive relationship between GPR assessment and green bond

TABLE 6 Endogeneity analysis.

The table reports the findings of the endogeneity analysis conducted to address potential endogeneity issues in the relationship between GPR and GRNBND. The analysis utilizes a pooled sample covering the period from 2000 to 2021. Model (1) employs an instrumental variable (IV) model with the two-stage least squares (2SLS) estimator. Model (2) utilizes an IV model with the two-step generalised method of moments (GMM) estimator. Model (3) applies an IV model with the conditional mixed process function approach (CMP) using a maximum likelihood estimator. The external instrument employed in the analysis is the country's e-participation index (EPART). Lastly, Model (4) employs Oster's (2019) test of coefficient stability to examine the presence of omitted variable bias. *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$.

	(1)	(2)	(3)	(4)
GPRLOG	0.978***	0.951***	1.112**	0.972***
	(0.116)	(0.115)	(0.463)	(0.358)
CRPUTIL	−0.283***	−0.228**	−0.279***	−0.278***
	(0.095)	(0.090)	(0.040)	(0.040)
SOVERG	0.277***	0.295***	0.279***	0.280***
	(0.073)	(0.072)	(0.046)	(0.050)
RATING	0.258***	0.303***	0.263***	0.263***
	(0.070)	(0.065)	(0.049)	(0.045)
UNDRWRTR	0.073**	0.060*	0.072***	0.072***
	(0.032)	(0.031)	(0.005)	(0.009)
PLCMNAD	−0.753***	−0.759***	−0.751***	−0.755***
	(0.104)	(0.104)	(0.062)	(0.080)
RISKPREM	25.307**	24.309**	23.543**	24.529***
	(11.988)	(11.974)	(11.445)	(8.872)
INFLTN	−0.007	−0.004	−0.008	−0.007
	(0.004)	(0.004)	(0.007)	(0.006)
GDPCAPLL	−1.120**	−0.759	−1.037***	−1.071***
	(0.512)	(0.467)	(0.374)	(0.391)
FMDPTH	−2.972***	−2.660***	−2.727***	−2.898***
	(0.755)	(0.734)	(0.635)	(0.641)
First stage				
EPART	1.782***		1.343***	
	(0.034)		(0.032)	
Second stage				
F-stat	721.365	721.554		.
Hansen *J* (pv)	2.999 (0.083)	2.999 (0.083)		
AR (2)		0.245		

(Continues)

TABLE 6 (Continued)

	(1)	(2)	(3)	(4)
Chi^2			3030.866	
Atanrho (pv)			−0.103 (0.245)	
Delta				0.048
Beta				0.384
Dummies	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
N	2474	2474	2524	2491

issuance. In summary, the outcomes from the diverse IV estimation methods consistently affirm the positive and statistically significant relationship between geopolitical risk conditions (GPR) and green bond issuance. This reinforces the notion that higher geopolitical risk is associated with increased green bond issuance.

5.3 | The Oster test of coefficient stability

To enhance the reliability of our results, we conduct additional tests. While we incorporate observable covariates into our model to alleviate potential confounding, relying solely on their inclusion may not entirely address bias stemming from unobserved factors. To tackle this concern, we utilize Oster's (2019) bias-adjusted treatment test, which assesses the effect of including unobserved covariates on omitted variable bias. Oster's test assesses bias by examining changes in the stability of coefficients and the degree to which regressors account for variation when moving from observed to unobserved covariates. Expanding on the work of Altonji et al. (2005), Oster (2019) introduced a novel approach to evaluate bias arising from unobserved factors. This method operates under the assumption that observable covariates constitute a random subset of all pertinent covariates. The level of confounding is determined by bounding the treatment effect while considering assumptions about the selection of unobserved covariates. In situations where there are omitted variables, it becomes difficult to directly isolate the coefficient β, which represents the treatment effect on the outcome variable. Instead, it becomes necessary to establish a range (bounds) for the treatment effect, which can be determined by considering the degree of proportionality, δ, between observable and unobservable covariates, along with the unknown overall model fit, $R_{\max}$. The parameter δ signifies the degree of correlation between unobservable covariates and the outcome variable in relation to observable covariates. Larger values of δ indicate a stronger level of endogeneity. When δ equals one, observable and unobservable covariates hold equal significance. Values of δ greater than one suggest that unobservable covariates exert a more pronounced influence, while values of δ less than one imply that observable covariates have a stronger effect. $R_{\max}$ quantifies the degree to which the variation in the outcome variable can be accounted for by considering both observable and unobservable covariates. However, it cannot be directly estimated from the data. Consequently, it is essential to make assumptions (bounds) regarding

δ and R_{max} to determine the value of β, the treatment effect. *n* Column (4) of Table 6, we provide the outcomes of the Oster test. The δ parameter is relatively small, suggesting that incorporating excluded instruments into the regression model results in only a minor alteration in the endogenous variable. This implies a reduced likelihood of endogeneity among the regressors. The statistically significant beta coefficient indicates that the IV is an effective predictor of the endogenous variable, thereby offering a valid approach for addressing endogeneity concerns.

6 | FURTHER ROBUSTNESS TESTS

6.1 | Additional control variables

The connection between geopolitical risk and green bond issuance is intricate, as several factors, including environmental, social, economic and geopolitical elements, can all influence this relationship. Consider weather conditions, for example, which can have multiple effects on geopolitical risk conditions and subsequently indirectly affect green bond issuance (Weber & Saravade, 2019). Severe weather events like floods, hurricanes and heatwaves can introduce uncertainty, resulting in temporary shortages and price hikes. Such developments can potentially erode investor confidence in supporting green energy projects, potentially reducing the demand for green bonds. Moreover, social fractionalisation conditions can affect the relationship between geopolitical risk conditions and green bond issuance (Peszko et al., 2020). Social group norms toward sustainability can indeed influence the demand for green bonds and the willingness of investors to engage with them. Countries that prioritise social cohesion and value strong family ties may exhibit a greater inclination to prioritise investments in renewable energy and green technologies, which could lead to an increase in the issuance of green bonds (Mertzanis & Tebourbi, 2023). We assess some of these hypotheses by individually introducing new control variables to address potential collinearity bias. We then re-estimate Equation (1) to examine the distinct effects of these GROUPS OF controls: Initially, we examine the influence of a country's temperature (TEMRT) and rainfall (PRECIPT) conditions. Data on temperature and rainfall rates are sourced from the World Development Indicators. Secondly, we explore the effect of a country's degree of ethnic fractionalisation (FRACETHN) and religious fractionalisation (FRACRELIG). Data on fractionalisation is obtained from Alesina et al. (2003). Third, we investigate the influence of a country's degree of and long-term orientation (LTOR) and uncertainty avoidance (UAI). Data on cultural values is sourced from Hofstede (2001). Table 7 presents the results. The introduction of these new social and environmental variables does not fundamentally alter the significant and positive relationship between geopolitical risk conditions and green bond issuance. Moreover, most of the additional controls exhibit statistical significance.

6.2 | Decomposition of the geopolitical risk effect

Caldara and Iacoviello (2022, p. 1198) propose a methodology for constructing their GPR index using a text-based approach. They create a dictionary of words that are associated with geopolitical 'events' and 'threats' based on their occurrence in newspaper articles. These words are then used to construct a composite index that captures the overall level of geopolitical risk.

TABLE 7 Additional controls.

The table reports the updated effects of the geopolitical risk index on the value of green bonds after incorporating new control variables. The standard errors, shown in parentheses, are clustered at the country level. The analysis covers the period from 2007 to 2021, and we employ an OLS model with country-year fixed effects. Model (1) introduces additional environmental controls (TEMRT, PRECIPT). Model (2) incorporates additional controls for ethnic and religious fractionalisation (FRACETHN, FRACRELIG). Model (3) includes additional cultural controls (UAI, LTOR). *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$.

	(1)	(2)	(3)
GPRLOG	0.926***	0.972***	0.791***
	(0.134)	(0.119)	(0.139)
CRPUTIL	−0.284***	−0.278***	−0.428***
	(0.098)	(0.096)	(0.136)
SOVERG	0.278***	0.280***	0.233**
	(0.075)	(0.074)	(0.100)
RATING	0.258***	0.263***	0.311***
	(0.071)	(0.072)	(0.073)
UNDRWRTR	0.073**	0.072**	0.139***
	(0.033)	(0.032)	(0.033)
PLCMNAD	−0.753***	−0.755***	−0.629***
	(0.107)	(0.106)	(0.134)
RISKPREM	26.873**	24.529**	9.999
	(11.674)	(12.152)	(16.247)
INFLTN	−0.004	−0.007	−0.034*
	(0.004)	(0.004)	(0.017)
GDPCAPLL	−0.956*	−1.071**	−0.934
	(0.518)	(0.531)	(0.964)
FMDPTH	−2.973***	−2.898***	−3.438**
	(0.757)	(0.779)	(1.431)
TEMRT	0.130		
	(0.113)		
PRECIPT	0.020**		
	(0.008)		
FRACETHN		14.831**	
		(7.044)	
FRACRELIG		−37.859*	
		(19.434)	
UAI			−0.036
			(0.024)

TABLE 7 (Continued)

	(1)	(2)	(3)
LTOR			−0.039*
			(0.022)
adj. R^2	0.492	0.489	0.554
RMSE	0.744	0.745	0.748
Country FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Dummies	Yes	Yes	Yes
N	2474	2491	1630

In our study, we investigate the effects of these two distinct historical measures of the GPR index: the historical threat index (GPRT) and the historical acts index (GPRA). We re-estimate Equation (1) separately by including these distinct effects of GPRT and GPRA on green bond market development. The results, presented in Table 8, demonstrate that both the historical threat index and the historical acts index are positively correlated with green bond issuance. Interestingly, the threat risk index exerts a notably stronger effect on green bond issuance vis-a-vis the effect of the actual historical acts. This suggests that geopolitical threats have a more immediate effect on investor sentiment and confidence, as well as on risk perceptions in the market, leading to increased market volatility and uncertainties which might lead to investors recalibrating their portfolios by adding green bonds as safer investments and to firms expediting the move towards investments in efficient energy to reduce the threat of energy security. In addition, market reactions and sentiment are more influenced by expectations, which are formed more rapidly in response to various threats. However, further analysis is necessary to delve into these differential effects and gain a deeper understanding of their underlying mechanisms.

6.3 | Dominance analysis

To discern the relative effect of each regressor in predicting the outcome variable, we employ dominance analysis, following the methodology developed by Azen and Budescu (2006). This technique enables us to assess the relative importance of individual regressors within our statistical model. Dominance analysis leverages the Shapley value decomposition from game theory to evaluate the contributions of each independent regressor to prediction by comparing the overall fit statistic. This approach calculates the average net increase in the model's overall R^2 when each independent predictor is incorporated into models built with all conceivable combinations of the remaining predictors. This process offers insights into the relative significance of each regressor in predicting the outcome variable (Luchman, 2021). Dominance analysis proves valuable in pinpointing the most influential predictors and offering a more precise comprehension of the associations between the predictors and the outcome variable.

TABLE 8 Effects of decomposed measures of geopolitical risk.

The table reports the revised effects of various measures of the geopolitical risk index on the value of green bonds. The standard errors, indicated in parentheses, are clustered at the country level. The analysis covers the period from 2007 to 2021, and we utilize an OLS model with country-year fixed effects. Model (1) examines the effect of the average historical geopolitical risk index (GPRH). Model (2) explores the influence of the historical threats geopolitical risk index (GPRT). Model (3) assesses the effect of the historical acts geopolitical risk index (GPRA). *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$.

	(1)	(2)	(3)
GPRLOG	161.107***		
	(19.693)		
GPRTLOG		4.150***	
		(0.507)	
GPRALOG			2.853***
			(0.349)
CRPUTIL	−0.278***	−0.278***	−0.278***
	(0.096)	(0.096)	(0.096)
SOVERG	0.280***	0.280***	0.280***
	(0.074)	(0.074)	(0.074)
RATING	0.263***	0.263***	0.263***
	(0.072)	(0.072)	(0.072)
UNDRWRTR	0.072**	0.072**	0.072**
	(0.032)	(0.032)	(0.032)
PLCMNAD	−0.755***	−0.755***	−0.755***
	(0.106)	(0.106)	(0.106)
RISKPREM	24.529**	24.529**	24.529**
	(12.152)	(12.152)	(12.152)
INFLTN	−0.007	−0.007	−0.007
	(0.004)	(0.004)	(0.004)
GDPCAPLL	−1.071**	−1.071**	−1.071**
	(0.531)	(0.531)	(0.531)
FMDPTH	−2.898***	−2.898***	−2.898***
	(0.779)	(0.779)	(0.779)
adj. R^2	0.489	0.489	0.489
RMSE	0.745	0.745	0.745
Country FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Dummies	Yes	Yes	Yes
N	2491	2491	2491

Table 9 shows the outcome of the dominance analysis. In column (1), the dominant effects exclusively associated with the specific characteristics of individual bond issues are presented. Column (2) presents the dominant effects of each component measure of the GPR. The dominant effects of both the specific characteristics of individual bond issues and the GPR component measures are examined in column (3). In column (4), the analysis shifts to country effects. The results in columns (1) and (3) reveal that the most dominant predictor of green bond issuance value is the underwriter's range (UNDRWRTR), which represents the number of book-managers per deal. It is followed

TABLE 9 Dominance analysis.

The table reports the results of applying dominance analysis to determine the relative importance of predictors in predicting the value of issued green bonds. Dominance is based on the Shapley decomposition theory. The dependent variable is the value of green bonds issued. Model (1) highlights the dominant effects of specific characteristics of individual bond issues exclusively. Model (2) focuses on the dominant effects of each component measure of the geopolitical risk index (GPR). Model (3) examines the dominant effects of both the specific characteristics of individual bond issues and the GPR component measures. Model (4) reveals the dominant effects of both the specific characteristics of individual bond issues and the GPR measure calculated separately for each country. The general dominance statistic indicates the relative importance rank, while the overall fit statistic indicates the effective contribution of a predictor to the overall model fit.

	(1)	(2)	(3)	(4)	
Variable	**Dominance statistic**	**Dominance statistic**	**Dominance statistic**	**Country**	**Dominance statistic**
UNDRWRTR	0.1144		0.1095	Israel	0.0210
PLCMNAD	0.0293		0.0291	South Africa	0.0135
G20	0.0254		0.0253	Colombia	0.0126
OECD	0.0192		0.0188	Peru	0.0114
RATING	0.0154		0.0154	Brazil	0.0111
RISKPREM	0.0124		0.0126	Venezuela	0.0110
OIC	0.0092		0.0093	Netherlands	0.0105
GDPCAPLL	0.0075		0.0071	Chile	0.0098
FMDPTH	0.0036		0.0036	Switzerland	0.0092
SOVERG	0.0032		0.0033	Germany	0.0088
CRPUTIL	0.0032		0.0031	United Kingdom	0.0083
INFLTN	0.0005		0.0005	Saudi Arabia	0.0082
GPRALOG		0.0031	0.0035	India	0.0075
GPRLOG		0.0099	0.0032	Russia	0.0074
GPRTLOG		0.0036	0.0017	Ukraine	0.0073
Fit-stat	0.2433	0.0167	0.2458		0.8252
N	2491	2491	2491		2491

by whether additional placement is allowed (PLACEMENT) and whether the country is a member of the G20. Furthermore, column (4) demonstrates that the GPR conditions in Israel hold the dominant position, followed by South Africa and Colombia. These interesting new findings highlight the significance of enhancing the breadth and depth of the underwriters' network as a priority for promoting growth in the green bond market. Additionally, they indicate that geopolitical risk conditions in certain countries have a particularly significant effect on green bond market. Further analysis is required to delve deeper into these effects and examine them in greater detail.

6.4 | Economic channels of the green bond effect

In the previous section, we highlighted the dominant influence of the underwriters' network in predicting the value of bond issuance (Ottonello et al., 2022; Siani, 2019). In this section, we investigate the potential influence of economic factors that could moderate the predominant effect of underwriters' networks on green bond market development. Specifically, three factors are considered: the denomination currency (CURR) of the green bond issue, the level of income inequality captured by the Gini coefficient (GINI) and the size of a country's domestic product market (MSIZE). The currency of the green bond issue is sourced from the Informa GM database, while data on the Gini index and market size index are obtained from the World Development Indicators. The denomination currency is crucial in green bond market development for it affects the attractiveness of green bonds to investors, influences the cost of issuing green bonds, effects pricing dynamics, and has implications for international market access and diversification (Siegfried et al., 2007). The underwriters' network is critical in mitigating the effects of these factors. Income inequality can also have implications for green bond issuance due to its influence on social and economic factors relevant to sustainable development and environmental initiatives (Brei et al., 2018). Disparities in access to resources, opportunities and basic services associated with income inequality can contribute to social and environmental challenges. Income inequality can affect investor demand for green bonds, particularly those focused on socially responsible or effect investing. Again, the underwriters' network mitigates the effects of these factors. Additionally, the domestic size of the product market can influence the issuance of green bonds as it signifies greater potential for green projects and indicates a greater need for sustainable infrastructure development and environmentally friendly solutions (Campello, 2003).

Table 10 presents the results of the analysis incorporating these new variables and their respective interactions. Column (1) shows the effect of the issue currency denomination, column (2) presents the effect of income inequality and column (3) displays the effect of domestic market size. Interaction effects are also included. The findings indicate that all three variables have a positive and significant effect on green bond issuance, which is moderated by the underwriters' network. The underwriters' network significantly promotes the growth of the green bond market by providing access to a wide range of potential investors globally, leveraging their reputation and risk-management expertise to ensure credibility, educating investors about the benefits and opportunities of green bonds, and offering expertise in structuring suitable financial instruments.

TABLE 10 Underwriter network and green bond issuance.

The table reports the updated effects of three factors influencing the underwriter network effect on green bond issuance. Country-robust standard errors are reported in parentheses. The analysis covers the period from 2007 to 2021, and an OLS model with country-year fixed effects is employed. Model (1) examines the effect of the currency denomination of the bond issuance (CURR). Model (2) investigates the influence of income inequality (GINI). Model (3) assesses the effect of the overall market size (MSIZE) in the country. *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$.

	(1)	(2)	(3)
CURRENCY	0.926***		
	(0.189)		
UNDRWRTR × CURRENCY	−0.026		
	(0.026)		
GINI		0.155***	
		(0.040)	
UNDRWRTR × GINI		−0.024***	
		(0.008)	
MSIZE			1.733***
			(0.613)
UNDRWRTR × MSIZE			−0.072***
			(0.015)
CRPUTIL	−0.244***	−0.428***	−0.316***
	(0.078)	(0.123)	(0.092)
SOVERG	0.329***	0.181	0.297***
	(0.082)	(0.116)	(0.073)
RATING	0.300***	0.112	0.248***
	(0.087)	(0.151)	(0.060)
PLCMNAD	−0.693***	−0.556***	−0.700***
	(0.115)	(0.166)	(0.110)
RISKPREM	30.976**	−8.294	10.386
	(12.072)	(13.617)	(9.424)
INFLTN	−0.007*	−0.005	−0.005
	(0.004)	(0.006)	(0.006)
GDPCAPLL	−1.544***	−1.126	−0.489
	(0.462)	(0.902)	(0.535)
FMDPTH	−2.721***	−2.302***	−1.712***
	(0.797)	(0.793)	(0.615)
adj. R^2	0.556	0.542	0.535

(Continues)

TABLE 10 (Continued)

	(1)	(2)	(3)
RMSE	0.694	0.725	0.711
Country FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Dummies	Yes	Yes	Yes
N	2491	734	2491

7 | CONCLUSIONS

This study examined the cross-country relationship between geopolitical risk conditions and green bond market development. We scrutinised the influence of comprehensive measures of geopolitical risk on the extent of green bond issuance in 73 countries during 2008–2021. Throughout this analysis, we considered the role of various economic and institutional factors. Geopolitical risk is a multifaceted phenomenon, presenting a spectrum of effects on businesses, encompassing both challenges and opportunities in the domain of green investments.

Our research uncovers a positive correlation between heightened geopolitical risk and an increase in the issuance of green bonds across our sample. The findings indicate that elevated geopolitical risks might hasten the shift towards safer investment alternatives, cleaner energy sources and investments in energy-efficient technologies. The presence of heightened geopolitical risks encourages increased investor interest in green bonds. In a bid to diversify their portfolio risks, particularly concerning geopolitical and reputational aspects, investors are gravitating more towards green bonds. These bonds are regarded as a secure refuge, providing a stable and ecologically sound investment choice in the face of geopolitical uncertainties. This emerging trend highlights the dual appeal of green bonds—they are not only seen as a conduit for environmental sustainability but also as a prudent financial asset in an unpredictable geopolitical environment. This recognition marks a significant shift in investor behaviour, emphasising the role of green bonds in balancing financial stability with environmental responsibility.

Various characteristics of the individual bond deals and country-level economic and institutional factors also contribute to this relationship. The overall effect remains robust even after conducting sensitivity tests and addressing endogeneity bias. Nonetheless, our findings indicate that alterations in geopolitical risk conditions might not lead to a linear or immediate effect on green bond issuance. This underscores potential delays in investors recognising new opportunities arising from shifts in risk, as well as variations in risks materialising, the maturity of the green bond market, and the influence of specific events like public health crises or natural disasters. Additionally, our findings emphasise the significant role of the underwriters' network as the primary predictor of green bond market growth. Nonetheless, countries aiming to enhance the supportive role of the underwriters' network in green bond finance should pay attention to factors such as the currency denomination of the bond, the extent of income inequality in the country and the size of the domestic product market.

While this study offers initial evidence of a positive association between geopolitical risk conditions and the expansion of the green bond market, it does come with certain limitations.

Our measures of geopolitical risk conditions would benefit from greater diversification to account for distinct types of risks. Furthermore, the influence of geopolitical risk conditions on the growth of the green bond market may be contingent on other issuer attributes, such as ownership structure, company size and industry sector. However, these factors were not explored in the scope of this study. Moreover, although we address endogeneity effects, it is important to acknowledge that the potential for omitted variables bias cannot be eliminated. Lastly, it is essential to explicitly examine the roles of additional institutions and policies and scrutinise their cross-country and longitudinal effects in greater detail. These institutions hold a key position in shaping monetary, regulatory, energy and environmental policies and exerting influence on the issuance of green bonds. For example, government agencies can incentivize green bond issuance through policies, regulations and fiscal measures such as tax incentives, subsidies and grants for green projects. Central banks can influence green bond issuance by incorporating sustainability criteria into their monetary policy frameworks, such as considering environmental risks in asset purchases and collateral eligibility. Financial regulators can establish reporting requirements, disclosure standards and certification frameworks for green bonds, ensuring that investors have access to reliable information and that issuers adhere to sustainable finance principles. Multilateral development banks can provide technical assistance, capacity building and financial support to issuers and investors in developing countries to facilitate green bond issuance. Industry associations and standards bodies can develop best practices, guidelines and certification schemes for green bonds, promoting market integrity and investor confidence. Exploring the effects of institutional policies could offer valuable insights into the broader socioeconomic and political factors that shape sustainable finance. Hence, future research endeavours should be directed towards a more in-depth examination of the specific roles and dynamics of these institutions. Such investigations will contribute to a refined understanding of the interplay between risk conditions, green bond issuance and the broader realm of sustainable development.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from Informa GM. Restrictions apply to the availability of these data, which were used under license for this study. Data are available from https://informaconnect.com/igm/igm-esgsri-bonds/ with the permission of Informa GM.

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REFERENCES

Abbas, J., Wang, L., Ben Belgacem, S., Pawar, P. S., Najam, H., & Abbas, J. (2023). Investment in renewable energy and electricity output: Role of green finance, environmental tax, and geopolitical risk: Empirical evidence from China. *Energy*, *269*, 126683.

Adebayo, T. S., Akadiri, S. S., & Rjoub, H. (2022). On the relationship between economic policy uncertainty, geopolitical risk, and stock market returns in South Korea: A quantile causality analysis. *Annals of Financial Economics*, *17*(1), 225–205.

Adger, W. N., Brown, I., & Surminski, S. (2018). Advances in risk assessment for climate change adaptation policy. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*, *376*(2121), 20180106.

Agliardi, E., & Agliardi, R. (2019). Financing environmentally-sustainable projects with green bonds. *Environment and Development Economics*, *24*(6), 608–623.

Aidar, G., & Braga, J. (2020). Country-risk premium in the periphery and the international financial cycle 1999-2019. *Investigación Económica*, *79*(313), 78–111.

Alesina, A., Devleeschauwer, A., Easterly, W., Kurlat, S., & Wacziarg, R. (2003). Fractionalization. *Journal of Economic Growth*, *8*(2), 155–194.

Alsagr, N., Cumming, D. J., Davis, J. G., & Sewaid, A. (2023). Geopolitical risk and crowdfunding performance. *Journal of International Financial Markets, Institutions and Money*, *85*, 101766. https://doi.org/10.1016/j.intfin.2023.101766

Altonji, J. G., Elder, T. E., & Taber, C. R. (2005). An evaluation of instrumental variable strategies for estimating the effects of catholic schooling. *Journal of Human Resources*, *40*(4), 791–821.

Andersen, T. J., (Ed.). (2023). *Responding to uncertain conditions: New research on strategic adaptation*. Emerald Publishing Limited.

Angrist, J. D., & Pischke, J.-S. (2009). *Mostly harmless econometrics: An Empiricist's companion*. Princeton University Press.

Anh Tu, C., Sarker, T., & Rasoulinezhad, E. (2020). Factors influencing the green bond market expansion: Evidence from a multi-dimensional analysis. *Journal of Risk and Financial Management*, *13*(6), 126.

Arellano, M., & Bover, O. (1995). Another look at the instrumental variable estimation of error-components models. *Journal of Econometrics*, *68*(1), 29–51.

Åström, J., Karlsson, M., Linde, J., & Pirannejad, A. (2012). Understanding the rise of e-participation in non-democracies: Domestic and international factors. *Government Information Quarterly*, *29*, 142–150.

Azen, R., & Budescu, D. V. (2006). Comparing predictors in multivariate regression models: An extension of dominance analysis. *Journal of Educational and Behavioral Statistics*, *31*(2), 157–180.

Azhgaliyeva, D., Kapoor, A., & Liu, Y. (2020). Green bonds for financing renewable energy and energy efficiency in South-East Asia: A review of policies. *Journal of Sustainable Finance & Investment*, *10*(2), 113–140.

Bachelet, M. J., Becchetti, L., & Manfredonia, S. (2019). The green bonds premium puzzle: The role of issuer characteristics and third-party verification. *Sustainability*, *11*(4), 1098.

Baldacci, B., & Possamaï, D. (2022). Governmental incentives for green bonds investment. *Mathematics and Financial Economics*, *16*(3), 539–585.

Ballouk, H., Mefteh-Wali, S., Tabbah, G., & Ben Jabeur, S. (2023). Institutional investors and public authority ownership impact on green bonds issue: Evidence from France. *Journal of Innovation Economics & Management*, *41*, 51–73. https://doi.org/10.3917/jie.pr1.0130

Banga, J. (2019). The green bond market: A potential source of climate finance for developing countries. *Journal of Sustainable Finance & Investment*, *9*(1), 17–32.

Barua, S., & Chiesa, M. (2019). Sustainable financing practices through green bonds: What affects the funding size? *Business Strategy and the Environment*, *28*(6), 1131–1147.

Bastida, F., Guillamón, M. D., & Benito, B. (2017). Fiscal transparency and the cost of sovereign debt. *International Review of Administrative Sciences*, *83*(1), 106–128.

Baulkaran, V. (2019). Stock market reaction to green bond issuance. *Journal of Asset Management*, *20*(5), 331–340.

Benito, B., Guillamón, M. D., & Bastida, F. (2016). The impact of transparency on the cost of sovereign debt in times of economic crisis. *Financial Accountability & Management*, *32*(3), 309–334.

Bernoth, K., Von Hagen, J., & Schuknecht, L. (2012). Sovereign risk premiums in the European government bond market. *Journal of International Money and Finance*, *31*(5), 975–995.

Bhatia, S. (2019). Predicting risk perception: New insights from data science. *Management Science*, *65*(8), 3800–3823.

Bhutta, U. S., Tariq, A., Farrukh, M., Raza, A., & Iqbal, M. K. (2022). Green bonds for sustainable development: Review of literature on development and impact of green bonds. *Technological Forecasting and Social Change*, *175*, 121378.

Black, S., & Munro, A. (2010). *Why issue bonds offshore? Bank of international settlements* (BIS Working Paper No. 334). https://www.bis.org/publ/work334.pdf

Le Blanc, D. (2020). *E-participation: A quick overview of recent qualitative trends* (DESA Working Paper No. 163).

Bosman, P., & de Mariz, F. (2023). The blue bond market: A catalyst for ocean and water financing. *Journal of Risk & Financial Management*, *16*(3), 184. https://doi.org/10.3390/jrfm16030184

Botetzagias, I., & van Schuur, W. (2012). Active greens: An analysis of the determinants of green party members' activism in environmental movements. *Environment and Behavior*, *44*(4), 509–544.

Bowman, M., & Minas, S. (2019). Resilience through interlinkage: The green climate fund and climate finance governance. *Climate Policy*, *19*(3), 342–353.

Brei, M., Ferri, G., & Gambacorta, L. (2018). *Financial structure and income inequality* (BIS Working Paper No. 756), Bank of International Settlements.

Brogaard, J., Dai, L., Ngo, P. T. H., & Zhang, B. (2020). Global political uncertainty and asset prices. *The Review of Financial Studies*, *33*(4), 1737–1780.

Caldara, D., & Iacoviello, M. (2022). Measuring geopolitical risk. *American Economic Review*, *112*(4), 1194–1225.

Campello, M. (2003). Capital structure and product markets interactions: Evidence from business cycles. *Journal of Financial Economics*, *68*, 353–378.

Capelle-Blancard, G., Crifo, P., Diaye, M. A., Oueghlissi, R., & Scholtens, B. (2019). Sovereign bond yield spreads and sustainability: An empirical analysis of OECD countries. *Journal of Banking & Finance*, *98*, 156–169.

Caramichael, J., & Rapp, A. C. (2022). The green corporate bond issuance premium (International Finance Discussion Paper 1346). https://doi.org/10.17016/ifdp.2022.1346

Carney, M. (2016). *Uncertainty, the economy and policy*. Bank of England.

Catalán, M., Natalucci, F., Qureshi, M. S., & Tsuruga, T. (2023). Geopolitics and fragmentation emerge as serious financial stability threats. *IMF Blog*. https://www.imf.org/en/Blogs/Articles/2023/04/05/geopolitics-and-fragmentation

Cheong, C., & Choi, J. (2020). Green bonds: A survey. *Journal of Derivatives and Quantitative Studies:* 선물연구, *28*(4), 175–189.

Climate Bonds Initiative. (2021). Sustainable Debt Summary Q3 2021. Climate Bonds Initiative. Retrieved November 2, 2021, from Climate Bonds Initiative website.

Criekemans, D. (2018). *Geopolitics of the renewable energy game and its potential effect upon global power relations*, 37–73. Springer International Publishing.

Dalby, S. (2015). Climate geopolitics: Securing the global economy. *International Politics*, *52*, 426–444.

Damodaran, A. (2022). Country risk: Determinants, measures, and implications. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.4161010

Dan, A., & Tiron-Tudor, A. (2021). The determinants of green bond issuance in the European Union. *Journal of Risk and Financial Management*, *14*(9), 446.

Das, D., Kannadhasan, M., & Bhattacharyya, M. (2019). Do the emerging stock markets react to international economic policy uncertainty, geopolitical risk, and financial stress alike? *The North American Journal of Economics and Finance*, *48*, 1–19.

Daubanes, J. X., Mitali, S. F., & Rochet, J. C. (2021). *Why do firms issue green bonds?* (Swiss Finance Institute Research Paper 21–97).

Dell'Atti, S., Di Tommaso, C., & Pacelli, V. (2022). Sovereign green bond and country value and risk: Evidence from European Union countries. *Journal of International Financial Management & Accounting*, *33*(3), 505–521.

Deschryver, P., & De Mariz, F. (2020). What future for the green bond market? How can policymakers, companies, and investors unlock the potential of the green bond market? *Journal of Risk and Financial Management*, *13*(3), 61. https://doi.org/10.3390/jrfm13030061

Dong, X., Xiong, Y., Nie, S., & Yoon, S. M. (2023). Can bonds hedge stock market risks? Green bonds vs conventional bonds. *Finance Research Letters*, *52*, 103367.

Doğan, B., Trabelsi, N., Tiwari, A. K., & Ghosh, S. (2023). Dynamic dependence and causality between crude oil, green bonds, commodities, geopolitical risks, and policy uncertainty. *The Quarterly Review of Economics and Finance*, *89*, 36–62.

Dutta, A., Jana, R. K., & Das, D. (2020). Do green investments react to oil price shocks? Implications for sustainable development. *Journal of Cleaner Production*, *266*, 121956.

Ehlers, T., & Packer, F. (2017). Green bond finance and certification. *BIS Quarterly Review*.

Falcone, P. M. (2020). Environmental regulation and green investments: The role of green finance. *International Journal of Green Economics*, *14*(2), 159–173.

Feng, C., Han, L., Vigne, S., & Xu, Y. (2023). Geopolitical risk and the dynamics of international capital flows. *Journal of International Financial Markets, Institutions and Money*, *82*, 101693.

Ferrer, R., Shahzad, S. J. H., & Soriano, P. (2021). Are green bonds a different asset class? Evidence from time-frequency connectedness analysis. *Journal of Cleaner Production*, *292*, 125988.

Flammer, C. (2021). Corporate green bonds. *Journal of Financial Economics*, *142*(2), 499–516. https://doi.org/10.1016/j.jfineco.2021.01.010

Gao, Y., Li, Y., & Wang, Y. (2021). Risk spillover and network connectedness analysis of China's green bond and financial markets: Evidence from financial events of 2015-2020. *The North American Journal of Economics and Finance*, *57*, 101386.

Ghitti, M., Gianfrate, G., Lopez-de-Silanes, F., & Spinelli, M. (2023). What's in a shade? The market relevance of green bonds' external reviews. *The British Accounting Review*, 101271. https://doi.org/10.1016/j.bar.2023.101271

Gong, C., Gong, N., Qi, R., & Yu, S. (2020). Assessment of natural gas supply security in Asia Pacific: Composite indicators with compromise benefit-of-the-doubt weights. *Resources Policy*, *67*, 101671.

Good, A. (2021). Utilities, power providers poised to tap sustainable financing market in 2022. S&P Global Market Intelligence. Retrieved December 30, 2021, from https://www.spglobal.com/marketintelligence/en/news-insights/latest-news-headlines/utilities-power-providers-poised-to-tap-sustainable-financing-market-in-2022-67639660

Green, D. (2018). Corporate refinancing, covenants, and the agency cost of debt. Covenants, and the Agency Cost of Debt. Harvard Business School.

Greene, W. H. (2012). *Econometric analysis* (7th ed.). Pearson.

Guo, D., & Zhou, P. (2021). Green bonds as hedging assets before and after COVID: A comparative study between the US and China. *Energy Economics*, *104*, 105696.

Gyura, G. (2020). Green bonds and green bond funds: The quest for the real impact. *The Journal of Alternative Investments*, *23*(1), 71–79.

Hachenberg, B., & Schiereck, D. (2018). Are green bonds priced differently from conventional bonds? *Journal of Asset Management*, *19*, 371–383.

Hafner, S., Jones, A., Anger-Kraavi, A., & Pohl, J. (2020). Closing the green finance gap–Asystems perspective. *Environmental Innovation and Societal Transitions*, *34*, 26–60.

Hailemariam, A., Smyth, R., & Zhang, X. (2019). Oil prices and economic policy uncertainty: Evidence from a nonparametric panel data model. *Energy Economics*, *83*, 40–51.

Hamman, E. (2016). The influence of environmental NGOs on project finance: A case study of activism, development, and Australia's Great Barrier Reef. *Journal of Sustainable Finance & Investment*, *6*(1), 51–66.

He, Z. (2023). Geopolitical risks and investor sentiment: Causality and TVP-VAR analysis. *The North American Journal of Economics and Finance*, *67*, 101947.

Hofstede, G. (2001). *Culture's consequences—Second Edition: Comparing values, behaviors, institutions, and organizations across nations*. Sage.

Iyke, B. N., Phan, D. H. B., & Narayan, P. K. (2022). Exchange rate return predictability in times of geopolitical risk. *International Review of Financial Analysis*, *81*, 102099.

Jernnäs, M., & Linnér, B. O. (2019). A discursive cartography of nationally determined contributions to the Paris climate agreement. *Global Environmental Change*, *55*, 73–83.

Jia, J., & Li, Z. (2020). Does external uncertainty matter in corporate sustainability performance? *Journal of Corporate Finance*, *65*, 101743.

Khan, K., Khurshid, A., & Cifuentes-Faura, J. (2023). Investigating the relationship between geopolitical risks and economic security: Empirical evidence from central and Eastern European countries. *Resources Policy*, *85*, 103872.

Lee, C. C., Lee, C. C., & Li, Y. Y. (2021). Oil price shocks, geopolitical risks, and green bond market dynamics. *The North American Journal of Economics and Finance*, *55*, 101309.

Leonard, M., Pisani-Ferry, J., Shapiro, J., Tagliapietra, S., & Wolff, G. B. (2021). The geopolitics of the European green deal (No. 04/2021). Bruegel Policy Contribution.

Li, H., Li, Q., Huang, X., & Guo, L. (2023). Do green bonds and economic policy uncertainty matter for carbon price? New insights from a TVP-VAR framework. *International Review of Financial Analysis*, *86*, 102502. https://doi.org/10.1016/j.irfa.2023.102502

Li, L., & Cheng, X. (2023). Do geopolitical risks increase corporate risk-taking? Based on the perspective of diversification expansion. *Corporate Governance: An International Review*. https://doi.org/10.1111/corg.12538

Li, Z. (2023). Do geopolitical risk, green finance, and the rule of law affect the sustainable environment in China? Findings from the BARDL approach. *Resources Policy*, *81*, 103403.

Li, Z., Tang, Y., Wu, J., Zhang, J., & Lv, Q. (2020). The interest costs of green bonds: Credit ratings, corporate social responsibility, and certification. *Emerging Markets Finance and Trade*, *56*(12), 2679–2692.

Lichtenberger, A., Braga, J. P., & Semmler, W. (2022). Green bonds for the transition to a low-carbon economy. *Econometrics*, *10*(1), 11. https://doi.org/10.3390/econometrics10010011

Liu, J., Ma, F., Tang, Y., & Zhang, Y. (2019). Geopolitical risk and oil volatility: A new insight. *Energy Economics*, *84*, 104548.

Liu, S., Qi, H., & Wan, Y. (2022). Driving factors behind the development of China's green bond market. *Journal of Cleaner Production*, *354*, 131705.

Luchman, J. N. (2021). Determining relative importance in Stata using dominance analysis: domin and domme. *The Stata Journal*, *21*(2), 510–538.

Löffler, K. U., Petreski, A., & Stephan, A. (2021). Drivers of green bond issuance and new evidence on the "greenium". *Eurasian Economic Review*, *11*, 1–24.

MacAskill, S., Roca, E., Liu, B., Stewart, R. A., & Sahin, O. (2021). Is there a green premium in the green bond market? Systematic literature review revealing premium determinants. *Journal of Cleaner Production*, *280*, 124491.

Maltais, A., & Nykvist, B. (2020). Understanding the role of green bonds in advancing sustainability. *Journal of Sustainable Finance & Investment*, 1–20. https://doi.org/10.1080/20430795.2020.1724864

de Mariz, F., & Ferreira Savoia, J. R. (2018). Financial innovation with a social purpose: The growth of social impact bonds. In S. Boubaker, D. Cumming, & D. K. Nguyen (Eds.), *Research handbook of investing in the triple bottom line, Ch. 13*. Edward Elgar. https://doi.org/10.4337/9781788110006.00021

Mazarr, M. J. (2012). The risks of ignoring strategic insolvency. *The Washington Quarterly*, *35*(4), 7–22.

Mensi, W., Hammoudeh, S., Yoon, S. M., & Nguyen, D. K. (2016). Asymmetric linkages between BRICS stock returns and country risk ratings: Evidence from dynamic panel threshold models. *Review of International Economics*, *24*(1), 1–19.

Mertzanis, C., & Tebourbi, I. (2023). National culture and green bond issuance around the world. *European Financial Management*, *30*, 879–934.

Mitsas, S., Golitsis, P., & Khudoykulov, K. (2022). Investigating the impact of geopolitical risks on the commodity futures. *Cogent Economics & Finance*, *10*(1), 2049477.

Mizen, P., & Tsoukas, S. (2014). What promotes greater use of the corporate bond market? A study of the issuance behaviour of firms in Asia. *Oxford Economic Papers*, *66*(1), 227–253.

Naeem, M. A., Farid, S., Ferrer, R., & Shahzad, S. J. H. (2021). Comparative efficiency of green and conventional bonds pre- and during COVID-19: An asymmetric multifractal detrended fluctuation analysis. *Energy Policy*, *153*, 112285.

Nanayakkara, M., & Colombage, S. (2019). Do investors in green bond market pay a premium? Global evidence. *Applied Economics*, *51*(40), 4425–4437.

Nguyen, H. T., & Örsal, D. K. (2023). Geopolitical risks and financial stress in emerging economies. *The World Economy*, *47*, 217–237. https://doi.org/10.1111/twec.13529

Nguyen, T. T. H., Naeem, M. A., Balli, F., Balli, H. O., & Vo, X. V. (2021). Time-frequency comovement among green bonds, stocks, commodities, clean energy, and conventional bonds. *Finance Research Letters*, *40*, 101739.

Nickel, C., Rother, P., & Ruelke, J.-C. (2011). Fiscal variables and bond spreads: Evidence from Eastern European countries and Turkey. *Applied Financial Economics*, *21*, 1291–1307.

Oster, E. (2019). Unobservable selection and coefficient stability: Theory and evidence. *Journal of Business & Economic Statistics*, *37*(2), 187–204.

Ottonello, G., Rizzo, A. E., & Zambrana, R. (2022). *Bank trading networks and access to the corporate bond market*. https://ssrn.com/abstract=4287217

Partridge, C., & Medda, F. R. (2020). Green bond pricing: The search for greenium. *The Journal of Alternative Investments*, *23*(1), 49–56.

Pastor, L., Stambaugh, R. F., & Taylor, L. A. (2021). Sustainable investing in equilibrium. *Journal of Financial Economics*, *142*, 550–571.

Peszko, G., van der Mensbrugghe, D., Golub, A., Ward, J., Zenghelis, D., Marijs, C., Schopp, A., & Rogers, J. A. (2020). *Preparedness for a low-carbon transition*. World Bank. https://doi.org/10.1596/978-1-4648-1340-5_ch5

Pham, L. (2016). Is it risky to go green? A volatility analysis of the green bond market. *Journal of Sustainable Finance & Investment*, *6*(4), 263–291.

Prajapati, D., Paul, D., Malik, S., & K. Mishra, D. (2021). Understanding the preference of individual retail investors on green bond in India: An empirical study. *Investment Management and Financial Innovations*, *18*, 177–189.

Prakash, N., & Sethi, M. (2021). Green bonds driving sustainable transition in Asian economies: The case of India. *The Journal of Asian Finance, Economics and Business*, *8*(1), 723–732.

Presbitero, A. F., Ghura, D., Adedeji, O. S., & Njie, L. (2016). Sovereign bonds in developing countries: Drivers of issuance and spreads. *Review of Development Finance*, *6*(1), 1–15.

Rahman, M., Isa, C. R., Dewandaru, G., Hanifa, M. H., Chowdhury, N. T., & Sarker, M. (2020). Socially responsible investment sukuk (Islamic bond) development in Malaysia. *Qualitative Research in Financial Markets*, *12*(4), 599–619.

Ramady, M. A. (2014). *Political, economic, and financial country risk: Analysis of the Gulf*. Springer.

Rasoulinezhad, E., Taghizadeh-Hesary, F., Sung, J., & Panthamit, N. (2020). Geopolitical risk and energy transition in Russia: Evidence from ARDL bounds testing method. *Sustainability*, *12*(7), 2689.

Reboredo, J. C., Rivera-Castro, M. A., & Ugolini, A. (2017). Wavelet-based test of comovement and causality between oil and renewable energy stock prices. *Energy Economics*, *61*, 241–252.

Reboredo, J. C., Ugolini, A., & Aiube, F. A. L. (2020). Network connectedness of green bonds and asset classes. *Energy Economics*, *86*, 104629.

Redondo Alamillos, R., & de Mariz, F. (2022). How can European regulation on ESG impact business globally? *Journal of Risk and Financial Management*, *15*(7), 291.

Reisel, N. (2014). On the value of restrictive covenants: Empirical investigation of public bond issues. *Journal of Corporate Finance*, *27*, 251–268.

Roodman, D. (2011). Fitting fully observed recursive mixed-process models with cmp. *The Stata Journal: Promoting communications on statistics and Stata*, *11*(2), 159–206.

Rumokoy, L. J., Omura, A., & Roca, E. (2023). Geopolitical risk and corporate investment in the metals and mining industry: Evidence from Australia. *Pacific-Basin Finance Journal*, *79*, 101991.

Rusike, T. G., & Alagidede, I. P. (2021). The impact of sovereign credit ratings on Eurobond yields: Evidence from Africa. *Research in International Business and Finance*, *58*, 101475.

Sangiorgi, I., & Schopohl, L. (2023). Explaining green bond issuance using survey evidence: Beyond the greenium. *The British Accounting Review*, *55*(1), 101071, https://doi.org/10.1016/j.bar.2021.101071

Sangiorgi, I., & Schopohl, L. (2021). Why do institutional investors buy green bonds: Evidence from a survey of European asset managers. *International Review of Financial Analysis*, *75*, 101738. https://doi.org/10.1016/j.irfa.2021.101738

Saravade, V., Chen, X., Weber, O., & Song, X. (2022). Effect of regulatory policies on green bond issuances in China: Policy lessons from a top-down approach. *Climate Policy*, *23*, 96–107. https://doi.org/10.1080/14693062.2022.2037337

Schaltenbrand, B., Foerstl, K., Azadegan, A., & Lindeman, K. (2018). See what we want to see? The effects of managerial experience on corporate green investments. *Journal of Business Ethics*, *150*, 1129–1150.

Sharma, P., Leung, T. Y., Kingshott, R. P. J., Davcik, N. S., & Cardinali, S. (2020). Managing uncertainty during a global pandemic: An international business perspective. *Journal of Business Research*, *116*, 188–192.

Sheng, Q., Zheng, X., & Zhong, N. (2021). Financing for sustainability: Empirical analysis of green bond premium and issuer heterogeneity. *Natural Hazards*, *107*(3), 2641–2651.

Siani, K. (2019). *Global demand spillovers: When the Central Bank Buys Corporate Bonds*. https://ssrn.com/abstract=3508937

Siegfried, N., Simeonova, E., & Vespro, C. (2007). *Choice of currency in bond issuance and the international role of currencies* (Working Paper Series No. 814). European Central Bank.

Sinha, A., Mishra, S., Sharif, A., & Yarovaya, L. (2021). Does green financing help to improve environmental & social responsibility? Designing SDG framework through advanced quantile modelling. *Journal of Environmental Management*, *292*, 112751.

Sohag, K., Hammoudeh, S., Elsayed, A. H., Mariev, O., & Safonova, Y. (2022). Do geopolitical events transmit opportunity or threat to green markets? Decomposed measures of geopolitical risks. *Energy Economics*, *111*, 106068.

Su, C. W., Khan, K., Tao, R., & Nicoleta-Claudia, M. (2019). Does geopolitical risk strengthen or depress oil prices and financial liquidity? Evidence from Saudi Arabia. *Energy*, *187*, 116003.

Su, T., Zhang, Z., & Lin, B. (2022). Green bonds and conventional financial markets in China: A tale of three transmission modes. *Energy Economics*, *113*, 106200.

Tan, X., Dong, H., Liu, Y., Su, X., & Li, Z. (2022). Green bonds and corporate performance: A potential way to achieve green recovery. *Renewable Energy*, *200*, 59–68.

Tang, D. Y., & Zhang, Y. (2020). Do shareholders benefit from green bonds? *Journal of Corporate Finance*, *61*, 101427.

Tang, Y., Chen, X. H., Sarker, P. K., & Baroudi, S. (2023). Asymmetric effects of geopolitical risks and uncertainties on green bond markets. *Technological Forecasting and Social Change*, *189*, 122348.

Tendulkar, R., & Hancock, G. (2014). Corporate bond markets: A global perspective (Staff working paper series SWP4/2014). International Organization of Securities Commissions Research Department, IOSCO.

The European Parliament (EP). (2015). Towards a revision of the European Citizens' initiative? Study for the PETI Committee, Directorate-General for Internal Policies, Citizens' rights, and constitutional affairs, European Union, Brussels.

The International Capital Markets Association (ICMA). (2017). *Green bond principles* https://www.icmagroup.org/assets/documents/Regulatory/Green-Bonds/GreenBondsBrochure-JUNE2017.pdf

The Organization of Economic Cooperation and Development (OECD). (2020). Green bonds: Mobilizing the debt capital markets for a low-carbon transition. OECD.

Tian, H., Long, S., & Li, Z. (2022). Asymmetric effects of climate policy uncertainty, infectious diseases-related uncertainty, crude oil volatility, and geopolitical risks on green bond prices. *Finance Research Letters*, *48*, 103008.

Tolliver, C., Keeley, A. R., & Managi, S. (2019). Green bonds for the Paris agreement and sustainable development goals. *Environmental Research Letters*, *14*(6), 064009.

Tolliver, C., Keeley, A. R., & Managi, S. (2020). Drivers of green bond market growth: The importance of nationally determined contributions to the Paris agreement and implications for sustainability. *Journal of Cleaner Production*, *244*, 118643.

Tsonkova, V. D. (2019). The sovereign Green bonds market in the European Union: Analysis and good practices. *KNOWLEDGE-International Journal*, *30*(1), 165–172.

Wang, E. K. (2017). Financing green: Reforming green bond regulation in the United States. *Brooklyn Journal of Corporate, Financial & Commercial Law*, *12*, 467. https://brooklynworks.brooklaw.edu/bjcfcl/vol12/iss2/9

Wang, J., Chen, X., Li, X., Yu, J., & Zhong, R. (2020). The market reaction to green bond issuance: Evidence from China. *Pacific-Basin Finance Journal*, *60*, 101294.

Wang, K. H., Kan, J. M., Jiang, C. F., & Su, C. W. (2022). Is geopolitical risk powerful enough to affect carbon dioxide emissions? Evidence from China. *Sustainability*, *14*(13), 7867.

Wang, K. H., Su, C. W., & Umar, M. (2021). Geopolitical risk and crude oil security: A Chinese perspective. *Energy*, *219*, 119555.

Wang, Y., Liu, C., & Wang, G. (2020). Geopolitical risk revealed in international investment and world trade. *Risk Management*, *22*, 133–154.

Weber, O., & Saravade, V. (2019). *Green bonds: Current development and their future* (CIGI Paper No 210). Center for International Governance and Innovation.

Wooldridge, J. M. (2010). *Econometric analysis of cross section and panel data*. MIT press.

Xu, Y., Li, S., Zhou, X., Shahzad, U., & Zhao, X. (2022). How environmental regulations affect the development of green finance: Recent evidence from polluting firms in China. *Renewable Energy*, *189*, 917–926.

Yilanci, V., & Kilci, E. N. (2021). The role of economic policy uncertainty and geopolitical risk in predicting prices of precious metals: Evidence from a time-varying bootstrap causality test. *Resources Policy*, *72*, 102039.

Zeng, S., Hu, J., Gu, F., & Carlos, L. A. (2023). Financial information, green certification, government subsidies and green bond credit spreads: Evidence from China. *International Entrepreneurship and Management Journal*, *19*(1), 321–341.

Zhang, R., Li, Y., & Liu, Y. (2021). Green bond issuance and corporate cost of capital. *Pacific-Basin Finance Journal*, *69*, 101626. https://doi.org/10.1016/j.pacfin.2021.101626

How to cite this article: Mertzanis, C., & Tebourbi, I. (2024). Geopolitical risk and global green bond market growth. *European Financial Management*, 1–46. https://doi.org/10.1111/eufm.12484