Demand for Green

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Abstract

We investigate whether the unique greenness characteristics of green bonds (GB), i.e., their commitment to allocate proceeds specifically to environmentally sustainable initiatives and regularly report their progress, are associated with cross-sectional variations in demand for corporate bonds. We leverage unique orderbook data of investment-grade fixed-coupon corporate bonds issued globally from 2013 to 2022 and find that GB attract, on average, about 12% to 15% higher demand multiples (with a median monetary value of $80-100 million) than comparable non-GB. These results are robust across multiple matching approaches. More importantly, we document substantial heterogeneity in demand and explain the credibility of this greenness signal depends on the regulatory environment. The higher relative demand exists only in markets with stringent sustainable finance regulations, such as the EU, compared to the US or other markets. Further, our results show that the issuers' ex-ante greenness profile, i.e., better environmental performance (lower CO_2), higher investments in green innovations, and lower ESG risk incidents, drives the heterogeneity in the demand for GB. Overall, our findings provide new evidence on investor demand in GB markets and highlight how issuer characteristics and institutional environments shape primary market outcomes.

JEL classifications: G14, G18, G32, M14, Q56

Keywords: Green Bonds, Green Characteristics, Investor Demand, Green Bond Demand Heterogeneity, Green Profile, Regulations.

1 Introduction

Green and sustainable financing is at the forefront of addressing environmental concerns (Pástor *et al.* 2022). The market for green bonds (GB), a debt instrument whose proceeds are used in eligible green projects, such as renewable energy, green transport, decarbonization practices, and clean water (ICMA 2018; Baker *et al.* 2022), has grown rapidly.[1] These bonds represent a financial innovation designed to help achieve the United Nations' (UN) Sustainable Development Goals (SDGs) (Climate Bonds Initiative 2019).[2]

In addition to the standard features of non-green bonds (non-GB), GB have unique 'greenness' characteristics, such as a commitment to invest in climate and environmentally friendly projects and a higher level of greenness-related transparency in the pre- and post-issuance phases. Such green characteristics make them desirable for a wide range of investors, including institutional, retail, high-net-worth, and ecologically and socially conscious investors. Given the relative importance of the unique green features of issuing GB in addressing climate change and other environmental concerns, we empirically answer the following two questions. First, do the unique greenness characteristics of GB explain the variations in the demand for corporate bond issuance, i.e., GB versus non-GB? Second, what are the potential firm-level drivers of the cross-sectional variation in the relative demand among GB issuances?

Understanding investor demand for GB in the primary market matters beyond the pricing implications. First, primary market demand directly determines the ease with which firms can raise capital for green projects, and the scale of offerings issuers can successfully place. Second, demand and pricing can diverge: strong orderbook demand does not always translate into yield premiums (greenium) when issuers face supply constraints or choose not to fully capture excess demand through pricing (Bessembinder *et al.* 2022; Siani 2025; Wang & Wu 2026).[3] While a contemporary work by Wang and Wu (2026) examines the role of investor demand in explaining pricing outcomes in GB markets, our focus is on the cross-sectional

[1] See https://www.icmagroup.org/sustainable-finance/the-principles-guidelines-and-handbooks/green-bond-principles-gbp/

[2] see https://www.climatebonds.net/files/reports/green-bonds_a-bridge-to-the-sdgs_062018.pdf

[3] Greenium is the yield difference between GB and non-GB, reflecting a premium for green assets (Tang & Zhang 2020; Pástor *et al.* 2022).

variation in demand itself. In particular, we study how investor demand differs across issuers, institutional environments, and time, providing new evidence on the conditions under which GB attract stronger demand. Recognizing demand heterogeneity thus enables issuers to structure more appealing GB offerings and helps explain inconsistent pricing evidence in the literature.

We draw on the signaling framework of information asymmetry (IA) to formulate our hypotheses. Relative to non-GB, we argue that GB issuers face lower IA frictions due to two unique features mandated by voluntary industry principles (ICMA 2018, 2021). First, GB issuers must disclose the specific use of proceeds in explicitly stated environmentally friendly projects in their prospectus, reducing adverse selection risk at the pre-subscription stage. In contrast, investors in non-GB typically remain unaware of specific fund usage (Park & Patel 2015). Second, post-issuance reporting requires credible third-party verification of the project's environmental impact, reducing moral hazard in the post-subscription stage. The ex-ante transparency and ex-post accountability commitments lower IA frictions that should attract both *values-based* investors (who seek non-pecuniary ESG impact) and *value* investors (who incorporate ESG factors to optimize risk-return profiles).[4] We test the hypothesis that the unique greenness characteristics of GB lead to higher demand than non-GB when issued by similar firms.

Having established our first hypothesis, we further examine what drives variation in demand *among* GB issuances. Expanding on the signalling framework, we argue that the information about issers' ex-ante environmental performance and ESG risk profiles serve as a credibility-enhancement mechanism that explains cross-sectional differences in investors' demand within GB issuance. First, we suggest that GB issued by firms with higher levels of greenness (i.e., better environmental performance, including lower CO_2 emissions and greening investment strategies) should attract greater demand. Second, the demand for GB may be

[4] *Value* investors include environmental, social, and governance (ESG) factors in their investment decisions to optimize their portfolio's financial risk-return profile with no intention of having any ESG-related impact (Starks 2023). The objective of the ESG inclusion criteria is to enhance return and/or manage risk. Conversely, *values-based* investors, also known as socially responsible investors (SRI), incorporate ESG dimensions into their investment decisions to have a real ESG impact, even at the expense of some financial returns (Edmans *et al.* 2022; Starks 2023).

influenced by the desire to invest in firms with potentially lower ESG risk,[5] as evidence suggests that firms with better environmental risk management practices are associated with a lower cost of equity and lower yield spreads on corporate bonds (Ramelli *et al.* 2021). We posit that issuers with a history of lower ESG risk will likely experience greater demand for GB issuance.

We test our hypotheses using a new comprehensive bond issuance dataset compiled and maintained by Informa Global Markets (IGM), including information on the orderbook and issue size collected by daily worldwide surveys on investment-grade fixed-coupon corporate bonds. While recent studies have also employed primary market data (Caramichael & Rapp 2024; Wang & Wu 2026), our IGM-sourced dataset offers one of the largest and most geographically diverse samples of GB issuances in the literature. We define orderbook size as the sum of the monetary value of orders (demand) submitted by investors to bookrunners around the issuance time. We also collect other bond characteristics, such as issue date, coupon rate, ratings, currency of issue, maturity, green and non-green label, bond type, issuer type, issuer, and country. In addition, for a firm that issues GB in a particular year, we identify a matched firm in the same country and industry that has not yet issued GB. Our final sample includes 451 GB and 1,641 non-GB issued by 419 firms over the period 2013-2022.[6]

In a multivariate setting, our analysis shows a 0.35 to 0.44 times higher demand multiple for GB than its matched non-GB counterparts, corresponding to around 12% to 15% of the average non-GB demand. For a median $675 million bond issue, additional demand is $80-100 million investor subscriptions for GB relative to an otherwise comparable non-GB. These effects are economically significant and stable across a range of identification strategies, suggesting that differences in investor demand between GB and non-GB are both systematic and persistent. Importantly, the richness of our data allows us to move beyond average effects and document substantial cross-sectional variation in demand across issuers, and markets.

[5] Most GB issuers release one report detailing the use of the proceeds and its impact (GHG reduction or energy savings) approximately a year after issuance. If the usage of the proceeds and/or its impact significantly changes, further and regular updates are made available (for reporting details see Section 2.3 of ICMA (2024)). For example, firms such as Apple, ABN AMRO, and ANZ update their reports regularly following ICMA guidelines. For Apple's report, see the 2023 report, for the ABN, see the ESG bonds page, and for ANZ see the Sustainability bonds page.

[6] Zerbib (2019) use 110 GB, Tang and Zhang (2020) use 132 GB and Flammer (2021) uses 152 GB issued by 65 unique issuers.

Importantly, we find that the effectiveness of this greenness signal depends on the regulatory environment. When comparing markets with stringent sustainable finance regulatory regimes, such as the European Union (EU), to those with voluntary frameworks, such as the United States (US) and the rest of the world, we find that the heightened demand for GB exists only in the EU. Our finding suggests that the credibility of the greenness signal is enhanced in regulatory environments that mandate disclosure, standardize definitions of "green," and penalize greenwashing. In such environments, investors can trust that the green label is meaningful, making them more willing to reward GB with higher demand. Since investing in GB remains voluntary for investors, the regulatory framework does not force demand; rather, it unlocks latent demand for credible green assets.

A battery of further robustness checks supports the main results. First, we find consistency in the higher demand for GB relative to matched non-GB, issued by non-financial firms to finance their green projects and by financial firms to finance their clients' green projects. Second, as an alternative matching strategy, we perform a bond-level matching whereby we match the GB with non-GB issued by the same firm within the last two years (alternatively, within the same industry) and share similar bond-level characteristics such as issue size, issue year, currency, rating, and maturity (Larcker & Watts 2020; Tang & Zhang 2020; Wang & Wu 2026). We find significantly greater demand for GB than for comparable non-GB. Fourth, we proceed with a non-parametric test. We randomly select 902 placebos (twice the number of GB in our sample) from the non-GB universe and run our baseline regressions 10,000 times. We find that demand for GB is significantly higher than for placebo non-GB 99.9% of the time, supporting our baseline results. Finally, we use the natural logarithm of the orderbook amount and the residual subscription as alternative measures of investor demand and find consistent results.

Consistent with our expectations, we find that the demand for GB issued by firms with lower CO_2 emissions (measured by CO_2 intensity), lower ESG risks (measured by the Reputation Risk Index (RRI)), and better greening strategies (proxied by the number of green patents) is significantly higher. Economically, a one-standard-deviation reduction in CO_2 and an equivalent improvement in RRI are associated with increases in the GB subscription

multiple of approximately 2.0 to 2.5 and 1.31 to 1.81, respectively. Further, a higher number of green patents is associated with a statistically discernible increase in GB's demand.

This study makes several contributions. We add to a scant body of research on GB's primary market offering (Larcker & Watts 2020; Bessembinder *et al.* 2022; Caramichael & Rapp 2024). GB research that focuses on secondary market pricing and stock returns provide mixed evidence due to differences in market structure and institutional context (Flammer 2020, 2021; Climate Bonds Initiative 2021a; Pástor *et al.* 2022).[7] We contribute by showing that GB attract substantially higher initial investor interest (0.35-0.44 times larger orderbooks), a demand signal that operates independently of and may help explain inconsistent pricing findings. Our finding complements Wang and Wu (2026) and Caramichael and Rapp (2024) highlighting the dynamic nature of GB pricing in the primary market. Strong demand may not always translate into yield premiums, when issuers face supply constraints in GB market, choose not to fully adjust pricing to clear excess demand or operate in sectors with concentrated GB issues (for example in industries with large volumes of green issuance) that cap pricing power.

More importantly, we extend Wang and Wu (2026) and Caramichael and Rapp (2024) by investigating the sources of heterogeneity in the investors demand. Specifically, we provide the first cross-market evidence that the GB demand premium is conditional on the regulatory environment and firm-level environmental drivers. We provide new evidence on how the GB demand varies across institutional environment. By documenting that higher GB demand exists only in markets with stringent sustainable regulations (EU) versus voluntary frameworks (US and rest of the world), we contribute to the emerging literature on how regulatory frameworks

[7] Zerbib (2019) reports a small but significant 'greenium' (approximately two basis points) in global secondary markets, based on a sample of corporate and financial bonds denominated in EUR and USD. Larcker and Watts (2020), by contrast, find no yield difference at issuance for US municipal bonds and argue that the lack of greenium was not due to supply/demand imbalances (issue size). These divergent findings stem from fundamental differences between the two markets. US municipal bonds offer tax-exempt status, which may crowd out any additional premium investors would be willing to pay for green attributes. Municipal bond investors are also predominantly retail and tax-motivated, whereas global corporate bond markets include a larger share of institutional investors with explicit ESG mandates. Furthermore, European markets have developed stronger regulatory frameworks around sustainable finance, potentially making green labels more salient to investors in Zerbib's (2019) sample. Caramichael and Rapp (2024), by contrast, find evidence of greenium only after 2019, attributable to demand pressures.

shape the credibility and effectiveness of corporate environmental commitments (Bolton & Kacperczyk 2021; Flammer 2021). This finding suggests that mandatory disclosure, standardized definitions of "green," and penalties for greenwashing enhance signal credibility and unlock latent investor demand for green assets.

Additionally, we offer new insights by identifying firm-specific greenness drivers that may explain cross-sectional variation in relative primary-market demand among GB issuances. We document that the bond issuer's past environmental performance (such as lower CO_2 emissions, ESG-relevant reputational risks, and strategies to invest in green innovations) explains greater demand for GB in the primary debt market. This finding addresses the additionality debate in green finance (Salakhova 2023; Lam & Wurgler 2024) by showing that investors look beyond the green label to assess the credibility of the issuer's overall environmental profile.

The remaining paper is organized as follows: Section Two formulates the testable hypotheses. Section Three explains the data and the empirical design. Section Four discusses the empirical results. Finally, we conclude the paper and offer implications in Section Five.

2 Theoretical framework and hypotheses development

We draw on information economics' signaling equilibrium framework to argue that, relative to non-GB issuance, the unique greenness characteristics of GB should attract a broader range of investors. These investors include both *value* and *values-based* investors and those who fall in between. Starks (2023) classifies ESG investors along a broad spectrum, with one end driven by *values-based* nonpecuniary preferences and the other by *value-based* pecuniary preferences. Nonpecuniary preferences may include addressing carbon footprint and other environmental concerns, mitigating animal cruelty, and eradicating child labor and poverty. Pecuniary preference implies that investors incorporate ESG factors solely to manage the risk-return profile of the investments. We use the signaling framework to offer insights into how GB's unique additional greenness features, compared to conventional non-GB, may appeal to *values* and *value-based* investors.

2.1 Theoretical framework: Signaling theory

Signaling theory is rooted in IA between two transacting parties (See Arrow 1963; Akerlof 1970; Ross 1973; Spence 1973; Rothschild & Stiglitz 1976; Holmström 1979; Stiglitz & Weiss 1981; Stiglitz 2002). Theoretical and empirical research acknowledge that IA exists between transacting parties in the primary security markets (Leland & Pyle 1977; Allen 1991; Dierkens 1991). Issuers possess superior information that determines the intrinsic value of their securities relative to outside investors. The prevalence of IA results in suboptimal economic outcomes for issuers and investors. The first non-optimal outcome for investors is the risk of adverse selection during the pre-transaction phase, i.e., the risk of selecting an overvalued security (Blouin 2003). The second concern is the possibility of moral hazard, the risk that issuers may misuse proceeds after issuance (Akerlof 1970; Ross 1973; Holmström 1979).

Accordingly, to address the friction of IA and separate themselves from others, quality issuers of securities disseminate credible dissipative signals to potential investors through their actions (Ross 1977). However, these signals must be sufficiently costly for competitors to imitate, as their purpose is to establish a separating equilibrium for the issuer from the pooled equilibrium of all types of issuers (Carter & Manaster 1990; Cohen & Dean 2005). To separate themselves, firms can use observable actions to convey private information about their quality and intentions to external parties.[8]

2.2 Signaling and greenness of bonds

In Figure 1, we argue that the pre-issuance information about the greenness of the projects and the post-issuance greenness progress reporting characteristics of GB impart unique, additional, and credible signals to potential bond investors about the purpose and use of the proceeds relative to issuing non-GB.

[Insert Figure 1 here]

[8] The literature notes various signaling actions, including changes in board composition, hiring more outside directors, dividend smoothing, underpricing, or third-party certifications (in case of securities issuance). These signals play a crucial role by providing otherwise unobservable information about the firm's transparency, financial competency, and socially responsible practices (King *et al.* 2005; Musteen *et al.* 2010; Montiel *et al.* 2012; Karpavičius 2014; Gomulya & Mishina 2016).

The GB principles of the ICMA (2018, 2021) note four unique characteristics of GB issues that convey greenness-specific information to investors. The first is related to the '*Use of Proceeds,*' where the issuer must provide specific (quantifiable, where feasible) information on the environmental benefits of green projects (examples include the expected magnitude of renewable energy generation, energy efficiency achieved, and reduced waste). Second, the GB issuer must communicate the '*Process for Project Evaluation and Selection*' to meet the specific environmental sustainability objectives. The project selection process needs justification and complementary information on perceived social and environmental risks. The '*Use of Proceeds'* and '*Process for Project Evaluation and Selection*' are not usually reported in the issuance of non-GB (Tang & Zhang 2020; Flammer 2021). These two unique greenness-related information components of GB issuance should significantly reduce the possibility of adverse selection concerns for GB investors more compared to non-GB investors.

The third unique component is '*Management of Proceeds*,' in which the issuer must establish a separate bank account to track GB proceeds used for promised environmental projects. The fourth component is '*Reporting*,' in which the issuer should report on the progress of the green projects and the specific, detailed use of GB proceeds. The guidelines state that this report should be updated and renewed annually with full details on projects and their impact. When possible, the impact reports should be certified by independent second-party verification. The '*Management of Proceeds'* and '*Reporting'* related unique post-issuance information of GB should significantly address the concerns of moral hazard (e.g., greenwashing) for investors. The detailed information on actual use of proceeds and fund allocation to different projects are reported in post-issuance periods (typically 12-24 months after issuance).

As a result, pre-issuance disclosure reduces adverse selection concerns by specifying how proceeds will be deployed, while the commitment to post-issuance reporting and verification addresses moral hazard concerns by creating ongoing accountability (ICMA 2018, 2021). Thus, the greenness signal does not resolve information asymmetry at a single point in time; rather, it attenuates information frictions through a combination of ex-ante transparency and ex-post accountability commitments that investors evaluate in aggregate when deciding to participate in the offering. Lu (2025) provides supporting evidence that GB issuance increases

post-issuance media scrutiny of environmental performance, creating a reputational bonding mechanism that enhances the credibility of the signal over time.

The effectiveness of these greenness signals also depends critically on the issuers' credibility. In markets with voluntary frameworks, issuers can self-label as "green" with limited verification, potentially weakening the signal's reliability. Conversely, regulatory environments that mandate disclosure, standardize definitions of "green," and impose verification requirements enhance signal credibility by reducing the risk of greenwashing. Thus, in equilibrium, GB issues provide greenness-specific and more credible signals to investors than non-GB issues.[9]

2.3 Hypothesis formulation: Demand by values and value-based investors

Having established that GB reduce IA through credible pre- and post-issuance signals, we now apply this framework to explain why both *values* and *value-based* investors should find GB attractive investments.

Values-based or socially responsible investments (SRI) have become critical since the 2006 UN PRI initiative (Edmans *et al.* 2022), with theoretical models demonstrating that green asset preferences can persist in equilibrium when investors derive nonpecuniary utility from sustainable holdings (Pástor *et al.* 2021). Evidence suggesting that the dual focus on non-pecuniary preferences and financial returns (Ioannou & Serafeim 2015) has catalyzed significant inflows into funds targeting firms with high ESG engagement (Pedersen *et al.* 2021).

The issuance of GB directly addresses SRI's preferences by mitigating concerns about adverse selection and potential moral hazard related to environmental impact objectives. Regarding adverse selection, studies argue that firms can attract *values-based* investors by aligning their greening strategies with SRI criteria through green and clean initiatives (Heinkel *et al.* 2001). As noted above, because the GB prospectus explicitly states how the proceeds will be used for defined green projects, SRI's potential concern about adverse investment selection in non-green projects is materially eliminated.

[9] We do not claim that GB markets achieve a fully separating equilibrium in which green signals perfectly distinguish high-quality issuers from other issuers. Rather, our reduced-form framework posits that pre- and post-issuance signals along with institutional features attenuate information frictions to varying degrees, generating cross-sectional and cross-market variation in demand that we can empirically examine.

The prospect of regular issuance of impact reports, generally certified by external agencies, in the post-issuance period should keep bond investors updated on the progress of the greenness of the pre-identified green projects. Such an update on progress on greenness should materially reduce the moral hazard concerns of *values-based* investors in GB. However, there are no provisions for disseminating progress-based information for non-GB.

While GB issuances have faced criticism regarding potential greenwashing (KPMG 2015; Shishlov *et al.* 2016), a sizeable body of dissenting empirical work documents positive post-issuance outcomes, including reduced CO_2 emissions and improved environmental scores (Flammer 2021; Zhang 2023), as well as enhanced country-level environmental quality and renewable energy production (Chang *et al.* 2022), thereby corroborating the lower potential for moral hazard in GB markets relative to non-green markets and explaining their appeal to *values-based* investors.[10]

Value-based investors are driven by higher financial returns and efficient risk management (Starks 2023). Prior evidence indicates that lower IA, which addresses the potential of adverse selections and moral hazard, is associated with favorable corporate outcomes, such as lower cost of capital (Diamond & Verrecchia 1991; Hughes *et al.* 2007; Lambert *et al.* 2012), lower issuance costs (Brugler *et al.* 2022), optimal dividend policy (Khang & King 2006), and enhanced liquidity in the primary and secondary markets (Welker 1995; Nikolova *et al.* 2020). This demonstrates that mitigating the friction of IA is associated with a better risk-return profile of the related asset.

Empirical evidence suggests that GB issuance offers several market and financially attractive signals. For example, equity investors exhibit a positive market reaction to the announcement of GB issuance (Tang & Zhang 2020; Daubanes *et al.* 2021; Flammer 2021). Event-study-based research indicates that, on average, the returns of GB issuing firms are more than 5% over a five-day window (Daubanes *et al.* 2021). Even for risk-adjusted returns, the overwhelming evidence shows that, on average, abnormal returns are positive, ranging from

[10] Another potential criticisms may be that GB may lack additionality when proceeds refinance existing projects (Lam & Wurgler 2024). However, the signaling mechanism operates through the transparency and accountability commitments embedded in GB frameworks, not solely through the novelty of funded projects. The enhanced disclosure requirements and reputational stakes associated with GB issuance create ongoing incentives to improve environmental performance, as evidenced by post-issuance environmental improvements documented by (Flammer 2021).

0.5% to 1.5% (Tang & Zhang 2020; Flammer 2021). Thus, compared to conventional debt announcements (Eckbo 1986; Mikkelson & Partch 1986), studies associate the positive wealth effects with lower IA related to the prospect of environmental and greenness rewards of GB (Klassen & McLaughlin 1996). Thus, the higher firm value associated with the GB issuance announcement should provide a greater safety net for bond investors, thereby lowering the default risk. Further evidence suggests that GB's yield spread over non-GB is materially lower (Zerbib 2019), indicating that investors are more confident about GB's creditworthiness, and thus a lower default probability (Daubanes *et al.* 2021).

The positive stock market reaction, lower default probability, and lower yield spread indicate a better risk-return profile for investing in GB than non-GB. *Value-based* investors may incorporate these signals into their assessment of the issuer's long-term risk-return profile, even if the specific GB and a comparable conventional bond issued by the same firm carry identical credit risk. Such positive risk-return prospects, complemented by GB's unique green features, should attract *value-based* investors.

These arguments suggest that, on average, given its unique greenness characteristics and positive financial return prospects, GB issuance should attract more *values* and *value-based* investors than non-GB issuance. Accordingly, we propose the following hypothesis.

H*$_1$: In comparison to non-GB, GB have a higher demand from investors.*

2.4 Drivers of cross-sectional variation in green bond demand

Building on our signaling framework, we argue that GB issuers' past environmental profiles (performance and risk) serve as credibility-reinforcement mechanism that help investors distinguish more credible issuers within the GB market. Rather than treating all GB issuers as homogeneous, investors can use these past environmental credentials to separate high-quality from lower-quality GB offerings.

The grenness is most effective when it is consistent with the issuer's broader environmental profile, creating a coherent bundle of signals that investors find credible. When the GB is issued by a firm with a weak environmental track record, investors may discount the signal as potentially opportunistic (Dutordoir *et al.* 2023). This interpretation is consistent with

legitimacy theory, which predicts that environmental commitments are most credible when they align with observed behaviour (Hoepner *et al.* 2024).

Alternatively, through a preference-based lens, *values-based* investors naturally gravitate toward GB that are both labelled green and issued by firms with genuinely strong environmental profiles, as these instruments best satisfy their non-pecuniary preferences for environmental impact (Pástor et al. 2021). Similarly, *value-based* investors may prefer issuers with strong environmental records because such firms are associated with lower regulatory and transition risks (Bolton & Kacperczyk 2021) (Bolton & Kacperczyk 2021; Krueger et al. 2020).

We, thus, argue that investors look beyond the label and are attracted to the greenness characteristics of the issuers, as it offers an "additionality" to the greenness of the bonds (Salakhova 2023).[11] Drawing on the ESG performance and risk literature, we identify specific factors that explain the heterogeneity in demand across GB issuances.

2.4.1 Past environmental performance

The literature underscores the importance of firms' ex-ante environmental performance-related factors in investment decisions across asset classes (Kim *et al.* 2019; Matos 2020). Firms with better environmental performance are associated with a lower cost of equity (Sharfman & Fernando 2008; Ng & Rezaee 2015), lower costs of bond and bank loans (Amiraslani *et al.* 2023; Degryse *et al.* 2023)[12], better bond ratings (Apergis *et al.* 2022), higher bond return (Duan *et al.* 2021), better alignment of financial and environmental goals (Hartzmark & Sussman 2019; Edmans & Kacperczyk 2022)[13], and higher institutional ownership (Pedersen *et al.* 2021).[14]

Regarding GB issuance, Kapraun *et al.* (2021) find that investors prefer GB issuers with strong environmental performance, as measured by ESG ratings' environmental scores.

[11] "Additionality" refers to the distinct environmental benefits beyond standard practice offered by funded projects through green finance (Lam & Wurgler 2024).

[12] Delis *et al.* (2018) report higher bank interest rates to firms using higher fossil fuels. Similarly, Kleimeier and Viehs (2022) note that banks judge higher CO_2-emitting firms riskier when assessing their creditworthiness.

[13] Evidence also suggests that investors are divesting from high CO_2 emitting firms (e.g., Bolton & Kacperczyk 2021; Pástor *et al.* 2022) as carbon-intensive firms' cash flows are vulnerable to climatic change risks, such as regulatory and transition risks (Ilhan *et al.* 2021). Similarly, studies argue that investors who exhibit prosocial behavior seek to invest in firms with parameters of higher social performance (Riedl & Smeets 2017; Hoepner *et al.* 2024). Evidence also highlights firms' corporate governance as an essential component investors consider in their investment decisions (Schnatterly & Johnson 2014; McCahery *et al.* 2016).

[14] Investors are more attracted to invest in firms with lower CO_2 emissions (Azar *et al.* 2021).

Kapraun *et al.* (2021) also argue that investors may perceive GB issued by firms with subpar environmental performance or overall ESG performance as signs of potential "greenwashing" strategies. Thus, firms that improve their *ex-ante* environmental performance signal their commitment to environmental sustainability to attract investors (Dutordoir *et al.* 2023).

We argue that firms with a history of higher environmental performance are more likely to be perceived as more credible GB issuers, appealing to *values* and *value-based* investors. Studies suggest that investors seek additional credible evidence on firms' environmental performance before risking their financial resources (Kapraun *et al.* 2021). Such higher *ex ante* environmental performance should further reduce frictions between issuers and investors in IA. Thus, we contend that the demand for GB issued by firms with superior *ex ante* environmental performance should be higher, as this provides an additional signal to investors about the credibility of the proceeds used in greener projects. This also implies that the demand for GB issuance should not only be higher than that for non-GB, but also that variations in demand among GB issuers should be positively associated with better *ex-ante* environmental performance. Accordingly, we propose the following hypothesis:

***H_2**: The demand for GB issued by firms with better ex-ante environmental performance is higher.*

2.4.2 Potential ESG risk

In this section, we argue that a firm's potential ESG-related risks can also explain variation in relative demand within the GB market. We follow Asante-Appiah and Lambert (2022), who define ESG risk as the possibility of media-reported adverse ESG incidents that significantly harm the firm's reputation. Extensive evidence suggests that firms with higher media-reported adverse ESG reputation incidents are associated with increased credit risk, lower revenue, lower capital market-based valuation, tarnished brand value, poor customer confidence, and downgraded analysts' earnings forecasts (Derrien *et al.* 2025). Studies also suggest that firms with better environmental risk management practices are associated with lower costs of equity and lower yield spreads on corporate bonds (Ramelli *et al.* 2021).

Dutordoir *et al.* (2023) note that firms with better ESG reputations are more likely to take positive environmental actions. Investors perceive these firms as having better ESG practices,

leading to more transparent and reliable information, which reduces IA between the firm and investors (Alessi *et al.* 2021). Since reputation building and maintenance are challenging (Branco & Rodrigues 2006), firms' better environmental reputation offers a competitive advantage (Dutordoir *et al.* 2023). Legitimacy theory also posits that firms with lower ESG risk are more trustworthy due to reduced adverse selection concerns (Hoepner *et al.* 2024). The concerns of moral hazard should be lower for firms with lower ESG reputations as they are less likely to engage in risky or unethical behavior in the future, making them more attractive to investors concerned about the potential negative impacts of environmental and social risks (Raghunandan & Rajgopal 2022).

The above argument suggests that a firm's potential ESG risk could provide a valuable signal to investors, both *values* and *value-based*. Firms issuing GB and classified as exhibiting lower potential ESG risk should be more attractive to investors than those with higher ESG risk. Accordingly, we propose the following hypothesis:

H*$_3$: The demand for GB issued by firms with lower ex-ante ESG risk is higher.*

3 Sample, variables, and identification strategy

3.1 Sample and data sources

Having developed our theoretical framework and hypotheses, we now turn to the empirical design and data construction necessary to test these predictions. We compile data from several sources. We extract all investment-grade corporate bond data from the London Stock Exchange Group Data & Analytics (LSEG) (formerly Refinitiv) database, including green-labeled bonds. Over 15 years (Jan-2007 to Dec-2022), the sample comprises 48,896 corporate bonds, including 7,826 labeled as GB, which we denote the GB universe. Columns (1) and (2) of

Table 1 shows the year-wise distribution of the GB universe, where we observe a sharp increase in the number of GB and the issuance size over the years. Compared with previous years, the observed significant rise in GB's number and issuance size from 2021 onward could be attributable to several converging factors. Enhanced regulatory frameworks, including the EU Taxonomy Delegated Act and China's updated Green Projects Catalogue, and a policy shift in the U.S. to support climate actions during the 2021 Leaders' Summit on Climate, provided

greater market standardization and investor confidence in GB (Climate Bonds Initiative 2021b). Additionally, the Bank of England's inclusion of GB in asset purchase programs, alongside post-pandemic sustainable recovery initiatives, fueled GB's growth. In Internet Appendix Table IA1, we report the distribution of GB issuance worldwide, noting significant variation in both volume and size across 82 countries. China leads the GB issuance, followed by Germany and the U.S.

[Insert Table 1 here]

Following the existing literature on GB (Larcker & Watts, 2020), we investigate investment-grade fixed-coupon corporate GB.[15] After excluding non-fixed-coupon and non-investment-grade bonds, we are left with 1,337 investment-grade fixed-coupon corporate GB, representing 17.08% (1,337/7,826) of all GB issued from Jan-2013 to Dec-2022.[16] Columns (3) and (4) of Table 1 show the year-wise distribution of this sample GB, which again shows a sharp increase in the number of GB and the issuance size, representative of the GB universe. Figure IA1 in the Internet Appendix shows the geographical distribution of this sample GB, highlighting variations in the number and issuance size across 48 countries, with the highest values in the U.S., the Netherlands, France, and Germany.

Next, we match the sample investment-grade fixed-coupon corporate GB with the bond-level issuance obtained from the unique new industry dataset compiled and maintained by IGM. This dataset contains bond-level issuance data, including details on orderbook size, which is collected through daily surveys of bank underwriters. We extract all the bonds' characteristics and related information from IGM. Out of the 1,337 investment-grade fixed-coupon GB from LSEG, we match complete issuance-related information on 817 GB from the IGM database issued between 2013 and 2022, which constitutes approximately 61% (817/1,337) of the investment-grade fixed-coupon corporate GB, making it, to our knowledge, the most representative of the total GB population used in the existing literature. Hereafter, we

[15] We discard the speculative (i.e., high-yield corporate bonds) due to their small market size, lower liquidity, and higher riskiness. It may also attract a more speculative and riskier category of investors than investment-grade bonds (see Krebbers *et al.* (2023) and Huynh and Xia (2021)).

[16] This period also covers notable developments such as the development of GB principles, the Paris Agreement of 2015, Donald Trump's Election of 2016, the USA's exit from the Paris Agreement on June 01, 2017, the USA's re-joining of the Paris Agreement, EU Taxonomy Delegated Act 2021, China Green Project Catalogue 2021, 2021 Leaders' Summit on Climate, the COVID pandemic, and many countries' commitments to achieve net zero targets and execution of policies and frameworks.

denote the sample of investment-grade fixed-coupon corporate GB with complete information as the GB sample.

We collect relevant firm-level variables from LSEG and S&P Capital IQ for our GB sample. To merge with the 817 GB IGM dataset, we identify the bond issuer details, such as names, International Security Identification Number (ISIN), and Capital IQ ID, from S&P Capital IQ. We extract other relevant data from LSEG, the Organization for Economic Cooperation and Development (OECD), the World Bank, and the International Monetary Fund (IMF).

Additionally, we collect data from several sources to test H_2 and H_3. We collect CO_2 and CO2-equivalent emissions from LSEG, and the Reputation Risk Index (RRI) as a proxy for media-based ESG risk from RepRisk. Finally, we collect the issuing firm's green patents and citation data from the World Patent Statistical Database (PATSTAT) and Orbis Intellectual Property.

3.2 Variables

3.2.1 Dependent and independent variables

Our dependent variable is bond demand captured by the bond's subscription multiple (B_Subs), i.e., the number of times a bond is subscribed relative to the issue size, measured as the orderbook size scaled by the size of the issue (Krebbers *et al.* 2023; Wang & Wu 2026). For example, if a company issues a bond worth $100 million and receives a subscription order of $300 million, the subscription multiple is three times.

Corporate bonds have a relatively lower level of liquidity in the secondary market (Asquith *et al.* 2013), as investors typically buy and hold bonds in their portfolio (Massa *et al.* 2013). Therefore, the primary market of bond issuance offers investors a unique opportunity to adjust their portfolio. We argue that the bond's subscription in the primary market provides an appropriate setting to gauge the investors' demand for the bond (Nikolova *et al.* 2020). The literature investigating the primary market of equity issuance and bond issuance also considers subscription as an appropriate measure of total demand by investors (Cornelli & Goldreich 2003; Krebbers *et al.* 2023; Siani 2025). Similar to Krebbers *et al.* (2023) and Siani (2025), we consider the final size of the orderbook determined during the "bookbuilding" stage of bond

underwriting.[17] During the price discovery process, which typically lasts a single day, a bond issue is announced along with the indicative credit spread, known as the initial price guidance. Underwriters (bookrunners) then gather investor orders in a joint orderbook.[18] While the orderbook remains open, investors can revise their orders, typically in response to updated pricing information, such as revised guidance or final pricing terms. Once the orderbook closes, all recorded orders are considered firm. We use the final orderbook size to determine investor demand for bonds.

As noted earlier, the significant difference between GB and conventional non-GB is GB's unique greenness features, following GB's principles of the ICMA (2018, 2021).[19] Thus, our key independent variable of interest is $D(Green)$, a dummy variable equals one if a bond is labeled green and zero otherwise. Thus, $D(Green)$ is the dummy variable reflecting the unique greenness features of the GB relative to non-GB.

3.2.2 Firm-level propensity score matching covariates

We identify prominent firm-level covariates ($F_Covariates$) to generate a comparable group of GB and non-GB issuers using the Propensity Score Matching (PSM) approach (See Flammer 2021; Dutordoir *et al.* 2023). First, as a proxy of firm size, we use the natural logarithm of total assets (F_Size). Next, we use firms' operating performance, proxied by return on assets (F_ROA). Third, we use firm leverage, captured by the ratio of total debt to total assets (F_Lev). Fourth, we use the firm's sales growth *(F_Rev_Gr).* These variables are included to ensure that differences in firm characteristics do not drive GB issuance.

3.2.3 Bond characteristics

Although PSM may control firm-level characteristics, we also need to control bond features in our empirical setup. We include several bond characteristics (B_Ch) as control variables that could simultaneously affect the investor demand for the bond (B_Subs) and the probability of GB issuance ($D(Green)$. The larger the size of the issue, the lower the demand for the bond

[17] Illustrative examples of the process are provided in Nikolova *et al.* (2020), Krebbers *et al.* (2023), and Siani (2025).
[18] Bookrunners or underwriters typically work on "best efforts" basis; however, they may work on "firm commitment" basis if they believe the demand for a bond issuance is weak (Krebbers *et al.* 2023).
[19] In defining non-GB, we exclude social and sustainable bonds that follow distinct ICMA principles/guidelines with similar structural requirements

(Krebbers *et al.* 2023; Wang & Wu 2026). Moreover, evidence suggests that the size of the issue is also smaller for GB compared to non-GB (Flammer 2021; Dutordoir *et al.* 2023); hence, we control the bond issue size (*B_Size*) calculated as the natural log of issue amount in US$.

Likewise, higher coupons and higher-rated bonds attract more investors (Krebbers *et al.* 2023), and GB are likely to be issued with lower coupons and higher ratings (Zerbib 2019; Larcker & Watts 2020; Dutordoir *et al.* 2023; Wang & Wu 2026). Accordingly, we control the bond's coupon rate (*B_Coupon*) and rating (*B_Rating*). We assign numerical values to the S&P credit ratings, with the highest value being 17 (AAA) and so on. Furthermore, we include the number of bookrunners as an additional control variable, as underwriters' roles are crucial in corporate bond primary markets (Nikolova *et al.* 2020). The large number of bookrunners may increase bond marketability through their networks and enhance visibility in the primary market, ultimately leading to higher demand (Krebbers *et al*. 2023). We also posit that the complexity of GB issuance may require more bookrunners; thus, we control for this by including the natural log of the number of bookrunners (*B_BR*).

We also include the bond issue currency (B_*Currency*) and maturity as fixed effects. We divide the bond's maturity into four buckets and denote it as *B_Maturity*, which takes a value of one if maturity is less than or equal to five years; two if it is between five and 10 years; three if it is between 10 and 30 years; and four if maturity is above 30 years (Barbiero *et al.* 2024; Couaillier *et al.* 2025).

3.2.4 Country characteristics

We also incorporate several country characteristics (C_Ch), such as flight-to-safety (*C_FTS),* flight-to-quality (*C_FTQ*), and real annual gross domestic product growth rates (*C_GDPGR*) as additional control variables. The *C_FTS* and *C_FTQ* indicate a sudden increase in investors' preference for safe and more liquid assets. Beber *et al.* (2009) show that investors demand less credit-risky securities, especially during crises, and Longstaff (2004) finds that investors demand more liquid securities. As the change in *C_FTS* and *C_FTQ* affects investors' portfolio decisions, they also impact their demand for the bond (Krebbers *et al.* 2021). Moreover, GB are marginally less liquid than conventional non-GB (Mazzacurati *et al.* 2021), yet they are considered safe assets, which may affect the issuance decision. Additionally, the country's

green initiatives, environmental considerations, supportive policies, and growth also affect the GB issuance decision of firms (Alharbi *et al.* 2023). Similarly, higher GDP is positively associated with green (renewable) energy production and consumption (Alharbi *et al.* 2023), which aligns with the GB proceeds used in renewable energy production and makes them more credible than non-GB, leading to higher demand. Hence, we capture these country-level differences in GB issuance and demand by controlling the GDP growth rates *(C_GDPGR).*

3.2.5 Drivers of GB demand

We use three proxies to explain the variation in demand for GB. The first two proxies represent past environmental performance; the third is ESG reputation risk. The first past environmental performance proxy is the firm's rescaled CO_2 intensity (F_CO2) measure, defined as total CO_2 emissions, in tons (scope 1 and 2 CO2 emissions and CO2 equivalent emissions), scaled by the firm's sales revenue. We rescale carbon intensity to facilitate tractable interpretation of the regression estimates, with higher values indicating lower carbon intensity.[20]

The second past ESG performance proxy is F_GRS, denoting a firm's greening strategies measured as the natural logarithm of the number of green patents registered. We collect patent information from PATSTAT, which covers 40 global intellectual property authorities, including the United States Patent and Trademark Office (USPTO), the European Patent Office (EPO), the Japan Patent Office (JPO), and the World Intellectual Property Organization (WIPO).[21] The database also provides information on innovation typologies identified using the International Patent Classification (IPC) and the Cooperative Patent Classification (CPC). The IPC and CPC are then mapped to four environmental policy goals: human health impacts of environmental pollution, addressing water scarcity, ecosystem health, and climate change mitigation (see Haščič & Migotto 2015, p. 20). We identify green patents following the OECD's definition and classification. Haščič and Migotto (2015) present a

[20] We rescale the CO_2 emission intensity by subtracting it from the maximum value of CO_2 emission intensity in our sample, such that the higher value denotes lower carbon intensity. Results remain similar when we use alternative rescaling such as inverse min-max scaling between [0,1]: $= 1 - \frac{F_CO2_u - \min(F_CO2_u)}{\max(F_CO2_u) - \min(F_CO_u)}$, where F_CO2_u denotes unscaled CO_2 intensity.

[21] Following Luong *et al.* (2017) and Boubakri *et al.* (2021), for all approved patents, we use the application date and the number of green patents registered a year before the GB issue to overcome the issue of truncation bias in patent databases, as there may be a backlog of many recent applications (Dass *et al.* 2017).

detailed classification mapping with the environmental policy goals. We count the number of green patents for each firm-year.

The final measure, reflecting a firm's ESG-related reputation risk, is denoted as F_RRI. F_RRI is computed by RepRisk from ESG-related news, and it ranges from one to 100, where a high RRI denotes high ESG risk (Li & Wu 2020). RepRisk is an ESG data science company specializing in ESG and business risk research (He *et al.* 2023). RepRisk screens over 100,000 media, stakeholder, and third-party sources daily in 23 languages, and its core research scope includes 28 ESG-related risk incidents (Kölbel *et al.* 2017).[22]

Once ESG incidents are identified and classified, they are categorized based on their severity, reach, and novelty. Severity is rated as low, medium, or high based on the consequences (such as no consequences, injury, or death for health and safety-related incidents), impact (such as on a single person, group, or larger number of people), and cause (by accident, negligence, intent, or in a systematic way) of the incidents. Reach is rated as limited (local media, small non-government organizations, local government bodies, and social media), medium (such as national and international media, international non-government organizations, state, national, and international government bodies), or high (few truly global media outlets) based on the readership, circulation, or importance of the media. Novelty is rated as a new incident or not based on whether the firm/project is exposed to the incident for the first time. RepRisk quantifies the risk incidents using its proprietary standard and customized risk metrics to calculate F_RRI.[23] We rescale the F_RRI where a higher score denotes lower ESG-related reputational risk.[24] We define all variables in Appendix Table A1.

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[22] For example, environment-related incidents include climate change, greenhouse gas emissions, pollution (global and local), impact on ecosystems, biodiversity, waste issues, and animal mistreatment. The social-related issues include human rights abuses, impact on communities, local participation issues, social discrimination, forced labor, child labor, discrimination on employment, and poor employment conditions. The governance-related issues include corruption, compensation issues, misleading communication (including greenwashing), fraud, tax evasion, and anti-competitive practices. Issues that relate to multiple categories of ESG are referred to as cross-cutting issues, such as controversial products and services, products (health and environmental issues), supply chain issues, violations of national regulations, and international standards.

[23] See https://www.reprisk.com/lab/reprisk_index_for_companies_math.html.

[24] We rescale the F_RRI by subtracting it from the maximum value of F_RRI in our sample. Results remain similar when we use alternative rescaling such as inverse min-max scaling between [0,1]: $= 1 - \frac{F_RRI_u - \min(F_RRI_u)}{\max(F_RRI_u) - \min(F_RRI_u)}$, where F_RRI_u denotes unscaled RRI.

3.2.6 Summary statistics

Table 2 presents details of all the variables, their summary statistics, and the number of observations. Panel A provides a summary of all the investment-grade fixed-coupon corporate bonds for which we have complete information. They are winsorized at a 1% level to eliminate the impact of outliers. On average, a bond is subscribed 3.33 times its issue size, whereas the median subscription is 2.67 times.[25] The average (median) *F_Size* is 281.92 bn US$ (64.38 bn US$) with a mean (median) *F_ROA* of 4.17% (2.92%). Similarly, the average (median) *F_Lev* is 35.67% (2.92%), and *F_Rev_Gr* is 1.84% (2.42%). These values align with those reported by Flammer (2021) and Tang and Zhang (2020).

Furthermore, an average (median) *B_Size* is 822.74 m US$ (674.84 m US$) with an average (median) *B_Coupon* of 2.34% (2.13%). The mean (median) *B_Rating* is 9.04 (10), suggesting the average (median) rating of BBB (BBB+). The average *B_Maturity* is 2.25 and 2.0 for GB and non-GB in our sample (i.e., 5 to 10 years). A bond is typically managed by 4.93 (4) bookrunners. These values are similar to Krebbers *et al.* (2021) and Krebbers *et al.* (2023). The average (median) *C_GDPGR* of the countries in our sample is 1.65% (2.20%) with a mean (median) *C_FTS* of 0.65% (0.47%) and *C_FTQ* of 0.13% (-0.04%).

Panel B of Table 2 presents initial evidence of significantly higher demand for GB than non-GB based on the entire sample. The average (median) *B_Subs* for GB is 3.56 times (3.0 times), whereas for non-GB is 3.32 times (2.67 times). The mean (median) difference of 0.24 times (0.33 times) is statistically significant at the 1% level.

[Insert Table 2 here]

We further visualize the GB and non-GB *B_Subs* using the kernel density plot. Figure 2 shows that the GB distribution exhibits a higher density at higher *B_Subs* than non-GB, suggesting a higher demand for GB. Both distributions taper off as the *B_Subs* increase, with a visible difference in the tail end of the density, as some of the GB are subscribed nearly 50 times more than issued. It further suggests that the highest density for GB is around a *B_Subs* of 3.0 times, whereas it is 2.0 times for non-GB. Overall, we find a significant demand for the greenness of a bond.

[Insert Figure 2 here]

[25] The new bonds are often oversubscribed, which is consistent with the existing literature (Nikolova *et al.* 2020).

3.3 Identification strategy

In Panel C of Table 2, we observe significant differences in the firm characteristics between GB and non-GB issuers and the bond features. The GB issuers are significantly larger (based on *F_Size)*, but are inferior in operating performance (captured by *F_ROA*) compared to non-GB issuers, consistent with Flammer (2021). Since GB issuances are costly due to third-party verifications and annual reviews, larger firms typically issue GB.

Likewise, the GB and non-GB significantly differ in bond characteristics as well. Consistent with Larcker and Watts (2020), GB have smaller issuance values (*B_Size*). While comparing *B_Coupon*, evidence suggests that GB trades at 'greenium' compared to similar non-GB (Zerbib 2019; Fatica *et al.* 2021; Baker *et al.* 2022; Pástor *et al.* 2022). As other literature does not find greenium (Larcker & Watts 2020; Flammer 2021), we interpret the result cautiously, as the greenium observed in our sample may disappear or persist in the secondary market when other bond characteristics are considered, which is not the focus of our study. Although our sample is investment-grade bonds, GB have a lower bond rating (*B_Rating*) but more bookrunners (*B_BR*).

It is thus evident that GB and non-GB characteristics and issues differ, and these differences may explain our regression results. Moreover, firms that issue GBs may systematically differ from non-GB issuers in unobservable dimensions, such as superior management or investor relations. In addition, issuers may strategically choose to issue GB when they anticipate stronger demand.

To address these potential endogeneity issues, we apply the PSM technique to balance covariates to generate near-random and, on average, statistically similar treated and control groups. The treated group includes firms that issue GB, whereas the control group comprises non-GB issuers during the sample period. We match the firms from the control group that operate in the same industry and country and are issued in the same year. We match the treated and control groups using the covariates *F_Size, F_ROA, F_Lev,* and *F_Rev_Gr* measured a year before GB issuance. When applying PSM, we first estimate a probit regression before and after matching using Equation (1) below:

$$Treat_{jt} = \alpha + \boldsymbol{\beta_1}.\left(F_Covariates_{jt-1}\right) + FE + \varepsilon_{jt} \quad (1)$$

where $Treat_{jt}$ is a dummy variable that takes the value of one if a firm j in the treated group issued a GB in year t and zero otherwise. $F_Covariates_{jt-1}$ refer to the covariates *F_Size, F_ROA, F_Lev,* and *F_Rev_Gr*. FE denotes year, industry, and country fixed effects. We cluster the standard errors at the firm and year levels. All the variables are defined previously and in Appendix Table A1.

Model (1) of Table 3 (Panel A) reports the probit model results of Equation (1) based on 4,473 firm-year observations before matching. Model (1) results show that the specification captures significant variation in the dependent variable, as indicated by a pseudo-R^2 of 22.7%. We use the propensity scores from Model (1) to perform one-to-one nearest-neighbor matching from the same country, industry, and year with a caliper of 0.1. The matching estimation generates 672 firm-year observations with 336 unique pairs of treated and control group firms. This corresponds to the treated and control firms' 451 GB and 1,641 non-GB, respectively.

We perform two diagnostic tests to ensure there are no observable statistical differences between the matched treated and control firms. First, we re-run probit regression using Equation (1) and restrict it to the matched firm-year observations. The results reported in Model (2) show that none of the matching covariates is statistically significant, suggesting no average statistical differences in the firm characteristics between GB issuing firms and non-GB issuing firms. Likewise, we also observe a considerable drop in the pseudo-R^2 from 22.7% prior to the matching to 0.4% after the matching.

[Insert Table 3 here]

Second, we conduct a univariate analysis of matching covariates between the treated and control groups and report their corresponding *t*-statistics in Panel B. The post-matched sample mean differences in the firm characteristics are statistically insignificant between the treated and control firms. Overall, the diagnostic tests suggest that our matching strategy removes any meaningful statistical average differences between the treated and control firms (other than differences in the investor demand for corporate bonds issued by these firms). In terms of bond level characteristics, we find GB are characterized with lower issue size, lower coupon (greenium), and have higher number of bookrunners, consistent with summary reported in Panel C of Table 2.

Table 4 shows the summary statistics of all the variables in the post-PSM matched sample. On average, a bond is subscribed 3.05 times its issue size, whereas the median subscription is 2.5 times.[26] The average (median) *F_Size* is 537.54 bn US$ (124.63 bn US$) with a mean (median) *F_Lev* of 34.37% (33.21%). Similarly, the average (median) *F_ROA* is 3.15% (1.74%), and *F_Rev_Gr* is 1.29% (1.50%). Furthermore, an average (median) *B_Size* is 786.47m US$ (618.57m US$) with an average (median) *B_Coupon* of 1.88% (1.6%). The mean (median) *B_Rating* is 9.27 (10), suggesting the average (median) rating of BBB (BBB+). The average *B_Maturity* is 2.28 and 2.0 for GB and non-GB in our sample (i.e., 5 to 10 years). A bond is typically managed by 4.84 (5) bookrunners. The average (median) *C_GDPGR* of the countries in our sample is 0.89% (2%) with a mean (median) *C_FTS* of 0.55% (0.36%) and *C_FTQ* of -0.18% (-0.54%).

[Insert Table 4 here]

Table 5 presents the distribution of matched GB and non-GB across 11 industries. Consistent with prior studies, we find that about 53% of corporate bonds in our sample (41% in the treated and 56% in the control) are issued by firms in the financial sector, followed by the utilities sector (around 15%) and the consumer discretionary sector (around 10%). Although GB issuance is concentrated in one industry, we still observe heterogeneity across other sectors. Moreover, financial firms primarily use GB proceeds for lending rather than direct investment in green projects (Tang & Zhang 2020). Hence, investors may perceive these GB differently from those issued by non-financial firms, where proceeds fund internal sustainability initiatives. Fatica *et al.* (2021) suggest that financial firms shift lending away from polluting activities post-issuance; however, whether investors recognize and reward this behavior remains unclear. Given that financial firms represent the majority of GB issuance, it is crucial to conduct industry-specific sub-analyses to understand better if investor demand for greenness differs across sectors. We explore this in Section 4.

[Insert Table 5 here]

[26] The new bonds are often oversubscribed, which is consistent with the contemporary literature (Nikolova *et al.* 2020).

4 Empirical analysis

4.1 Demand for greenness

We begin our analyses by investigating the distribution of the *B_Subs* of GB and non-GB, followed by univariate and multivariate analyses. We present the kernel density of *B_Subs* in Figure 3, which provides insights into the frequency distribution of investor demand. Figure 3 shows a consistently higher density of *B_Subs* of GB than non-GB, suggesting a higher demand for greenness. Both distributions taper off as the *B_Subs* increase, with a visible difference at the tail end of the density, as some of the GB are subscribed nearly 50 times. It further suggests that the highest density for GB is around *B_Subs* of 3.0 times, whereas for non-GB, it is 2.0 times.

[Insert Figure 3 here]

Figure 4 plots the annual trend in *B_Subs* of GB and non-GB. Panel (a) compares the *B_Subs* of GB (green line) and non-GB (red line) from 2013 to 2022. Except in 2013 and 2014, we see that *B_Subs* of GB are consistently higher than that of non-GB. Both bond types demonstrate variability over time, with demand peaking in 2015 and 2020, particularly for GB. The Paris Agreement of 2015 and subsequent regulatory initiatives progressively enhanced the institutional infrastructure supporting GB credibility. The peak demand for GB in 2015 is consistent with the view that regulatory progress has made green signals more credible over time. Higher demand in 2020 also coincides with quantitative easing during the 2020 pandemic and the implementation of the EU Taxonomy Regulation, which increased the investors' attraction towards green investments, including GB.

Panel (b) of Figure 4 shows the annual mean difference in *B_Subs* between GB and non-GB. Consistent with Panel A, we observe statistically higher *B_Subs* after 2015, indicating a gradual increase in demand for GB's greenness. This trend suggests that investors preference GB has increased alongside improvement in regulatory frameworks.

[Insert Figure 4 here]

We examine univariate differences in bond subscription multiples in our matched sample. In Panel A of Table 6, we find that the mean (median) difference in the *B_Subs* for GB, relative to non-GB, is 0.69 (0.60), statistically significant at 1%. In other words, the demand for GB is 25.8% (i.e., 0.69/2.90) higher than for non-GB, lending support to our H_1.

While suggestive, these univariate results do not control confounding factors. To address this, we estimate the following regression model as our multivariate framework estimation.

$$B_Subs_{ijkt} = \beta.D\left(Green_{ijkt}\right) + \boldsymbol{\alpha}.F_Covariates_{jkt-1} + \boldsymbol{\gamma}.B_Ch_{ijkt} + \boldsymbol{\delta}.C_Ch_{kt-1} + FE + \varepsilon_{ijkt} \quad (2)$$

where *i, j, k,* and *t* are indexed as bond, issuer firm, country, and time (year), respectively. *B_Ch* is bond characteristics and *C_Ch* is country characteristics. All other variables are discussed in section 3.2 and defined in Appendix Table A1. Our regression includes several fixed effects to rule out trends such as year, industry, country, *B_Currency*, and *B_Maturity*. ε_{ijkt} is the error term clustered at firm and year levels.

Table 6, Panel B, presents the results of Equation (2). We compare 451 GB and 1,641 matched non-GB identified using firm-level PSM. Model (1) includes the year, industry, *B_Currency,* and *B_Maturity* fixed effects. Model (2) incorporates country-fixed effects as additional fixed effects to capture any country-level differences that may affect the investors' demand for GB. The coefficient of our main variable for GB versus non-GB ($D(Green)$) is positive and statistically significant at a 1% level in Model (1) and at a 5% level of significance in Model (2), showing a significantly higher demand for GB proxied by the bond subscription in the primary market. Holding other factors constant, GB demand is, on average, 0.35 to 0.44 times larger than conventional non-GB, supporting our *H1*. Economically, GB demand is 11.93% to 15.03% (=0.346/2.90 and =0.436/2.90) higher than the non-GB demand. So, for a median $675 million bond issue, additional demand translates to $80-100 million additional investor subscriptions for GB relative to an otherwise comparable non-GB. This is consistent with the signaling argument that GB signals a firm's commitment to the environment, lowering the information asymmetry about proceeds use and attracting higher investor demand. The results suggest that both *value* and *values-based* investors consider the GB issuance a credible signal of their environmental commitment.

[Insert Table 6 here]

In terms of other variables, as expected, we find a statistically significant negative (positive) coefficient for issuance size (coupon), suggesting that bonds with higher issuance size (higher coupon) have lower (higher) investor demand. We also find that higher flight-to-

safety contributes to higher orderbook demand. Statistically, if the difference between long- and short-term government debt rises by 1%, corporate bond subscription multiple could increase by 0.18 to 0.52 times. For investment-grade corporate bonds, the positive flight-to-safety coefficient suggests that investors exhibit yield-seeking behavior, driven by historically lower government yields during our sample period, and may perceive the sample bonds as relatively safe alternatives to government debt.

Our main results show that GB attract higher demand than non-GB, consistent with *H1*. However, for the greenness signal to be effective, it must be credible. We argue that the credibility of the greenness signal is enhanced in markets with stringent sustainable finance regulatory regimes. We therefore expect the demand premium for GB to be stronger in markets with stringent sustainable finance regulations, such as the EU, compared to markets relying primarily on voluntary principles, such as the US.

The concentration of the GB demand premium in the EU is consistent with multiple reinforcing channels. On the supply side, the EU's regulatory framework, including the Sustainable Finance Disclosure Regulation (SFDR), the EU Taxonomy, and the EU Green Bond Standard, enhances the credibility of the green label by imposing mandatory disclosure, standardised definitions of "green," and verification requirements.[27] Stringent EU regulations also enhance the expected quality of post-issuance allocation and impact reporting, making pre-issuance green commitments more credible. By reducing greenwashing risk, these regulations enhance the credibility of the greenness signal, making it more effective in attracting investor demand. On the demand side, these same regulations increase the institutional presence of ESG-mandated investors. Asset managers subject to SFDR classification face disclosure requirements that incentivise allocation to green-labelled instruments, while the EU Action Plan on Sustainable Finance has encouraged the growth of dedicated GB funds.

[27] Although these regulations were adopted after 2019 (such as SFDR in November 2019, EU Taxonomy in June 2020, and EU Green Bond Standard in October 2023), the EU had already put in place several foundational regulations and directives that are highly relevant to current sustainable finance regulatory environment. These include EU Emissions Trading System in 2005, Energy Efficiency and Renewable Energy Directives 2009 – 2012, Non-Financial Reporting Directive in October 2014, and various accounting and transparency frameworks that enhanced ESG, corporate social responsibility, and general sustainability disclosure.

In contrast, the US and most other markets rely primarily on voluntary principles, such as the ICMA Green Bond Principles, with limited mandatory oversight. In these environments, the greenness signal may be less credible because issuers can self-label as "green" without stringent verification. Investors concerned about greenwashing may discount the greenness signal, attenuating the demand.

We examine regional heterogeneity by separately estimating variations of Equation (2) for the US firms, the EU firms, and firms in the rest of the world (excluding both regions). The results are presented in Table 7. Model (1) examines the US sub-sample, Model (2) the EU sub-sample and Model (3) the rest of the world.

[Insert Table 7 here]

Consistent with our argument, the coefficient on $D(Green)$ is positive and statistically significant for the EU subsample in Model (2) but insignificant for the US subsample in Model (1), and the rest of the world (Model 3). The findings reveal that observed higher demand for GB in our main analysis is not uniform across markets. When comparing regions with different regulatory approaches to sustainable finance, we find that the heightened demand for GB exists only in markets with stringent regulatory frameworks, specifically the EU. In contrast, the US and other markets that rely primarily on voluntary principles, such as the ICMA Green Bond Principles, show no statistically significant demand premium for GB. This finding is not simply a matter of regulatory compulsion; investing in GB remains entirely voluntary for investors in all markets. Rather, the EU's mandatory disclosure requirements, standardized taxonomy, and verification mechanisms enhance the credibility of the greenness signal, reducing greenwashing risk and allowing investors to trust that the green label is meaningful. In effect, stringent regulation unlocks latent investor demand for credible green assets.[28]

4.2 Robustness tests

We conduct several robustness tests to ensure our baseline results (reported in Table 6) are not driven by specific sample characteristics, matching procedures, or measurement choices. Tables for these tests are reported in the Appendix, with outcomes briefly discussed below.

[28]

4.2.1 Financial versus non-financial issuers

Financial institutions issue GB primarily to fund green loans to clients, whereas non-financial firms use proceeds to finance their own green projects (Tang & Zhang 2020). This raises the question of whether investors perceive the greenness signal differently across sectors, as tracing proceeds to specific projects may be more difficult for financial issuers (Fatica *et al.* 2021).

We estimate our baseline specification separately for financial and non-financial sub-samples. The results in Appendix Table A2 show that the demand premium for GB is present in both sectors. Both univariate and multivariate analyses confirm positive and statistically significant effects, suggesting that investors view GB issuance as a credible signal of environmental commitment regardless of issuer type.

4.2.2 Alternative matching strategies

Our baseline analysis uses PSM on firm-level characteristics. However, bond-level differences between GB and non-GB could still affect our results. We address this using two alternative matching strategies.

First, we match GB to non-GB issued by the same firm within 2 years, with the same currency, rating, bond type, coupon type, and maturity bucket, selecting the non-GB with the closest issue size to the GB. This within-firm matching controls both observed and unobserved firm characteristics. We match 237 GB with 295 non-GB. The results in Appendix Table A3 Panel A show that GB demand is significantly higher than non-GB demand even within the same issuer.

Second, we match GB to non-GB within the same industry using identical bond-level criteria. We identify 524 GB that matches 706 non-GB. The results in Appendix Table A3, Panel B, confirm that GB attract significantly higher demand than comparable non-GB firms within the same industry. The consistency across matching strategies suggests our findings are not artifacts of the matching procedure.

4.2.3 Non-parametric test

To verify that our results are not matching-dependent, we conduct a non-parametric test. We randomly select a placebo control group of non-GB equal to twice the number of GB in our

sample from the universe of non-GB with complete information and re-estimate our baseline specification (Model 1 of Table 6) 10,000 times.

Appendix Figure A1 presents the cumulative distribution function of estimated coefficients across all iterations. The coefficient is positive and statistically significant in 99.9% of iterations, with 90% of the remaining iterations falling within the 95% confidence interval of our baseline estimate. This provides strong evidence that higher GB demand is not an artifact of our matching strategy.

4.2.4 Alternative measures of investor demand

Our baseline analysis uses the subscription multiple as the demand measure. We re-estimate specifications using two alternatives: the natural logarithm of the orderbook amount (capturing absolute investor interest) and the residual subscription multiple (accounting for time trends and industry-specific demand patterns).

The results in Appendix Table A4 are consistent with our baseline findings. GB attract significantly higher orderbook amounts and residual demand than comparable non-GB, confirming that our findings are not sensitive to how investor demand is measured.

Across all the above-noted robustness tests, we find consistent evidence that GB attract higher investor demand than comparable non-GB. This holds for both financial and non-financial issuers, across alternative matching strategies, in non-parametric analyses, and with alternative demand measures. These results strengthen confidence in our baseline finding.

4.3 Drivers of GB demand

Having established robust support for H_1, i.e., GB attracts higher demand than non-GB, we now investigate the mechanisms underlying this result. Specifically, in this section, we test the hypotheses related to drivers of demand for GB (H_2 and H_3) using the following regression Equation (3), following Caramichael and Rapp (2024) and Klausmann *et al.* (2025) .

$$B_Subs_{ijkt} = \boldsymbol{\beta}.D\left(Green_{ijkt}\right) \times \left(Drivers_{jkt-1}\right) + \boldsymbol{\alpha}.F_Covariates_{jkt-1} + \boldsymbol{\gamma}.B_Ch_{ijkt} + \boldsymbol{\delta}.C_Ch_{kt-1} + FE + \varepsilon_{ijkt} \quad (3)$$

where, $Drivers$ denotes drivers related to environmental performance, ESG risk, and greening strategies discussed in section 3.2. All other variables are as previously defined.

4.3.1 Firm's environmental performance and GB demand

We test H_2 using two proxies of *ex-ante* environmental performance. First, we use the rescaled measure of CO_2 intensity to represent the firm's environmental performance. We argue that the demand for greenness is driven by both *values* and *value-based* investors' desire to invest in firms with better carbon footprint management (i.e., lower CO_2 emissions). Literature extensively studies the implications of toxic emissions and notes that investors' awareness of the firm's CO_2 emission and climatic risk has increased over the years, with investors' demand shifting toward low-emitting firms (Ramelli *et al.* 2021). For instance, Bolton and Kacperczyk (2021) and Pástor *et al.* (2022) show that investors are divesting from firms that emit high CO_2, consistent with a *values-based* investment strategy.

The CO_2-intensive firms are less attractive to *value* bond investors as their cash flows are vulnerable due to risks arising from CO_2-reduction regulations and policies (Ilhan *et al.* 2021; Hoepner *et al.* 2024). A vulnerable cash flow is associated with a greater chance of cash shortfalls, which increases the default probability of bonds (Minton & Schrand 1999), resulting in reduced demand for bonds issued by these firms. Low-emitting firms are also more attractive due to their higher return performance. Duan *et al.* (2021) find higher returns on bonds issued by low emitters due to the predictability of their cash flows, creditworthiness, and environmental actions. Finally, evidence suggests institutional investors are more attracted to firms with low CO_2 emissions (Azar *et al.* 2021), as high CO_2 emissions generate material regulatory and transition risks to firms (Krueger *et al.* 2020). Thus, we argue that GB issued by firms with lower CO_2 emissions is more attractive to investors compared to GB issued by firms with higher CO_2 emissions.

We use a variation of Equation (3) using carbon intensity (*F_CO2*) as a driver for greenness. Table 8 Models (1) and (2) show that the demand for GB is significantly higher than that for a non-GB in firms with lower *F_CO2*, at 5% in Model 1 and weakly significant at 10% in Model 2 (higher *F_CO2* value denotes lower carbon intensity). Economically, one standard deviation reduction in *F_CO2* (about 33.46 tons per billion U.S. dollar sales) increases the GB subscription multiple by 2 to 2.5 times ($33.46 \times 0.059 = 2$ and $33.46 \times 0.074 = 2.5$). Thus, we find evidence consistent with our argument that the firm's carbon intensity serves as a credible signal of its environmental performance to investors in the GB market.

[Insert Table 8 here]

Our second proxy for ex-ante environmental performance is the number of green patents granted to the firm, reflecting its commitment to investing in innovative green technologies. Studies note that a firm's strategic approach to environmentally-friendly business practices can better mitigate and manage climatic risk, thus improving the firm's ESG profile and performance (Krueger *et al.* 2020; Bolton & Kacperczyk 2021; Ilhan *et al.* 2021). One such strategic initiative is investment in green innovations (GI) (Kogan *et al.* 2017; Hegde *et al.* 2022). Evidence suggests that firms use GI to reduce operational expenses such as energy consumption, waste reduction, and raw materials handling (Hart 1995; Ambec & Lanoie 2008). Studies also indicate that investments in GI boost firms' competitive advantage and build a favorable reputation, leading to better environmental, operational, and financial performance (Hart 1995; Ambec & Lanoie 2008). Consequently, a firm's adoption of GI provides evidence of its commitment to transitioning to greener practices, appealing to investors interested in positive environmental change (Dyck *et al.* 2019).

We argue that higher past investments in GI are credible signals to potential investors regarding their commitment to environmentally-friendly practices, as it requires redirecting research and development efforts, which incur high costs (Andriosopoulos *et al.* 2022). We argue that firms issuing GB and those with a history of higher investments in GI should exhibit higher appeal to both *value* and *values-based* investors. *Values-based* investors are likely to be attracted to firms with higher levels of GI because such a strategic approach aligns with the environmental preferences of investors (Ceccarelli *et al.* 2024). On the other hand, *value* investors should also be attracted as GI mitigates future environmental and climate risks of the firms and adds financial value (Ceccarelli *et al.* 2024).

We use another variation of Equation (3), with an alternative measure of green patents, where F_GRS is the primary variable of interest. F_GRS is the lag of the natural log of the number of green patents. The results are reported in Models (3) and (4) of Table 8. We find that the interaction coefficients are positive and significant at the 5% level, suggesting that investors value firms' greening initiatives when issuing GB.

In economic terms, a 10% increase in green patents is associated with a roughly 0.018 increase in the subscription multiple.[29] While 0.018 times may appear small in isolation, patent portfolios often vary by order of magnitude (e.g., 10 vs. 1,000 patents). Therefore, the result is best interpreted as that firms with significantly larger patent portfolios command a statistically discernible and higher subscription multiple. Hence, we confirm *H2*. The demand for GB issued by firms with better greening strategies is higher than that issued by firms with low greening strategies.

4.3.2 Firm's ESG risk and GB demand

In this section, we investigate H_3 using a variation of Equation (3), where we use ESG reputation risk (*F_RRI*) as a driver of GB demand. The higher *F_RRI* denotes lower ESG risk representing the better reputation (Lu, 2025).

In Table 9, Models (1) and (2), we find the coefficient of the interaction term to be positive and significant, at 1% in Model 1 and weakly significant at 10% in Model 2, suggesting that the demand for greenness is higher for GB issued by firms with lower ESG reputation risk (i.e., better reputation). Economically, a 1-standard-deviation increase in F_RRI (16.42) results in an increase in GB demand of 1.31 (= 0.008×16.42) to 1.81 (= 0.011×16.42) times the subscription multiple. Hence, GB issuer's environmental reputation plays an important credibility-reinforcement role to attract higher primary market demand from investors.

[Insert Table 9 here]

5 Conclusion

GB have become an important financial instrument for channeling capital toward environmentally sustainable projects. Using a comprehensive dataset that provides information on orderbook size for investment-grade fixed-coupon corporate bonds issued globally between 2013 and 2022, we investigate whether the unique greenness characteristics of GB explain cross-sectional variation in demand for corporate bonds. Our study contributes to a growing body of research on G primary markets (Larcker & Watts 2020; Bessembinder *et al.* 2022; Caramichael & Rapp 2024; Wang & Wu 2026) by moving beyond the aggregate demand

[29] $\Delta Y \approx \beta \times ln\,(1 + \%\,\Delta X)$. Using the coefficient beta ≈ 0.186, a 10% increase in green patents is associated with an increase in the subscription multiple of 0.186 × ln(1.10), equal to around 0.018 times.

premium to examine the conditions under which it arises and the firm-level environmental drivers that explain heterogeneity within the GB market.

Our first finding is that GB attract significantly higher demand than comparable non-GB areas, with subscription multiples approximately 12% to 15% higher than matched conventional bonds. The GB framework, comprising pre-issuance use-of-proceeds disclosure and commitments to post-issuance impact reporting and third-party verification, attenuates information asymmetry through a combination of ex ante transparency, which reduces adverse selection, and ex post accountability commitments, which reduces moral hazard. This makes GB attractive to both *value*- and *values-based* investors.

Our second finding is that this demand premium is not uniform across markets. The heightened demand for GB exists only in the EU, where mandatory disclosure requirements are stringent, a standardized taxonomy is in place, and verification mechanisms are in place. In contrast, the US and other markets that rely primarily on voluntary principles exhibit no statistically significant demand premium. Importantly, investing in GB remains entirely voluntary for investors in all markets; regulation works not by compelling behaviour but by creating institutional conditions that allow willing investors to act on their existing preferences.

Our third set of findings identifies firm-level drivers of demand heterogeneity. Companies with lower carbon emissions, stronger green innovation strategies (proxied by green patents), and lower ESG reputation risks attract greater investor demand for their GB issuances. Our findings suggest that the greenness is most effective when it is consistent with the issuer's broader environmental profile, creating a coherent bundle of signals that investors find credible. While prior work reveals higher GB demand and links investor demand to pricing outcomes, our results highlight how demand varies systematically across issuers and markets.

These findings have several implications. For investors, GB issuance represents a credible signal of environmental commitment, particularly in markets with strong regulatory oversight, and the issuer's broader environmental profile offers meaningful information for assessing the quality of that commitment. For issuers, our findings highlight the importance of building a credible environmental track record and disclosing greater detail on the overall environmental strategy when issuing GB. The demand premium is not automatic; it accrues

disproportionately to issuers whose green label is reinforced by observable environmental performance. This aligns with the recently implemented EU Green Bond Standards, which require firms to describe their transition plans.

For policymakers, our regional findings suggest that voluntary principles alone may be insufficient to unlock the full potential of GB markets. The EU's regulatory framework works not by compelling behavior but by solving an information problem that prevents willing capital from flowing to green assets. Additionally, this environment should increase the base of ESG focused investors creating new and higher demand for sustainable financing instruments. Jurisdictions seeking to develop their GB markets may find that establishing credible, enforceable standards is more effective than relying solely on voluntary frameworks. At the same time, regulation complements rather than substitutes for genuine environmental commitment by issuers. Both elements are necessary for GB markets to realize their potential to advance global sustainability objectives.

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Figure 1: Signaling theory and greenness of green bonds (GB)
Note: This figure shows the theoretical framework highlighting the independent construct, mediators, and dependent constructs.

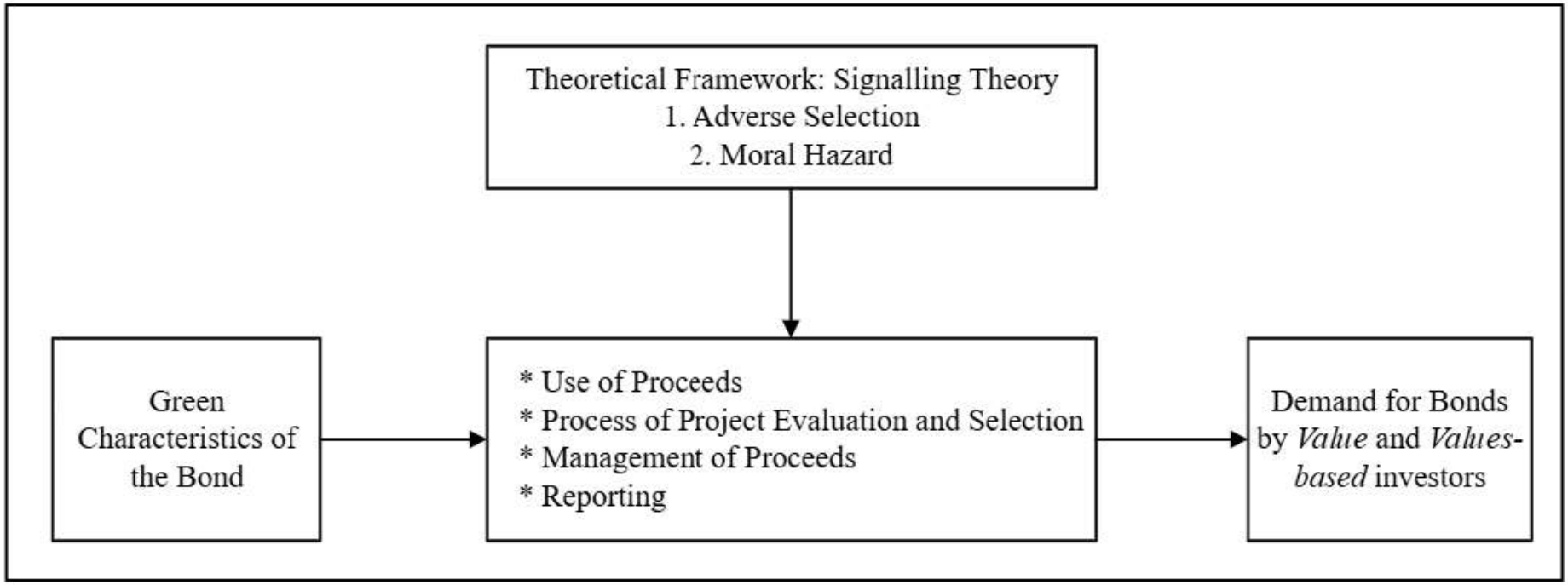


Figure 2: Kernel density estimates (full sample)
Note: The figure presents a density plot of *B_Subs* (defined in Appendix Table A1) of GB (green line) and non-GB (red dashed line) for the full sample. The plot uses a Gaussian kernel and the Silverman rule for bandwidth selection.

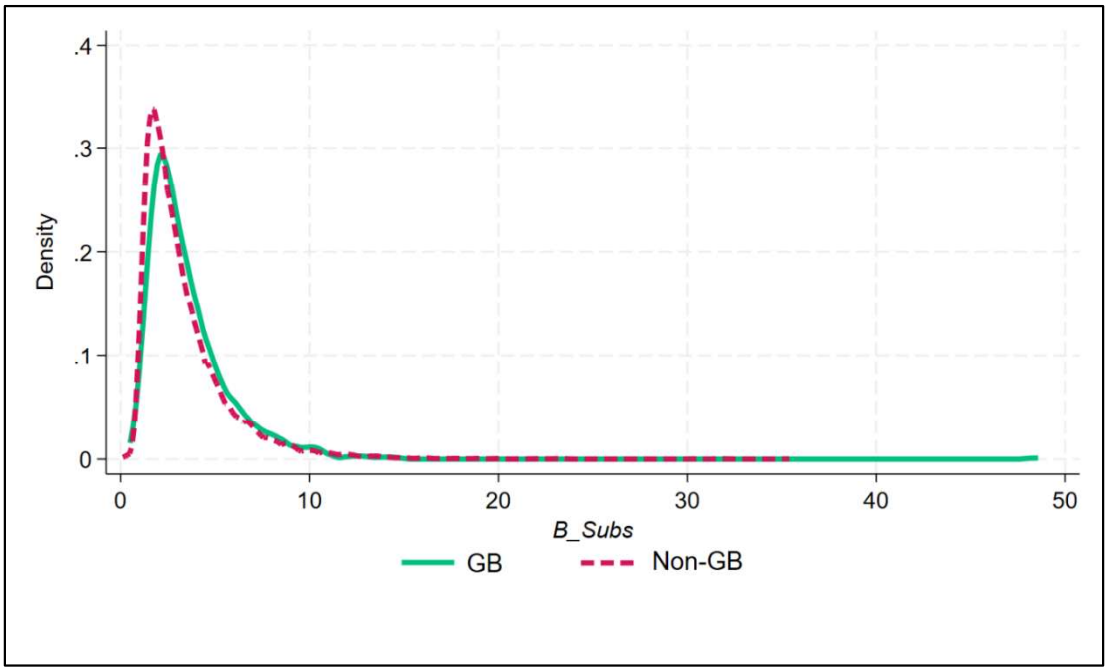


Figure 3: Kernel density estimates (matched sample)
Note: The figure presents a density plot of the *B_Subs* (defined in Appendix Table A1) of GB and non-GB for the matched sample. The plot uses a Gaussian kernel and the Silverman rule for bandwidth selection.

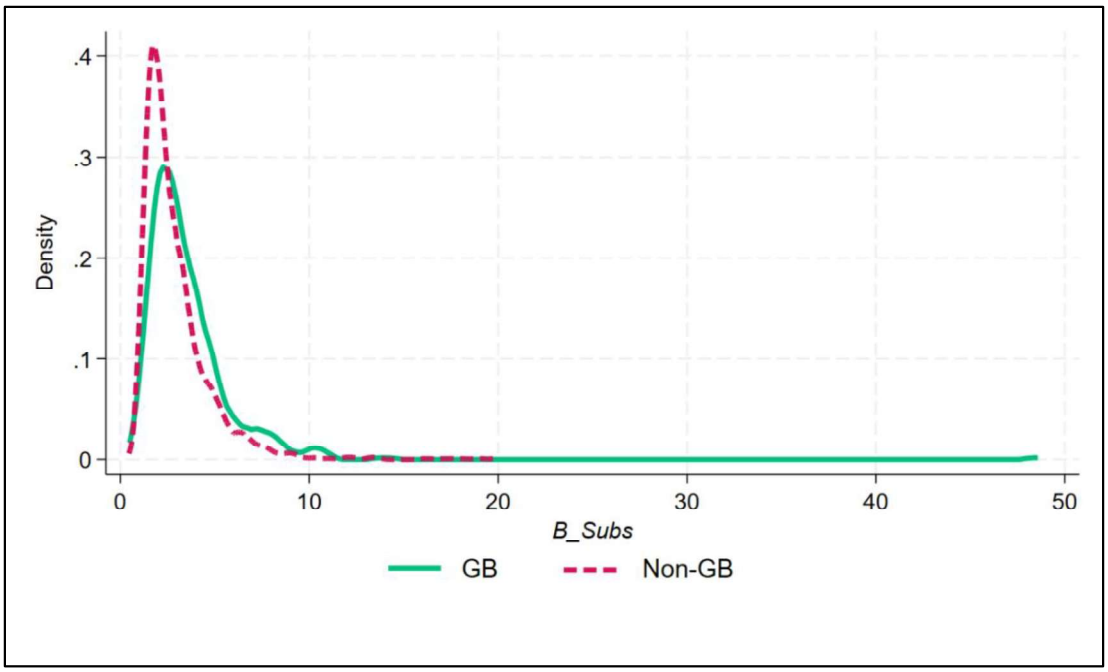
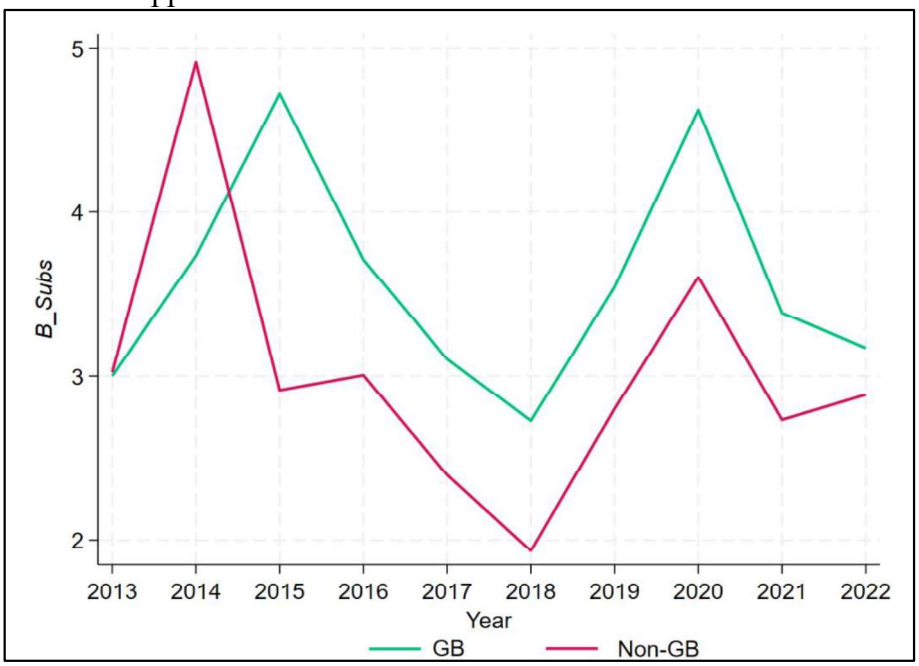
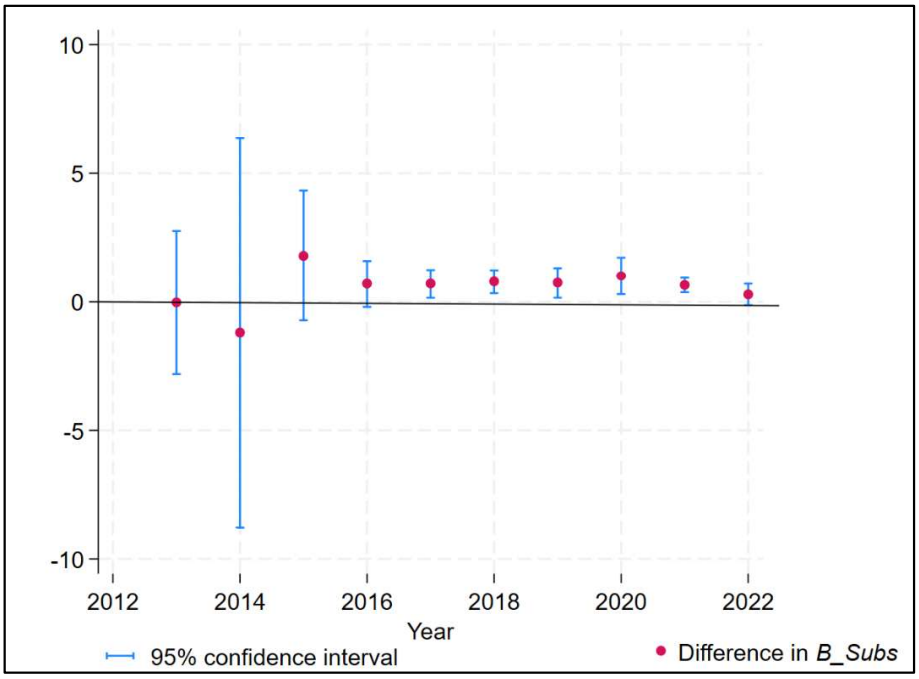


Figure 4: Annual trend and mean difference
Note: Panel (a) compares the annual average *B_Subs* of the matched sample of GB (green line) and non-GB (red line) from 2013 to 2022. Panel (b) shows the yearly mean difference in annual *B_Subs* between the matched sample of GB and non-GB with its confidence interval (blue). *B_Subs* is defined in Appendix Table A1.



(a) Annual average *B_Subs* of the matched sample of GB and non-GB



(b) Mean difference in annual *B_Subs* between the matched sample of GB and non-GB

Table 1: Time series of GB issuance
Note: This table reports the number of GB issued (#) and the issue amount (million US dollars) since its debut in 2007 through 2022. It also documents the universe of investment-grade fixed coupon corporate GB, followed by our sample investment-grade fixed coupon corporate GB with bond subscription information from their debut covering the period of 2013 to 2022 worldwide.

Year	Total GB universe		Investment-grade fixed coupon corporate GB Universe		Investment-grade fixed coupon corporate GB Sample	
	#	Issue amount (m$)	#	Issue amount (m$)	#	Issue amount (m$)
2007	1	629.5				
2008	2	473.9				
2009	5	893.8				
2010	53	2,691.7				
2011	29	812.8				
2012	24	2,408.2				
2013	45	12,465.4	4	2,474.3	3	2,105.3
2014	140	30,584.7	10	5,246.2	3	2,130.1
2015	305	48,928.9	15	8,449.7	8	3,567.9
2016	258	98,941.2	42	26,487.6	26	16,572.4
2017	455	160,324.1	79	44,311.4	43	24,452.4
2018	545	157,389.6	74	41,547.1	42	28,536.1
2019	949	284,948.7	170	87,903.8	98	62,972.0
2020	1,203	297,903.2	218	103,154.0	136	80,918.1
2021	2,095	636,889.8	358	179,144.3	232	133,891.4
2022	1,717	540,330.4	367	197,632.6	226	147,124.0
Total	7,826	2,276,615.9	1,337	696,350.8	817	502,269.7

Table 2: Sample summary statistics (before matching)
Note: Panel A reports the summary statistics [Number of observations (Observation), Mean, Median, Standard Deviation (Std. Dev.), Minimum and Maximum] of the universe of investment-grade fixed coupon corporate bonds (GB and non-GB universe). Panel B summarizes the mean and median differences between GB and non-GB subscriptions (*B_Subs*). Panel C summarizes mean differences between GB and non-GB by firm-level covariates and bond characteristics. All the variables are defined in Appendix Table A1.

Panel A: Summary statistics of the bond universe with subscription data

	Observation	Mean	Median	Std. Dev.	Minimum	Maximum
Dependent variable						
B_*Subs* (times)	12593	3.33	2.67	2.17	1.00	12.20
PSM covariates						
F_*Size* (b$)	10540	281.92	64.38	479.10	.26	1948.23
F_*ROA* (%)	10531	4.17	2.92	4.95	-8.29	24.32
F_*Lev* (%)	10305	35.67	32.51	21.14	0	99.74
F_*Rev_Gr* (%)	9913	1.84	2.42	22.97	-146.48	99.89
Bond characteristics						
B_*Size* (m$)	12593	822.74	674.84	526.50	6.70	7000.00
B_*Coupon* (%)	12593	2.34	2.13	1.61	0.00	11.50
B_*Rating*	12593	9.04	10.00	4.709	1.00	17.00
B_*Maturity*	12593	2.25	2.00	0.83	1.00	4.00
B_*BR*	12593	4.93	4.00	3.13	0.00	40.00
Country characteristics						
C_*GDPGR* (%)	12248	1.65	2.20	3.42	-9.30	8.10
C_*FTS* (%)	12221	0.65	0.47	0.86	-1.22	4.03
C_*FTQ* (%)	12221	0.13	-0.04	1.67	-2.51	4.79

Panel B: Univariate Analysis of Bond Oversubscription (*B_Subs*)

	GB (1)	Non-GB (2)	Diff. (1) – (2)	*t*-stat
Mean *B_Subs*	3.56	3.32	0.24***	3.56
Median *B_Subs*	3.00	2.67	0.33***	5.273
Observations	817	11776		

Panel C: Mean differences between firm and bond variables for GB and Non-GB				
	GB (1)	**Non-GB (2)**	**Diff. (3) = (1) – (2)**	***t*-stat (4)**
Firm-level covariates				
F_*Size* (b$)	323.91	278.76	45.15**	2.02
F_*ROA* (%)	3.27	4.23	-0.96***	-6.37
F_*Lev* (%)	35.30	35.64	-0.34	-0.47
F_*Rev_Gr*(%)	1.63	1.86	-0.23	-0.27
Bond characteristics				
B_*Size* (m$)	633.43	835.87	-202.44***	-18.00
B_*Coupon* (%)	1.83	2.38	-0.55***	-10.53
B_*Rating*	8.22	9.10	-0.88***	-5.16
B_*Maturity*	2.22	2.25	-0.03	-1.04
B_*BR*	5.80	4.87	0.93***	6.60

Table 3: Diagnostic test for propensity score matching (PSM)
Note: Panel A reports the estimates of the following probit model.

$$Treat_{jt} = \alpha + \beta_1.\left(F_Covariates_{jt-1}\right) + FE + \varepsilon_{jt}$$

The dependent variable ($Treat_{jt}$) is one if a firm *j* is in the treated group for the year *t* and zero otherwise. The treated group consists of firms that have issued GB and the control group that have not issued GB. The *F_Covariates* include *F_Size*, *F_ROA*, *F_Lev* and *F_Rev_Gr.* All the variables are defined in Appendix Table A1. FE denotes the fixed effects used in the pre-match and post-match equations, which include year, industry, and country-fixed effects. Model (1) predicts the likelihood of being treated (GB-Issuer) in the entire sample of firms with no missing covariates. Model (2) predicts the probability of matched treated and control firms using PSM with no replacement. Standard errors are clustered at the country-industry level, *t*-statistics are presented in parentheses, and *, **, and *** denote statistical significance at the 10%, 5%, and 1% significance levels. Panel B shows the mean values of PSM covariates and bond characteristics for treated group in column (1) and control group in column (2), mean difference in column (3), and *t*-statistics in column (4). *, **, and *** denote statistical significance at the 10%, 5%, and 1% significance levels.

Panel A: Probit model		
	$Treat_{jt}$ = 'one' if it belongs to treated (i.e., firm issuing the GB); 'zero' otherwise.	
	Pre-match	**Post-match**
	(1)	**(2)**
F_*Size*	0.120***	0.031
	(3.16)	(0.81)
F_*ROA*	0.004	0.030
	(0.40)	(1.44)
F_*Lev*	0.000	0.003
	(0.07)	(0.81)
F_*Rev_Gr*	-0.003**	0.001
	(-2.22)	(0.30)
Year fixed effects	Yes	Yes
Industry fixed effects	Yes	Yes
Country fixed effects	Yes	Yes
Pseudo R^2	0.227	0.004
No. of Obs. (firm-year)	4,473	702

Panel B: Mean difference between treated and control group				
	Treated (1)	**Control (2)**	**Diff. (3) = (1) – (2)**	***t*-stat (4)**
PSM Covariates				
F_*Size* (ln)	17.98	17.94	0.04	0.26
F_*ROA* (%)	3.20	2.88	0.32	1.19
F_*Lev* (%)	37.31	36.69	0.62	0.40
F_*Rev_Gr* (%)	2.22	1.42	0.81	0.67
Bond characteristics				
B_*Size* (m$)	627.10	830.27	-203.17***	-11.21
B_*Coupon* (%)	1.76	1.91	-0.15**	-1.97
B_*Rating*	9.12	9.31	-0.19	-0.85
B_*Maturity*	2.32	2.26	0.06	1.30
B_*BR*	5.39	4.68	0.71***	4.07

Table 4: Summary statistics of PSM sample
Note: This table reports reports the summary statistics [Number of observations (Observation), Mean, Median, Standard Deviation (Std. Dev.), Minimum and Maximum] of the matched sample. All the variables are defined in Appendix Table A1.

Panel A: Summary statistics of the matched bond, issuer firms and country						
	Observation	**Mean**	**Median**	**Std. Dev.**	**Minimum**	**Maximum**
Dependent variable						
B_*Subs* (times)	2092	3.05	2.5	1.72	1.03	10.11
PSM covariates						
F_*Size* (b$)	2090	537.54	124.63	801.09	0.41	418.27
F_*Lev* (%)	2090	34.37	33.21	18.63	0.00	98.91
F_*ROA* (%)	2011	3.15	1.74	3.68	-3.76	20.17
F_*Rev_Gr* (%)	1955	1.29	1.50	14.43	-56.96	59.32
Bond characteristics						
B_*Size* (m$)	2092	786.47	618.57	459.91	21.39	4500
B_*Coupon* (%)	2092	1.88	1.60	1.45	0.00	8.00
B_*Rating*	2092	9.27	10.00	4.43	1.00	17.00
B_*Maturity*	2092	2.28	2.00	.83	1.00	4.00
B_*BR*	2092	4.84	5.00	3.01	1.00	40.00
Country characteristics						
C_*GDPGR* (%)	2084	0.89	2.00	3.91	-10.8	8.50
C_*FTS* (%)	2084	0.55	0.36	0.66	-2.02	4.34
C_*FTQ* (%)	2084	-0.18	-0.54	1.66	-2.88	6.05

Table 5: Industry classification

Note: This table reports the demand characteristics [number of bonds (#), issue amount, and the share of issued amount (%)] by treated (GB-issuing) and control (non-GB issuing) firms.

The industry classification of firm-year observation post-PSM									
	Treated			Control			All firms		
Industry	**#**	**Issue amount (b$)**	**%**	**#**	**Issue amount (b$)**	**%**	**#**	**Issue amount (b$)**	**%**
Basic materials	9	5.30	1.9	15	8.84	0.6	24	14.14	0.9
Communication services	4	3.84	1.4	40	76.84	5.6	44	80.68	4.9
Consumer discretion	24	18.40	6.5	154	144.11	10.6	178	162.51	9.9
Consumer staples	4	3.85	1.4	18	15.38	1.1	22	19.23	1.2
Energy	7	3.67	1.3	12	10.74	0.8	19	14.41	0.9
Financials	188	115.81	40.9	846	761.62	55.9	1034	877.43	53.3
Health care	3	2.68	0.9	24	21.91	1.6	27	24.59	1.5
Industrials	22	12.78	4.5	41	31.59	2.3	63	44.37	2.7
Information technology	7	5.56	2.0	28	22.84	1.7	35	28.40	1.7
Real estate	73	41.76	14.8	145	91.74	6.7	218	133.50	8.1
Utilities	110	69.17	24.5	318	176.85	13.0	428	246.02	15.0
Total	451	282.82		1641	1362.46		2092	1645.28	

Table 6: Baseline results

Note: This table reports the results of univariate mean differences (Panel A) and multivariate regression estimates (Panel B). The multivariate regression results are reported by running two variants of the following specification:

$$B_Subs_{ijkt} = \beta.D\left(Green_{ijkt}\right) + \boldsymbol{\alpha}.F_Covariates_{jkt-1} + \boldsymbol{\gamma}.B_Ch_{ijkt} + \boldsymbol{\delta}.C_Ch_{kt-1} + FE + \varepsilon_{ijkt}$$

where *i, j,k,* and *t* are indexed as the bond, issuer firm, country, and time (year), respectively. All the variables are defined in Appendix Table A1. FE denotes fixed effects in terms of year, industry, country, currency, and maturity bucket. The standard errors are clustered at firm and year. *t*-stats are presented in parentheses and *, **, and *** denote statistical significance at the 10%, 5%, and 1% significance levels, respectively. The sample includes all firm-year observations of the treated and matched control firms worldwide from 2013–2022.

Panel A: Univariate analysis of bond oversubscription (*B_Subs*)				
	GB (1)	**Non-GB (2)**	**Diff. (2) – (1)**	***t*-stat**
Mean *B_Subs*	3.59	2.90	0.69***	4.85
Median *B_Subs*	3.00	2.40	0.60***	7.65
Observations	451	1641		

Panel B: Multivariate analysis		
	(1)	**(2)**
$D\left(Green_{ijkt}\right)$	0.436***	0.346**
	(4.79)	(3.05)
F_*Size*	0.016	0.018
	(0.41)	(0.45)
F_*ROA*	-0.002	0.000
	(-0.05)	(0.01)
F_*Lev*	-0.002	-0.002
	(-0.71)	(-0.75)
F_*Rev_Gr*	-0.002	-0.002
	(-0.66)	(-0.95)
B_*Size*	-0.948***	-0.893***
	(-7.09)	(-4.92)
B_*Coupon*	0.330***	0.302***
	(3.71)	(3.80)
B_*Rating*	0.001	-0.008
	(0.08)	(-0.67)

B_*BR*	0.158**	0.075
	(2.79)	(1.35)
C_*FTS*	0.175**	0.516***
	(3.25)	(4.56)
C_*FTQ*	-0.004	0.192
	(-0.05)	(0.87)
C_*GDPGR*	0.010	0.040***
	(0.64)	(3.29)
Year fixed effects	Yes	Yes
Industry fixed effects	Yes	Yes
Country fixed effects	-	Yes
B_Currency fixed effects	Yes	Yes
B_Maturity fixed effects	Yes	Yes
Number of observations	1878	1877
Adjusted R^2	0.181	0.197

Table 7: Regional heterogeneity

We report the results of variants of the following regression specification using sub-samples of the US firms in Model (1), EU firms in Model (2), and the rest of the world in Model (3).

$$B_Subs_{ijkt} = \boldsymbol{\beta}.D\left(Green_{ijkt}\right) + \boldsymbol{\alpha}.F_Covariates_{jkt-1} + \boldsymbol{\gamma}.B_Ch_{ijkt} + \boldsymbol{\delta}.C_Ch_{kt-1} + FE + \varepsilon_{ijkt}$$

where *i, j, k,* and *t* are indexed as the bond, issuer firm, country, and time (year), respectively. All the variables are defined in Appendix Table A1. FE denotes fixed effects in terms of year, industry, country, currency, and maturity bucket. The standard errors are clustered at firm and year. *t*-stats are presented in parentheses, and *, **, and *** denote statistical significance at the 10%, 5%, and 1% significance levels, respectively. The sample includes all firm-year observations of the treated and matched control firms from 2013–2022 worldwide.

	US	**EU**	**Rest of the world**
	(1)	**(2)**	**(2)**
$D\left(Green_{ijkt}\right)$	0.153	0.364***	0.745
	(0.70)	(3.73)	(1.72)
F_*Size*	0.143	-0.015	-0.011
	(0.50)	(-0.13)	(-0.14)
F_*ROA*	0.077	-0.026	-0.140
	(0.99)	(-0.37)	(-1.19)
F_*Lev*	0.007	-0.005	-0.003
	(0.73)	(-1.48)	(-0.26)
F_*Rev_Gr*	-0.026**	0.003	0.009
	(-3.27)	(0.52)	(1.06)
B_*Size*	-1.316**	-0.502***	-1.121**
	(-5.04)	(-3.40)	(-3.01)
B_*Coupon*	0.362**	0.166	0.413***
	(4.73)	(1.34)	(4.03)
B_*Rating*	0.059	-0.0153	-0.003
	(0.37)	(-1.66)	(-0.11)
B_*BR*	0.248	-0.108	0.027
	(0.78)	(-0.64)	(0.13)
C_*FTS*		0.195	0.521**
		(0.45)	(2.74)
C_*FTQ*		0.121	0.610
		(0.16)	(1.53)
C_*GDPGR*		0.047	0.009
		(0.56)	(0.17)
Year fixed effects	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes
Country fixed effects	-	Yes	Yes
B_Currency fixed effects	Yes	Yes	Yes
B_Maturity fixed effects	Yes	Yes	Yes
Number of observations	552	780	543
Adjusted R^2	0.215	0.303	0.167

Table 8: GB demand: Carbon emissions and greening strategies

Note: This table reports the results of estimating the role of carbon emissions and greening strategies as drivers of GB's demand by employing different specifications of the following regression equation:

$$B_Subs_{ijkt} = \beta.D\left(Green_{ijkt}\right) \times \left(Drivers_{jkt-1}\right) + \boldsymbol{\alpha}.F_Covariates_{jkt-1} + \boldsymbol{\gamma}.B_Ch_{ijkt} + \boldsymbol{\delta}.C_Ch_{kt-1} + FE + \varepsilon_{ijkt}$$

where *i, j, k,* and *t* are indexed as the bond, issuer firm, country, and time (year), respectively. $Drivers_{jkt-1}$ is proxied using F_CO2_{jkt-1} in Models (1) and (2), and F_GRS_{jkt-1} in Models (3) and (4). All the variables are defined in Appendix Table A1. FE denotes fixed effects in terms of year, industry, country, currency, and maturity bucket. The standard errors are clustered at firm and year level. *t*-stats are presented in parentheses, and *, **, and *** denote statistical significance at the 10%, 5%, and 1% significance levels, respectively. The sample includes all firm-year observations of the treated and matched control firms from 2013–2022.

	CO_2		**Greening strategies**	
	(1)	**(2)**	**(3)**	**(4)**
$D\left(Green_{ijkt}\right) \times \left(F_CO2_{jkt-1}\right)$	0.074**	0.059*		
	(2.27)	(2.02)		
$D\left(Green_{ijkt}\right) \times \left(F_GRS_{jkt-1}\right)$			0.186**	0.146**
			(3.24)	(2.81)
F_*Size*	-0.072	-0.053	-0.001	0.00248
	(-1.25)	(-0.34)	(-0.03)	(0.07)
F_*ROA*	-0.008	-0.009	0.011	0.0151
	(-0.15)	(-0.18)	(0.47)	(0.79)
F_*Lev*	0.002	0.008	-0.002	-0.00147
	(0.55)	(0.98)	(-0.71)	(-0.69)
F_*Rev_Gr*	0.002	0.001	0.000	0.000
	(0.24)	(0.22)	(0.27)	(0.15)
B_*Size*	-1.025***	-0.870***	-0.864***	-0.789***
	(-6.94)	(-3.58)	(-11.97)	(-9.06)
B_*Coupon*	0.402***	0.362***	0.321***	0.301***
	(4.30)	(4.08)	(4.30)	(4.47)
B_*Rating*	0.003	0.001	-0.003	-0.011
	(0.11)	(0.05)	(-0.28)	(-0.96)
B_*BR*	0.163	-0.027	0.158**	0.115*
	(1.23)	(-0.20)	(2.66)	(2.21)
C_*FTS*	0.120	0.672***	0.232***	0.418***
	(1.60)	(3.62)	(4.94)	(4.34)
C_*FTQ*	-0.069	0.147	-0.027	0.175
	(-0.76)	(0.63)	(-0.39)	(0.98)
C_*GDPGR*	-0.009	0.029	0.039**	0.052**
	(-0.24)	(0.97)	(2.42)	(2.64)
Year fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Country fixed effects	-	Yes	-	Yes
B_Currency fixed effects	Yes	Yes	Yes	Yes
B_Maturity fixed effects	Yes	Yes	Yes	Yes
Number of observations	1213	1211	1878	1877
Adjusted R^2	0.166	0.193	0.228	0.248

Table 9: GB demand and ESG risk

Note: This table reports the results of estimating the role of ESG risk as the driver of GB's demand by employing two different specifications of the following regression equation:

$$B_Subs_{ijkt} = \beta.D(Green_{ijkt}) \times (Drivers_{jkt-1}) + \boldsymbol{\alpha}.F_Covariates_{jkt-1} + \boldsymbol{\gamma}.B_Ch_{ijkt} + \boldsymbol{\delta}.C_Ch_{kt-1} + FE + \varepsilon_{ijkt}$$

where *i, j, k,* and *t* are indexed as the bond, issuer firm, country, and time (year), respectively. $Drivers_{jkt-1}$ refers to F_RRI_{jkt-1} in Models (1) and (2). All the variables are defined in Appendix Table A1. FE denotes fixed effects in terms of year, industry, country, currency, and maturity bucket. The standard errors are clustered at firm and year level. *t*-stats are presented in parentheses, and *, **, and *** denote statistical significance at the 10%, 5%, and 1% significance levels, respectively. The sample includes all firm-year observations of the treated and matched control firms from 2013–2022.

	(1)	**(2)**
$D(Green_{ijkt}) \times (F_RRI_{jkt-1})$	0.011***	0.008*
	(5.58)	(1.99)
F_*Size*	-0.001	-0.054
	(-0.01)	(-0.80)
F_*ROA*	-0.065	-0.073
	(-0.75)	(-0.77)
F_*Lev*	0.006	0.010
	(0.55)	(1.04)
F_*Rev_Gr*	-0.003	-0.003
	(-0.77)	(-1.65)
B_*Size*	-1.087***	-1.009***
	(-6.11)	(-5.96)
B_*Coupon*	0.646***	0.656***
	(9.01)	(6.22)
B_*Rating*	0.009	0.004
	(0.35)	(0.20)
B_*BR*	0.188*	-0.081
	(2.08)	(-0.39)
C_*FTS*	0.158***	0.554***
	(4.44)	(4.50)
C_*FTQ*	0.019	0.243*
	(0.25)	(1.95)
C_*GDPGR*	-0.017	0.034
	(-0.44)	(0.96)
Year fixed effects	Yes	Yes
Industry fixed effects	Yes	Yes
Country fixed effects	-	Yes
B_Currency fixed effects	Yes	Yes
B_Maturity fixed effects	Yes	Yes
Number of observations	1000	997
Adjusted R^2	0.210	0.236

Appendix Table A1: Variable description

Note: This table reports all the variables used in the study, along with their definition and data sources. The subscripts *i, j, k,* and *t* denote the '*i*'th bond issued by firm '*j*' in country '*k*' at time '*t*.'

Variable names	Definition	Data Source
Dependent variables		
B_Subs_{ijkt}	Bond subscription (demand) multiple obtained as amount of orderbook divided by the amount of bond issued.	Informa Global Markets (IGM)
$Ln(B_Orderbook_{ijkt})$	Natural logarithm of the size of the orderbook in amount ($).	IGM
$Resid_B_Subs_{ijkt}$	Residuals bond subscription multiple obtained by regressing the bond subscriptions (*B_Subs)* on the log of the number of bonds issued before the concerned issuance and the industry average *B_Subs*.	IGM & LSEG Author's calculation
Independent variables		
$D(Green_{ijkt})$	A dummy variable that takes value of one if an investment-grade fixed coupon corporate bond is a green bond (GB) and zero otherwise (comparable non-GB). GB is any debt instrument whose proceeds are used for environmentally friendly projects, such as water cleaning, waste management, and renewable energy (ICMA 2021).	IGM & LSEG
$F_CO_{2\ jkt-1}$	The firm's rescaled carbon (CO_2) intensity is calculated as rescaled total CO_2 emissions (CO_2 and CO_2 equivalent emissions) divided by total sales revenue in billion US dollars. Rescaled total CO_2 is calculated as maximum value of total CO_2 emission in our sample minus the total CO_2 emissions of a firm. A higher value of rescaled CO_2 intensity denotes a better carbon footprint management.	Derived from LSEG
F_RRI_{jkt-1}	The firm's rescaled reputation risk index (RRI) calculated as maximum value of RRI in our sample minus the RRI of a firm. The rescaled RRI ranges between one and 100, where a higher score indicates a lower ESG-related reputation risk.	Derived from RepRisk
F_GRS_{jkt-1}	Natural logarithm of cumulative number of green patents registered by the GB issuer. A higher number reflects the firm's higher degree of green innovation initiatives.	Derived from PATSTAT

$F_Covariates_{jkt-1}$	*Firm-level covariates*	
F_Size	Natural logarithm of the firm's total assets.	Capital IQ & LSEG
F_ROA	The operating income before depreciation divided by the book value of total assets.	Capital IQ & LSEG
F_Lev	Total debt divided by the total assets.	Capital IQ & LSEG
F_Rev_Gr	Annual growth rate of sales revenue.	Capital IQ & LSEG
B_Ch_{ijkt}	*Bond characteristics*	
B_Size	Natural logarithm of the size of the bond issued.	Derived from IGM & LSEG
B_Coupon	Plain vanilla fixed coupon rates offered for each bond.	IGM & LSEG
B_Rating	A numerical value assigned to the S&P Credit Rating for each bond. AAA bonds are assigned 17, AA+ bonds are assigned 16 and so on.	IGM & LSEG
B_BR	Natural logarithm of the number of bookrunners for each bond issuance.	IGM
B_Maturity	A numerical value assigned based on the maturity bucket. It takes the value of 'one' if a bond's maturity is less than or equal to five years; 'two' for maturity between five to 10 years; 'three' for 10 to 30 years bonds; and 'four' for all bonds maturing above 30 years.	Derived from LSEG
B_Currency	Currency in which the bonds are issued.	LSEG
C_Ch_{kt-1}	*Country characteristics*	
C_FTS	Flight to safety calculated as the difference between the long-term government bond rate and the short-term rate of the bond issuer's country (Costantini & Sousa 2022).	OECD/World Bank/IMF
C_FTQ	Flight to quality calculated as the difference between long-term (i.e., 10-year) government bond rates of bond-issued countries and the benchmark long-term government bond rates. We use the USA's long-term government bond rate as a benchmark for non-USA firms and Germany's long-term government bond rate as a benchmark for USA firms. The proxies for "safe-haven" (benchmark) can be the long-term interest rate of the USA, Japan, or Germany, depending upon the relevance of the studies (Costantini & Sousa 2022).	OECD/World Bank/IMF
C_GDPGR	Annual growth rate of each country's real gross domestic product (GDP).	IMF

Appendix Table A2: Financial and non-financial firms

Note: Panel A of the Table reports the mean differences in *B_Subs* by financial and non-financial sectors. In Panel B, we report the results of two variants of the following regression specification using sub-samples of the non-financial and financial firms (banks) sectors, i.e., four regression results.

$$B_Subs_{ijkt} = \boldsymbol{\beta}.D\left(Green_{ijkt}\right) + \boldsymbol{\alpha}.F_Covariates_{jkt-1} + \boldsymbol{\gamma}.B_Ch_{ijkt} + \boldsymbol{\delta}.C_Ch_{kt-1} + FE + \varepsilon_{ijkt}$$

where *i, j, k,* and *t* are indexed as the bond, issuer firm, country, and time (year), respectively. All the variables are defined in Appendix Table A1. FE denotes fixed effects in terms of year, industry, country, currency, and maturity bucket. The standard errors are clustered at firm and year. *t*-stats are presented in parentheses, and *, **, and *** denote statistical significance at the 10%, 5%, and 1% significance levels, respectively. The sample includes all firm-year observations of the treated and matched control firms from 2013–2022 worldwide.

Panel A: Univariate analysis of bond subscription (*B_Subs*)

	All (1)	**GB (2)**	**Non-GB (3)**	**Diff. (2) – (3)**	***t*-stat**
A.1. Financial firms					
Mean *B_Subs*	2.53	3.10	2.40	0.70***	5.01
Median *B_Subs*	2.00	2.60	2.00	0.60***	6.26
Observations	1034	188	846		
A.2. Non-financial firms					
Mean *B_Subs*	3.56	3.95	3.43	0.52**	2.33
Median *B_Subs*	3.00	3.33	2.90	0.43***	3.50
Observations	1058	263	795		

Panel B: Regression results for non-financial and financial firms

	Non-financial firms		**Financial firms**	
	(1)	**(2)**	**(1)**	**(2)**
$D\left(Green_{ijkt}\right)$	0.428***	0.317**	0.518**	0.453**
	(4.48)	(2.49)	(3.38)	(2.93)
F_*Size*	-0.074	-0.034	0.001	-0.026
	(-1.10)	(-0.39)	(0.03)	(-0.76)
F_*ROA*	-0.020	-0.013	0.098***	0.104***
	(-0.46)	(-0.31)	(5.21)	(5.03)
F_*Lev*	0.005	0.010*	-0.004**	-0.005**

	(0.71)	(2.30)	(-3.07)	(-2.85)
F_*Rev_Gr*	-0.005	-0.007*	0.005	0.004
	(-1.29)	(-2.11)	(1.23)	(1.44)
B_*Size*	-1.163***	-1.042***	-0.763***	-0.694***
	(-6.04)	(-5.81)	(-7.19)	(-4.43)
B_*Coupon*	0.378***	0.369***	0.219	0.177
	(7.67)	(6.47)	(1.58)	(1.40)
B_*Rating*	0.023	0.013	-0.004	-0.011
	(0.56)	(0.35)	(-0.50)	(-1.11)
B_*BR*	0.467**	0.314	-0.060	-0.082
	(3.09)	(1.44)	(-0.84)	(-0.83)
C_*FTS*	0.050	0.578**	0.304***	0.503**
	(0.38)	(2.48)	(5.43)	(3.26)
C_*FTQ*	0.042	0.094	-0.053	0.333***
	(0.22)	(0.33)	(-1.49)	(3.76)
C_*GDPGR*	-0.007	-0.029	0.042*	0.068*
	(-0.14)	(-0.69)	(1.98)	(1.96)
Year fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Country fixed effects	-	Yes	-	Yes
B_Currency fixed effects	Yes	Yes	Yes	Yes
B_Maturity fixed effects	Yes	Yes	Yes	Yes
Number of observations	998	994	879	878
Adjusted R^2	0.103	0.113	0.251	0.281

Appendix Table A3: Alternative matching strategies

Note: This table reports the results of employing alternative matching strategies. In Panel A, we report the OLS outcome of samples matched not only against *F_Covariates* but also against bond characteristics (i.e., the GB and Non-GB issued by the same firm, same currency, same S&P rating, same country, same maturity bucket, issued not earlier than two years and closest possible to issue size). Panel B reports that the OLS outcome of the samples matched against the firm-level covariates (*F_Covariates*) within the same industry. We report the results of various models of the following regression equation based on the two alternative matching strategies:

$$B_Subs_{ijkt} = \beta.D(Green_{ijkt}) + \boldsymbol{\alpha}.F_Covariates_{jkt-1} + \boldsymbol{\gamma}.B_Ch_{ijkt} + \boldsymbol{\delta}.C_Ch_{kt-1} + FE + \varepsilon_{ijkt}$$

where *i, j, k,* and *t* are indexed as the bond, issuer firm, country, and time (year), respectively. All the variables are defined in Appendix Table A1. FE denotes fixed effects in terms of year, industry, country, currency, and maturity bucket. The standard errors are clustered at firm and year, and *t*-stats are presented in parentheses, and *, **, and *** denote statistical significance at the 10%, 5%, and 1% significance levels, respectively. The sample includes all firm-year observations of the treated and matched control firms from 2013–2022.

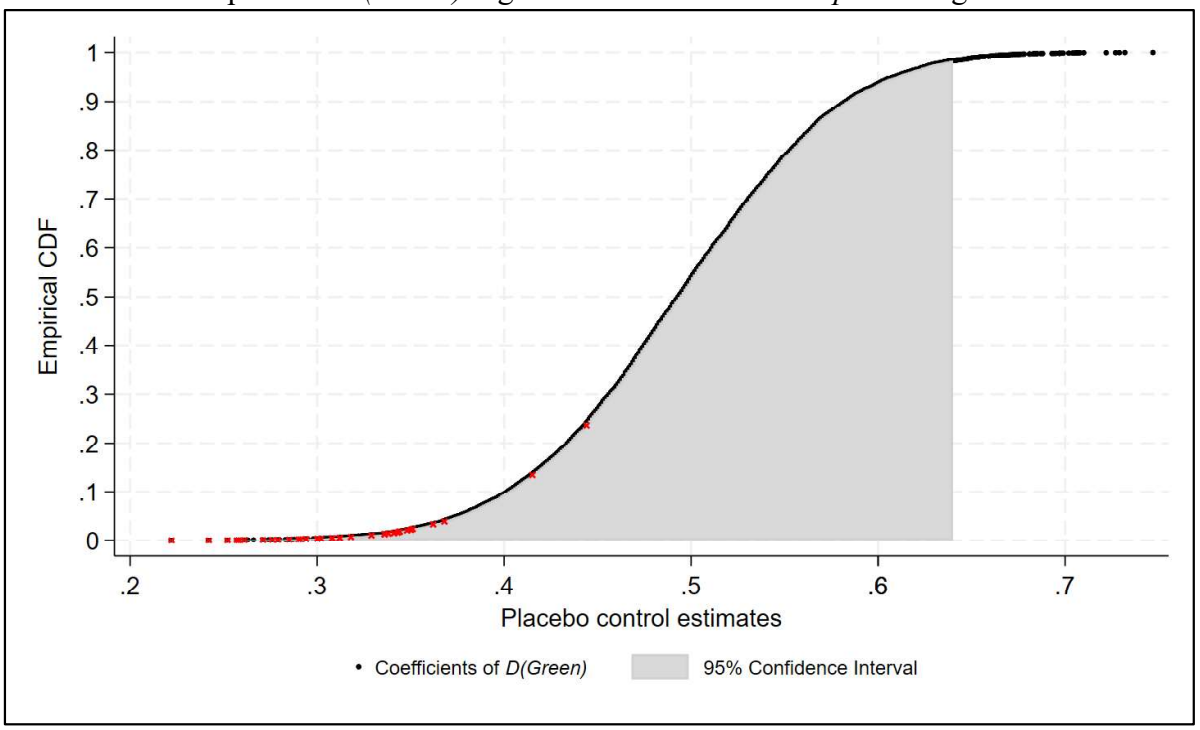
	Panel A: Same firm's GB and non-GB		**Panel B: Same industry's GB and non-GB**	
	(1)	**(2)**	**(1)**	**(2)**
$D(Green_{ijkt})$	0.600***	0.544***	0.524***	0.483***
	(5.82)	(5.32)	(4.20)	(4.64)
F_*Covariates*	Yes	Yes	Yes	Yes
B_*Characteristics*	Yes	Yes	Yes	Yes
C_*Characteristics*	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Country fixed effects	-	Yes	-	Yes
B_Currency fixed effects	Yes	Yes	Yes	Yes
B_Maturity fixed effects	Yes	Yes	Yes	Yes
Number of observations	285	278	620	616
Adjusted R^2	0.244	0.265	0.244	0.298

Appendix Figure A1: Non-parametric test

Note: This graph shows the cumulative distribution function (CDF) of 10,000 different regression estimates of the dummy variable *D(Green*) by running 10,000 different iterations of the following baseline regression specification as reported in Model (1) of Table 6.

$$B_Subs_{ijkt} = \beta.D(Green_{ijkt}) + \boldsymbol{\alpha}.F_Covariates_{jkt-1} + \boldsymbol{\gamma}.B_Ch_{ijkt} + \boldsymbol{\delta}.C_Ch_{kt-1} + FE + \varepsilon_{ijkt}$$

It considers 902 random corporate non-GB from the universe of corporate non-GB, twice the number of corporate GB with complete information. The shaded area represents the 95% confidence interval of the leading coefficients of *D(Green)* of Model (1) of Table 6. The red **x**-marks estimate represents *D(Green)* regression coefficients with *p*-values greater than 0.10.



Appendix Table A4: Alternative definition of investor demand
Note: This table report the results using two alternative definitions of investor demand using the following general specification:

$$Alt_B_Subs_{ijkt} = \beta.D(Green_{ijkt}) + \boldsymbol{\alpha}.F_Covariates_{jkt-1} + \boldsymbol{\gamma}.B_Ch_{ijkt} + \boldsymbol{\delta}.C_Ch_{kt-1} + FE + \varepsilon_{ijkt}$$

where *i, j, k,* and *t* are indexed as the bond, issuer firm, country, and time (year), respectively. $Alt_B_Subs_{ijkt}$ is $Ln(B_Orderbook_{ijkt})$ in Models (1) and (2) and $Resid_B_Subs_{ijkt}$ in Models (3) and (4). All the variables are defined in Appendix Table A1. FE denotes fixed effects in terms of year, industry, country, currency, and maturity bucket. The standard errors are clustered at firm and year. *t*-stats are presented in parentheses, and *, **, and *** denote statistical significance at the 10%, 5%, and 1% significance levels, respectively. The sample includes all firm-year observations of the treated and matched control firms from 2013–2022.

	Panel A: Natural log of orderbook amount		**Panel B: Residual subscription**	
	(1)	**(2)**	**(3)**	**(4)**
$D(Green_{ijkt})$	0.122***	0.094**	0.436***	0.350***
	(3.82)	(3.07)	(5.97)	(3.68)
F_*Covariates*	Included	Included	Included	Included
B_*Characteristics*	Included	Included	Included	Included
C_*Characteristics*	Included	Included	Included	Included
Year fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Country fixed effects	-	Yes	-	Yes
B_Currency fixed effects	Yes	Yes	Yes	Yes
B_Maturity fixed effects	Yes	Yes	Yes	Yes
Number of observations	1878	1877	1878	1877
Adjusted R^2	0.533	0.546	0.122	0.14253

Internet Appendix Table IA1: Geographical Distribution of GB

By country-wise, this Table reports the number of bonds (#), the issue size (*Issue Amount*), and the share of the issue size *(% Share*) for the entire GB issued from 2007 to 2022 and that of investment-grade fixed coupon corporate GB from 2013 to 2022.

Domicile	Total GB (#)			Investment-grade fixed coupon corporate GB		
	#	Issue Amount (m$)	% Share	#	Issue Amount (m$)	% Share
United States	740	216,400	9.507%	210	123,000	17.674%
Netherlands	212	154,500	6.788%	133	93,800	13.478%
France	465	209,900	9.222%	95	68,900	9.900%
Germany	702	251,000	11.027%	126	62,000	8.909%
Spain	137	65,700	2.886%	43	28,900	4.153%
Japan	438	63,800	2.803%	64	28,300	4.066%
South Korea	317	60,300	2.649%	64	26,400	3.793%
United Kingdom	216	86,300	3.792%	66	24,000	3.449%
Italy	75	59,700	2.623%	39	23,700	3.405%
Canada	119	56,400	2.478%	48	22,900	3.291%
Hong Kong	149	54,700	2.403%	61	21,800	3.132%
Luxembourg	226	97,800	4.297%	38	20,000	2.874%
Norway	237	46,000	2.021%	31	18,000	2.586%
Mexico	36	20,140	0.885%	14	16,600	2.385%
Sweden	753	75,700	3.326%	55	16,100	2.313%
Finland	71	25,700	1.129%	21	11,500	1.652%
China (Mainland)	1,515	343,400	15.087%	29	11,400	1.638%
Austria	60	16,970	0.746%	19	8,330	1.197%
Cayman Islands	22	12,150	0.534%	11	7,830	1.125%
Chile	30	16,850	0.740%	14	7,600	1.092%
Australia	45	20,350	0.894%	22	6,750	0.970%
Denmark	62	38,490	1.691%	11	6,490	0.933%
British Virgin Islands	27	7,790	0.342%	16	5,710	0.820%
Singapore	43	18,240	0.801%	13	4,740	0.681%
United Arab Emirates	21	6,350	0.279%	11	4,580	0.658%
Belgium	31	62,560	2.749%	8	4,360	0.626%

Domicile	Total GB (#)			Investment-grade fixed coupon corporate GB		
	#	Issue Amount (m$)	% Share	#	Issue Amount (m$)	% Share
Ireland	32	25,590	1.124%	7	3,490	0.501%
Indonesia	29	16,120	0.708%	5	2,520	0.362%
Peru	10	1,945	0.085%	6	1,840	0.264%
India	69	14,140	0.621%	4	1,540	0.221%
Macau	9	3,390	0.149%	6	1,540	0.221%
Iceland	9	1,923	0.084%	4	1,280	0.184%
Switzerland	70	16,470	0.724%	8	1,270	0.182%
Poland	12	6,020	0.264%	2	1,060	0.152%
Jersey	3	1,548	0.068%	1	1,060	0.152%
New Zealand	36	6,309	0.277%	8	809	0.116%
Portugal	12	6,028	0.265%	1	798	0.115%
Liechtenstein	3	855	0.038%	1	639	0.092%
Lithuania	4	733	0.032%	2	639	0.092%
Slovakia	7	1,337	0.059%	3	619	0.089%
Romania	4	607	0.027%	4	607	0.087%
Czech Republic	3	1,437	0.063%	1	532	0.076%
Guernsey	29	612	0.027%	1	426	0.061%
Hungary	24	6,033	0.265%	5	423	0.061%
Bermuda	7	2,500	0.110%	2	400	0.057%
Philippines	74	11,800	0.518%	1	300	0.043%
South Africa	22	1,269	0.056%	1	300	0.043%
Latvia	6	412	0.018%	2	160	0.023%
Mauritius	30	14,700	0.646%			
Brazil	63	6,430	0.282%			
Taiwan	89	6,360	0.279%			
Russia	8	3,400	0.149%			
Thailand	54	3,110	0.137%			
Ivory Coast	20	2,690	0.118%			
Greece	7	2,450	0.108%			

Domicile	Total GB (#)			Investment-grade fixed coupon corporate GB		
	#	Issue Amount (m$)	% Share	#	Issue Amount (m$)	% Share
Argentina	26	2,150	0.094%			
Serbia	2	2,130	0.094%			
Turkey	9	2,090	0.092%			
Malaysia	224	1,740	0.076%			
Venezuela	5	1,660	0.073%			
Ukraine	2	1,650	0.072%			
Egypt	2	1,500	0.066%			
Georgia	4	1,500	0.066%			
Saudi Arabia	2	1,500	0.066%			
Honduras	6	1,020	0.045%			
Costa Rica	2	1,000	0.044%			
Israel	1	1,000	0.044%			
Colombia	10	772	0.034%			
Panama	14	614	0.027%			
Pakistan	1	500	0.022%			
Bangladesh	1	387	0.017%			
Vietnam	3	351	0.015%			
Cyprus	1	319	0.014%			
Nigeria	6	305	0.013%			
Laos	3	242	0.011%			
Belarus	1	81	0.004%			
Slovenia	1	80	0.004%			
Estonia	1	68	0.003%			
Fiji	2	45	0.002%			
Seychelles	1	15	0.001%			
Morocco	1	13	0.001%			
Namibia	1	4	0.000%			
Total	7,826	2,276,144	100%	1,337	695,942	100%

Internet Appendix Figure IA1: Geographical Distribution of Green Bonds (GB)
This figure shows the geographical distribution of the size (indexed colors represent the total amount) of investment-grade fixed coupon corporate GB issued globally between 2013 and 2022. The red circle denotes the country where GB are issued; its size is proportional to the number of GB issued in the country between 2013 and 2022.

