

Institutional Ownership and Underpricing of Corporate Green Bonds

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This paper investigates green bond underpricing as a strategic signal of issuer credibility. The incentives of green bond issuers are determined based on the environmental preferences of their institutional shareholders. The findings indicate a positive association between underpricing and the greenness of the issuer's ownership composition, and that the relationship persists in seasoned bond offerings, suggesting limited learning effects. Green bond announcements are associated with a negative stock market reaction, but this reaction is less pronounced for issuers with a greener ownership composition or higher underpricing. The results are consistent with a signaling framework in which green bond underpricing serves as a costly signal of the bond issuer's credibility.

EFM Classification Codes: 230, 220, 150

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1. Introduction

Institutional shareholders who value corporate sustainability efforts may serve as stewards of the green¹ transition, given their crucial role in the ownership structure of publicly listed firms. In terms of market capitalization, institutional shareholders hold approximately 68% of the U.S. equity market (Medina et al., 2022). The influence of green stewardship² on firm behavior and firm value has been increasingly studied in academic literature. Investors with preferences for sustainable investing may allocate capital to firms they perceive as credible in their sustainability efforts (Heinkel et al., 2001). In doing so, major shareholders can substitute for regulatory pressure and promote corporate green transformation (Wiedemann, 2023). However, investors face asymmetric information regarding the credibility of corporate sustainability efforts and exposure to climate-related risks (Ilhan et al., 2023). This paper investigates the role of institutional shareholders as stewards of the corporate green transition, and asks whether the proportion of ownership by shareholders who value corporate sustainability is associated with green bond underpricing.

The literature commonly identifies institutional shareholders with green preferences either through institutional portfolio holdings (e.g, Gibson and Krueger (2017)) or through self-declared preferences. In terms of portfolio holdings, survey evidence shows that the institutional demand for non-financial corporate green bonds is currently not fully met and is positively associated with the bond issuer’s green credentials and post-issuance reporting (Sangiorgi and Schopohl, 2021). Green preferences of institutional shareholders can also be self-declared by joining climate initiatives such as Ceres (Flammer et al., 2021), United Nations Principles for Responsible Investment (UNPRI) (Dimson et al., 2025) and Climate Action 100+ (CA100+) (Wiedemann, 2023). However, climate initiatives differ significantly in terms of their objectives and governance structures. An absence of review mechanisms within the UNPRI has been argued to lead to free-rider

¹The terms "sustainable" and "green" will be used interchangeably throughout this paper.

²Investor stewardship is used in terms of engaging, monitoring and voting (Bebchuk et al., 2017).

problems and potentially undermine their credibility ([Bauckloh et al., 2023](#)).

Conversely, investor climate alliances such as CA100+ are considered to provide a unique infrastructure that facilitates communication between management and institutional shareholders. Signatories of CA100+ can interact with management through various channels. First, capacity constraints of institutional shareholders can be improved by defining focus companies, lead shareholders and implementing benchmarking practices. Second, it facilitates non-financial disclosures since management can identify shareholder preferences more easily. Third, the self-declaration of shareholder preferences can spare management costly proxy battles and improve information asymmetries between shareholders and management ([Miazad, 2025](#)). Among several engagement tools, CA100+ defines a proxy season strategy as part of its signatory handbook. The alliance "flags key shareholder proposals and other votes aligned with the goals of the initiative for investors to take into consideration during proxy season" ([Climate Action 100+, 2023](#), p.21). Although only a fraction of successful environmental shareholder proposals get voted on, [Dyck et al. \(2019\)](#) argue that they are used as a lever in shareholder negotiations. Since CA100+ is considered the largest collaborative engagement group on climate risk (e.g., [Wiedemann \(2023\)](#)), it is used as an identifier of credible green shareholder preferences. To conclude, signatories of investor climate alliances may help to improve information asymmetries in the green bond market, by enhancing corporate sustainability efforts.

The empirical analysis begins by examining the relationship between green bond underpricing and the perceived credibility i.e. "greenness" of the issuer. The greenness of the firm is measured by the shareholders self-declared preferences for sustainable investing. The institutional shareholders with green preferences are identified using the signature lists of climate initiatives such as CA100+. Green bond underpricing is higher when the proportion of shareholders with green preferences exceeds 20% and they actively engage with firm management. This relationship is consistent over first and seasoned green bond offerings, indicating limited learning effects. In a stock market

setting, the announcement of a green bond is associated with negative market-adjusted returns. However, the negative stock market reaction is less pronounced when green shareholder preferences exceed 20% or the underpricing is higher. This implies that the stock market reaction to a green bond announcement is related to the bond issuer's credibility.

The results contribute to the literature by examining how green shareholder preferences relate to the pricing and credibility of green bonds. The findings suggest that green stewardship, when practiced through active and collaborative engagement, can enhance the perception of firms' sustainability efforts. Moreover, underpricing can serve as a signal of green bond issuers' credibility, consistent with a signaling framework developed by [Spence \(1973\)](#). The findings contribute to the literature on value-alignment between non-pecuniary shareholder preferences and firm behavior. The remaining paper is structured as follows. The literature review in section 2 relates the theoretical literature on information asymmetry and market signaling to green bond demand. Section 2.2 describes the working hypothesis of the research paper. Section 3 describes the construction of the main data sample. The empirical methodology is described in section 4. Finally, section 5 reviews the empirical results and discusses the implication of the findings.

2. Literature Review

Theoretical literature such as [Fama and French \(2007\)](#); [Heinkel et al. \(2001\)](#); [Baker et al. \(2022\)](#) discusses asset pricing implications of sustainable investing. Investor preferences for green assets are driven by non-pecuniary motives. According to [Fama and French \(2007\)](#) investors with tastes for green assets can impact demand dynamics and distort asset prices away from their intrinsic value. Increased tastes for sustainable investments can lead to higher asset prices. The impact of investor tastes on asset prices depends on

the distribution of tastes in the market. The larger the amount invested in green assets, the larger the impact on the market value. In terms of green bonds, the impact of tastes would imply that greener assets trade at a premium due to higher demand, meaning that the price would be higher and the yield would be lower for bonds that align with investor tastes. The equilibrium model by [Pástor et al. \(2021\)](#) suggests, that realized returns are higher and expected returns are lower for firms more aligned with evolving investor tastes. The investors accept a lower yield because of their preference for holding green assets ([Pástor et al., 2022](#)).

2.1. Determinants of the Green Bond Premium

Green bonds are debt instruments that are characterized by its predefined use of proceeds. They are issued to finance projects with environmental benefits. The projects should be certified by a third party such as Climate Bond Initiative (CBI) prior to the green bond issuance. The management of proceeds is predefined and the disclosure of the use of funds should be readily available to prospective investors ([ICMA, 2021](#)). The credibility of the green bond issuer could curb green-washing concerns. There is an ongoing debate whether investors are willing to pay a premium for green bonds that exert credible green characteristics such as labels and certifications ([Dorflleitner et al., 2022](#)).

This research is related to the literature focusing on the price premium of green bonds compared to conventional bonds. A consensus on whether a price premium exists for green bonds has not been met as the results are mixed. While some studies such as [Baker et al. \(2022\)](#); [Zerbib \(2019\)](#) report a price premium, others such as [Flammer et al. \(2021\)](#); [Tang and Zhang \(2020\)](#) do not find a significant price difference between green bonds and conventional bonds. The question of a green premium is relevant since a higher price or lower yield would imply that it is less costly for a firm to finance its project with a green bond. This might motivate firms to issue a green bond to finance

a non-green project and may threaten the integrity of the green bond market (Flammer et al., 2021). This poses the question of how investors can differentiate the credibility of bond placements if the information on corporate sustainability efforts is asymmetric.

Signaling theory provides a framework for distinguishing between good and bad quality bonds under asymmetric information. When an investment decision is made under uncertainty, and firms hold private information, they can signal their type to investors. In his seminal paper, Spence (1973) argues that a credible signal is costly to the sender. An equilibrium arises when the investors' beliefs about a sender's type are confirmed. More specifically, Ross (1977); Myers (1984); Allen and Faulhaber (1989) show that signaling can mitigate asymmetric information when insider information is revealed to the capital market. In practice, issuers can offer a bond at a price below its intrinsic value in the primary market to help bond investors differentiate it from lower quality bonds. This practice is referred to as underpricing. Better quality firms know that they can recover from this costly signal. Conversely, signaling theory implies that lower quality firms might issue bonds with lower underpricing (Cai et al., 2007).

The information asymmetry prevailing after the initial offering stage relates underpricing to liquidity risks in the secondary market. Ellul and Pagano (2006) argue that after the initial offering stage, residual information asymmetry remains regarding whether asset holdings will be liquidated after the issuance. An issuance which is less liquid is expected to have higher underpricing. Conversely, Booth and Chua (1996) state, that underpricing fosters a broader ownership base in the primary market and thus higher liquidity in the secondary market. An issuance with higher underpricing can attract a broader ownership base and is expected to be more liquid in the secondary market. Although the authors focus on initial public offerings (IPOs) of stocks, Cai et al. (2007) investigates the liquidity argument in corporate bond offerings and finds that liquidity risk does not impact underpricing.

More recent empirical literature on bond underpricing focuses on information asymmetries in the primary bond market. [Nikolova et al. \(2020\)](#) analyses the relationship between informed investors and initial bond returns. They find that first day returns increase with trading history between underwriters and issuers and information production during the underwriting process. [Filatova and Javakhadze \(2024\)](#) examine the presence of investment advisors on firm boards and their relation to bond pricing and find a positive relation between information asymmetries and underpricing. [Wang \(2022\)](#) suggests that underpricing in the green bond market is related to the information collection during the bookbuilding process. A tighter offering spread for green bonds compared to conventional bonds links the underpricing in the primary market to trends in investor demand. Moreover it is argued, that underwriters suppress green bond spreads more aggressively. Overall, the underpricing of green bonds is attributed to demand information revealed during bookbuilding.

Another strand of literature discusses how managers utilize green bond issuances to signal corporate sustainability efforts. [Bancel and Glavas \(2018\)](#) argue that managers use the information disclosure in green bond prospectuses as a signal to investors. [Daubanes et al. \(2022\)](#) build a signaling model based on management’s sensitivity to abnormal earnings shocks associated with green bond announcements. The information conveyed by green bond issuing firms provides insights on the expected profitability of the firm’s green investment project. [Gao and Schmittmann \(2022\)](#) relate the green bond premium to greenwashing in the market and enforcement of carbon pricing. [Schneider \(2024\)](#) focuses on the issuer’s commitment to finance green projects. Management actively reduces its flexibility of fund allocation by choosing to issue a certified green bond over a conventional bond. This commitment is interpreted as a credible signal of greenness of the firm. The author finds lower yields in green bonds with longer maturities and that firms become less sensitive to climate concerns after issuing a green bond.

This research is also related to greenness demand literature such as [Noh et al. \(2023\)](#);

Jankowitsch et al. (2024); Bretscher et al. (2024) who examine institutional portfolio holdings following the demand system approach by Kojen and Yogo (2019). Noh et al. (2023) apply the demand based asset pricing system to the sustainable equity market. They report positive demand effects associated with third party environmental scores and low emission intensity. Investors that are signatories of the Principles for Responsible Investment (UNPRI) initiative do not show a higher demand for sustainable equity investments compared to non-signatories. They document that institutional investor's bond demand varies by investor type and can impact bond pricing. Jankowitsch et al. (2024) find that bonds issued by firms with high environmental performance have lower yields on average. Due to greenness demand, firms can reduce bond yields and expand their capital by issuing corporate bonds more frequently. They conclude that greenness demand impacts corporate behavior because the firms adjust to dynamic investor preferences which is in line with recent theoretical literature such as Dangl et al. (2023a). According to Dangl et al. (2023b), firms re-evaluate social preferences and anticipate that they will change over time. If investors do not anticipate firms to transform, the impact on asset prices will be larger as no expectation is priced in. Overall the model implies that asset prices evolve in a dynamic setting of demand and supply that reflects the perceived credibility of shareholder preferences and corporate behavior.

Finally, this research contributes to the empirical literature examining the relationship between green bond pricing and the perceived greenness of bonds. The issued green bonds are sorted into shades of green, commonly differentiating between "light green" and "dark green" shades. Where the former category includes bond emissions by firms with lower environmental ratings or less clearly communicated funding allocations. The latter category includes bonds where the quality of the financed project is established either through credibility of the issuer or characteristics of the project. The bond investors remunerate the credibility of the green bond by accepting higher prices in the secondary market. Prior research has demonstrated a positive pricing effect related to green labels (Hu et al., 2024), external reviews (Dorfleitner et al., 2022), and the

issuer's ESG rating ([Immel et al., 2021](#)). The authors argue that the credibility of the green bond helps to mitigate information asymmetries between bond investors and management and reduces greenwashing risk.

The empirical literature focuses on green bond announcements, non-financial disclosures, and green bond attributes such as green labels, external reviews and ESG ratings as signals of corporate sustainability efforts. However, little attention has been paid to underpricing as a strategic signal of issuer credibility in the green bond market. This paper investigates whether shareholder preferences are associated with underpricing of green bond issuances. More specifically, the analysis examines whether shareholder preferences are associated with the perceived credibility of issuers in the green bond market. This contributes to understanding how green bond issuances convey corporate sustainability efforts.

2.2. Hypotheses Development

The first hypothesis relates green bond issuances to signaling theory, assuming a firm with a significant proportion of shareholders with green preferences demonstrates true sustainability efforts. The informed agent is the green bond issuing firm and the uninformed agents are the bond investors. Bond investors cannot observe the quality of the green bond issuance as information on the firm type is private. The firm can send a costly signal to reveal their type and issue the green bond below its expected market value and continue to do so in seasoned offerings to signal non-pecuniary preferences. The bond investors receive the signal and reward the issuing firm by paying a premium in the secondary bond market. An equilibrium arises as the firms with higher underpricing have a greener shareholder base. Thus, the prior beliefs of the investors are confirmed as argued by [Spence \(1973\)](#).

Hypothesis 1: Green bonds issued by firms with shareholders demonstrating credible green preferences are associated with higher underpricing.

The second hypothesis is formulated based on the literature concerning institutional shareholders and corporate control, linking the preferences of shareholders to the perceived credibility of firms investing in environmentally beneficial projects through active engagement. The formation of collaborative investor networks can reduce the shareholder's costs of engagement by joining resources and influence (Dimson et al., 2025; Ringe, 2023). Significant ownership concentration can be achieved by minority shareholders that either individually or as a coalition hold a certain amount of shares. The cost of forming a coalition may be lower if the shareholders, among themselves, can identify a community with common interests (Leech, 1987). Prior literature uses a fixed 20% rule to classify a controlling shareholder or coalition within a firm's ownership structure. Leech (2001) deviates from the fixed rule and defines a more flexible minority control model that also depends on the distribution of shareholders that are not part of the controlling group (Appendix A.1). The threshold for minority shareholders to exercise control is found to be close to 20%. For large firms, it takes close to 20% of cash flow rights to exercise 20% of voting rights (La Porta et al., 1999). This simplifying assumption is borrowed for the identification of the controlling group.

Heinkel et al. (2001) provide evidence that a green shareholder base exceeding 20% can impact management's sustainability efforts. The perceived credibility of the sustainability efforts can impact a firm's cost of capital through exclusionary investing by shareholders who allocate their funds into firms they view as credible. In their equilibrium model, responsible investors categorize firms into two categories, acceptable and unacceptable, based on their level of pollution. Assets of unacceptable firms are only held by responsible investors if the firm is willing to transform. A firm is seen as transforming if more than 20% of its shareholders have green preferences. If an unacceptable firm is unwilling to transform, it has a smaller investor base, as it is only

held by neutral investors. This smaller investor base demands a higher expected return to hold an asset they would not otherwise. According to the equilibrium model, the proportion of shareholders with green preferences is perceived as a credible signal to the investors regarding the firm's willingness to transform. Implying that a large enough shareholder base can impact management's sustainability efforts. To ensure consistency with prior literature, the threshold for significant green shareholding in the empirical analysis is set to 20%.

Hypothesis 2: A firm is perceived as credible in their sustainability efforts when the shareholders are actively engaged and a significant proportion of shareholders declare green preferences.

The third hypothesis is related to the announcement effect of debt offerings under asymmetric information. In their theoretical model, [Miller and Rock \(1985\)](#) predict a negative stock market reaction to financing announcements of firms under the assumption that the manager holds private information on the true state of the firm. However, the negative stock market reaction may be mediated if information asymmetry is reduced and the firm can credibly signal a positive investment prospect. In the context of green bonds, prior empirical results are ambiguous. The seminal paper of [Flammer \(2021\)](#) finds that investors in the stock market react positively to issuance announcements and that the results are more pronounced for certified green bonds. This supports the notion, that investors value the credibility of green bond issuances. Conversely, [Lebelle et al. \(2020\)](#) find a negative stock market reaction to green bond announcements. Their results imply that investors react negatively to corporate bond announcements in general and do not differentiate between green and conventional bonds.

The recent literature on value alignment between shareholders and management discusses how non-pecuniary preferences of shareholders impact firm behavior ([Hart and Zingales](#),

2017; Wu and Zechner, 2023; Bonnefon et al., 2025). More generally, a firm can create shareholder value by taking into account their preferences. According to Bonnefon et al. (2025), shareholders invest in firms that align with their values. Thus, management may take actions, such as improving the credibility of the firm’s corporate sustainability efforts, to align with shareholders’ non-pecuniary motives and maintain their support. Consequently, management may expand its shareholder base with value-aligned investors and enhance firm value (Wu and Zechner, 2023). In the context of green bonds, management may decide to issue green bonds at a discount, to ensure a successful emission. Assuming that shareholders hold non-pecuniary preferences, management actions that signal value alignment may be associated with a less negative stock market reaction to a green bond announcement.

Hypothesis 3: Green bond announcements by firms with shareholders who exhibit credible green preferences are associated with a less pronounced negative stock market reaction.

3. Data

The data covers green bond offerings in the period between January 2016 and June 2024. The corporate green bond data is retrieved from the LSEG Green Bond Guide. To ensure consistency, the bonds are cross-references with the Bloomberg green labeled bonds³. The start of the sample period is set in 2016 to ensure an established green bond market. Over the sample period 352 corporate green bonds are issued in USD. To reconstruct the bond issuer’s institutional ownership structure, the firms are matched to equity holdings reported to the Securities and Exchange Commission (SEC). The equity holdings reported in quarterly 13F filings to the SEC are filed by institutional

³Bloomberg labels a green bond when it (a) is self-labeled as "green" by the issuer or (b) is a "sustainability-oriented bond issue" with additional information on the funds directed towards the respective project (The Green Bond Principles (2017), p.5).

investors with investment discretion over more than USD 100 million (SEC, 2025). The data is retrieved from the Wharton Research Data Services (WRDS) database. The equity holdings data over the sample period cover 7729 institutional shareholders. The matching reduces the green bond sample to 256 observations. Outliers with a Z-score larger than 3 and bonds issued by financial institutions are excluded from the sample following prior literature⁴. This reduces the green bonds sample to 212 observations. Bond covenants are gathered from the LSEG Mergent Fixed Income Securities Database (FISD) and daily over the counter trading data is obtained from the Trade Reporting and Compliance Engine (TRACE). To avoid data issues reported with TRACE data, the data is cleaned and filtered following Dick-Nielsen (2013). Bonds not traded on the offering date are removed. The bond’s credit and environmental, social, and governance (ESG) ratings are retrieved from LSEG Workspace. Firm fundamentals and daily stock prices are from The Center for Research in Security Prices (CRSP) database. The FISD, TRACE and CRSP data is retrieved from WRDS. The final sample covers 134 corporate green bonds issued by 60 firms.

3.1. Green Bond Data

Table 1 depicts the descriptive statistics of the bonds in the sample. The average time to maturity is 15.03 years. The lowest time to maturity observed in the sample is 2.02 years. The mean bond offering price is USD 996.21 and the mean offering amount is USD 605.820 milion. The bond’s credit rating in Table 1 is given in numeric form. The average credit rating of the bonds in the sample is 5.07 which is closest to credit rating A3 (Moody’s) and A- (S&P). The bond issuers have, on average, an ESG Score of 0.70.

⁴While non-financial issuers use the proceeds to finance specific projects, financial issuers commonly use green bonds to fund green loans (Fatica et al., 2021).

	Mean	SD	Min	Q1	Median	Q3	Max
Time to Maturity	15.03	10.34	2.02	8.20	10.03	30.01	40.03
Offering Price	996.21	3.98	980.71	995.06	997.55	998.91	1000.00
Credit Rating	5.07	2.53	0.00	4.00	5.00	6.00	12.00
ESG Score	0.70	0.12	0.16	0.65	0.71	0.76	0.88
Offering Amount	605,820	345,767	175,000	400,000	500,000	700,000	2,500,000

Table 1: Descriptive statistics of the sample corporate green bonds.

The underpricing variable is calculated based on [Cai et al. \(2007\)](#) using bond transaction data from TRACE and FISD. The TRACE bond price data is provided as a flat price. Consistent with [Bessembinder et al. \(2009\)](#) accrued interest is added to obtain the full bond price. The bond return over n days is defined as

$$\text{Bond Return}_{i,n} = \frac{P_{t+n} + AI_{t+n} - P_t}{P_t} \quad (1)$$

Where P_t is the bond's offering price. Variable P_{t+n} is the weighted average bond price on the first day of trading. AI_{t+n} is the accrued interest on the first trading day. The excess return over the holding period is calculated by subtracting the actual bond return by the return of a broad green bond market index⁵ over the initial trading period.

$$\text{Underpricing}_{i,n} = \text{Bond Return}_{i,n} - \prod_{j=1}^n \text{Index Return}_{i, t-n+j} \quad (2)$$

⁵For the primary analysis the Bloomberg US Corporate Green Bond Index (31563US) is used.

3.2. Institutional Ownership Data

The summary statistics of the institutional shareholders in the sample are depicted in Table 2. The number of institutional shareholders for the time period from 2015⁶ to 2017 is 3998 and increases to 6329 in time period from 2022 to 2024. The average ownership shares decrease over the sample period. In the time period from 2015 to 2017 the average ownership share is 0.09% compared to 0.07% in the time period from 2022 to 2024. The largest ownership share increases from 20.74% in the time period from 2015 to 2017 to 30.47% in the time period 2020 to 2021. The median ownership share held decrease from 0.003% in the period form 2015 to 2017 to 0.002% in the period from 2022 to 2024.

Period	N	Mean (%)	Median (%)	Max (%)
2015-2017	3998	0.091	0.003	20.739
2018-2019	4500	0.084	0.002	17.096
2020-2021	5497	0.075	0.002	30.474
2022-2024	6329	0.067	0.002	21.448

Table 2: Descriptive statistics of the sample institutional shareholders.

The identification of green preferences is based on signatory lists of CA100+ and UNPRI, initiated in 2017 and 2006, respectively. The time-varying share of institutional shareholders with green preferences is constructed by combining the reported equity holdings and the signatory dates of the shareholders. Institutional shareholder names are matched to the signatory lists using an approximate (fuzzy) string-matching algorithm. Over the sample period, 223 out of 657 CA100+ signatories are matched to the reported equity holdings. The primary source of the signatory dates is UNPRI. As CA100+ is an investor-led initiative coordinated by investor networks such as UNPRI, membership

⁶The complete sample of institutional shareholders covers the time period from October 2015 to March 2024. Institutional shareholder filings from Q4 2015 are use to reconstruct the ownership structure of green bond issuers in Q1 2016.

in one of the investor networks is a prerequisite to becoming a CA100+ signatory. The earliest possible signatory date for the CA100+ investors is the date on which they became a member of the UNPRI network. The founding CA100+ signatories are assumed to have green preferences prior to 2017. For institutional shareholders that joined an investor network other than UNPRI and their CA100+ signatory date is not publicly available, the signatory date is supplemented by press releases of CA100+.

The CA100 + signatories are classified as green and are depicted in Table 3. In the period 2015 to 2017, 100 institutional shareholders are matched to CA100+, the number increases to 206 in the period from 2022 to 2024. The average ownership share increased from 0.18% to 0.37% in the period from 2020 to 2021. The largest ownership share increases from 11.81% in the period from 2015 to 2017 to 17.89% in the period from 2022 to 2024. The median ownership share reduces to 0.016% in the period 2022 to 2024 from 0.029% in the time period 2015 to 2017. The average ownership share of the subsample is larger than the ownership share across all time periods displayed in Table 2.

Period	N	Mean (%)	Median (%)	Max (%)
2015-2017	100	0.177	0.029	11.809
2018-2019	131	0.176	0.022	11.731
2020-2021	173	0.374	0.020	14.738
2022-2024	206	0.337	0.016	17.890

Table 3: Descriptive statistics of institutional shareholder’s with green preferences.

To analyze whether active engagement matters to bond investors, a subsample of shareholders with light green preferences is constructed using signatories of UNPRI. A total of 590 UNPRI investors are matched to the reported equity holdings. The descriptive statistics of the sample are reported in Table 4. The number of institutional shareholders

increased from 213 in the period from 2015 to 2017 to 580 signatories in the period from 2022 to 2024 and the average ownership decreased from 0.47% to 0.30%. The largest ownership stake decreased slightly over the sample period. The median ownership share decreases from 0.037% in the time period from 2015 to 2017 to 0.012% in the period from 2022 to 2024. The light green category initially covers institutional shareholders with a larger average and maximum ownership shares than the dark green category. The average ownership shares are in a similar range in the time period between 2020 and 2024. The number of light green investors increased significantly in the time period from 2020 to 2021. The number of green signatories has increased more steadily over the sample period.

Period	N	Mean (%)	Median (%)	Max (%)
2015-2017	213	0.465	0.037	19.246
2018-2019	279	0.394	0.023	17.096
2020-2021	472	0.329	0.015	18.170
2022-2024	580	0.302	0.012	18.230

Table 4: Descriptive statistics of institutional shareholder's with light green preferences.

The measure of green shareholder preferences used in the empirical analysis is constructed using the reported equity holdings. The total green share in firm i at time t is defined as

$$\text{Green share all}_{i,t} = \frac{\text{Shares owned by green institutional shareholders}_{i,t}}{\text{Total shares outstanding}_{i,t}} \quad (3)$$

In line with the cutoff value at 20% of ownership, the green share variable used in the primary analysis is

$$\text{Green share}_{i,t} = \begin{cases} 0, & \text{if } 0 \leq \text{Green share all}_{i,t} \leq 0.2 \\ \text{Green share all}_{i,t}, & \text{if } 0.2 < \text{Green share all}_{i,t} \end{cases} \quad (4)$$

The firm-level institutional ownership concentration is measured by the Herfindahl-Hirschman index, based on the shares owned by each institutional investor i . The concentration index is normalized such that it takes a value between 0 and 1. The effective number of shareholders HHI_{inv} used in the primary analysis is expressed as the inverse of the Herfindahl-Hirschman index, where

$$\text{Herfindahl-Hirschman Index}_{i,t} = \sum_{j=1}^N \left(\frac{\text{Shares owned by institutional investor } j}{\text{Total shares outstanding}_{i,t}} \right)^2 \quad (5)$$

The descriptive statistics of the constructed variables are depicted in Table 5. The variable *Green share* is used as the main explanatory variable in the empirical analysis. The largest value of the green share variable is 40%. The median value is approximately 20%. Moreover, the *Green share_{light}* variable based on the subsample of shareholders with light green preferences is included in the table. The largest value of the *Green share_{light}* variable is 63% and the median value is 40%. The underpricing in the sample ranges from -32bps to +23bps. The HHI_{inv} variable depicts the effective number of shareholders and ranges from 1 for ultimate power concentration to 39 for less concentrated controlling power.

	N	Mean	SD	Min	Q1	Median	Q3	Max
Green share	134	0.125	0.124	0.000	0.000	0.202	0.241	0.400
Green share _{light}	134	0.359	0.172	0.000	0.312	0.393	0.470	0.627
Underpricing	134	0.003	0.006	-0.032	0.000	0.002	0.005	0.023
HHI _{inv}	134	17.869	7.025	1.000	14.923	18.514	21.797	38.882

Table 5: Descriptive statistics of the constructed variables.

Table 6 represents the population means of firms with a high proportion and low proportion of green shareholders. A two sided Welch’s t-test returns a p-value of 0.029. The null hypothesis of equal population means is rejected. The average underpricing over the sample green bonds is 26 bps. Firms with a lower proportion of green shareholders display, on average, lower underpricing (16 bps) than firms with a higher proportion of green shareholders (36 bps).

Group	N	Mean
Green share $\leq$ 20%	65	16 bps
Green share $>$ 20%	69	36 bps
Difference		20 bps

Table 6: Descriptive statistics of underpricing by issuer type.

3.3. ESG Characteristics

Figure 1 shows the correlation of the *ESG Score* and the uncapped *Green share all* variable. The correlation between the two variables is marginally negative at -0.02. Considering the threshold of 20%, green bond issuers with a higher proportion of green shareholders display an ESG score of close to 0.4 or higher. Conversely, the issuers with a lower proportion of green shareholders have more dispersed ESG scores.

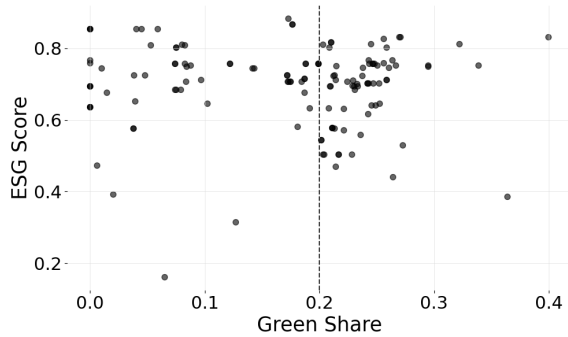


Figure 1: Correlation of the uncapped green share and ESG Score

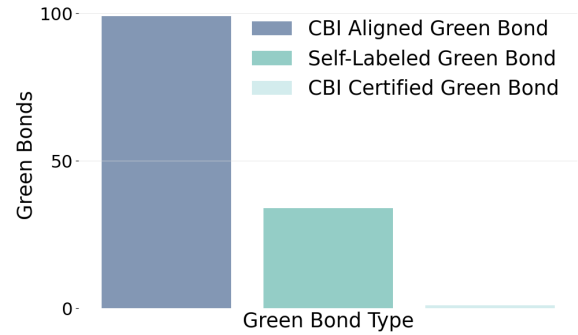


Figure 2: Green bond type distribution

Three different green bond types are included in the sample and displayed in Figure 2. The Climate Bonds Initiative (CBI) is a voluntary labelling scheme and provides a framework for taxonomy alignment and use of proceeds in line with scientific targets CBI (2025). The types are CBI aligned, CBI certified and self-labeled green bonds. The green bond label enters the empirical analysis as a dummy variable where the value is 1 if the green bond is CBI aligned or certified and 0 otherwise. CBI aligned green bonds are the most common ESG Bond Type in the sample, with 99 bonds classified under this category. Self-labeled green bonds are the second most common category, comprising 34 bonds, while only one green bond is CBI certified.

3.4. Stock Market Data

The daily stock market data of green bond issuers is from the CRSP Daily Stock Database obtained through WRDS. The main market index used in the analysis is the S&P 500 Composite Index retrieved from CRSP. Moreover, the Russell 3000 Index and green bond announcement dates are obtained from LSEG Workspace. Four bond announcements are dropped from the sample due to insufficient data availability, reducing the sample to 130 observations. The announcement date and offering date are identical for 125 observations

in the sample. The market-adjusted return is defined as

$$AR_{i,n} = R_{i,n} - R_{m,n} \quad (6)$$

and cumulated over the event window. Where $R_{i,n}$ is the stock return of firm i on day n . The variable $R_{m,n}$ is the daily market return.

4. Methodology

To explore the determinants of green bond underpricing at issuance, I calculate the following model:

$$\begin{aligned} \text{Underpricing}_{i,n} = & \beta_0 + \beta_1 \text{Green share}_{i,t-1} + \beta_2 \text{HHI}_{\text{inv}i,t-1} + \beta_3 \text{ESG Score}_{i,t} \\ & + \beta_4 \text{Bond Controls}_{i,t} + \beta_5 \text{Firm Controls}_{i,t-1} + \varepsilon_{i,t} \end{aligned} \quad (7)$$

More specifically, the model investigates if a green bond's underpricing at issuance is relates to the issuers' green institutional shareholders. To account for the controlling power of institutional shareholders irrespective of their preferences, the control variable $\text{HHI}_{\text{inv}i,t-1}$ is included. The $\text{ESG Score}_{i,t}$ is included to control for green bond demand associated with the firm's ESG rating. Several bond specific characteristics that could affect the bond investors demand for the green bond are controlled for. $\text{Bond Controls}_{i,t}$ represents the control variables *Treasury Spread*, the natural logarithm of the offering amount $\text{Ln}(\text{Amount})$, the natural logarithm of the time to maturity in years $\text{Ln}(\text{TTM})$ and the dummy variables indicating the bond type such as *Rule 144a*⁷, *Convertible*, *Global*

⁷Rule 144a is an exemption from a public trading restriction of controlled securities, such as privately placed securities (SEC, 2013).

for global issuance, *Investment Grade*, *Senior* and *CBI* alignment. *Firm Controls*_{*i,t-1*} represents control variables one quarter prior to the bond issuance and includes the financial ratios *Leverage*, *ROA*, *Turnover*, interest *Coverage*, and the natural logarithm of total assets $\ln(\text{Firm Size})$. The financial ratios are winsorized at the 1% and the 99% level. The stock market reaction is explored using the following model:

$$\begin{aligned} AR_{i,t} = & \alpha_0 + \alpha_1 \text{Issuer Credibility} + \alpha_2 \text{ESG Score}_{i,t} \\ & + \alpha_3 \text{Bond Controls}_{i,t} + \alpha_4 \text{Firm Controls}_{i,t-1} + v_{i,t} \end{aligned} \quad (8)$$

The model in equation 8 is used to assess whether the stock market reaction to a green bond announcement is related to green signaling. The dependent variable $AR_{i,t}$ is the market-adjusted return. The main explanatory variable *Issuer Credibility* includes the *Underpricing*_{*i,t*} and the *Green share*_{*i,t-1*} variables. The *ESG Score*_{*i,t*} controls for the quality of the green bond issuer. The *Bond Controls*_{*i,t*} and *Firm Controls*_{*i,t-1*} remain unchanged from equation 7. A variable overview can be found in the Appendix Table 34.

One firm can issue multiple green bonds over the sample period. To account for possible clusters in regressors and residuals the models are estimated with clustered standard errors at the firm level. The clusters are formed at the most aggregate level following (Abadie et al., 2022) which is the unique equity identifier. A Variance Inflation Factor test is performed to test for multicollinearity in the model. No significant multicollinearity is detected.

5. Results

The primary analysis investigates the relationship between shareholders' green preferences and the underpricing of green bonds. More specifically, it examines whether active shareholder engagement is related to the perceived credibility of corporate sustainability

efforts. The baseline model is estimated using the green preferences identified by CA100+ signatories, and the results are compared to a model using light green preferences based on UNPRI signatories.

5.1. Primary Analysis

The first hypothesis, which examines whether green preferences are associated with higher underpricing, is tested using the model defined in equation 7. The model output in Table 7 depicts a significant and positive relationship between green bond underpricing and a high proportion of green shareholder preferences. Moreover, having a more concentrated institutional ownership structure is related to higher underpricing as reflected in the negative HHI_{inv} coefficient. After controlling for firm characteristics in specification (4), the coefficient is marginally negative and statistically significant at the $\alpha = 0.05$ level. The result implies that firms with a more concentrated ownership structure issue their green bond below its market value. When the ownership is concentrated among a small number of shareholders the bondholders might demand a higher compensation for taking on the risk of not receiving their fixed claim (Myers, 1977). Such risk compensation takes the form of a higher yield at issuance, implying a lower issuing price and higher underpricing. The results support the first hypothesis, that green bonds issued by firms signaling credible sustainability efforts are associated with higher underpricing.

	Underpricing			
	(1)	(2)	(3)	(4)
Constant	-0.0172 (0.0184)	-0.0234 (0.0198)	-0.0235 (0.0193)	-0.0173 (0.0166)
Green share	0.0101** (0.0046)	0.0116** (0.0049)	0.0122** (0.0050)	0.0131*** (0.0048)
HHI _{inv}		-0.0001 (0.0001)	-0.0001 (0.0001)	-0.0002** (0.0001)
ESG Score			0.0052 (0.0052)	0.0016 (0.0056)
Bond Controls	Yes	Yes	Yes	Yes
Firm Controls	No	No	No	Yes
R-squared	0.2379	0.2489	0.2557	0.3188
R-squared Adj.	0.1759	0.1812	0.1819	0.2190

Table 7: OLS regression using firm-level clustered standard errors. Column (1) depicts the simplest regression function with bond controls. Columns (2) and (3) add the firm's ownership dispersion HHI and ESG Score, respectively. Specification (4) adds firm controls. Significance level: $*p < .1$, $**p < .05$, $***p < .01$. Standard errors in parentheses.

The second hypothesis investigates how bond investors perceive issuer credibility in the presence of actively engaged green shareholders. To test if green bond underpricing is related to active engagement, the model is calculated using the proportion of shareholders that signed the UNPRI initiative as a measure of light green preferences. The model output in Table 8 displays the coefficient of the *Green share_{light}* variable. The coefficient is smaller in magnitude compared to the green share coefficient in Table 7. The direction of the coefficient is positive, however, the results are not statistically significant. The magnitude and direction of all control variables is comparable to the results in Table 7.

The output in Tables 7 and 8 depict a positive relationship between green shareholder

preferences and green bond underpricing. The results are consistent with [Cai et al. \(2007\)](#) who postulate that higher quality firms are associated with higher underpricing in the bond market. In the context of green bonds this might signal a higher credibility in terms of the issuer's sustainability efforts. This can lead to higher demand for the green bond among investors with non-pecuniary motives. As discussed in [Fama and French \(2007\)](#); [Pástor et al. \(2021\)](#); [Baker et al. \(2022\)](#), investor preferences can impact asset prices. An increased demand in the bond market can increase the intrinsic value of the green bond. The results imply that bond investors reward the credibility of green bond issuing firms with higher demand in the initial bond trading period.

	Underpricing			
	(1)	(2)	(3)	(4)
Constant	-0.0122 (0.0192)	-0.0186 (0.0212)	-0.0186 (0.0209)	-0.0147 (0.0178)
Green share _{light}	0.0042 (0.0035)	0.0059 (0.0039)	0.0062 (0.0039)	0.0067 (0.0045)
HHI _{inv}		-0.0001 (0.0001)	-0.0001 (0.0001)	-0.0002* (0.0001)
ESG Score			0.0045 (0.0058)	0.0012 (0.0064)
Bond Controls	Yes	Yes	Yes	Yes
Firm Controls	No	No	No	Yes
R-squared	0.2066	0.2159	0.2209	0.2832
R-squared Adj.	0.1421	0.1452	0.1437	0.1782

Table 8: OLS regression using firm-level clustered standard errors. Column (1) depicts the simplest regression function with bond controls. Columns (2) and (3) add the firm's ownership dispersion HHI and ESG Score, respectively. Specification (4) adds firm controls. Significance level: * $p < .1$, ** $p < .05$, *** $p < .01$. Standard errors in parentheses.

The results support the hypothesis that green shareholder preferences are positively associated with the credibility of the issuing firm. Bond investors value the green bond above its offering price when shareholders demonstrate green preferences. Consistent with [Miazad \(2025\)](#) investor climate alliances can impact management across multiple channels. Aligned shareholder preferences can facilitate non-financial information disclosure and reduce information asymmetries between bond investors and management. The results are in line with [Dorffleitner et al. \(2022\)](#); [Hu et al. \(2024\)](#); [Immel et al. \(2021\)](#), who argue that issuer and firm level evaluation with a clear guidance on the shade of green can reduce the information asymmetry on the greenness of the bond. Since investors are sensitive to information asymmetries in the green bond market, a reduction of the information asymmetries reassures the quality of the green bond and mitigates the risk of green washing. The reduction of information asymmetry regarding greenness is rewarded with a higher traded green bond price.

The estimated model does not provide statistically significant results for the coefficient of light green shareholder preferences. The results suggest that bond investors do not consider light green preferences of shareholders as a credible signal of greenness. This is consistent with [Bauckloh et al. \(2023\)](#) who describe a potential credibility problem of the voluntary UNPRI network. On one hand, the absence of a reputable review mechanism is mentioned as a potential threat to the networks credibility. In addition, the financial sector may not be able to regulate itself and have a free-rider problem among late signatories. In addition, shareholders with green preferences may engage more actively in monitoring and voting than shareholders with light green preferences. More specifically, active investor climate alliances such as CA100+ may reduce the costs of shareholder engagement and proxy voting ([Miazad, 2025](#)). The second hypothesis states that active shareholder engagement is related to the perceived credibility of green bond issuers. The regression results, jointly with prior research, support the hypothesis that not only ownership thresholds, but also factors like review mechanisms and disclosure practices contribute to the perceived credibility of green bond issuing firms.

5.2. Additional Analyses

To assess the robustness of the results presented in the primary analysis, this section explores the explanatory power of the green share proxy and alternative determinants of underpricing in the green bond market. First, it is examined whether green shareholder preferences are associated with underpricing in conventional corporate bonds. Second, the role of learning effects in underpricing of green bonds is analyzed. Finally, liquidity controls are included as additional determinants of underpricing.

5.2.1. Discussion of Conventional Corporate Bonds

The first analysis investigates whether green shareholder preferences are specifically related to the underpricing of green bonds. The green shareholder preference variable is used as a proxy for the credibility of a firm's sustainability efforts. To assess the robustness of this proxy, the sample is extended to include both green and conventional corporate bonds issued by the same firms. Of the 72 green bond issuers, 43 issued green and conventional bonds in the same financial year. The extended sample covers 174 corporate bonds, of which 82 are green bonds and 92 are conventional bonds. Descriptive statistics of the extended bond sample are presented in Appendix Table 16.

	Underpricing			
	(1)	(2)	(3)	(4)
Constant	-0.0846 (0.1168)	-0.0610 (0.0921)	-0.0612 (0.0884)	-0.0734 (0.1068)
Green share	0.0387 (0.0373)	0.0320 (0.0300)	0.0316 (0.0298)	0.0238 (0.0202)
HHI		0.0005 (0.0006)	0.0006 (0.0007)	0.0007 (0.0008)
ESG Score			0.0150 (0.0154)	0.0110 (0.0131)
Bond Controls	Yes	Yes	Yes	Yes
Firm Controls	No	No	No	Yes
R-squared	0.0358	0.0389	0.0414	0.0500
R-squared Adj.	-0.0091	-0.0105	-0.0126	-0.0276

Table 9: OLS regression using firm-level clustered standard errors. The main explanatory variable is the green share variable. Significance level: $*p < .1$, $**p < .05$, $***p < .01$. Standard errors in parentheses.

The model output is reported in Table 9. While the coefficient of the *Green share* variable is positive and larger compared to the primary analysis, it is not statistically significant. Model fit reduces substantially in the extended sample. The absence of firm-level effects suggests that green shareholder preferences are relevant for green bonds specifically. There is no significant relationship to the underpricing of issued bonds when green and conventional bonds are included in the sample.

5.2.2. Discussion of Learning Effects

The signaling model of [Allen and Faulhaber \(1989\)](#) focuses on initial public offerings and argues that underpricing can be used as a credible signal when private information is first revealed to the capital market. Consistent with the signaling argument, [Cai et al. \(2007\)](#) distinguish underpricing between first-time and seasoned offerings in the corporate bond market. They find evidence of underpricing in both types of bond offerings. However, underpricing is found to be higher for bonds which are a firm's first public offering, supporting the signaling function of underpricing. In the context of green bonds, issuers might similarly signal their type through underpricing in their first bond offering. This analysis investigates whether the relationship between green shareholder preferences and underpricing changes in seasoned offerings.

For the purpose of the analysis, the sample bonds are categorized as first-time and seasoned offerings. The sample of 134 green bonds includes 56 first-time offerings and 78 seasoned offerings. The average underpricing is 19 bps for first-time offerings and 32 bps for seasoned offerings. The difference between the population means is 13 bps, but this difference is not statistically significant. To test if first-time offerings are associated with higher risk, a Levene's test is performed to assess the differences in variances. The population variances do not differ significantly. This suggests that first-time offerings are not associated with higher risk compared to seasoned offerings.

	Underpricing			
	(1)	(2)	(3)	(4)
Constant	-0.0154 (0.0187)	-0.0101 (0.0069)	-0.0165 (0.0170)	-0.0168 (0.0171)
Green share	0.0068 (0.0045)	0.0094** (0.0041)	0.0110** (0.0049)	0.0113** (0.0049)
GB _{First}	-0.0006 (0.0013)	-0.0010 (0.0010)	0.0001 (0.0011)	0.0002 (0.0011)
Green share $\times$ GB _{First}	0.0084 (0.0077)	0.0086 (0.0069)	0.0059 (0.0064)	0.0063 (0.0064)
HHI _{inv}		-0.0002** (0.0001)	-0.0002** (0.0001)	-0.0002** (0.0001)
ESG Score				0.0033 (0.0052)
Bond Controls	Yes	No	Yes	Yes
Firm Controls	No	Yes	Yes	Yes
R-squared	0.2472	0.2382	0.3266	0.3286
R-squared Adj.	0.1726	0.1830	0.2212	0.2167

Table 10: OLS regression using firm-level clustered standard errors. The main explanatory variables are the Green share, the dummy variable GB_{First}, taking value 1 if first green bond issuance and 0 otherwise, and the Green share $\times$ GB_{First} interaction term. Significance level: * $p < .1$, ** $p < .05$, *** $p < .01$. Standard errors in parentheses.

To test whether learning takes place in the bond market, a dummy is created with value one if the green bond is the issuer's first green bond issuance and zero otherwise. Table 10 depicts the regression output featuring the dummy variable GB_{First} and the interaction term $Green\ share \times GB_{First}$. The dummy coefficient is marginal and not statistically significant. The results suggest no significant association between underpricing and being a first-time issuer. The coefficient of the interaction term is positive and not statistically

significant. There is no significant difference in the relationship between underpricing and shareholders with green preferences between first-time and seasoned green bond issuers. The coefficient of the *Green share* variable is positive and statistically significant after controlling for firm-specific characteristics. This implies higher underpricing of green bond issuances where a high proportion of shareholders has green preferences. The persistence of underpricing is in line with prior literature.

5.2.3. Discussion of Bond Liquidity

According to [Ellul and Pagano \(2006\)](#) the underpricing observed in seasoned assets supports the notion that information asymmetries are not the only determinant of underpricing. They postulate that liquidity risk might impact the excess return on the first day of trading and thus underpricing. To test whether underpricing in the green bond sample is attributed to liquidity risks, three proxies are included as control variables. First, the number of trades $\ln(\text{Trade Count})$ and the price range $\ln(\text{Price Range})$ on the first day of trading are included. The price range is the difference between the lowest and the highest price paid on the first day of trading. Second, the *Liquidity* measure by [Amihud \(2002\)](#) is used to account for the price impact of bond orders. A high *Liquidity* measure implies that a bond's price is more sensitive to bond orders relative to its trading volume (see equation 9 in Appendix). Such a bond is less liquid and provides a larger compensation to the bond holders. Although the *Liquidity* measure was introduced for the equity market, prior literature such as [Friewald et al. \(2012\)](#) use it as a liquidity proxy for the bond market. The model output is depicted in Table 11.

	Underpricing			
	(1)	(2)	(3)	(4)
Constant	-0.0168 (0.0196)	-0.0221 (0.0211)	-0.0229 (0.0209)	-0.0182 (0.0171)
Green share	0.0098** (0.0046)	0.0111** (0.0048)	0.0116** (0.0049)	0.0115** (0.0045)
Liquidity	0.0039** (0.0017)	0.0038** (0.0019)	0.0038** (0.0017)	0.0046*** (0.0015)
Ln(Price Range)	0.0009 (0.0009)	0.0009 (0.0010)	0.0009 (0.0010)	0.0010 (0.0009)
Ln(Trade Count)	0.0003 (0.0003)	0.0003 (0.0003)	0.0002 (0.0003)	0.0002 (0.0003)
HHI		-0.0001 (0.0001)	-0.0001 (0.0001)	-0.0001 (0.0001)
ESG Score			0.0054 (0.0052)	-0.0003 (0.0052)
Bond Controls	Yes	Yes	Yes	Yes
Firm Controls	No	No	No	Yes
R-squared	0.3044	0.3121	0.3191	0.3967
R-squared Adj.	0.2291	0.2312	0.2326	0.2899

Table 11: OLS regression using firm-level clustered standard errors. Liquidity proxies included as control variables. Significance level: $*p < .1$, $**p < .05$, $***p < .01$. Standard errors in parentheses.

The model results show that the price range and trade count coefficient are marginal and positively related to underpricing. The two proxies are not statistically significant across all specifications. The results suggest that the trade count and price range are not the driving factors behind the underpricing. The *Liquidity* measure is positively and significantly related to underpricing, implying that green bonds with low liquidity

are associated with higher excess returns. The result is in line with liquidity models such as [Ellul and Pagano \(2006\)](#) which relates lower liquidity to higher underpricing. In the context of green bonds, controlling for liquidity does not change the results of the primary analysis. The *Green share* coefficient is positive and statistically significant after controlling for price range, trade count and price impact of trading volume. This implies, that the relationship between the green investor share and underpricing is not exclusively determined by the investigated bond liquidity factors.

5.3. Stock Market Signaling

The final part of the analysis focuses on stock market signaling of green bond announcements. The aim is to assess the third hypothesis on how equity investors react to green bond announcements. To capture the initial stock market reaction to a green bond's information disclosure, the event date is defined as the green bond announcement. Since 125 out of 130 announcements coincide with the offering date, the bond announcement is likely to convey price information. The expected returns are calculated based on a 200 trading day event window prior to the announcement date with intervals $[-220, -21]$. The event window time interval is $[-5, 5]$ where the announcement date is equal to time 0. The time interval for the event window is commonly used in prior literature such as [Lebelle et al. \(2020\)](#). An extended time interval shown in Appendix Figure 4 supports the assumption that information is incorporated into the stock price prior to the announcement date.

Table 12 presents the results for the third hypothesis, which relates green shareholder preferences to the stock market reaction on green bond announcements. The stock market reacts negatively overall, the market adjusted return using the S&P 500 is marginally negative and significant. The test windows with time intervals $[-15, -5]$ and $[5, 15]$ display positive and not statistically significant results. The test windows assess movements in the stock market that are likely unrelated to the bond announcement. To test for robustness, the market adjusted return is calculated using the Russell 3000

index. The market adjusted return is negative and not statistically significant at the $\alpha=0.05$ level. The direction and magnitude is comparable to the main result using the S&P 500 index. The sample green bond announcements are associated with a negative stock market reaction in line with prior literature.

Event Window	N	AR	SE	t-stat	p-value
AR _{S&P 500}					
[-5, 5]	130	-0.015**	0.007	-2.039	0.043
[-15, -5]	130	0.004	0.004	0.766	0.445
[5, 15]	130	0.002	0.006	0.395	0.693
AR _{Russell 3000}					
[-5, 5]	130	-0.014*	0.007	-1.950	0.053
[-15, -5]	130	0.005	0.006	0.783	0.435
[5, 15]	130	0.003	0.006	0.509	0.611

Table 12: Market-adjusted returns (AR) using firm-level clustered standard errors. Significance level: * $p < .1$, ** $p < .05$, *** $p < .01$.

To test the signaling power of green bond announcements, the market-adjusted returns are calculated for the subsample of non-green firms. Table 13 displays the results for the subset of bond issuers. The subsample of non-green firms exhibits statistically significant negative market-adjusted returns around green bond announcements. The magnitude of the stock market reaction is larger for the subsample. The robustness is tested using the Russell 3000 index to control for a broader market. The magnitude and direction of the market-adjusted returns is in line with the baseline result displayed in Table 12.

Event Window	N	AR	SE	t-stat	p-value
AR _{S&P 500}					
[-5, 5]	61	-0.031***	0.011	-2.727	0.008
[-15, -5]	61	0.007	0.009	0.734	0.466
[5, 15]	61	0.009	0.006	1.479	0.144
AR _{Russell 3000}					
[-5, 5]	61	-0.030**	0.011	-2.632	0.011
[-15, -5]	61	0.007	0.010	0.717	0.476
[5, 15]	61	0.009	0.006	1.495	0.140

Table 13: Market-adjusted returns (AR) for non-green firms using firm-level clustered standard errors. Significance level: * $p < .1$, ** $p < .05$, *** $p < .01$.

The model defined in equation 8 is estimated to assess the relationship between the stock market reaction and green bond issuer credibility. The results are presented in Table 14. Underpricing and green shareholder preferences are positively related to market-adjusted returns. The coefficients are statistically significant at the $\alpha = 0.05$ level. Firm characteristics capture some of the relationship between green shareholder preferences and the stock market reaction as displayed in column (4). Overall, the stock market reaction is less negative for green bond announcements with higher underpricing or a higher proportion of green shareholders. This supports the hypothesis that underpricing of green bonds signals credible sustainability efforts to the market. The result are consistent with the signaling framework by Spence (1973), where a costly signal such as green bond underpricing is rewarded by the stock market with a less negative reaction to a green bond announcement. The result supports the value-alignment view of shareholders with non-pecuniary preferences, assuming management can credibly signal corporate sustainability efforts.

	AR _{S&P500}			
	(1)	(2)	(3)	(4)
Constant	0.2442 (0.2039)	0.1732 (0.2201)	0.0575 (0.2169)	0.0777 (0.2205)
Underpricing	0.0415** (0.0203)	0.0376** (0.0168)		
Green share			0.1625** (0.0700)	0.1395** (0.0657)
ESG Score		0.0571 (0.0804)		0.0765 (0.0784)
Bond Controls	Yes	Yes	Yes	Yes
Firm Controls	No	Yes	No	Yes
R-squared	0.1695	0.2940	0.1527	0.2727
R-squared Adj.	0.0998	0.1940	0.0815	0.1697

Table 14: OLS regression using firm-level clustered standard errors. The dependent variable is market-adjusted return, the main explanatory variables are underpricing and green share. The Underpricing variable is scaled by 100. Significance level: * $p < .1$, ** $p < .05$, *** $p < .01$. Standard errors in parentheses.

6. Conclusion

This paper examines the relationship between institutional shareholders with green preferences and green bond underpricing. The empirical results show that credible green preferences are positively associated with underpricing. Shareholders' preferences are considered credible when they are members of climate alliances with active engagement practices. Active engagement may reduce information asymmetries between shareholders, management, and bond investors which may impact the firm's practices. The results are consistent with the hypothesis that underpricing may serve as a signal of credible sustainability efforts.

No significant association is found for institutional shareholders with light green preferences, potentially due to the absence of review mechanisms and free-rider problems highlighted by prior literature. Moreover, no relationship is found between green shareholder preferences and underpricing when conventional and green bonds are analyzed jointly. This suggests that the effect is specific to green bonds and that membership in investor climate alliances is primarily recognized by investors in the green bond market. The absence of firm-level effects further indicates that the proportion of shareholders with green preferences does not merely proxy for the presence of large institutional investors but informs green bond investors specifically.

The analysis demonstrates that green shareholder preferences are only associated with bond pricing when their ownership share is large enough to exercise control. Consistent with prior literature, an ownership threshold above twenty percent is used to define a credible green shareholder base. Overall, the findings suggest that green bond underpricing is positively associated with issuers that have actively engaged shareholders capable of exercising control. The evidence supports the hypothesis that investors with non-pecuniary motives value the quality of non-financial disclosures and signaling in the green bond market. Underpricing is not associated with learning effects. While bond liquidity is associated with underpricing, it does not affect the relationship between institutional shareholder preferences and underpricing.

Finally, the study examines stock market reactions to green bond announcements and the role of underpricing in stock market signaling. The results align with a signaling framework in which underpricing in green bonds serves as a costly signal of issuer credibility. Underpricing is positively related to market-adjusted returns around green bond announcements, which reinforces the hypothesis that underpricing credibly signals green bond quality. The paper contributes to the literature on price signaling in the green bond

market and value-alignment between institutional owners and corporate sustainability efforts. Future research could examine green bond allocation in the primary market. The preferences of initial bondholders could give insights into liquidity in the secondary market and clarify the relationship between shareholders' and bondholders' incentives in the green bond market.

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A. Appendix

A.1. Minority Control Model

The model depicted in Figure 3 shows the ownership concentration and the controlling power functions by Leech (2001). The x-axis depicts an increasing coalition size k . The y-axis depicts the controlling power in a firm. Point MC marks a majority coalition and k^* marks a minority coalition that has ownership concentration of less than 50%. The minority coalition owns shares S_k^* and holds close to ultimate controlling power Π^* of the firm.

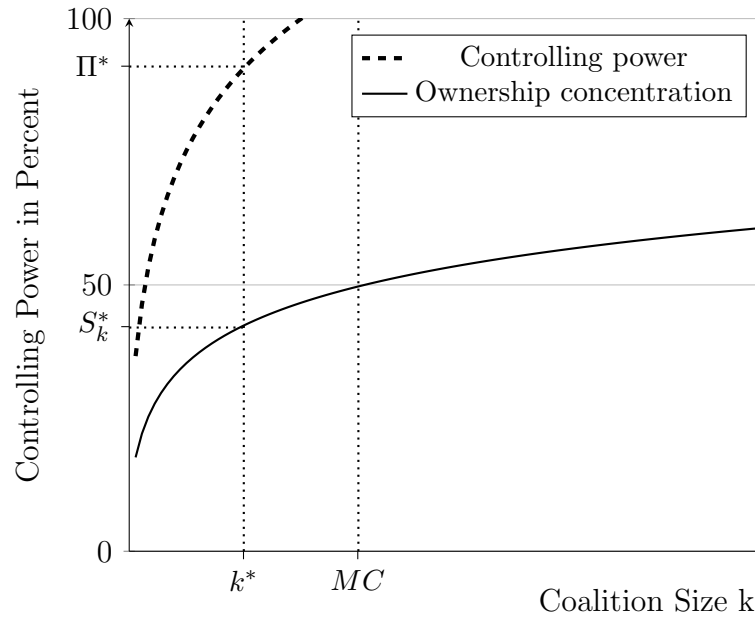


Figure 3: The Minority Control Model by Leech (1987, 2001)

The threshold for a controlling group of minority shareholders to exercise firm control via common voting behavior is found to be close to 20%. The threshold is adopted for the

analysis as it is assumed that shareholders with green preferences can form controlling groups if the costs of forming a coalition are effectively reduced. Investor alliances such as CA100+ can reduce the costs of identifying a group of shareholders with common interests.

A.2. Additions to the Primary Analysis

The model output in Table 15 shows the main regression table with all variables. The coefficient of the time to maturity is positive and significant in all model specifications. The coefficient of the Rule 144a dummy is positive and statistically significant at the $\alpha = 0.05$ level in (4). The underpricing is positively associated with the Rule 144a which may affect the liquidity of the bond.

	Underpricing			
	(1)	(2)	(3)	(4)
Constant	-0.0172 (0.0184)	-0.0234 (0.0198)	-0.0235 (0.0193)	-0.0173 (0.0166)
Green share	0.0101** (0.0046)	0.0116** (0.0049)	0.0122** (0.0050)	0.0131*** (0.0048)
Treasury Spread	0.0865 (0.0644)	0.0760 (0.0616)	0.0706 (0.0617)	0.0737 (0.0640)
Ln(Amount)	0.0009 (0.0013)	0.0014 (0.0014)	0.0012 (0.0013)	0.0000 (0.0013)
Ln(TTM)	0.0027*** (0.0008)	0.0027*** (0.0008)	0.0028*** (0.0008)	0.0020** (0.0008)
Rule 144a	0.0052* (0.0027)	0.0049* (0.0026)	0.0047* (0.0025)	0.0052** (0.0026)
Convertible	-0.0087	-0.0087	-0.0070	-0.0012

	(0.0073)	(0.0073)	(0.0071)	(0.0062)
Global	-0.0008	-0.0003	-0.0002	-0.0004
	(0.0011)	(0.0011)	(0.0011)	(0.0011)
Investment Grade	-0.0008	-0.0004	-0.0008	-0.0004
	(0.0009)	(0.0009)	(0.0009)	(0.0009)
Senior	0.0010	0.0011	0.0011	0.0009
	(0.0013)	(0.0014)	(0.0014)	(0.0015)
CBI	0.0004	0.0004	0.0003	0.0006
	(0.0010)	(0.0010)	(0.0009)	(0.0010)
HHI _{inv}		-0.0001	-0.0001	-0.0002**
		(0.0001)	(0.0001)	(0.0001)
ESG Score			0.0052	0.0016
			(0.0052)	(0.0056)
Ln(Firm Size)				0.0012*
				(0.0006)
Leverage				0.0018
				(0.0032)
ROA				0.1240*
				(0.0646)
Turnover				0.0077
				(0.0086)
Coverage				-0.0002**
				(0.0001)
R-squared	0.2379	0.2489	0.2557	0.3188
R-squared Adj.	0.1759	0.1812	0.1819	0.2190

Table 15: OLS regression using firm-level clustered standard errors. Column (1) depicts the simplest regression function with bond controls. Columns (2) and (3) add HHI_{inv} and ESG Score, respectively. Specification (4) adds firm controls. Significance level: * $p < .1$, ** $p < .05$, *** $p < .01$. Standard errors in the parentheses.

A.3. Additions to Conventional Corporate Bonds

The extended sample covers 174 corporate bonds, of which 82 are green bonds and 92 are conventional bonds. The average time to maturity is 17,21 years. The average offering price and offering amount are USD 990,51 and USD 897.706 respectively. The mean numeric credit rating is 4.47 which is approximately A3 (Moody's) and A- (S&P).

	Mean	SD	Min	Q1	Median	Q3	Max
Time to Maturity	17.21	11.45	1.96	9.99	10.14	30.02	50.01
Offering Price	990.51	73.72	25.00	994.76	997.38	998.91	1000.00
Credit Rating	4.47	2.46	0.00	4.00	5.00	6.00	11.00
Offering Amount	897,706	776,309	100,000	500,000	600,000	1,000,000	4,626,005

Table 16: Descriptive statistics of extended bond sample. The table shows the characteristics of the conventional and green bonds in the sample.

A.4. Additions to Bond Liquidity

The liquidity proxy by [Amihud \(2002\)](#) is used to account for the price impact of the bond orders. The proxy is expressed as the daily absolute bond return divided by the daily trading volume in USD provided by TRACE. To improve interpretability, the value is scaled by a factor of 10^9 .

$$\text{Liquidity}_{i,n} = 10^9 \times \frac{|\text{Bond Return}_{i,n}|}{\text{Volume}_{i,n}} \quad (9)$$

A.5. Additions to Stock Market Signaling

The graph 4 depicts the average market adjusted returns over an extended event window. The green bond announcement is associated with a negative stock price reaction. The

average adjusted return is plotted against the distance to the bond announcement in trading days and shows when information on the bond is incorporated in the stock market price. The information is incorporated in the stock price prior to the bond announcement. The adjusted return enters a downward trend six trading days prior to the announcement and starts moving upward five trading days after the bond announcement.

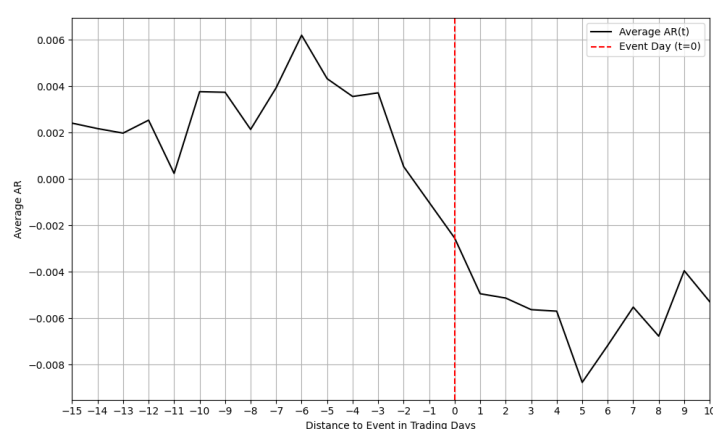


Figure 4: Market adjusted return using S&P 500 Index

A.6. Discussion of Industry Groups

The following analysis splits the sample green bonds into GICS industry groups. Table 17 holds the sample distribution in columns "Company (%)" and "Bond (%)" and the average green shareholders in column "Green Share (%)" across all firms in the industry group. The Consumer Services sector comprises 6.72% of bonds in the sample. The average proportion of green shareholders is 12.89% which is the second lowest in the sample. The industry groups Electric Utilities and Real Estate & Financial Services are the largest groups of green bond issuers. Real Estate & Financial Services has the highest green preference share.

Industry Group	Company (%)	Bond (%)	Green Share (%)	GICS Industries
Communication Technology	8.33	12.69	8.86	Div. Telecommunication Services, Semiconductors & Equipment, Media
Consumer Services	8.33	6.72	12.89	Automobiles, Beverages, Consumer Staples Distribution & Retail
Multi Utilities	20.84	20.16	17.82	Multi-Utilities, Independent Power and Renewable Electricity Producers
Electric Utilities	23.61	28.35	16.01	Electric Utilities
Real Estate & Financial Services	23.61	20.89	22.73	Office-, Industrial-, Health Care-,Retail-, Residential-, and Diversified REITs, Insurance, Financial Services
Industrials & Materials	15.28	11.19	18.77	Chemicals, Machinery, Containers & Packaging, Ground Transportation

Table 17: Sample distribution of green bond emitting firms and average green share across Global Industry Classification Standard (GICS) industry groups.

Table 18 depicts the regression output using interaction terms of the *Green share* variable and an industry group dummy. The columns (1)-(5) represent different model specifications. The industry group with most green bonds in the sample Electric Utilities is not statistically significant. The coefficient of Consumer Services is positive and statistically significant at the 1% level for all specifications. The coefficient of Industrials & Materials is positive and significant at the 5% and 1% significance level in specifications (1), (3), (4) and (5). The results suggest that green preferences of shareholders are related to underpricing in the industry group Consumer Services across all specifications.

	Underpricing				
	(1)	(2)	(3)	(4)	(5)
Constant	0.0015** (0.0007)	0.0003 (0.0012)	-0.0182 (0.0204)	-0.0277 (0.0178)	-0.0277 (0.0177)
Communication Technology	-0.0032 (0.0032)	-0.0061* (0.0035)	0.0018 (0.0070)	0.0215 (0.0144)	0.0216 (0.0144)
Consumer Services	0.0456*** (0.0036)	0.0424*** (0.0039)	0.0467*** (0.0065)	0.0514*** (0.0075)	0.0501*** (0.0071)
Multi Utilities	0.0199** (0.0090)	0.0176* (0.0088)	0.0138 (0.0091)	0.0173* (0.0095)	0.0160 (0.0099)
Electric Utilities	0.0090* (0.0046)	0.0085* (0.0044)	0.0050 (0.0043)	0.0065 (0.0045)	0.0058 (0.0045)
Real Estate & Financial Services	0.0011 (0.0033)	-0.0006 (0.0035)	0.0042 (0.0037)	0.0049 (0.0056)	0.0044 (0.0058)
Industrials & Materials	0.0130** (0.0053)	0.0115* (0.0062)	0.0219** (0.0108)	0.0394*** (0.0088)	0.0378*** (0.0097)
ESG Score				0.0027 (0.0049)	0.0030 (0.0049)
HHI _{inv}				-0.0002** (0.0001)	-0.0001* (0.0001)
Bond Controls	No	No	Yes	Yes	Yes
Firm Controls	No	No	No	Yes	Yes
Time Dummy	No	Yes	Yes	No	Yes
R-squared	0.1055	0.1237	0.3078	0.3900	0.3930
R-squared Adj.	0.0633	0.0750	0.2131	0.2691	0.2661

Table 18: OLS regression using firm-level clustered standard errors. The main independent variables are the GICS sector interaction terms. Time dummy included for Q4 2019 to Q3 2023. The interaction term is calculated using the *Green share* variable. Significance level: * $p < .1$, ** $p < .05$, *** $p < .01$. Standard errors in parentheses.

A.7. Discussion of Green Investor Clusters

To test if underpricing is related to characteristics of institutional investors holding equity in the bond issuing firm, clusters of green institutional investors are included as controls. The clusters are formed using cosine dissimilarity of mixtures of von Mises-Fisher distributions (Hornik and Grün, 2014). Institutional investors are divided into clusters based on the similarity of their equity portfolios at the time of green bond issuance. More specifically, each cluster is formed based on whether institutional investors hold equity in the bond issuing firms at the time of green bond issuance and how similar the holdings are compared to their peers. Table 19 shows results of the cluster analysis based on a binary incidence matrix. The institutional investors are divided into clusters based on whether they are invested in the bond issuer at the time of issuance, irrespective of the size of their holding. The first cluster includes the institutional investors with the most dissimilar holdings. The cluster controls depict the relative share of green investors in each cluster. The fourth cluster holds the institutional investors with most similar holdings across investors.

The coefficients of the institutional investor clusters are not statistically significant across all specifications. The coefficients of *Cluster 3* and *Cluster 4* are consistently negative. The *Green share* coefficients is significant at the 5% significance level and of larger magnitude compared to the baseline results depicted in Table 7. While not statistically significant, the presence of institutional investors more heavily invested in firms at the time of green bond issuance is negatively related to underpricing. The presence of investors that simultaneously invest in other green bond issuers does not have a statistically significant relationship to underpricing of green bonds. The results suggest that institutional investor clusters across green bond issuers do not explain the relationship between green shareholder preferences and underpricing.

	Underpricing			
	(1)	(2)	(3)	(4)
Constant	-0.0078 (0.0191)	-0.0072 (0.0187)	-0.0080 (0.0186)	-0.0088 (0.0179)
Green share	0.0138** (0.0061)	0.0146** (0.0061)	0.0150** (0.0063)	0.0150** (0.0058)
HHI _{inv}		-0.0002 (0.0001)	-0.0002 (0.0001)	-0.0002 (0.0001)
ESG Score			0.0051 (0.0057)	0.0012 (0.0061)
Cluster 1	-0.0035 (0.0068)	0.0018 (0.0066)	0.0008 (0.0069)	-0.0012 (0.0073)
Cluster 2	0.0041 (0.0043)	0.0112 (0.0070)	0.0105 (0.0071)	0.0053 (0.0065)
Cluster 3	-0.0025 (0.0043)	-0.0016 (0.0046)	-0.0008 (0.0045)	-0.0018 (0.0050)
Cluster 4	-0.0076 (0.0057)	-0.0050 (0.0062)	-0.0059 (0.0061)	-0.0040 (0.0068)
Bond Controls	Yes	Yes	Yes	Yes
Firm Controls	No	No	No	Yes
R-squared	0.2620	0.2742	0.2805	0.3282
R-squared Adj.	0.1752	0.1819	0.1821	0.2022

Table 19: OLS regression using firm-level clustered standard errors. Investor clusters added as controls. Significance level: $*p < .1$, $**p < .05$, $***p < .01$. Standard errors in parentheses.

B. Robustness Checks

The first part of this section examines the robustness of the primary analysis and the second part examines the robustness of the stock market signaling results.

B.1. Robustness of Primary Analysis

B.1.1. Use of HAC Robust Standard Errors

The following table displays the baseline regression with heteroskedasticity and autocorrelation (HAC) robust standard errors with lag 3. The results are comparable in significance with the baseline results. The coefficients of the green share and rule 144a in specification (3) are now significant at the 1% and 5% significance level respectively, compared to 5% and 10% significance in the baseline model.

	Underpricing			
	(1)	(2)	(3)	(4)
Constant	-0.0172 (0.0157)	-0.0234 (0.0176)	-0.0235 (0.0172)	-0.0173 (0.0149)
Green share	0.0101** (0.0044)	0.0116** (0.0047)	0.0122*** (0.0046)	0.0131*** (0.0044)
Treasury Spread	0.0865 (0.0568)	0.0760 (0.0537)	0.0706 (0.0544)	0.0737 (0.0617)
Ln(Amount)	0.0009 (0.0011)	0.0014 (0.0012)	0.0012 (0.0012)	0.0000 (0.0011)
Ln(TTM)	0.0027*** (0.0007)	0.0027*** (0.0007)	0.0028*** (0.0007)	0.0020*** (0.0006)
Rule 144a	0.0052** (0.0021)	0.0049** (0.0020)	0.0047** (0.0019)	0.0052*** (0.0018)
Convertible	-0.0087 (0.0071)	-0.0087 (0.0070)	-0.0070 (0.0071)	-0.0012 (0.0061)

Global	-0.0008 (0.0011)	-0.0003 (0.0012)	-0.0002 (0.0012)	-0.0004 (0.0011)
Investment Grade	-0.0008 (0.0011)	-0.0004 (0.0012)	-0.0008 (0.0011)	-0.0004 (0.0012)
Senior	0.0010 (0.0012)	0.0011 (0.0011)	0.0011 (0.0011)	0.0009 (0.0011)
CBI	0.0004 (0.0011)	0.0004 (0.0011)	0.0003 (0.0011)	0.0006 (0.0011)
HHI		-0.0001 (0.0001)	-0.0001 (0.0001)	-0.0002** (0.0001)
ESG Score			0.0052 (0.0055)	0.0016 (0.0058)
Ln(Firm Size)				0.0012* (0.0006)
Leverage				0.0018 (0.0028)
ROA				0.1240** (0.0624)
Turnover				0.0077 (0.0068)
Coverage				-0.0002** (0.0001)
R-squared	0.2379	0.2489	0.2557	0.3188
R-squared Adj.	0.1759	0.1812	0.1819	0.2190

Table 20: OLS regression using HAC robust standard errors with lag = 3. Significance level: * $p < .1$, ** $p < .05$, *** $p < .01$. Standard errors in parentheses.

B.1.2. Use of Alternative Green Share Proxy

The following table depicts the results using the alternative green share proxy $Green\ share_{inst}$ following Wiedemann (2023). The proportion of shareholders with green preferences is put in relation to the total shares held by institutional shareholders. The direction and magnitude of the coefficients are comparable to the baseline results.

	Underpricing			
	(1)	(2)	(3)	(4)
Constant	-0.0080 (0.0179)	-0.0134 (0.0183)	-0.0130 (0.0178)	-0.0104 (0.0161)
Green share _{inst}	0.0084* (0.0048)	0.0110** (0.0048)	0.0110** (0.0048)	0.0115** (0.0045)
HHI		-0.0001 (0.0001)	-0.0001 (0.0001)	-0.0002* (0.0001)
ESG Score			0.0032 (0.0055)	-0.0008 (0.0058)
Bond Controls	Yes	Yes	Yes	Yes
Firm Controls	No	No	No	Yes
R-squared	0.2173	0.2294	0.2321	0.2968
R-squared Adj.	0.1537	0.1599	0.1560	0.1937

Table 21: OLS regression using firm-level clustered standard errors. Including alternative green share proxy $Green\ share_{inst}$. Significance level: * $p < .1$, ** $p < .05$, *** $p < .01$. Standard errors in parentheses.

B.1.3. Use of a Time Dummy

Table 22 includes a time dummy for the period with a sharp increase in institutional investors Q4 2019 to Q3 2023. The green share coefficient of the analysis are consistent in direction and magnitude with the baseline results in Table 7. However, the specification

(1) and (4) results differ in terms of statistical significance level from the results in the baseline model. Since direction and magnitude are comparable, the results are considered robust.

	Underpricing			
	(1)	(2)	(3)	(4)
Constant	-0.0188 (0.0186)	-0.0238 (0.0196)	-0.0239 (0.0191)	-0.0180 (0.0168)
Green share	0.0088* (0.0046)	0.0102** (0.0048)	0.0107** (0.0050)	0.0116** (0.0049)
HHI		-0.0001 (0.0001)	-0.0001 (0.0001)	-0.0001* (0.0001)
ESG Score			0.0058 (0.0051)	0.0022 (0.0055)
Bond Controls	Yes	Yes	Yes	Yes
Firm Controls	No	No	No	Yes
Time Dummy	Yes	Yes	Yes	Yes
R-squared	0.2563	0.2637	0.2720	0.3279
R-squared Adj.	0.1892	0.1906	0.1931	0.2226

Table 22: OLS regression using firm-level clustered standard errors. Including time dummy. Significance level: * $p < .1$, ** $p < .05$, *** $p < .01$. Standard errors in parentheses.

B.1.4. Use of Alternative Bond Market Index

The output in Table 23 is calculated using the Bloomberg US Corporate Bond Index as daily market return benchmark compared to a green bond index in the baseline model. The results using the Bloomberg US Corporate Bond Index are robust compared to the primary analysis.

	Underpricing			
	(1)	(2)	(3)	(4)
Constant	-0.0142 (0.0185)	-0.0208 (0.0199)	-0.0209 (0.0186)	-0.0139 (0.0166)
Green share	0.0117** (0.0048)	0.0119** (0.0051)	0.0127** (0.0052)	0.0139** (0.0054)
HHI _{inv}		-0.0001 (0.0001)	-0.0001 (0.0001)	-0.0001 (0.0001)
ESG Score			0.0103* (0.0057)	0.0067 (0.0064)
Bond Controls	Yes	Yes	Yes	Yes
Firm Controls	No	No	No	Yes
Time Dummy	No	Yes	Yes	Yes
R-squared	0.2217	0.2430	0.2670	0.3134
R-squared Adj.	0.1584	0.1679	0.1876	0.2059

Table 23: OLS regression using firm-level clustered standard errors. Alternative bond index used. Significance level: $*p < .1$, $**p < .05$, $***p < .01$. Standard errors in parentheses.

B.1.5. Exclusion of Control Variables

Table 24 presents the results when HHI_{inv} and ESG Score are excluded from the set of control variables. The coefficient of the *Green share* in columns (2) and (3) is comparable in significance, magnitude and direction to the baseline model. The relationship between underpricing and green shareholder preferences is partially explained by the time dummy, since the magnitude of the coefficient reduces in column (4).

	Underpricing			
	(1)	(2)	(3)	(4)
Constant	0.0016** (0.0008)	-0.0172 (0.0184)	-0.0099 (0.0157)	-0.0119 (0.0161)
Green share	0.0087** (0.0041)	0.0101** (0.0046)	0.0100** (0.0044)	0.0085* (0.0044)
Bond Controls	No	Yes	Yes	Yes
Firm Controls	No	No	Yes	Yes
Time Dummy	No	No	No	Yes
R-squared	0.0377	0.2379	0.2935	0.3089
R-squared Adj.	0.0304	0.1759	0.2036	0.2144

Table 24: OLS regression using firm-level clustered robust standard errors. The explanatory variables HHI_{inv} and $ESG\ Score$ are excluded from the set of control variables. Significance level: * $p < .1$, ** $p < .05$, *** $p < .01$. Standard errors in parentheses.

B.1.6. Use of Relative Ranks

Table 25 uses relative ranks instead of winsorized (1% and 99%) firm specific control variables *Leverage*, *ROA*, *Coverage* and *Turnover*. Columns (1) and (2) use the green share variable without the 20% threshold and columns (3) and (4) use the green share variable with 20% cutoff. The results are comparable to the baseline model.

	Underpricing			
	(1)	(2)	(3)	(4)
Constant	-0.0116 (0.0188)	-0.0118 (0.0189)	-0.0157 (0.0189)	-0.0160 (0.0188)
Green share			0.0131** (0.0053)	0.0114** (0.0052)
Green share all	0.0151** (0.0068)	0.0115 (0.0071)		
HHI _{inv}	-0.0002* (0.0001)	-0.0001 (0.0001)	-0.0001* (0.0001)	-0.0001 (0.0001)
ESG Score	0.0045 (0.0055)	0.0049 (0.0054)	0.0063 (0.0054)	0.0065 (0.0053)
Ln(Firm Size)	0.0002 (0.0004)	0.0001 (0.0004)	0.0004 (0.0004)	0.0002 (0.0004)
Coverage _{rank}	-0.0019 (0.0021)	-0.0021 (0.0021)	-0.0017 (0.0020)	-0.0019 (0.0020)
Turnover _{rank}	0.0017 (0.0020)	0.0019 (0.0019)	0.0019 (0.0018)	0.0022 (0.0018)
ROA _{rank}	0.0020 (0.0020)	0.0012 (0.0020)	0.0014 (0.0019)	0.0006 (0.0019)
Leverage _{rank}	0.0015 (0.0015)	0.0017 (0.0015)	0.0017 (0.0015)	0.0017 (0.0015)
Bond Controls	Yes	Yes	Yes	Yes
Time Dummy	No	Yes	No	Yes
R-squared	0.2667	0.2795	0.2828	0.2986
R-squared Adj.	0.1592	0.1667	0.1777	0.1888

Table 25: OLS regression using firm-level clustered robust standard errors. The main explanatory variables are Green share all and Green share. The firm characteristics are relative ranks. Significance level: $*p < .1$, $**p < .05$, $***p < .01$. Standard errors in parentheses.

B.1.7. Use of Continuous Green Share

Table 26 holds the calculation using the continuous variable *Green share all*. The coefficients of the green share are not statistically significant at the 1% or 5% level. The direction and magnitude are comparable to the baseline results.

	Underpricing			
	(1)	(2)	(3)	(4)
Constant	-0.0115 (0.0181)	-0.0190 (0.0192)	-0.0187 (0.0187)	-0.0143 (0.0167)
Green share all	0.0115* (0.0061)	0.0124* (0.0069)	0.0125* (0.0069)	0.0129* (0.0073)
HHI		-0.0001 (0.0001)	-0.0001 (0.0001)	-0.0002* (0.0001)
ESG Score			0.0047 (0.0051)	0.0010 (0.0057)
Bond Controls	Yes	Yes	Yes	Yes
Firm Controls	No	No	No	Yes
Time Dummy	No	Yes	Yes	Yes
R-squared	0.2254	0.2527	0.2582	0.3116
R-squared Adj.	0.1624	0.1786	0.1779	0.2038

Table 26: OLS regression using firm-level clustered robust standard errors. The main explanatory variable is *Green share all*. Significance level: * $p < .1$, ** $p < .05$, *** $p < .01$. Standard errors in parentheses.

B.2. Robustness of Stock Market Signaling

B.2.1. Use of Issuer Credibility Variables

The Table below shows the results when the underpricing and green share variables are included simultaneously. The direction and magnitude of the underpricing coefficient is comparable to the results in Table 14. The relationship between green shareholder preferences and market-adjusted returns is partially captured by underpricing since the coefficient of the green share is smaller compared to Table 14. The results support the hypothesis, that underpricing serves as a signal of issuer credibility.

	AR _{S&P500}			
	(1)	(2)	(3)	(4)
Constant	0.2442 (0.2039)	0.1158 (0.2016)	0.1119 (0.2010)	0.1163 (0.2107)
Underpricing	0.0415** (0.0203)	0.0346* (0.0193)	0.0335* (0.0187)	0.0320** (0.0160)
Green share		0.1268** (0.0629)	0.1368** (0.0673)	0.1049* (0.0589)
ESG Score			0.0794 (0.0789)	0.0742 (0.0773)
Bond Controls	Yes	Yes	Yes	Yes
Firm Controls	No	No	No	Yes
R-squared	0.1695	0.2104	0.2197	0.3181
R-squared Adj.	0.0998	0.1368	0.1397	0.2146

Table 27: OLS regression using firm-level clustered standard errors. The dependent variable is market adjusted return, the main explanatory variable is underpricing. The Underpricing variable is scaled by 100. Significance level: * $p < .1$, ** $p < .05$, *** $p < .01$. Standard errors in parentheses.

B.2.2. Use of HAC Robust Standard Errors

The tables in this section present the results of stock market signaling using HAC robust standard errors. Tables 28 and 29 hold the market adjusted returns, for the whole sample and the sub-sample, respectively. Table 30 holds the regression output using HAC robust standard errors. The results are comparable in direction and magnitude to the output presented in the main analysis.

Event Window	N	AR	SE	t-stat	p-value
AR _{S&P 500}					
[-5, 5]	130	-0.015**	0.007	-2.031	0.044
[-15, -5]	130	0.004	0.005	0.831	0.408
[5, 15]	130	0.002	0.006	0.352	0.725
AR _{Russell 3000}					
[-5, 5]	130	-0.014*	0.008	-1.927	0.056
[-15, -5]	130	0.005	0.005	0.837	0.404
[5, 15]	130	0.003	0.006	0.451	0.653

Table 28: Market-adjusted returns (AR) using HAC robust standard errors with lag = 3. Significance level: * $p < .1$, ** $p < .05$, *** $p < .01$.

Event Window	N	AR	SE	t-stat	p-value
AR _{S&P 500}					
[-5, 5]	61	-0.031**	0.013	-2.384	0.020
[-15, -5]	61	0.007	0.008	0.822	0.415
[5, 15]	61	0.009	0.006	1.599	0.115
AR _{Russell 3000}					
[-5, 5]	61	-0.030**	0.013	-2.298	0.025
[-15, -5]	61	0.007	0.009	0.800	0.427
[5, 15]	61	0.009	0.006	1.575	0.120

Table 29: Market-adjusted returns (AR) for non-green firms using HAC robust standard errors with lag = 3. Significance level: * $p < .1$, ** $p < .05$, *** $p < .01$.

	AR _{SP} [−5, 5]			
	(1)	(2)	(3)	(4)
Constant	0.2442 (0.1823)	0.1158 (0.1799)	0.1119 (0.1766)	0.1163 (0.1804)
Underpricing	0.0415** (0.0209)	0.0346* (0.0197)	0.0335* (0.0190)	0.0320** (0.0163)
Green share		0.1268** (0.0606)	0.1368** (0.0632)	0.1049** (0.0524)
ESG Score			0.0794 (0.0839)	0.0742 (0.0845)
Bond Controls	Yes	Yes	Yes	Yes
Firm Controls	No	No	No	Yes
R-squared	0.1695	0.2104	0.2197	0.3181
R-squared Adj.	0.0998	0.1368	0.1397	0.2146

Table 30: OLS regression with market-adjusted returns (AR) as dependent variable calculated using HAC robust standard errors with lag = 3. The Underpricing variable is scaled by 100. Significance level: * $p < .1$, ** $p < .05$, *** $p < .01$.

B.2.3. Use of Alternative Stock Market Index

Table 31 holds the regressions with market adjusted returns using the Russell 3000 index. The magnitude and direction is robust compared to the results in Table 14. the main explanatory variables green share and underpricing are of similar magnitudes. Compared to the output Table 14 the *Green share* variable in specifications (2) is no longer statistically significant at the 5% significance level.

	AR _{Russell3000}			
	(1)	(2)	(3)	(4)
Constant	0.2501 (0.2082)	0.1232 (0.2044)	0.1194 (0.2038)	0.1304 (0.2116)
Underpricing	0.0421** (0.0206)	0.0353* (0.0196)	0.0342* (0.0190)	0.0326** (0.0162)
Green share		0.1253* (0.0627)	0.1352** (0.0671)	0.1046* (0.0596)
ESG Score			0.0782 (0.0812)	0.0714 (0.0785)
Bond Controls	Yes	Yes	Yes	Yes
Firm Controls	No	No	No	Yes
R-squared	0.1732	0.2124	0.2214	0.3206
R-squared Adj.	0.1037	0.1390	0.1415	0.2174

Table 31: OLS regression using firm-level clustered standard errors. The Underpricing variable is scaled by 100. Significance level: * $p < .1$, ** $p < .05$, *** $p < .01$. Standard errors in parentheses.

B.2.4. Use of Alternative Issue Amount

The calculated model in Table 32 replaces the $\ln(\text{Amount})$ and $\ln(\text{Firm Size})$ controls with the *Offering Ratio* which scales the offering amount by the firm size. The coefficients of underpricing and green share are not statistically significant at the 5% significance level. The direction and magnitude of the coefficients is comparable to the baseline model.

	AR _{S&P500}			
	(1)	(2)	(3)	(4)
Constant	-0.0711** (0.0348)	-0.0856** (0.0369)	-0.1201* (0.0681)	-0.1511* (0.0776)
Underpricing	0.0409* (0.0206)	0.0353* (0.0196)	0.0344* (0.0191)	0.0302* (0.0159)
Offering Ratio	0.6266*** (0.2130)	0.5349*** (0.1980)	0.5262** (0.2027)	0.6161*** (0.2268)
Green share		0.1062* (0.0547)	0.1153* (0.0606)	0.1125* (0.0597)
ESG Score			0.0510 (0.0749)	0.0475 (0.0779)
Bond Controls	Yes	Yes	Yes	Yes
Firm Controls	No	No	No	Yes
R-squared	0.2261	0.2548	0.2589	0.3259
R-squared Adj.	0.1610	0.1854	0.1829	0.2305

Table 32: OLS regression using firm-level clustered standard errors. The Underpricing variable is scaled by 100. Significance level: * $p < .1$, ** $p < .05$, *** $p < .01$. Standard errors in parentheses.

Table 33 represents the model output with HAC robust standard errors. The *Green share* coefficient is statistically significant at the 5% significance level. The *Underpricing* coefficient is statistically significant at the 5% significance level in column (1).

	AR _{S&P500}			
	(1)	(2)	(3)	(4)
Constant	-0.0711** (0.0318)	-0.0856*** (0.0329)	-0.1201* (0.0710)	-0.1511* (0.0787)
Underpricing	0.0409** (0.0206)	0.0353* (0.0193)	0.0344* (0.0187)	0.0302* (0.0157)
Offering Ratio	0.6266*** (0.2238)	0.5349*** (0.1858)	0.5262*** (0.1858)	0.6161*** (0.2214)
Green share		0.1062** (0.0538)	0.1153** (0.0586)	0.1125** (0.0544)
ESG Score			0.0510 (0.0782)	0.0475 (0.0783)
Bond Controls	Yes	Yes	Yes	Yes
Firm Controls	No	No	No	Yes
R-squared	0.2261	0.2548	0.2589	0.3259
R-squared Adj.	0.1610	0.1854	0.1829	0.2305

Table 33: OLS regression using HAC robust standard errors with lag=3. The Underpricing variable is scaled by 100. Significance level: * $p < .1$, ** $p < .05$, *** $p < .01$. Standard errors in parentheses.

C. Data Overview and Descriptive Statistics

Variable Name	Data Source	Scale	Description
Underpricing	FISD, Trace	Percentage	Excess return on the first day of trading.
Treasury Spread	FISD	Basis Points	Difference between the issue's offering yield and the treasury benchmark yield.

Green share	CA100+, 13F Filings	Percentage	Proportion of shareholders with green preferences.
Ln(Amount)	LSEG	Logarithmic Scale	Natural logarithm of issue's offering amount.
Ln(TTM)	LSEG	Logarithmic Scale	Natural logarithm of the difference between the offering date and maturity date in years.
ESG Score	LSEG	Normalized Score (0-1)	LSEG ESG Score.
HHI _{inv}	13F Filings	Inverse of normalized index (0-1)	Ownership dispersion measure, inverse of the Herfindahl-Hirschman Index.
Ln(Firm Size)	CRSP	Logarithmic Scale	Natural logarithm of the firm's total assets.
Leverage	CRSP	Percentage	Book value of the firm's long-term debt plus current liabilities divided by total assets.
ROA	CRSP	Percentage	Return on assets is the ratio of net income to total assets.
Cash	CRSP	Percentage	Ratio of cash and short-term investments to total assets.
(Asset) Turnover	CRSP	Percentage	Ratio of the firm's sales to total assets.
(Interest) Coverage	CRSP	Times	Firm's operating income divided by interest expense.

Table 34: Overview and description of the variables used in the primary analysis of the research project. The firm controls are defined following prior underpricing literature e.g., [Filatova and Javakhadze \(2024\)](#).

C.1. Descriptive Statistics

Variable	N	Mean	Std Dev	Min	Q1	Median	Q3	Max
Underpricing	134	0.003	0.006	-0.032	0.000	0.002	0.005	0.023
Green share all	134	0.170	0.093	0.000	0.083	0.202	0.241	0.400
Green share	134	0.125	0.124	0.000	0.000	0.202	0.241	0.400
Green share all _{light}	134	0.366	0.158	0.000	0.312	0.393	0.470	0.627
Green share _{light}	134	0.359	0.172	0.000	0.312	0.393	0.470	0.627
Treasury Spread	134	0.009	0.008	0.000	0.000	0.010	0.014	0.033
Ln(TTM)	134	2.475	0.696	0.702	2.096	2.306	3.401	3.690
Ln(Firm Size)	134	10.572	1.228	7.151	9.750	10.676	11.154	13.681
ESG Score	134	0.697	0.117	0.161	0.646	0.713	0.757	0.883
HHI _{inv}	134	17.869	7.025	1.000	14.923	18.514	21.797	38.882
Ln(Amount)	134	13.201	0.452	12.073	12.899	13.122	13.459	14.732
Leverage	134	0.357	0.160	0.000	0.351	0.399	0.435	0.708
ROA	134	0.007	0.016	-0.091	0.004	0.007	0.012	0.038
Turnover	134	0.074	0.058	0.015	0.040	0.054	0.087	0.281
Coverage	134	4.286	7.497	-21.658	1.899	2.773	4.055	57.644

Table 35: Descriptive statistics of all continuous variables used in the primary analysis. The financial ratios are winsorized at 1% and 99%.

C.2. Pairwise Correlation Matrix

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Underpricing	1.000												
Green share all	0.199	1.000											
Green share	0.228	0.862	1.000										
Treasury Spread	0.097	0.111	0.092	1.000									
Ln(Amount)	0.028	0.000	-0.170	-0.046	1.000								
Ln(TTM)	0.285	0.091	0.004	0.241	0.004	1.000							
ESG Score	0.184	-0.022	-0.086	0.123	0.181	0.082	1.000						
HHI _{inv}	0.088	0.424	0.233	0.101	0.322	0.230	0.177	1.000					
Ln(Firm Size)	0.119	-0.074	-0.248	-0.015	0.493	0.251	0.205	0.339	1.000				
Leverage	0.124	-0.023	-0.110	-0.034	0.052	0.163	-0.126	0.088	0.220	1.000			
ROA	0.361	0.153	0.136	0.065	0.083	0.151	0.332	0.137	0.290	0.090	1.000		
Turnover	-0.007	-0.081	-0.156	0.091	0.324	-0.012	0.088	0.162	0.143	0.277	0.204	1.000	
Coverage	0.088	-0.083	-0.017	-0.080	0.120	-0.104	0.104	0.117	0.212	-0.006	0.531	0.343	1.000

Table 36: Pairwise correlation matrix of the continuous variables used in the primary analysis.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Underpricing	1.000												
Green share _{light} all	0.141	1.000											
Green share _{light}	0.174	0.987	1.000										
Treasury Spread	0.097	0.124	0.116	1.000									
Ln(Amount)	0.028	-0.066	-0.069	-0.046	1.000								
Ln(TTM)	0.285	0.170	0.184	0.241	0.004	1.000							
ESG Score	0.184	-0.066	-0.055	0.123	0.181	0.082	1.000						
HHI _{inv}	0.088	0.466	0.433	0.101	0.322	0.230	0.177	1.000					
Ln(Firm Size)	0.119	-0.148	-0.119	-0.015	0.493	0.251	0.205	0.339	1.000				
Leverage	0.124	-0.047	-0.027	-0.034	0.052	0.163	-0.126	0.088	0.220	1.000			
ROA	0.361	0.139	0.182	0.065	0.083	0.151	0.332	0.137	0.290	0.090	1.000		
Turnover	-0.007	-0.159	-0.166	0.091	0.324	-0.012	0.088	0.162	0.143	0.277	0.204	1.000	
Coverage	0.088	-0.166	-0.143	-0.080	0.120	-0.104	0.104	0.117	0.212	-0.006	0.531	0.343	1.000

Table 37: Pairwise correlation matrix of the UNPRI signatories with light green preferences.