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Choices and Effects of Different Green Labels in the EU Bond Market

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Abstract: This paper demonstrates that green-labeling forms an integral part of financial investment vehicles. We use data from the EU green bond market to show that green labels reduce the required yields on bonds (the "greenium") in the long run, with the effect being more pronounced when labels are externally certified. We also find that green bonds can increase investors' short-term attention when they are externally labeled. Further evidence suggests that the greenium of self-labeled green bonds is mainly attributed to a weak signaling effect, whereas that of externally-labeled bonds results from a combination of signaling effect and pro-environmental preferences. Our findings indicate that investors value the reassurance that third-party certifications provide about the ethical use of bond proceeds. This highlights the potential benefits of introducing stricter oversight of green bond proceeds in the bond market.

Keywords: Green Bond Label; Signaling Effect; Pro-environmental Taste

JEL classification: G12; G41; Q59

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1. Introduction

Green bonds have become a popular financial instrument for investors to diversify their portfolios (e.g., Reboredo, 2018; Guo & Zhou, 2021) and for issuers to raise funds for their environmentally-friendly projects (e.g., Zerbib, 2019; Tang & Zhang, 2020; Díaz & Escribano, 2021). The EU green bond market has experienced substantial growth over the past decade, with a total issuance surpassing \$350 billion of rated bonds (see Figure 1). This surge in demand for green bonds has also increased scholarly attention (Jankovic et al., 2022). However, a consensus remains elusive in the empirical studies as to whether green bond labeling affects investors' required returns. For instance, Zerbib (2019) and Lau et al. (2022) find a small green premium, or 'greenium', but Larcker and Watts (2020), Fatica et al. (2021), and Flammer (2021) show that the greenium is insignificant. Even studies that report a significant greenium offer disparate interpretations, with some attributing it to investors' pro-environmental taste (Zerbib, 2019) while others to issuers' signaling effect (Flammer, 2021). Hereafter, we refer to this ongoing debate as the "greenium puzzle".





Notes: Figure 1 depicts the annual total dollar amount of proceeds funded through issuing green bonds in the EU market. The sample period is from 2012 to 2021.

Prior studies mainly used matching techniques to estimate greenium. For instance, Zerbib (2019) uses a two-step approach that emphasizes the importance of liquidity and maturity in

matching green bonds with equivalent synthetic conventional bonds. Flammer (2021) applies the multivariate nearest neighbor matching method to pair a green bond with its conventional counterpart. Nevertheless, existing evidence is mixed and sensitive to the matching technique used (see Table 1). In an attempt to resolve the greenium puzzle, we go one step further by carefully examining the differences in the labels used by various green bond issuers. We believe that tapping into the "green box" will enhance our understanding of how green bonds are labeled and the relationship between greenness labels and greenium.

Prior empirical studies	Matching Criteria	Greenium
Zerbib (2019)	issuer, maturity, currency, rating, seniority, collateral, coupon, issue date, size, liquidity	2 bps
Tang and Zhang (2020)	issuer, market to book value, liquidity, size, issue date	6.94 bps
Larcker and Watts (2020)	issuer, rating, callable, call date, coupon, maturity	not significant
Flammer (2021)	rating, issuance amount, maturity, coupon, issue date	not significant
Lau et al. (2022)	issuer, currency, rating, issue date, maturity	1 bp

Table 1 Key empirical findings on green bonds' greenium.

This table lists the key findings in prior empirical studies pertaining to the estimation of green bonds' greenium. This table also summarizes the matching criteria each paper employed in their model specification.

In this paper, we use the term 'greenness' to describe the credibility of green labels. Arguably, the greenness of the label is closely correlated with the authenticity of green bonds. Specifically, the greenness signals carried by externally-labeled bonds are likely to be more credible ('darker greenness') thanks to stricter compliance rules, so these green bonds are likely to have higher authenticity. In contrast, self-labeled bonds are more likely to be subject to greenwashing and may, therefore, be considered to be 'lighter greenness'. As a result, green bonds with external labels should generate different greeniums vis-à-vis their self-labeled counterparts. Between 2012 and 2021, the two most popular green labels in the EU are certified by the International Capital Market Association¹ (ICMA) and Climate Bonds Initiative² (CBI). Compared with self-labeled green bonds, issuing green bonds in line with ICMA or/and CBI's requirements stands for higher assurance of authenticity of green projects. However, marketing green bonds with external certification may mitigate, but not necessarily eliminate, investors' concerns about greenwashing (Gounopoulos et al., 2023). Besides, external certifications can involve substantial compliance costs and administrative burdens for issuers, which might offset some of the perceived benefits to investors (Montiel et al., 2016). Therefore, our study aims to provide a more comprehensive analysis of the choices and effects of various green labels. To achieve this, we have developed two key hypotheses.

¹ For more information about ICMA, please see https://www.icmagroup.org.

² For more information about CBI, please see https://www.climatebonds.net.

First, we hypothesize that investors require lower yields on externally-labeled green bonds compared to self-labeled green bonds. The signaling theory (Riley, 1979) underscores the idea that reputable standards and certifications can serve as credible signals, reducing information asymmetry between investors and managers (e.g., Halim et al., 2019; Flammer, 2021; Bellucci et al., 2023). Bedendo et al. (2023) show that institutional investors issue green bonds to "signal their commitment to finance the green transition". In this vein, we argue that external labels can serve as a stronger signal of assurance to stakeholders that the proceeds will be appropriately used. The taste-based framework (Fama & French, 2007) also predicts that investors are willing to accept lower payoffs from assets that align with their preferences or tastes (Du et al., 2017). As corporate environmental responsibility and climate concerns gain increasing prominence (e.g., El Ghoul et al., 2011; Ferriani, 2023), green investors are increasingly willing to accept lower returns in exchange for higher assurance of green projects (El Ghoul et al., 2018).

Second, we conjecture that, by having a third-party endorsement on the pro-environmental mission of the bond proceeds, issuing green bonds with external labels attracts more investor attention. As a trending topic, green bond issuance receives wider media coverage and public attention than conventional bonds (e.g., Krüger, 2015; Tang & Zhang, 2020; Flammer, 2021). Although investor attention is often short-lived (Ben-Rephael et al., 2017), external labels can significantly enhance issuers' information transparency, especially when the market is acutely concerned about how the proceeds will be utilized.

To test these hypotheses, we manually collected the label information for all green bonds issued in EU markets and employed the endogenous treatment effect model for the baseline tests. We first show that issuers have distinct motives for issuing green bonds. Specifically, issuers prefer financing through externally-labeled green bonds when they are from countries with lower sustainable development scores or after the EU signed the Paris Agreement on climate change. We then confirm our hypothesis that externally-labeled green bonds have a lower required yield than self-labeled and conventional bonds. Our findings are robust to alternative empirical measures and modeling techniques. Furthermore, we employ the Propensity Score Matching jointly with the Difference-in-Differences (PSM-DID) approach to confirm the hypothesis that green bonds with external labels attract greater investors' attention. We also conduct heterogeneity tests to quantify the taste-based and the signaling channels. Further analysis suggests that the effect of external labels on bond yields is attributed to both channels, while that of selflabeling can only be partly explained by the signaling effect.

This study makes three contributions to the literature. First, most empirical studies on greenium implicitly assume that green labeling is a random event rather than an endogenous corporate decision. Only a few studies consider the motivations for labeling bonds (e.g., Daubanes et al.,

2021; Dutordoir et al., 2023). For example, Daubanes et al. (2021) investigate the impacts of managerial incentives and carbon pricing on firms' decisions to issue green bonds. In contrast, our paper emphasizes the choice between different green labels (no label, self-label, and external label) and addresses the potential selection bias when investigating the impact of these labels on bond yield and investor attention.

Second, we contribute to the business ethics literature by extending the research from the extensive margin ('to be green or not to be green') to the intensive margin ('to be light green or to be dark green'). We show that a higher level of greenness not only attracts pro-environmental investors, but also enables issuers to send a more credible signal about their commitment to environmental responsibility. By complying with externally assured standards, issuers can differentiate themselves in a competitive market, enhancing their reputation, and benefiting from a higher greenium, as investors view these bonds as more credible and impactful in driving environmental progress.

Third, our work makes a step towards resolving the greenium puzzle in the green finance literature. For example, Flammer (2021) and Larcker and Watts (2020) do not find evidence for the greenium, while Zerbib (2019) and Lau et al. (2022) show that the greenium is positive and significant. In contrast, we find that self-labeled green bonds do not attract significant investors' attention, carry weak signals, or receive insignificant greeniums, whereas externally-labeled green bonds attract higher investor attention, send stronger signals, and generate significant greeniums. Thus, the discrepancies in the literature can be reconciled by the nuanced relationship between greenness and greenium.

The remainder of the study proceeds as follows. Section 2 describes the institutional background of the EU bond market and develops our hypotheses. Section 3 presents the data and outlines the empirical methods. Section 4 discusses the empirical findings and Section 5 concludes.

2. Institutional Background and Hypothesis Development

2.1. Institutional Background

The EU market represents a mature financial environment, with well-established regulations, legislations, and institutions. These characteristics have nurtured a stronger green taste among market participants. Green bond issuers in the EU markets choose one of the following three labels: self-, ICMA-, or CBI-label. The self-labeled bond issuers assert that bond proceeds will be used for green projects, but without committing themselves to third-party principles. In

contrast, issuers of green bonds with external certification obtain third-party recognition and declare their adherence to standards set by ICMA or CBI.

We conduct a formal content comparison of ICMA and CBI standards and organize the main certification requirements of these bodies in Appendix Table A1. The analysis suggests that ICMA and CBI have similar requirements for pre- and post-issuance stages of green bonds³. They not only provide additional assurance to the bond proceeds, but also ask for additional disclosures of impacts from the project. Since obtaining external certification involves additional compliance costs as well as more assurance of the project's environmental effects, we argue that externally-labeled green bonds should generate different greeniums from their self-labeled counterparts. Given these labeling discrepancies among EU green bonds, analyzing issuers' selection of green bond labels can potentially resolve the conflicting findings on greeniums associated with green bond issuance (e.g., Zerbib, 2019; Tang & Zhang, 2020; Díaz & Escribano, 2021).

2.2. Research Hypothesis

Our work relates to the numerous empirical studies that have investigated the process of ESG label selection. However, most of the existing work focuses primarily on how these labels affect mutual funds, highlighting the ethical concerns that relate to the motives behind ESG label selections. For instance, Raghunandan and Rajgopal (2022) underscore the ethical risks associated with self-labeled ESG funds, revealing that mutual funds may not adhere to their ethical claims and may invest in companies with poor compliance records. This suggests that the motivation to select an ESG label might sometimes be driven more by marketing considerations than by a genuine commitment to ethical standards, potentially leading to greenwashing. Similarly, Kim and Yoonb (2023) reveal that even funds affiliated with well-known ESG initiatives, such as the United Nations Principles for Responsible Investment (UN PRI), may fail to deliver on their ethical promises, as their ESG performance does not always improve post-affiliation. Gounopoulos et al. (2023) further emphasize that while investors are drawn to ESG-labeled funds, this attraction often leads to an overemphasis on the label itself rather than the underlying ethical or sustainability practices. This behavior highlights the ethical implications of labeling, as the decision to adopt an external label can drive investment flows and shape perceptions, regardless of the fund's underlying ethical practices.

³ Employing the machine learning textual analysis methods of Ali and Qaiser (2018), we also compare the TF-DFI scores of keywords between ICMA and CBI's documentations. The similarity metric of the two standards is 85.3%, confirming the qualitative content analysis in Appendix Table A1. Results are available on request.

To investigate green label selection for green bonds, we draw upon the following theoretical perspectives. First, the signaling hypothesis, as outlined by Riley (1979), suggests that since investors often lack sufficient information to evaluate the company's commitment to the environment (e.g., Lyon & Maxwell, 2011; Lyon & Montgomery, 2015), adherence to reputable standards/certifications can be viewed as a credible signal⁴ that mitigates information asymmetry and provides additional assurance to the project (e.g., Halim et al., 2019; Flammer, 2021; Bellucci et al., 2023). Existing literature emphasizes the role of certification in enhancing the firm reputation and reducing investor skepticism. For instance, Paeleman et al. (2024) document that the adverse effects of higher leverage are weaker for Certified B Corporations than for common commercial firms. Chen et al. (2023) discuss how industry reputation crises can lead firms to seek certification as a strategy to differentiate themselves and restore trust among consumers and investors. These findings support the idea that widely accepted standards can increase market confidence, which further reinforces the value of external certifications (Montiel et al., 2016).

Furthermore, the taste-based theory predicts that investors are willing to accept lower payoffs from assets that satisfy their preferences or tastes (e.g., Du et al., 2017; Fatica et al., 2021). In this sense, with increasing attention to corporate environmental responsibility, investors who prioritize climate concerns will accept lower returns on green projects (e.g., El Ghoul et al., 2011; El Ghoul et al., 2018; Ferriani, 2023). Thus, based on the signaling and taste-based frameworks, we hypothesize that green bonds with external labels have a lower required yield (or a higher greenium) than their self-labeled (and conventional) counterparts:

(H1a) Investors require lower yields on green bonds than conventional bonds.

(H1b) Externally-labeled green bonds have lower yields than their self-labeled counterparts.

The second hypothesis relates to the spillover effect of green bond issuance on investor attention to the issuing firms. Investors' attention to corporate news is scarce and limited. As a trending topic, green bond issuance receives wider media coverage than its conventional counterpart (e.g., Krüger, 2015; Flammer, 2021). Tang and Zhang (2020) find that green bond issuance can raise investors' attention to the issuers' stock and benefit the shareholders. In turn, investor attention can also influence green bond returns and volatility, with the effect being stronger in

⁴ During the whole financing period of a project, both ICMA and CBI require issuers to disclose third-party verified documents, such as Green Bond Framework, Allocation Report, and Impact Report, which allow investors to be better informed about the uses of bond proceeds as well as the monitoring processes and safeguards applied.

the short run (Pham & Huynh, 2020). These findings highlight the importance of investor attention in directing financial flows toward green bonds. Furthermore, existing literature also underscores that external certification can attract investor attention by providing credibility and visibility. For example, Miles and Munilla (2004) find certifications can enhance a firm's market positioning and attract new investor segments by providing additional transparency and trust in the firm's environmental commitments. Accordingly, we posit that since external certification is more effective in mitigating information asymmetry than self-labeling, green bonds with external labels can attract more attention from green investors. This leads us to hypothesize that:

(H2) Issuing externally-labeled green bonds can attract more investor attention than issuing self-labeled green bonds.

3. Data and Methods

3.1. Data Collection and Preliminary Findings

Our sample contains all green and conventional bonds issued in the EU market from 2012 to 2021. Since the number of conventional bonds is far greater than that of green bonds, we employ the propensity score matching (PSM) method to pair the green and conventional bonds in terms of price at issuance, amount, years to maturity, issuance time, and issuer's sector. We find significant structural differences between the conventional bonds and green bonds before matching, but there are no significant differences in the issuers and bond characteristics between the two types of bonds after PSM⁵. Next, we manually collected each bond's detailed labeling information from the issuers' Green Bond Framework and other related documents, including the official websites and the annual financial reports. Data on bond characteristics, such as years to maturity, bond size, issuer size at issuance, and ISIN number, are obtained from the Refinitiv database. Bond market activity data, such as daily yield, bid-ask spread, and issuers' default probability, are collected from Bloomberg. Finally, we web crawl the Google search volume of each issuer 12 months before and after the insurance of green bonds. Table A2 in the Appendix provides a detailed description of the data sources and variable definitions.

Table 2 reports descriptive statistics of the key variables. Green bonds and paired convention bonds tend to have low coupon rates (with a mean of 3.848% and a standard deviation of 3.852) and longer maturities (with a mean of 9.355 years and a standard deviation of 6.649). Meanwhile, the differences between the maximum and mean values for both coupon rates and

⁵ The t-test results of covariates between the conventional and green bonds before and after PSM are available on request.

maturity suggest that a small proportion of green bonds are exposed to high levels of interest rate risk. The mean value of the dummy variable *FirstGreen* (first-time green bond issuer) is 0.211, indicating that the majority of green bonds are brought to market by experienced issuers. Green bonds are especially popular among infrastructure-related projects, such as clean transportation, with such projects accounting for slightly over a third of green bond proceeds⁶ (34.88%).

	-		•		
Variable	Obs.	Mean	Std. Dev.	Min	Max
YieldIssue	2,003	4.060	4.527	0.000	32.167
Amount (\$million)	2,003	624.115	753.441	1.000	15817.033
Coupon	2,003	3.848	3.852	0.050	13.260
Yrs2Maturity	2,003	9.355	6.649	3.003	30.019
RatingScale	2,003	11.990	7.193	1	20
FirstGreen	2,003	0.211	0.408	0	1
GreenBond	2,003	0.540	0.499	0	1
Self-label	2,003	0.040	0.197	0	1
External-label	2,003	0.499	0.500	0	1
ICMA	2,003	0.477	0.500	0	1
CBI	2,003	0.065	0.247	0	1
Financials	2,003	0.442	0.497	0	1
Listed	2,003	0.240	0.427	0	1
Callable	2,003	0.407	0.491	0	1
CleanTransport	2,003	0.189	0.391	0	1
SDG	2,003	77.694	5.323	7.580	86.420
ParisAgreement	2,003	0.948	0.223	0	1
MarketSentiment	2,003	1.907	0.805	1	3
ECB_PolicyRate	2003	3.714	3.490	1	10
Inflation	2,003	7.886	3.167	1	10
GoogleTrends	73,712	36.967	26.679	0.000	100.000
NewsHeat	18,256	0.040	0.175	0	1

 Table 2 Descriptive statistics of key variables.

This table shows the summary statistics for paired bonds' cross-sessional data and investors' monthly attention data. Yrs2Maturity is the number of years from the issuance date to the maturity date. GreenBond equals 1 when the bond has a green label. *FirstGreen* equals 1 when it is the issuer's first time issuing green bonds and 0 otherwise. *Self-label* equals 1 when the green bond does not follow external green bond standards. External-label equals 1 when a green bond is labeled by third parties. Dummy variables ICMA and CBI are used to identify which external green bond principle is followed by the issuer. Financials and Listed identify whether the issuer belongs to the financial sector and is listed respectively. Callable is a dummy variable used to identify whether the bond has a call option, respectively. CleanTransport equals 1 when green bonds are financed for clean transport projects and 0 otherwise. SDG stands for the issuer-located country's overall sustainable score in the year before the bond issuance. ParisAgreement equals 1 when the green bond is issued after April/2016. MarketSentiment is the categorized value of Sentix Economic Indices Euro Aggregate Overall Index. ECB PolicyRate stands for the categorized value of the European Central Bank's interest rate on the main refinancing operations. Inflation is the categorized value of the EU inflation rate. GoogleTrends refers to the issuers' monthly Google Search Volume, a proxy for individual investor attention. NewsHeat is the institutional investor attention from Bloomberg news heat. More variable definitions and sources are provided in Appendix Table A2.

Table 3 presents the Pearson correlation coefficients between the main variables. It shows that green labeling is significantly associated with certain bond characteristics. For example,

⁶ More detailed summary of green bonds' use of proceeds can be found in Appendix Table A3.

GreenBond is negatively correlated with *YieldIssue* (-0.151***), indicating that green bonds are more likely to have a lower yield than paired conventional bonds. *SDG* is positively correlated with the propensity of choosing external labels (0.132***), but not related to the self-labeling decision. This suggests that issuers from countries with high sustainable development scores prefer to issue externally-labeled green bonds. Finally, the self- and externally-labeled green bonds are correlated differently with the *YieldIssue*, with correlations being 0.0227 and -0.160***, respectively. The varying significance and magnitude of the greenness-greenium relationship provide a potential explanation for the controversial findings in prior literature on greenium (e.g., Zerbib, 2019; Larcker & Watts, 2020; Flammer, 2021).

We then use univariate analyses to examine the potential structural differences between groups of bonds with different green labels. Table 4 reports the by-group mean of the bond characteristics and the t-test results. Panel A compares the green and conventional bonds, whereas Panel B reports the differences between the self- and externally-labeled green bonds. Panel A shows that the green and conventional bonds differ significantly in their characteristics, such as the coupon rate, maturity, and issuer types. Similar results are reported in Panel B, which indicates that the characteristics of the self-labeled bonds are significantly different from those of externally-labeled counterparts. These discrepancies among different groups of green bonds together with the potential self-selection issue call for the heterogeneous treatment of green bonds with different labels.

	YieldIssue	lnAmount	Coupon	Years to	Rating	Green	Self-	External-	Financials	Listed	Callable	Clean	SDG	Paris
				Maturity	Scale	Bond	label	label				Transport		Agreement
YieldIssue	1													
lnAmount	0.0477*	1												
Coupon	0.965***	0.0535*	1											
Yrs2Maturity	-0.0508*	0.0157	-0.0296	1										
RatingScale	0.274***	-0.205***	0.274***	-0.164***	1									
GreenBond	-0.151***	-0.302***	-0.170***	-0.0946***	0.0468*	1								
Self-label	0.0227	-0.0464*	0.0280	-0.0273	0.0352	0.190***	1							
External-label	-0.160***	-0.283***	-0.181***	-0.0835***	0.0328	0.922***	-0.205***	1						
Financials	-0.191***	-0.116***	-0.195***	-0.0812***	-0.206***	0.152***	0.0572*	0.129***	1					
Listed	-0.00785	0.0799***	0.00993	0.0123	-0.0205	-0.0928***	-0.0383	-0.0775***	-0.0154	1				
Callable	0.162***	0.260***	0.182***	0.162***	0.0777***	-0.153***	-0.0978***	-0.114***	-0.291***	0.196***	1			
CleanTransport	-0.168***	-0.0774***	-0.180***	-0.0597**	0.0122	0.443***	0.0435	0.424***	0.108***	-0.0292	-0.0800***	1		
SDG	-0.351***	-0.144***	-0.373***	0.00214	-0.00274	0.119***	-0.0320	0.132***	-0.00510	-0.0655**	-0.0322	0.113***	1	
ParisAgreement	-0.00846	-0.0426	-0.0106	-0.112***	-0.00998	0.0884***	-0.168***	0.154***	-0.00274	-0.00412	0.122***	0.0963***	0.0501*	1

Table 3 Correlation coefficient matrix of main variables.

This table reports the Pearson correlation between the test variables' cross-sessional data. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

Panel A: Conventional bonds vs. green bonds								
	Conventional	Green	diff.	St. Err.	T-value	P-value		
	(N=1,038,540)	(N=1,073,811)						
Yield	3.832	3.397	0.434	0.005	101.450	0.000		
Amount(\$million)	874.104	479.293	394.810	1.032	382.800	0.000		
Coupon	4.618	3.337	1.281	0.005	242.150	0.000		
Yrs2Maturity	10.524	8.988	1.536	0.009	170.800	0.000		
Puttable	0.007	0.002	0.005	0.000	53.150	0.000		
Callable	0.441	0.308	0.132	0.001	200.500	0.000		
Financials	0.348	0.521	-0.175	0.001	-259.550	0.000		
Listed	0.284	0.204	0.080	0.001	136.150	0.000		
CleanTransport	0.001	0.322	-0.322	0.001	-699.900	0.000		
Panel B: Green bon	ds self-labeled vs.	externally-labeled						
	Self-label	External-label	diff.	St. Err.	T-value	P-value		
	(N=118,835)	(N=954,976)						
Yield	3.388	3.466	-0.077	0.009	-8.000	0.000		
Amount(\$million)	479.811	475.137	4.675	1.871	2.500	0.013		
Coupon	3.257	3.980	-0.723	0.011	-65.750	0.000		
Yrs2Maturity	8.971	9.121	-0.150	0.019	-7.800	0.000		
Callable	0.333	0.110	0.224	0.002	159.000	0.000		
Financials	0.510	0.618	-0.108	0.002	-70.450	0.000		
Listed	0.208	0.164	0.045	0.001	36.150	0.000		
CleanTransport	0.336	0.207	0.130	0.002	90.650	0.000		

Table 4 Univariate tests on differences in bond characteristics.

This table reports the bond characteristics with different labels. We report t-values and p-values of the between-group t-tests on bond characteristics. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

3.2. Estimation Approach

To formally model the causalities among variables, we propose a structural model to account for endogeneity. Since green bond labels are self-selected rather than randomly distributed, we use the two-step endogenous treatment effect model (e.g., Cumming et al., 2019; Akins et al., 2020). The first step of the model involves the estimation of the selection equation of labels:

$$\Pr(D=1) = \Phi(\alpha'_{z}z + \alpha'_{x}x), \tag{1}$$

where D is one of the dependent (dummy) variables: *GreenBond*, *Self-label*, *External-label*; **z** is a vector of endogenous variables (*SDG* and *ParisAgreement*), where *SDG* is the issuer-located country's sustainable score in the year before the bond issuance, and *ParisAgreement* is

a dummy to identify whether the bond is issued after the EU signed the Paris Agreement⁷; \mathbf{x} is a vector of other explanatory variables including *DefaultProbability*, *Bid-Ask Spread*, *Listed*, *Financials*, *Listed*, *CleanTransport*, and *Callable*. We compute the inverse Mills' ratio (*IMR*) based on equation (1) and include it in the second step, i.e., outcome equation (2), to correct for the self-selection bias:

$$Yield = \delta D + \gamma IMR + \beta' \mathbf{x} + \epsilon, \tag{2}$$

The endogenous treatment effect model is similar to, but not to be confused with, the Heckman selection model, which deals with sample selection rather than self-selection bias. In the Heckman selection model, the dependent variable is not observable when untreated (D = 0). The endogenous treatment effect model is superior to the nearest neighbor matching and the propensity score matching, as the matching process does not control for the non-randomness in the green labels. The "matched" counterparts in the treated and control groups are still systematically different due to the self-selection bias. In contrast, the endogenous treatment model explicitly integrates the selection equation (1) into the estimation of the Heckman outcome model, equation (2).

The estimation results of equations (1) and (2) can shed light on (H1), while (H2) is tested by using a PSM-DID method. This method can test the spillover effect of green bond issuance by treating the green labels as shocks to stock market investors. The treatment effect on investor attention can be estimated based on equation (3):

InvestorAttention =
$$\sum_{\tau=-2}^{2} d_{\tau} D_{t+\tau} + \mathbf{b}' \mathbf{\tilde{x}} + \boldsymbol{\xi}.$$
 (3)

The lag and lead periods ($\tau = -2, -1, 0, 1$, and 2 months) relative to the bond issuance day (*D*) are included to gauge the persistence of the impact on investors' attention. The vector of control variables $\tilde{\mathbf{x}}$ includes *Callable*, *FirstGreen*, *Listed*, *Financials*, *CleanTransport*, *SDG*, and *ParisAgreement*. Following the framework of Fatica et al. (2021), we also control the fixed effects of issuers and time, bond size, maturity, rating, and market conditions⁸ in all regressions.

⁷ The Paris Agreement on climate change was signed by EU on 22/Apr/2016. More information can be found from: https://www.consilium.europa.eu/en/press/press-releases/2016/04/22/paris-agreement-global-climate-ac-tion/

⁸ Our results remain robust when replacing the European Central Bank (ECB) policy rate by inflation rate to control market conditions (as results shown in Appendix Table A5 and A6).

4. Empirical results

4.1. Green label and bond yield

We use the endogenous treatment effect to deal with endogeneity concerns relating to the structural differences among green bonds with different labels. Table 5 presents the estimation results of the issuers' label selection process. Columns (1) to (3) outline the issuers' choice between green and conventional bonds, while column (4) distinguishes the choice between selflabeling and external certification.

			timation results of the	selection equation.	
Green vs. conventional bondsSelf-labeled green vs. conventional bondsExternally-labeled green vs. conventional bondsExternally-labeled vs. conventional bondsSDG0.014***0.035***0.012***-0.005***(69.900)(62.190)(56.590)(-11.730)ParisAgreement0.142***-0.937***0.449***1.489***(40.520)(-168.850)(107.480)(223.558)Callable-0.172***-0.648***-0.114***0.522***(-62.762)(-107.044)(-40.364)(86.361)DefaultProbability2.465***4.080***1.892***-4.442***(80.971)(67.626)(60.027)(-72.465)BA_Spread0.159***-0.0050.191***0.109***(13.841)(4.498)(11.692)(-3.594)Financials0.420***0.404***0.394***-0.181***(161.572)(81.926)(147.444)(-37.543)CleanTransport3.484**8.906***3.475***0.052***(52.207)(-75.168)(-57.288)(8.505)ControlsYesYesYesYesFixed EffectsYesYesYesPseudo R ² 0.3100.3850.3200.242Observations1,915,743764,0731,799,413879,650		(1)	(2)	(3)	(4)
conventional bondsvs. conventional bondsvs. conventional bondsvs. self-labeledSDG0.014***0.035***0.012***-0.005***(69.900)(62.190)(56.590)(-11.730)ParisAgreement0.142***-0.937***0.449***1.489***(40.520)(-168.850)(107.480)(223.558)Callable-0.172***-0.648***-0.114***0.522***(-62.762)(-107.044)(-40.364)(86.361)DefaultProbability2.465***4.080***1.892***-4.442***(80.971)(67.626)(60.027)(-72.465)BA_Spread0.159***-0.0050.191***0.109***(52.405)(-0.914)(60.802)(19.389)Listed0.115***0.107***0.095***-0.053***(13.841)(4.498)(11.692)(-3.594)Financials0.420***0.404***0.394***-0.181***(161.572)(81.926)(147.444)(-37.543)CleanTransport3.484***8.906***3.475***0.052***(193.670)(487.178)(198.350)(11.904)Constant-1.056***-3.320**-1.165***0.275***(-52.207)(-75.168)(-57.288)(8.505)ControlsYesYesYesPseudo R ² 0.3100.3850.3200.242Observations1.915,743764,0731.799,413879,650		Green vs.	Self-labeled green	Externally-labeled green	Externally-labeled
$\begin{array}{llllllllllllllllllllllllllllllllllll$		conventional bonds	vs. conventional bonds	vs. conventional bonds	vs. self-labeled
ParisAgreement(69.900)(62.190)(56.590)(-11.730)ParisAgreement0.142***-0.937***0.449***1.489***(40.520)(-168.850)(107.480)(223.558)Callable-0.172***-0.648***-0.114***0.522***(-62.762)(-107.044)(-40.364)(86.361)DefaultProbability2.465***4.080***1.892***-4.442***(80.971)(67.626)(60.027)(-72.465)BA_Spread0.159***-0.0050.191***0.109***(52.405)(-0.914)(60.802)(19.389)Listed0.115***0.107***0.095***-0.053***(13.841)(4.498)(11.692)(-3.594)Financials0.420***0.404***0.394***-0.181***(161.572)(81.926)(147.444)(-37.543)CleanTransport3.484***8.906***3.475***0.052***(193.670)(487.178)(198.350)(11.904)Constant-1.056***-3.320***-1.165***0.275***(-52.207)(-75.168)(-57.288)(8.505)ControlsYesYesYesYesFixed EffectsYesYesYesYesPseudo R ² 0.3100.3850.3200.242Observations1.915,743764,0731.799,413879,650	SDG	0.014***	0.035***	0.012***	-0.005***
ParisAgreement 0.142^{***} -0.937^{***} 0.449^{***} 1.489^{***} (40.520)(-168.850)(107.480)(223.558)Callable -0.172^{***} -0.648^{***} -0.114^{***} 0.522^{***} (-62.762)(-107.044)(-40.364)(86.361)DefaultProbability2.465^{***} 4.080^{***} 1.892^{***} -4.442^{***} (80.971)(67.626)(60.027)(-72.465)BA_Spread 0.159^{***} -0.005 0.191^{***} 0.109^{***} (52.405)(-0.914)(60.802)(19.389)Listed 0.115^{***} 0.107^{***} 0.95^{***} -0.053^{***} (13.841)(4.498)(11.692)(-3.594)Financials 0.420^{***} 0.404^{***} 0.394^{***} -0.181^{***} (161.572)(81.926)(147.444)(-37.543)CleanTransport 3.484^{***} 8.906^{***} 3.475^{***} 0.052^{***} (193.670)(487.178)(198.350)(11.904)Constant -1.056^{***} -3.320^{***} -1.165^{***} 0.275^{***} ControlsYesYesYesYesYesFixed EffectsYesYesYesYesPseudo R ² 0.310 0.385 0.320 0.242 Observations $1.915,743$ $764,073$ $1,799,413$ $879,650$		(69.900)	(62.190)	(56.590)	(-11.730)
$\begin{array}{llllllllllllllllllllllllllllllllllll$	ParisAgreement	0.142***	-0.937***	0.449***	1.489***
$\begin{array}{llllllllllllllllllllllllllllllllllll$		(40.520)	(-168.850)	(107.480)	(223.558)
$\begin{array}{llllllllllllllllllllllllllllllllllll$	Callable	-0.172***	-0.648***	-0.114***	0.522***
$\begin{array}{llllllllllllllllllllllllllllllllllll$		(-62.762)	(-107.044)	(-40.364)	(86.361)
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	DefaultProbability	2.465***	4.080***	1.892***	-4.442***
$\begin{array}{cccccccccccccccccccccccccccccccccccc$		(80.971)	(67.626)	(60.027)	(-72.465)
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	BA_Spread	0.159***	-0.005	0.191***	0.109***
$\begin{array}{cccccccccccccccccccccccccccccccccccc$		(52.405)	(-0.914)	(60.802)	(19.389)
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	Listed	0.115***	0.107***	0.095***	-0.053***
$\begin{array}{cccccccccccccccccccccccccccccccccccc$		(13.841)	(4.498)	(11.692)	(-3.594)
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	Financials	0.420***	0.404***	0.394***	-0.181***
$\begin{array}{c cccc} CleanTransport & 3.484*** & 8.906*** & 3.475*** & 0.052*** \\ & (193.670) & (487.178) & (198.350) & (11.904) \\ Constant & -1.056*** & -3.320*** & -1.165*** & 0.275*** \\ & (-52.207) & (-75.168) & (-57.288) & (8.505) \\ \hline Controls & Yes & Yes & Yes & Yes \\ \hline Fixed Effects & Yes & Yes & Yes & Yes \\ \hline Pseudo R^2 & 0.310 & 0.385 & 0.320 & 0.242 \\ \hline Observations & 1,915,743 & 764,073 & 1,799,413 & 879,650 \\ \hline \end{array}$		(161.572)	(81.926)	(147.444)	(-37.543)
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	CleanTransport	3.484***	8.906***	3.475***	0.052***
$\begin{array}{cccccccccccccccccccccccccccccccccccc$		(193.670)	(487.178)	(198.350)	(11.904)
$\begin{array}{ccccccc} (-52.207) & (-75.168) & (-57.288) & (8.505) \\ \hline Controls & Yes & Yes & Yes & Yes \\ \hline Fixed Effects & Yes & Yes & Yes & Yes \\ \hline Pseudo R^2 & 0.310 & 0.385 & 0.320 & 0.242 \\ \hline Observations & 1,915,743 & 764,073 & 1,799,413 & 879,650 \\ \hline \end{array}$	Constant	-1.056***	-3.320***	-1.165***	0.275***
Controls Yes Yes Yes Yes Fixed Effects Yes Yes Yes Yes Pseudo R ² 0.310 0.385 0.320 0.242 Observations 1,915,743 764,073 1,799,413 879,650		(-52.207)	(-75.168)	(-57.288)	(8.505)
Fixed Effects Yes Yes Yes Pseudo R ² 0.310 0.385 0.320 0.242 Observations 1,915,743 764,073 1,799,413 879,650	Controls	Yes	Yes	Yes	Yes
Pseudo R ² 0.310 0.385 0.320 0.242 Observations 1,915,743 764,073 1,799,413 879,650	Fixed Effects	Yes	Yes	Yes	Yes
Observations 1,915,743 764,073 1,799,413 879,650	Pseudo R ²	0.310	0.385	0.320	0.242
	Observations	1,915,743	764,073	1,799,413	879,650

Table 5 The estimation results of the selection equation

Results from the 1st stage estimation of treatment effect model. Dependent variables in columns (1) and (2) are *Green-Bond* and *Self-label* respectively. The dependent variable of both columns (3) and (4) are *External-label*. Control variables include bond size, maturity, rating, and market conditions (ECB policy rate). Two-way fixed effects (issuer, time) are included. Robust *t* statistics (in parentheses) are based on clustered standard errors at the issuer level. * p < 0.1, ** p < 0.05, *** p < 0.01

The significantly positive coefficients on endogenous variables, *SDG* and *ParisAgreement* (0.014*** and 0.142***), in column (1) of Table 5 present issuers' concern regarding environmental awareness, indicating that issuers from countries with high SDG scores or after the EU signed the Paris Agreement are more inclined to issue green bonds than conventional bonds. Meanwhile, the significantly positive coefficient on default probability in column (1) is consistent with the view that riskier issuers tend to send stronger signals to reassure investors.

Similar results are reported in columns (2) and (3). Furthermore, we estimate the label selection within green bonds. The significantly negative coefficient on *SDG* (-0.005***) in Column (4) of Table 5 implies that issuers from countries with low SDG scores exert greater efforts to signal their commitment to the environment. The coefficient on *ParisAgreement* (1.489***) suggests that green bond issuers are more likely to obtain external certification after the EU signed the Paris Agreement. The above findings show that issuers' selections of green bonds and green labels involve the consideration of their green image to investors, suggesting the existence of selection bias.

			1	
	(1)	(2)	(3)	(4)
Yield	Green	Self-labeled	Externally-labeled	Externally-labeled
	vs. conventional	vs. conventional	vs. conventional	vs. self-labeled
D = GreenLabel	-1.97 1***			
	(-3.960)			
D = Self-label		-0.533		
		(-0.537)		
D = External-label			-2.099***	-1.829**
			(-4.202)	(-2.077)
IMR	1.073***	0.298	1.139***	0.785*
	(3.865)	(0.563)	(4.062)	(1.719)
Callable	0.651^{***}	0.596^{***}	0.724^{***}	0.836***
	(4.478)	(2.899)	(5.049)	(3.061)
DefaultProbability	21.191***	25.255***	19.811***	17.873***
	(8.372)	(6.653)	(7.711)	(5.136)
BA_Spread	2.441***	2.025***	2.441***	3.024***
	(10.249)	(5.753)	(9.632)	(9.832)
Listed	-0.657***	-0.925***	-0.667***	-0.591*
	(-3.405)	(-3.393)	(-3.405)	(-1.818)
Financials	0.514^{***}	0.372^{*}	0.515***	0.096
	(3.190)	(1.872)	(3.331)	(0.433)
CleanTransport	0.654^{**}	0.089	0.763**	-0.078
-	(2.077)	(0.114)	(2.367)	(-0.468)
Constant	5.726***	0.705	6.295***	3.782***
	(8.057)	(0.910)	(9.128)	(3.428)
Controls	Yes	Yes	Yes	Yes
Fixed Effects	Yes	Yes	Yes	Yes
Adjusted R ²	0.557	0.522	0.557	0.559
Observations	1,915,743	764,073	1,799,413	879,650

Table 6 The estimation results of the outcome equation.

Estimation results from the 2nd stage of the endogenous treatment effect model. The dependent variable of all columns is *Yield. IMR*s are generated through the corresponding estimations in Table 5. Controls include bond size, maturity, rating, and market conditions (ECB policy rate). Two-way fixed effects (issuer, time) are included. Robust *t* statistics (in parentheses) are based on clustered standard errors at the issuer level. * p < 0.1, ** p < 0.05, *** p < 0.01

Table 6 reports the regression results of the outcome equation, which provides a further distinction between the effects of self- and external-labels on bond yield. We visualize this labelgreenium relationship in Figure 2. These results illustrate that, the significant greenium within green bonds is mainly the outcome of external labeling. In addition, the statistically significant *IMR*s observed in column (1) of Table 6 indicate the existence of selection bias when directly comparing green bonds with their conventional counterparts, providing a further potential explanation for the controversial findings in prior literature (e.g., Zerbib, 2019; Larcker & Watts, 2020; Flammer, 2021). Combined with Table 5, results from the treatment effect model substantiate the existence of the signal and/or green taste channel in decreasing bond yield, and, thereby, support both (H1a) and (H1b).



Notes: This figure depicts the yield greenium induced by the label greenness. The shaded area is the 95% confidence interval.

In the robustness tests, we verify the sensitivity of the label-greenium relationship observed in the baseline analysis. Instead of the binary endogenous treatment effect model, we use the ordered-Heckman model, following the framework of Chiburis and Lokshin (2007) to deal with the self-selection bias. More specifically, we include an ordinal variable as an additional independent variable in the ordered-Heckman model and use the following specification to estimate a consistent *IMR** (Chiburis & Lokshin, 2007):

$$IMR_{i}^{*} = \frac{\phi(\hat{\mu}_{j} - \hat{s}_{i}^{*}) - \phi(\hat{\mu}_{j+1} - \hat{s}_{i}^{*})}{\Phi(\hat{\mu}_{j+1} - \hat{s}_{i}^{*}) - \Phi(\hat{\mu}_{j} - \hat{s}_{i}^{*})}, \text{ for issuer } i \text{ with label greenness } j \in [0, 1, 2].$$
(4)

The cutting value $\hat{\mu}_j$ and predicted score \hat{s}_i^* are based on an ordered probit regression of the 3-scale "label (assurance to) greenness", which replaces the probit regression of the baseline endogenous treatment effect model.

	Panel A: Ordere	d Heckman	Panel B: OLS				
	(1)	(2)	(3)	(4)	(5)		
	Stage 1	Stage 2	Green	Self-labeled	Externally-labeled		
	Label selection	Outcomes	vs. conventional	vs. conventional	vs. conventional		
	LabelGreenness	Yield	Yield	Yield	Yield		
LabelGreenness		-0.150**					
		(-2.012)					
IMR		3.392***					
		(4.982)					
D = GreenLabel			-0.323**				
			(-1.969)				
D = Self-label				-0.048			
				(-0.146)			
D = Externally-label					-0.354**		
					(-2.134)		
SDG	0.013***						
	(63.997)						
ParisAgreement	0.319***						
-	(98.693)						
Callable	-0.031***	0.745***	0.685^{***}	0.649^{***}	0.720^{***}		
	(-12.300)	(5.278)	(4.655)	(3.102)	(4.941)		
DefaultProbability	2.065***	25.871***	20.613***	25.412***	19.518***		
	(73.201)	(9.322)	(8.353)	(6.828)	(7.747)		
BA Spread	0.144***	2.780***	2.385***	2.034***	2.360^{***}		
	(50.737)	(11.547)	(9.886)	(5.778)	(9.172)		
Listed	0.085***	-0.407*	-0.625***	-0.932***	-0.617***		
	(12.002)	(-1.871)	(-3.155)	(-3.460)	(-3.028)		
Financials	0.331***	1.326***	0.325**	0.353*	0.333**		
	(140.023)	(5.301)	(2.054)	(1.875)	(2.153)		
CleanTransport	1.832***	5.629***	-0.197	-0.306	-0.186		
-	(540.963)	(4.760)	(-1.220)	(-0.691)	(-1.136)		
Constant		3.322***	5.305***	1.353*	5.925***		
		(4.566)	(7.433)	(1.755)	(8.609)		
Fixed Effects	Yes	Yes	Yes	Yes	Yes		
Pseudo R-squared	0.211						
Adjusted R-squared		0.566	0.539	0.508	0.538		
Observations	1 915 743	1 915 7/3	1 915 7/3	764 073	1 799 /13		

Table 7 Results of the ofdered-neckinal and OLS analysis	Table 7	Results	of the	ordered-Heckman	n and OLS analys	is.
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Panel A presents results from the ordered-Heckman model, in which column (1) shows results from the ordered probit model in which the dependent variable *LabelGreenness* refers to different levels of label greenness (conventional bond=0, self-label=1, external-label=2). Colum (2) records the 2nd stage results of ordered-Heckman estimation. Panel B reports results from the OLS regression. The dependent variable of columns (2) to (5) is bond yield. Controls include bond size, maturity, rating, and market conditions (ECB policy rate and investor sentiment). Two-way fixed effects (issuer, time) are included. Robust *t* statistics (in parentheses) are based on clustered standard errors at the issuer level. * p < 0.1, ** p < 0.05, *** p < 0.01

Panel A of Table 7 presents the regression results of alternative Heckman outcome model specifications. We present the issuers' label selection process in column (1) and further report each factor's marginal effects in Appendix Table A4. The overall results show that issuers primarily focus on the selection between conventional bonds and externally-labeled green bonds, with the main determinants being the use of proceeds and the need for signaling lower risks. Following these factors, the climate concerns raised by the Paris Agreement exert relatively greater marginal effects compared to other factors in the issuers' label selection process.

Besides, the coefficients on *LabelGreenness* and *IMR* in Table 7 are both significant, highlighting the importance of considering the self-selection bias. Compared with the OLS estimation results reported in Panel B, both results from Table 6 and Panel A of Table 7 indicate the presence of selection bias behind green bonds' labeling, biasing the OLS estimates of the yield on green bonds. Furthermore, given the ordered-Heckman model is more restrictive in the model specification, it does not appropriately capture the selection process between self- and externally-labeled green bonds in column (4) of Table 5. This result not only reconfirms the necessity of making comparisons within different groups of green bonds, but also highlights the difference between green and conventional bonds. Therefore, we draw our conclusions based on the treatment effect model and use the ordered-Heckman model solely for robustness purposes.

4.2. Green Label and Investor Attention

After showing that investors have a special taste for green bonds (see Table 7), we test the extent to which different green labels attract wider investor attention (H2). We treat the month of the bond issuance as an exogenous event to the market and apply the PSM-DID method to compare the effect of green bond issuance on investor attention.

Following the literature summarized in Table 1, we apply the PSM approach to match green and conventional bond issuers using a comprehensive set of factors, including issuer size, bond size, years to maturity, issuance year and month, rating, call option, sector, and issuer location. We web crawl the monthly Google search volume of issuers to measure the individual investor attention and we use the Bloomberg news heat⁹ data to construct a proxy for institutional investor attention. We then employ DID estimation to investigate the impact of green bond issuance on individual and institutional investor attention respectively. Table 8 reports the DID estimation results.

Panel A of Table 8 reports regression results for individual investor attention. We show that the contemporaneous month dummies (D_t) are the only significant coefficients in regressions, consistent with (H2). We also find that only green bonds with external certification are more effective than conventional bonds in raising issuers' investor attention in the short term. This

⁹ As the subscribers of Bloomberg Terminals are mainly institutional investors, the search and reading activities ("news heat") on the stock-specific news on Bloomberg Terminals track the attention a specific stock is receiving from institutional investors.

finding is consistent with evidence from Tang and Zhang (2020) and Flammer (2021) that the shocks in stock returns resulting from the green bond issuance are short-lived.

Panel A: Impact on issuers' Google Trends							
	(1)	(2)	(3)				
GoogleTrends	Green	Self-labeled	Externally-labeled				
	vs. conventional	vs. conventional	vs. conventional				
Month (-1): D_{t-1}	4.178	6.201	0.690				
	(1.46)	(1.05)	(0.22)				
Month (0): D_t	8.008**	7.201	6.609**				
	(2.30)	(1.51)	(2.01)				
Month (+1): <i>D</i> _{<i>t</i>+1}	2.298	6.001	6.073				
	(0.94)	(0.98)	(1.36)				
Adjusted R ²	0.083	0.090	0.082				
Observations	53,332	48,776	51,992				
Panel B: Impact on issuers' Bloomberg news heat							
	(1)	(2)	(3)				
NewsHeat	Green	Self-labeled	Externally-labeled				
	vs. conventional	vs. conventional	vs. conventional				
Month (-1): D_{t-1}	0.0205	0.103	0.0007				
	(0.81)	(1.47)	(0.16)				
Month (0): D_t	-0.0009	0.155	0.0296**				
	(-0.29)	(1.07)	(2.09)				
Month (+1): <i>D</i> _{<i>t</i>+1}	-0.0205	-0.0516	0.0003				
	(-1.00)	(-0.77)	(0.07)				
Adjusted R ²	0.511	0.351	0.377				
Observations	14,438	13,674	14,547				
Controls $(\mathbf{\tilde{x}})$	Yes	Yes	Yes				
Fixed Effects	Yes	Yes	Yes				

Table 8 The impact of bond issuance on investor attention.

Result from the PSM-DID estimation. The dependent variables in Panels A and B are the issuers' monthly Google Trends and Bloomberg news heat, respectively. Control variables $\tilde{\mathbf{x}}$ includes *SDG*, *ParisAgree*, *Callable*, *Financials*, *Listed*, *CleanTransport*, bond size, maturity, rating, and market conditions. Two-way fixed effects (issuer, time) are included. Robust *t* statistics (in parentheses) are based on clustered standard errors at the issuer level. * p < 0.1, ** p < 0.05, *** p < 0.01

Since the proportion of listed issuers is less than one-fourth (as the figure shown in Table 2), using Google Trends as the proxy allows us to retain as many issuers as possible. However, the Google Trends measure captures mainly retail investors' attention while institutional investors are nowadays dominant in financial markets, especially green bonds markets. To gauge institutional investors' attention, we follow Ben-Rephael et al. (2017) and download the Bloomberg news heat data. The original daily Bloomberg news heat is assigned with a score of 1, 2, 3 or 4. Higher scores represent higher numbers of reading and searching activities of the firm-specific news. Following Huang et al. (2022), we first generate a dummy variable (*AIA*) for daily abnormal institutional attention that equals 1 if Bloomberg's daily maximium is 3 or 4, and 0 otherwise. We then calculate the monthly average of the daily *AIA* as our proxy for monthly institutional investor attention (*NewsHeat*). We run regression of equation (3) using

NewsHeat as the depedent variable. Panel B of Table 8 shows that externally-labeled green bonds can increase the attention for institutional investors.



Figure 3 Robustness tests of investor attention around the issuance of green bonds.

Notes: This figure shows the dynamics of investor attention, as measured by Google Trends (in Panel A) and Bloomberg news heat (in Panel B), in the month around the issuance of green bonds following the stacked DID approach from Cengiz et al. (2019). The panels show the pre-trend and the treatment effects of self- and externally-labeled green bond issuance respectively. The vertical bars are 95% confidence intervals.

Furthermore, we address the overestimation bias in the PSM-DID and verify the robustness of (H2) using the stacked DID framework from Cengiz et al. (2019). The traditional DID method has been heavily criticized for its biased estimates of the average treatment effect, especially in the absence of strong restrictions on treatment-effect homogeneity. Instead, the stacked DID allows us to address the under-identification problems of the conventional DID method in the staggered treatment setting. To further verify the validity of the results relating to the investor attention hypothesis, we repeat our analysis using the propensity score matching jointly with the stacked DID method. Figure 3 presents the coefficient estimates of each month relative to the issuance of bonds with green labels and their 90% confidence intervals.

Figure 3 confirms the results in Table 8. Specifically, green bonds with self-labels do not attract investor attention, suggesting the market essentially treats such bonds as being equivalent to their conventional counterparts. In Panel B, the coefficients on *Month* t = 1 are positive and significant, while none of the coefficients on the post-event months are significant. This implies that the issuance of externally-labeled green bonds increases investor attention in the contemporaneous month, but such an effect is short-lived. This evidence is again consistent with the regression results in columns (2) and (3) of both Panels in Table 8. Overall, the use of a more rigorous DID model specification also supports the investor attention hypothesis.

4.3. Signaling Effect and Pro-environmental Taste

The signaling effect and pro-environmental taste can exert similar influences on the greennessgreenium relationship. This is because, in addition to greenness assurance, the external certification embedded in green labels can carry other signals. For example, external certification might imply that the issuing firm is more transparent or more committed to being eco-friendly, which, in turn, attracts green investors. To distinguish the pro-environmental taste channel from the credit-related signaling effect channel, we conduct heterogeneity tests and report the results in Table 9.

We begin by categorizing our sample into four groups of bonds based on issuers' default probability and bond label type. We posit that if green labels carry signals of the firms' financial health, the credit-related signaling effect from the label would be influenced by issuers' default probabilities. As results shown in Panel A of Table 9, the coefficients on both externally- and self-labeled bonds in columns (2) and (4) are significantly negative, with the credit signal from the former being stronger. In addition, the coefficients on both labels in the high default probability group are insignificant, suggesting that the signaling effect is weaker for bonds with higher default risks. Hence, our results confirm that all green bond labels have a signaling effect on the yield, with the effect being stronger for externally-labeled ones. Meanwhile, this effect is the icing on the cake for issuers, which offers limited assistance to issuers with higher default rates.

In a similar vein, if the impact of green labels on yield is supported by the green taste channel, the greenness-greenium relationship would be different for issuers from 'brown' (high emission) industries. Panel B of Table 9 confirms that the effect of external labels is weaker for issuers in the brown industries, implying the existence of a pro-environment taste. In contrast, the coefficients on *Self-label* in columns (1) and (2) are not significantly different, indicating that the effect of self-labeled green bonds is unlikely due to investors' taste for green assets.

Panel A: Heterogene	ity test for the signaling	g effect		
	(1)	(2)	(3)	(4)
Yield	Subsample: Higher	Subsample: Lower	Subsample: Higher	Subsample: Lower
	DefaultProbability	DefaultProbability	DefaultProbability	DefaultProbability
D = Self-label	0.421	-0.468*		
	(0.66)	(-1.82)		
D = External-label			-0.255	-0.297**
			(-0.89)	(-2.33)
Constant	1.562***	1.776***	1.397***	1.577***
	(3.53)	(8.16)	(4.15)	(8.82)
Controls (x)	Yes	Yes	Yes	Yes
Fixed Effects	Yes	Yes	Yes	Yes
Chow test F-value	7,883.200*** 576.380***			
Adjusted R ²	0.581	0.522	0.609	0.530
Observations	356,925	695,727	619,758	1,237,338
Panel B: Heterogene	ity test for the green tas	ste		
	(1)	(2)	(3)	(4)
Yield	Subsample:	Subsample:	Subsample:	Subsample:
	BrownIssuer	Non-BrownIssuer	BrownIssuer	Non-BrownIssuer
D = Self-label	0.879	0.0248		
	(1.40)	(0.07)		
D = External-label			-0.383	-0.375**
			(-0.86)	(-2.14)
Constant	3.070***	1.491***	2.757***	1.475***
	(4.60)	(7.40)	(5.13)	(8.98)
Controls (x)	Yes	Yes	Yes	Yes
Fixed Effects	Yes	Yes	Yes	Yes
Chow test F-value	390.	090***	296.	790***
Adjusted R ²	0.657	0.566	0.619	0.581
Observations	92,126	960,334	205,411	1,651,493

Table	9 Hetero	geneity to	ests for	the s	ignaling	effect	and th	e green	taste	effect
					0 0					

This table presents the results of subsample regressions to examine the signaling effect and green taste hypothesis. The dependent variable in each regression is bond yield. Control variables **x** include *SDG*, *ParisAgree*, *Callable*, *DefaultProbability*, *BA_Spread*, *Listed*, *Financials*, *CleanTransport*, bond size, maturity, rating, and market conditions. Two-way fixed effects (issuer, time) are included. Robust *t* statistics (in parentheses) are based on clustered standard errors at the issuer level. * p < 0.1, *** p < 0.05, **** p < 0.01

5. Conclusion

This study investigates the choice and effects of green bond labeling and the mechanisms through which green labels affect bond yield and investor attention. Based on the certification requirements for the EU green bond issuers, we classify green bonds into groups based on their labeling approach. We find that green bond issuers with greater information asymmetry prefer to use external certification for signaling purposes (e.g., when the issuer-located country's image is relatively less eco-friendly). Furthermore, we confirm that the greeniums of externally-labeled bonds are greater than their self-labeled counterparts. We also show that issuing bonds with external green labels is positively associated with investor attention, while this relationship is weaker for self-labeled bonds. To summarize, the novel distinction between bonds with

different label greenness accommodates three prevailing theories of green finance, i.e., the proenvironmental taste theory, signaling effect theory, and investor attention theory.

One key contribution of this study stems from the endeavor to resolve the greenium puzzle by providing novel insights into the role of labeling in green bonds. Our approach enables us to reconcile some of the conflicting findings in the literature. On the one hand, consistent with Flammer (2021) and Larcker and Watts (2020), we find that self-labeling hardly attracts investor attention, sends signals, or generates greenium. On the other hand, and in line with Zerbib (2019) and Lau et al. (2022), we show that external labeling reduces bond yield in the long term and heightens investor attention in the short term. Further analysis indicates that the lower green bond yield associated with self-labeling is mainly driven by the (weak) signaling effect, while that of their externally-labeled counterparts aligns with both the signaling effect and taste-based framework.

Our study provides several practical implications for issuers, investors, and policymakers in the green bond markets. First, it highlights the necessity of paying careful attention to different green bond labels rather than using a single umbrella label to encompass all green bonds. Issuers should carefully choose labels that accurately reflect the environmental impact of their projects, as this can influence investor perception and, consequently, the cost of capital. A onesize-fits-all label might undermine the distinct advantages that certain green projects offer, potentially leading to higher borrowing costs or reduced market attention. Second, investors need to assess the specific criteria and standards behind each label to make informed decisions. Recognizing the heterogeneity in green labeling allows investors to better align their portfolios with their ESG goals and avoid greenwashing risks. Investors should also advocate for regular and detailed disclosures from issuers, ensuring that the proceeds are used as intended and deliver the promised environmental benefits. Third, the global nature of environmental problems and financial markets calls for policymakers to join their effort towards standardizing green labels and regulatory frameworks that ensure transparency and comparability across countries; in order to mitigate market confusion and improve the reliability of green investments. Specifically, in countries with weak third-party institutions (e.g., developing countries), it maybe be necessary for governments to step in. The establishment of credible third-parties and green certifications has positive externalities, which justify an appropriate level of government intervention (e.g., subsidy, endorsement) as seen in other environment-related problems and solutions.

Like most other academic studies, our paper is not free from limitations that could be addressed by future research. Restricting our study's scope to the Eurobond market, which is relatively homogeneous due to the common market features of the EU, limits our ability to generalize our findings to other markets. Future research could extend data coverage to the global market, where label greenness exhibits greater diversity. A careful evaluation of green certification standards can generate more nuanced levels of label greenness, resulting in a more comprehensive estimation of the greenness-greenium relationship. Moreover, the EU Green Bond Standard (GBS) was officially published in December 2023, which may significantly influence issuers' label selection. The GBS sets a 'gold standard' for green bonds within the EU and is more prescriptive compared to the prevailing ICMA and CBI standards. With the availability of more data on green bonds issued after 2023, it is interesting to explore issuers' switching behavior between existing and new external labels. Another potential line of research is to investigate whether the GBS encourages a convergence towards global best practices or whether it creates regional divergence, with certain markets developing parallel standards. This, in turn, could have implications for the global green bond market, influencing cross-border investments and the harmonization of business ethics across different jurisdictions.

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Appendix

Table A1 ICMA and CBI requirements on green bonds.

Stage	Documents	•	ICMA	СВІ
		use of proceeds	In the event that all or a proportion of the proceeds are or may be used for refinancing, it is recommended that issuers provide an estimate of the share of financing vs. re-financ- ing, and where appropriate, also clarify which investments or project portfolios may be refinanced, and, to the extent relevant, the expected look-back period for refinanced eli- gible Green Projects.	The Issuer shall document the Nominated Projects & Assets which are proposed to be as- sociated with the Bond and which have been assessed as likely to be Eligible Projects & Assets. The Issuer shall establish a list of Nominated Projects & Assets that can be kept up-to-date during the term of the Bond. The expected Net Proceeds of the Bond shall be no greater than the Issuer's total invest- ment exposure to the proposed Nominated Projects & Assets, or the relevant proportion of the total Market Value of the proposed Nominated Projects & Assets that are owned or funded by the Issuer.
pre- issuance	pro p eva sel pre- green bond ssuance framework	process for project evaluation and selection	The issuer of a Green Bond should clearly communicate to investors: 1. The environmental sustainability objectives of the eligible Green Projects; 2. The process by which the issuer determines how the projects fit within the eligible Green Projects categories (examples are identified above); and 3. Complementary information on processes by which the issuer identifies and manages per- ceived social and environmental risks associated with the relevant project(s).	The issuer shall establish, document, and maintain a decision-making process that it uses to determine the eligibility of the Nominated Projects & Assets. The decision-making process shall include, without limitation: 1. A statement on the climate-related objectives of the Bond; 2. How the climate-related objectives of the Bond are positioned within the context of the Is- suer's overarching objectives, strategy, policy, and/or processes relating to environmental sus- tainability; 3. The Issuer's rationale for issuing the Bond; 4. A process to determine whether the Nominated Projects & Assets meet the eligibility re- quirements specified in the Climate Bonds Standard.
		management of proceeds	The net proceeds of the Green Bond (GBP), or an amount equal to these net proceeds, should be credited to a sub-account, moved to a sub-portfolio or otherwise tracked by the issuer in an appropriate manner, and attested to by the issuer in a formal internal process linked to the issuer's lending and investment operations for eligible Green Projects. So long as the Green Bond is outstanding, the balance of the tracked net proceeds should be periodically adjusted to match allocations to eligible Green Projects made during that period. The issuer should make known to investors the intended types of temporary placement for the balance of unallocated net proceeds. The Green Bond Principles encourage a high level of transparency and recommend that an issuer's management of proceeds be supplemented by the use of an external auditor, or other third parties, to verify the internal tracking method and the allocation of funds from the Green Bond proceeds.	 The systems, policies, and processes to be used for management of the Net Proceeds shall be documented by the Issuer and disclosed to the Verifier, and shall include arrangements for the following activities: 1. Tracking of Proceeds: The Net Proceeds of the Bond can be credited to a sub-account, moved to a sub-portfolio, or otherwise tracked by the Issuer in an appropriate manner and documented. 2. Managing unallocated proceeds: The balance of unallocated Net Proceeds can be managed as per the requirements in Clause 7.3. 3. Earmarking funds to Nominated Projects & Assets: An earmarking process can be used to manage and account for funding to the Nominated Projects & Assets and enables estimation of the share of the Net Proceeds being used for
		reporting	Issuers should make, and keep, readily available up-to-date information on the use of proceeds to be renewed annually until full allocation, and on a timely basis in case of material developments.	The Issuer shall prepare a Green Bond Framework and make it publicly available prior to Issuance or at the time of Issuance. The Issuer shall prepare an Update Report at least annually while the Bond remains outstanding

Panel A: Prior-issuance requirement of ICMA and CBI

Stage	Documents	ICMA	CBI
	asset allocation report	The annual report should include a list of the projects to which Green Bond proceeds have been allocated, as well as a brief description of the projects, the amounts allocated, and their expected impact. Where confidentiality agreements, competitive considerations, or a large number of underlying projects limit the amount of detail that can be made available, the Green Bond Principles (GBP) recommends that information be presented in generic terms or on an aggregated portfolio basis.	 The Allocation Reporting shall include, without limitation: 1. Confirmation that the Bonds issued under the Green Bond Framework are aligned with the Climate Bonds Standard. This may include statements of alignment with other applicable standards; 2. A statement on the climate-related objectives of the Bond; 3. The list of Nominated Projects & Assets to which Net Proceeds have been allocated (or reallocated); 4. The amounts allocated to the Nominated Projects & Assets; 5. An estimate of the share of the Net Proceeds used for financing and refinancing, and which Nominated Projects & Assets have been refinanced. 6. The geographical distribution of the Nominated Projects & Assets.
post- issuance	impact report	Transparency is of particular value in communicating the expected and/or achieved im- pact of projects. The GBP recommends the use of qualitative performance indicators and, where feasible, quantitative performance measures and disclosure of the key underlying methodology and/or assumptions used in the quantitative determination. Issuers should refer to and adopt, where possible, the guidance and impact reporting templates provided in the Harmonized Framework for Impact Reporting.	 The Impact Reporting shall, without limitation: 1. Provide the expected or actual outcomes or impacts of the Nominated Projects & Assets with respect to the climate-related objectives of the Bond; 2. Use qualitative performance indicators and, where feasible, quantitative performance measures of the outcomes or impacts of the Nominated Projects & Assets with respect to the climate-related objectives of the Bond; 3. Provide the methods and the key underlying assumptions used in the preparation of the performance indicators and metrics.
	eligibility report		The Eligibility Reporting shall include, without limitation: 1. Confirmation that the Nominated Projects & Assets continue to meet the relevant eligibility requirements specified in Part C of the Climate Bonds Standard; 2. Information on the environmental characteristics or performance of Nominated Projects & Assets which is prescribed by the relevant Sector Eligibility Criteria.
others	additional costs related to the label/certification	ICMA has varied membership fees for tier 1, 2A, 2B, and 3 members. The membership fee for tier 3 is CHF 17,500 per year for full and associate membership. (Tier 3 is basic membership: Subsidiaries of all international/regional/domestic firms, all public institutions, associate mem- bers (non-full members), and firms similar to domestic firms but with a smaller revenue base.)	A Minimum Fee of USD\$2,000 (two thousand US dollars) for Issuers in developed countries and USD\$1,000 (one thousand US dollars) for Issuers in developing countries will be charged by the Climate Bonds Initiative upon awarding the Certification label. Following the issuance of any certified bond (or a series of bonds in a Programmatic Certification process) a Variable fee of 1/10th of a basis point (i.e., x 0.00001) of the bond issuance amount will be calculated. (For example, on a USD\$500 million bond, the certification fee is USD\$5,000 [five-thousand US dollars].) For Programmatic Issuers, the Minimum Fee will only apply to the first bond issued under the program; the Variable fee for each subsequent programmatic issuance will be calculated based on the aggregate issuance amounts under the program and any fees previously billed (including the Minimum fee) will be deducted from the cumulative Variable Fee.

Table A1 ICMA and CBI requirements on green bonds (continued).

Panel B: Post-issuance requirement from ICMA and CBI

This table lists and compares ICMA and CBI's requirements to issuers after the issuance of green bonds.

Variable Name	Description	Data Source
Dependent variables:		
Yield	Bond daily yield from the issuance date to the end of 2022	Bloomberg
GoogleTrends	Issuers' monthly Google search index.	GoogleTrends
NewsHeat	The monthly average of daily abnormal institutional investor attention(AIA). AIA is a dummy variable that equals 1 when the issuers' Bloomberg news heat score is 3 or 4, and 0 otherwise .	Bloomberg
Control variables:		
SDG	The issuer located the country's overall sustainable score in the year before the bond issuance	SDG Index and Dashboards
ParisAgreement	A dummy variable equals 1 when the green bond is issued after April/2016.	
GreenBond	A dummy variable equals 1 when the bond is labeled as green.	Documents disclosed by issuers.
Self-labeled	A dummy variable equals 1 when the green bond does not follow external green bond standards.	Documents disclosed by issuers.
Externally-labeled	A dummy variable equals 1 when the green bond has a label from third parties (ICMA or/and CBI).	Documents disclosed by issuers.
ICMA	A dummy variable equals 1 when the issuer declares to follow ICMA's Green Bond Principles in disclosed documents.	Documents disclosed by issuers.
CBI	A dummy variable equals 1 when the issuer declares to follow CBI's Climate Bond Standard in disclosed documents.	Documents disclosed by issuers.
Greenness	An ordinal variable that uses 0, 1, and 2 to represent conventional bonds, self- label green bonds, and externally-labeled green bonds, respectively.	
FirstGreen	A dummy variable equals 1 when it is the issuer's first time issuing green bonds.	Refinitiv
Amount (\$million)	The total dollar amounts outstanding of the bond at issuance.	Refinitiv
Coupon	Annualized coupon rate of the bond (measured in %).	Refinitiv
Yrs2Maturity	Years to maturity since bond issuance.	Refinitiv
Puttable	A dummy variable equals 1 when the bond has a put option.	Refinitiv
Callable	A dummy variable equals 1 when the bond has a call option.	Refinitiv
Financials	A dummy variable equals 1 when the issuer belongs to the financial sector defined by the Refinitiv Business Classification Sector.	Refinitiv
BrownIssuer	A dummy variable equals 1 when the issuer belongs to high-emission sectors (e.g., Oil and Gas, Transportation, Utilities).	Refinitiv
Listed	A dummy variable equals 1 when the issuer is a listed company.	Refinitiv
CleanTransport	A dummy variable equals 1 when bond proceeds are financed from green projects in clean transport.	Refinitiv
IssuePrice	Bond first-day price.	Refinitiv
YieldIssue	First-day yield estimated by issue price and annualized coupon rate.	Refinitiv
RatingScale	An ordinal variable based on Moody's rating ranging from 1 to 20, with the lower value indicating higher Moody's rating.	Refinitiv
BA_Spread	Bond daily bid-ask spread.	Bloomberg
DefaultProbability	Issuers' default probability in the next 5 years	Bloomberg
<i>HigherDefaultProbability</i>	A dummy variable equals 1 when the issuers' default probability is higher than the average level.	
MainMarket	A dummy variable equals 1 if the issuer's location is Netherlands, Germany, Lux- embourg, United Kingdom, or Hong Kong (EU green bonds issued by issuers from these five markets account for 42% of total green bonds issued in the EU during 2012-2021).	
InvestorSentiment	The categorized value of Sentix Economic Indices: Euro Aggregate Overall Index	Bloomberg
ECB_PolicyRate	European Central Bank's interest rate on the main refinancing operations.	European Central Bank
Inflation	The categorized value of the EU inflation rate.	Eurostat

Table A2 Var	iable D	Definiti	ions.
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This table provides a detailed description and data source for test variables in this paper.

Use of Proceeds	Freq.	Percent
Panel A: Green bonds		
Clean Transport	377	34.88
Energy Efficiency	248	22.94
Eligible Green Projects	106	9.81
Climate Change Adaptation	94	8.7
Green Construction/Buildings	75	6.94
Renewable Energy Projects	44	4.07
Circular Economy Adapted/Eco-efficient Products, Production Technologies/Processes	27	2.5
General Purpose	23	2.13
Aquatic Biodiversity Conservation	17	1.57
Alternative Energy	16	1.48
Sustainable Water or Wastewater management	13	1.2
Pollution Prevention & Control	8	0.74
Refinance/Financing expenses	7	0.65
Access to Essential Services	5	0.46
Carbon reduction through reforestation and avoided deforestation	4	0.37
The Belt and Road Initiative	4	0.37
Acquisition	3	0.28
Others	<=2	0.91
Panel B: Conventional bonds		
General Purpose	592	74.28
Acquisition	46	5.77
Repay Bank Loan or Bridge Financing	28	3.51
Redeem Existing Bonds or Securities	22	2.76
Refinance/Financing expenses	22	2.76
China Urban Construction	11	1.38
Access to Essential Services	10	1.25
Purchase of Funding Agreement	9	1.13
Budgetary Purpose	7	0.88
General Purpose/Refinance	6	0.75
Climate Change Adaptation	4	0.5
Dividend or Distribution to Shareholders	3	0.38
Other Education	3	0.38
Pandemic	3	0.38
Social Housing/Affordable Housing	3	0.38
Tender Offer	3	0.38
Working capital	3	0.38
Others	<=2	2.75

Table A3 Use of bond proceeds

Bond use of proceeds recorded in Refinitiv.

Table A4 Marginal effects in issuers' label selection process.

Number of obs. = 1,915,743

Model VCE: Robust

Average marginal effects

1._predict: Pr(LabelGreenness==0), predict(pr outcome(0))

2._predict: Pr(LabelGreenness==1), predict(pr outcome(1))

3._predict: Pr(LabelGreenness==2), predict(pr outcome(2))

Delta-method

	dy/dx	std. err.	Z	P>z	[95% cor	f. interval]
DefaultProbability						
_predict						
1	-0.619	0.008	-73.470	0.000	-0.636	-0.603
2	0.012	0.000	63.360	0.000	0.012	0.012
3	0.607	0.008	73.430	0.000	0.591	0.623
CleanTransport						
predict						
$\overline{1}$	-0.550	0.001	-628.610	0.000	-0.551	-0.548
2	0.011	0.000	107.780	0.000	0.011	0.011
3	0.539	0.001	658.970	0.000	0.537	0.540
Financials						
predict						
$\overline{1}$	-0.099	0.001	-142.290	0.000	-0.101	-0.098
2	0.002	0.000	95.110	0.000	0.002	0.002
3	0.097	0.001	141.970	0.000	0.096	0.099
ParisAgreement						
predict						
$\overline{1}$	-0.096	0.001	-99.390	0.000	-0.098	-0.094
2	0.002	0.000	83.830	0.000	0.002	0.002
3	0.094	0.001	99.090	0.000	0.092	0.096
BA Spread						
predict						
$\overline{1}$	-0.043	0.001	-50.870	0.000	-0.045	-0.042
2	0.001	0.000	47.310	0.000	0.001	0.001
3	0.042	0.001	50.850	0.000	0.041	0.044
Listed						
predict						
$\overline{1}$	-0.026	0.002	-12.000	0.000	-0.030	-0.021
2	0.000	0.000	11.940	0.000	0.000	0.001
3	0.025	0.002	12.000	0.000	0.021	0.029
Callable						
predict						
$\overline{1}$	0.009	0.001	12.310	0.000	0.008	0.011
2	-0.000	0.000	-12.150	0.000	-0.000	-0.000
3	-0.009	0.001	-12.310	0.000	-0.011	-0.008
SDG						
_predict						
1	-0.004	0.000	-64.200	0.000	-0.004	-0.004
2	0.000	0.000	57.350	0.000	0.000	0.000
3	0.004	0.000	64.170	0.000	0.004	0.004

This table reports the marginal effects of variables in the ordered probit model (Panel A of Table 7). In which the column dy/dx shows each variable's marginal effects in the issuer's bond label selection process.

	(1)	$\langle 0 \rangle$	(2)	(\mathbf{A})
T7 , 11	(1)	(2)	(3)	(4)
Yield	Green	Self-labeled	Externally-labeled	Externally-labeled
	vs. conventional	vs. conventional	vs. conventional	vs. self-labeled
D = GreenLabel	-1.988***			
	(-3.996)			
D = Self-label		-0.539		
		(-0.551)		
D = External-label			-2.123***	-1.875**
			(-4.249)	(-2.121)
IMR	1.073***	0.298	1.139***	0.785*
	(3.865)	(0.563)	(4.062)	(1.719)
Callable	0.643***	0.601***	0.715***	0.824***
	(4.427)	(2.935)	(4.986)	(3.022)
DefaultProbability	21.893***	25.748***	20.545***	18.698***
	(8.760)	(6.801)	(8.103)	(5.522)
BA_Spread	2.464***	2.031***	2.466***	3.046***
	(10.380)	(5.782)	(9.776)	(9.889)
Listed	-0.652***	-0.930***	-0.662***	-0.570*
	(-3.348)	(-3.395)	(-3.354)	(-1.752)
Financials	0.530***	0.386*	0.532***	0.118
	(3.271)	(1.943)	(3.412)	(0.527)
CleanTransport	0.663**	0.095	0.777**	-0.072
	(2.112)	(0.124)	(2.415)	(-0.429)
Constant	6.379***	1.481*	6.958***	4.489***
	(8.928)	(1.913)	(10.053)	(3.970)
Fixed Effects	Yes	Yes	Yes	Yes
Adjusted R ²	0.547	0.512	0.547	0.549
Observations	1.915.677	764.007	1,799,347	879,650

Table A5	The estimation	on results of the	he outcome eq	uation.

Estimation results from the 2nd stage of the treatment effect model with a different market condition measure: We repeat estimations in Table 6 but replace the ECB policy rate with the inflation rate. Two-way fixed effects (issuer, time) are included. Robust *t* statistics (in parentheses) are based on clustered standard errors at the issuer level. * p < 0.1, ** p < 0.05, *** p < 0.01

Panel A: Impact on issuers' Google Trends					
	(1)	(2)	(3)		
Google Trends	Green	Self-labeled	Externally-labeled		
-	vs. conventional	vs. conventional	vs. conventional		
Month (-1): D_{t-1}	4.071	5.765	0.748		
	(1.42)	(0.96)	(0.24)		
Month (0): D_t	7.951**	7.611	6.473**		
	(2.27)	(1.57)	(1.99)		
Month (+1): D_{t+1}	2.189	6.197	6.245		
	(0.89)	(1.01)	(1.40)		
Adjusted R-squared	0.083	0.090	0.082		
Observations	53,332	48,776	51,992		
Panel B: Impact on issuer-related	ed news readership	heat			
	(1)	(2)	(3)		
NewsHeat	Green	Self-labeled	Externally-labeled		
	vs. conventional	vs. conventional	vs. conventional		
Month (-1): D_{t-1}	0.0205	0.103	0.0007		
	(0.81)	(1.47)	(0.16)		
Month (0): D_t	-0.0009	0.155	0.0296**		
	(0.20)	(1, 0, 7)	(0 , 0 , 0)		
	(-0.29)	(1.07)	(2.09)		
Month (+1): D_{t+1}	-0.0205	(1.07) -0.0516	(2.09) 0.0003		
Month (+1): D_{t+1}	-0.0205 (-1.00)	(1.07) -0.0516 (-0.77)	(2.09) 0.0003 (0.07)		
Month (+1): D_{t+1} Adjusted R-squared	-0.29) -0.0205 (-1.00) 0.511	(1.07) -0.0516 (-0.77) 0.351	(2.09) 0.0003 (0.07) 0.377		
Month (+1): D_{t+1} Adjusted R-squared Observations	-0.29) -0.0205 (-1.00) 0.511 14,438	(1.07) -0.0516 (-0.77) 0.351 13,674	(2.09) 0.0003 (0.07) 0.377 14,547		
Month (+1): D_{t+1} Adjusted R-squared Observations Control ($\mathbf{\tilde{x}}$)	(-0.29) -0.0205 (-1.00) 0.511 14,438 Yes	(1.07) -0.0516 (-0.77) 0.351 13,674 Yes	(2.09) 0.0003 (0.07) 0.377 14,547 Yes		

 Table A6 The impact of bond issuance on investor attention.

Result from the PSM-DID estimation. We repeat the estimations in Table 8 but replace the ECB policy rate with the inflation rate. Control variables $\tilde{\mathbf{x}}$ includes *SDG*, *ParisAgree*, *Callable*, *Financials*, *Listed*, *CleanTransport*, bond size, maturity, rating, and market conditions. Two-way fixed effects (issuer, time) are included. Robust *t* statistics (in parentheses) are based on clustered standard errors at the issuer level. * p < 0.1, ** p < 0.05, *** p < 0.01