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Climate concerns, salient events, and green preferences ☆

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ABSTRACT

This paper examines how climate concerns and climate-related events influence investor preferences for sustainable assets by analyzing the dynamics of greenium, defined as the yield discount on labeled green bonds under strict matching conditions. Using daily data from 2017 to 2023 for USD and Euro denominated bonds, and controlling for liquidity, yield curve slope, and volatility, we find that the greenium is modest on average. However, it responds significantly to shifts in climate-related attention and climate events. The latter effect is found only in European markets. Decomposing climate concerns variations into positive and negative components reveals a reversible response, raising concerns about the stability of green preferences as a long-term funding channel.

1. Introduction

The cost of physical climate risks for the world's 1200 largest companies is projected to reach $800 billion annually in the 2030s and $1.6 trillion in the 2090s.[1] As a result, climate change concern has increased markedly in recent years.[2] The rising frequency of natural disasters, often seen as a salient "symptom" of climate change, has further heightened investor attention to climate risks.[3]

Pástor et al. (2021) identify two channels through which climate concerns influence asset prices: (i) investors derive non-pecuniary utility from holding green assets, and (ii) they perceive climate risks, both physical and transitional, as financially material. Recent research highlights sustainable preferences among financial professionals (Zerbib, 2019; Barber et al., 2021; Pástor et al., 2022). Since such preferences improve firms' funding conditions (Flammer, 2021), understanding the magnitude and persistence of the green premium is key to assessing the ability of financial markets to support the climate transition. Yet, the dynamics of green preferences and their link to climate-related factors remain underexplored (Caramichael and Rapp, 2024; Dragotto et al., 2025).

This paper investigates two key drivers of attention: salient climate events and climate-related concerns. Salient events are identified using data from the National Oceanic and Atmospheric Administration (NOAA) and the EM-DAT disaster database. Climate concerns are captured through two novel measures: (a) the Unexpected Media Coverage (UMC) index developed by Ardia et al. (2023); and (b) the Twitter-based climate attention index proposed by Arteaga-Garavito et al. (2025). These two indices are complementary. The UMC index effectively isolates shocks in climate change attention from baseline concern levels but is primarily based on U.S. newspaper coverage. In contrast, the Twitter-based index (TBI), derived from the textual analysis of 23 million Tweets worldwide, permits a clearer identification of regional variations in the overall level of climate attention. The use of daily frequency data for both measures helps mitigate confounding factors often present in lower-frequency datasets.

We exploit the unique characteristics of green bonds to disentangle pecuniary and non-pecuniary motivations for holding green assets. Green bonds are structurally similar to traditional bonds but exclusively finance environmentally sustainable projects. When green and traditional (brown) bonds are consistently matched, the yield discount on green bonds – the greenium – captures investors' willingness to accept lower returns and provides a direct measure of investor preferences.

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[1] https://www.spglobal.com/esg/insights/featured/special-editorial/ceraweek-physical-risk.
[2] https://www.jpmorgan.com/insights/sustainability/climate/navigating-the-new-climate-era.
[3] https://www.usgs.gov/faqs/how-can-climate-change-affect-natural-disasters.

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Our dataset consists of 221 labeled green bonds[4] and their matched brown counterparts from both U.S. and European markets. Using daily data from 2017–2023, we estimate a strict greenium, controlling for bond characteristics,[5] liquidity, yield curve slope (Nelson and Siegel, 1987; Svensson, 1994), and volatility.[6]

Our findings show that the greenium, a proxy for green investor preferences, is modest (around 4 bp) and not consistently significant over time. However, it responds to climate concerns (both UMC and TBI) and weather- and climate-related natural disasters. It increases by about 0.25 bp when climate concerns rise by one standard deviation, and by a similar amount following natural disasters. The disaster effect is region-specific, significant in Europe but not in the U.S., possibly due to political polarization (Smith et al., 2024; Anderson and Robinson, 2024). In addition, distinguishing between positive and negative variation of global attention reveals a reversible effect, challenging greenium stability.

By examining the effects of climate concerns and natural disasters on greenium dynamics, we contribute to the literature on green investor preferences (Barber and Odean, 2001; Pástor et al., 2022; Ardia et al., 2023), greenium responsiveness (Zerbib, 2019; Caramichael and Rapp, 2024; Dragotto et al., 2025), and the economic consequences of natural disasters (Goebel et al., 2015; Dessaint and Matray, 2017; Brown et al., 2018; Bourdeau-Brien and Kryzanowski, 2020; Kong et al., 2021).

2. Data description

2.1. Sample of green bonds and matched non-green bonds

We construct our sample from the LSEG/Datastream universe of EUR- and USD-denominated corporate and government/supranational bonds with an issued nominal amount above USD 200 million, outstanding or repaid as of December 31, 2023. This yields 84,780 bonds, including 1,586 identified as green. For each green bond, we match a bond from the same issuer, based on currency, seniority, credit rating, callability, and issue size (within a 4:1 ratio), as well as issuance and maturity dates (within one year). If multiple matches are available, we select the bond minimizing the sum of absolute differences in issuance and maturity dates. This process yields an initial sample of 288 matched pairs. After retrieving daily yields and bid–ask prices, and restricting the sample to January 1, 2017–December 31, 2023, we obtain a final panel of 221 matched pairs. Our 221 green bonds have an average initial maturity of 9.15 years (s.d. 5.79) and an average amount at issuance of 1.22 bn USD (s.d. 1.60).

2.2. Climate concerns and natural disasters

To capture climate concerns, we use two measures. First, we use the Unexpected Media Coverage (UMC) measure developed by Ardia et al. (2023), which isolates the daily unexpected component of climate-related attention based on media coverage. The authors provide the full indicator, along with several decompositions.[7] Second, we use the Twitter-based index (TBI) proposed by Arteaga-Garavito et al. (2025), derived from the textual analysis of 23 million Tweets worldwide. To account for the structure of our sample, we measure overall attention for EUR countries using the average TBI values for the three main markets: France, Germany, and Italy.

Table 1
Strict greenium statistics, by year and currency.

Panel A: Annual strict greenium by year	Mean	Median	Number of observations
2017	−0.0433**	−0.0503***	25
2018	0.0038	−0.0061	44
2019	−0.0103	0.0071	60
2020	−0.0414***	−0.0296***	94
2021	−0.0268***	−0.0243	136
2022	−0.0527***	−0.0455***	171
2023	−0.0140	−0.0231***	204
2017–2023	−0.0410***	−0.0254***	221
Panel B: Annual greenium by currency	**Mean**	**Median**	**Number of observations**
EUR	−0.0374***	−0.0223***	146
USD	−0.0481***	−0.0487***	75
Equal means	0.87		
Equal medians		1.85*	

This table shows annual averages, medians (Panel A), and tests of equal means and medians (Panel B) of the estimated strict greenium across issuance currencies. To estimate the strict greenium g_i, we follow Zerbib (2019) and consider the fixed-effect of the following regression:

$$\text{Gross greenium}_{i,t} = \beta \Delta \text{BA}_{i,t} + \gamma \text{Slope}_{i,t} + \delta \text{Sigma}_t + g_i + \varepsilon_{i,t},$$

where $Gross\ greenium_{i,t}$ corresponds to the difference in yield between green bond i and its brown matched counterpart at date t, $\Delta BA_{i,t}$ to the difference in bid–ask spreads, $Slope_{i,t}$ to the difference in zero-coupon rates and $Sigma_t$ to the VIX (respectively, VSTOXX) for USD (EUR) denominated bonds. The one-way fixed-effects panel regression is estimated using the Newey–West estimator. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

We also focus on events that may make climate change more salient. Specifically, we consider events that (i) are influenced by climate change and/or are likely to be perceived as such by investors, and (ii) have the greatest potential to impact daily bond prices. We thus examine weather- and climate-related natural disasters.

For the United States, we use the National Oceanic and Atmospheric Administration (NOAA) Billion-Dollar Weather and Climate Disasters database, which records events with total damages exceeding USD 1 billion. Since we are interested in weather- and climate- related events, we retain only events classified as Flooding, Severe Storm, Tropical Cyclone, or Winter Storm, resulting in a total of 123 natural disasters.

For Europe, we use the EM-DAT International Disasters database. Given the broad scope of disasters covered by EM-DAT, which includes biological and technological events, we restrict the sample to those classified as Climatological, Hydrological, or Meteorological.[8] Our sample of natural disasters in Europe consists of 193 events.

3. Methodology and results

3.1. Strict greenium measurement

To minimize noise, we employ a strict matching methodology considering bonds issued by the same issuer with stringent constraints on issue size, currency, credit rating, seniority, callability, issue date, and maturity date. In addition to these *a priori* conditions, we make *a posteriori* adjustments to ensure comparability between the yields of green and matched brown bonds. Therefore, we control for liquidity differences between green and brown bonds, as well as for overall market volatility. Moreover, since our matching allows for maturity differences of up to one year, we account for potential yield-curve effects by including $Slope_{i,t}$, the difference in zero-coupon yields between the green bond

[4] Standards and guidelines are among the ICMA-Green Bonds Principles, Climate Bonds Initiative, or EU Taxonomy.

[5] Zerbib (2019), Gianfrate and Peri (2019), Fatica et al. (2021), Simeth (2022), Baker et al. (2022), Teti et al. (2022), Caramichael and Rapp (2024), Hu et al. (2024) and Dragotto et al. (2025).

[6] On the relationship between volatility and liquidity, see, for instance, Choi and Munro (2022) and Drechsler et al. (2020).

[7] We rely on the September 2024 update of the data, which extends the original sample through June 29, 2024.

[8] Due to missing data on damages and costs for most events, we are unable to filter based on these criteria.

Table 2
Regression results.

	Panel A UMC – Ardia et al. (2023)			Panel B TBI – Arteaga-Garavito et al. (2025)		
	(1)	(2)	(3)	(4)	(5)	(6)
	Whole sample	EUR bonds	USD bonds	Whole sample	EUR bonds	USD bonds
ΔBA	6.500***	5.6348***	9.8944***	8.3284***	8.6246***	6.3965***
	(0.6544)	(0.7269)	(1.4647)	(0.6678)	(0.7062)	(1.8522)
Slope	0.4423***	0.3950***	0.5237***	0.2552***	0.1850***	0.3771***
	(0.0515)	(0.0725)	(0.0534)	(0.0482)	(0.0605)	(0.0642)
Sigma	0.0005***	0.0010***	−0.0004	0.0002	0.0005***	−0.0003
	(0.0002)	(0.0002)	(0.0003)	(0.0002)	(0.0002)	(0.0004)
CConcerns	−0.0034**	−0.0026	−0.0059***	−0.0942**	−0.1410**	−0.0755*
	(0.0015)	(0.0021)	(0.0017)	(0.0417)	(0.0663)	(0.0404)
Event EU	−0.0022*	−0.0034**	−0.0003	−0.0021*	−0.0033**	0.0009
	(0.0012)	(0.0016)	(0.0016)	(0.0012)	(0.0015)	(0.0018)
Event US	0.0013	0.0006	0.0021	0.0023	0.0011	0.0029
	(0.0014)	(0.0017)	(0.0024)	(0.0014)	(0.0017)	(0.0026)
Green bonds FE	Yes	Yes	Yes	Yes	Yes	Yes
Number of bonds	221	146	75	180	116	64
Observations	156,432	102,042	54,390	112,618	75,213	37,405
R^2	21.86%	19.79%	30.80%	42.21%	44.89%	33.09%

This table shows the parameter estimates of the following Eq. (2) for the whole sample and the USD and EUR subsamples, considering two measures of climate concerns (*CConcerns*): UMC (Ardia et al., 2023) and TBI (Arteaga-Garavito et al., 2025).

$$\text{Gross greenium}_{i,t} = \delta_1 \text{CConcerns}_t + \delta_2 \text{Event}_t + \beta \Delta \text{BA}_{i,t} + \gamma \text{Slope}_{i,t} + \delta \text{Sigma}_t + g_i + \varepsilon_{i,t},$$

$Gross\ greenium_{i,t}$ corresponds to the difference in yield between green bond i and its brown matched counterpart at date t. $\Delta BA_{i,t}$ is the daily difference in bid–ask spreads. $Slope_{i,t}$ is the daily difference in the zero-coupon rates between a green bond and its matched brown bond, computed using daily parameters from the Nelson–Siegel–Svensson model (Nelson and Siegel, 1987; Svensson, 1994). $Sigma_t$ corresponds to the VIX (VSTOXX) for USD- (EUR-) denominated bonds. Event EU and Event US are dummy variables equal to 1 if a climate event occurs in Europe or in the U.S., respectively. Standard errors are reported in parentheses, using the Newey–West estimator. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

and its matched counterpart. This variable is computed daily using the yield curve models of Nelson and Siegel (1987) and Svensson (1994), based on parameters corresponding to each currency (USD or EUR). Following Zerbib (2019), the strict greenium g_i is the time-invariant component captured by the individual fixed effect from the regression:

$$\text{Gross greenium}_{i,t} = \beta \Delta \text{BA}_{i,t} + \gamma \text{Slope}_{i,t} + \delta \text{Sigma}_t + g_i + \varepsilon_{i,t}, \quad (1)$$

where $Gross\ greenium_{i,t}$ corresponds to the difference in yield between green bond i and its brown matched counterpart at date t, $\Delta BA_{i,t}$ to the difference in bid–ask spreads, $Slope_{i,t}$ to the difference in zero-coupon rates and $Sigma_t$ to the VIX (respectively, VSTOXX) for USD (EUR) denominated bonds.

Table 1 shows the estimated “strict” greenium. The results align with existing literature: the greenium is negative and statistically significant, although its average magnitude is only 4 bp. The average greenium is significant in 2017 and from 2020 to 2022. The median greenium is significant in 2017, 2020, 2022 and 2023, suggesting heterogeneity in the greenium across some years. Panel B shows that mean and median greenium values are lower for EUR bonds but the difference is only significant for the median values.

3.2. Dynamics of the greenium

Our two primary variables of interest are climate concerns and natural disasters. We test whether increased climate concerns are associated with a greater willingness among investors to accept lower yields for green bonds, thereby increasing the greenium. We further assume that investors interpret natural disasters as potential manifestations of climate change. These events are commonly used in the literature as exogenous shocks to identify shifts in investor behavior. Although the natural disasters we study may not directly affect bond issuers, we posit that their salience enhances investor attention to climate issues.

In our empirical analysis, we focus on the dynamics of the greenium extending the regression described by Eq. (1) to incorporate the climate concerns variable $CConcerns_t$ (defined either by UMC_t or TBI_t) and a dummy variable equal to one if a weather- or climate-related natural disaster starts on day t ($Event_t$), distinguishing between U.S. and European events. We have:

$$\text{Gross greenium}_{i,t} = \delta_1 \text{CConcerns}_t + \delta_2 \text{Event}_t + \beta \Delta \text{BA}_{i,t} + \gamma \text{Slope}_{i,t} + \delta \text{Sigma}_t + g_i + \varepsilon_{i,t}. \quad (2)$$

Table 2 shows the results of the regressions. In the baseline model (columns 1 and 4), we find a negative and significant effect of UMC and TBI on the greenium. An increase in climate concerns is associated with a rise in the greenium,[9] suggesting that investors are willing to pay a higher price for green bonds relative to comparable brown bonds. These results align with Pástor et al. (2022) and Ardia et al. (2023) on stocks, who find lower expected returns for greener shares. Similarly, weather- or climate-related natural disasters also significantly increase the greenium. Both effects are of similar economic magnitude. Natural disasters in Europe increase the greenium by 0.25 bp (non significant in the U.S.), while a one standard deviation change in UMC (resp. TBI) corresponds to roughly 0.15 bp (respectively 0.25 bp). Thus, both attention to climate issues and the occurrence of climate-related events lead to a larger greenium, reflecting investor preferences for green assets.

Regarding control variables, the positive coefficient for *ΔBA* indicates a smaller gross greenium for green bonds that are less liquid than their matched counterparts. Additionally, a longer maturity for a green bond is associated with a smaller gross greenium. We obtain mixed results for volatility, which is significant only in Europe.

We then explore potential differences between U.S. and European markets. In columns 2, 3, 5, and 6, we distinguish between EUR- and USD-denominated bonds. UMC is highly significant for USD-denominated bonds, where a one standard deviation increase corresponds to approximately 0.3 bp. In contrast, UMC is not statistically

[9] The greenium denotes a lower yield on green bonds, implying a negative premium relative to non-green bonds. A negative coefficient on *CConcerns* indicates an increase in the greenium.

Table 3
Asymmetric sensitivity to climate concerns.

	(1)	(2)	(3)
	Whole sample	EUR bonds	USD bonds
ΔBA	8.3286***	8.6247***	6.3981***
	(0.6676)	(0.7061)	(1.8502)
Slope	0.2552***	0.1849***	0.3774***
	(0.0482)	(0.0605)	(0.0642)
Sigma	0.0002	0.0005***	−0.0003
	(0.0002)	(0.0002)	(0.0004)
TBI			
Up	−0.0991**	−0.1428**	−0.0844**
	(0.0427)	(0.0667)	(0.0423)
Down	−0.1108**	−0.1547**	−0.0968**
	(0.0454)	(0.0700)	(0.0456)
Event EU	−0.0023*	−0.0036**	0.0011
	(0.0012)	(0.0016)	(0.0018)
Event US	0.0023	0.0009	0.0029
	(0.0014)	(0.0017)	(0.0026)
Up = Down p-value	0.0110**	0.0532*	0.0477**
Green bonds FE	Yes	Yes	Yes
Number of bonds	180	116	64
Observations	112,618	75,213	37,405
R-squared	42.22%	44.89%	33.10%

This table shows the parameter estimates for the whole sample and the USD and EUR subsamples, extending equation 2 by considering an asymmetric sensitivity to climate concerns using the Arteaga-Garavito et al. (2025) measure. *Up* (respectively, *Down*) identifies a daily increase (respectively, decrease) in climate concerns, and zero otherwise. *ΔBA* is the daily difference in bid–ask spreads. *Slope* is the daily difference in the zero-coupon rates between a green bond and its matched brown bond, computed using daily parameters from the Nelson–Siegel–Svensson model (Nelson and Siegel, 1987; Svensson, 1994). *Sigma* denotes the VIX for USD bonds and the VSTOXX for EUR bonds. Event EU and Event US are dummy variables equal to 1 if a climate event occurs in Europe or in the U.S., respectively. Standard errors are reported in parentheses, using the Newey–West estimator. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

significant for EUR-denominated bonds, potentially due to the U.S.-centric nature of the media sources underlying the index of Ardia et al. (2023). Additionally, global attention measured by the TBI has a significant effect on both markets, with a stronger impact observed in the EUR market, suggesting greater sensitivity of European markets to climate-related attention. A one standard deviation increase in TBI corresponds to approximately 0.4 basis points for EUR-denominated bonds (and only 0.2 for USD-denominated bonds). We find an impact of natural disasters only in Europe. The occurrence of a natural disaster in Europe increases the greenium of EUR-denominated bonds by 0.3 bp.[10]

Finally, in Table 3, we decompose the TBI variable into two components: TBI Up (positive daily variation, zero otherwise) and TBI Down (negative daily variation, zero otherwise). For the full sample (column 1), we find an opposite and asymmetric reaction of the greenium to changes in TBI. An increase in TBI raises the greenium, while a decrease leads to a stronger decline. Both coefficients are significant. Green asset prices rise when climate concerns intensify. The effect is short-lived, as the greenium falls when attention to climate issues declines.[11] Moreover, the sensitivity to decreases is larger in absolute value. When focusing on EUR- and USD- denominated bonds separately (columns 2 and 3), we find broadly similar results.

4. Conclusion

This paper investigates how climate-related attention, proxied by climate concerns and natural disasters, influences investor preferences for sustainable assets. Using a strictly defined greenium as a proxy, we find that although the greenium is modest (around 4 bp) and not consistently significant over time, it responds notably to both salient climate events and shifts in concern about climate change. The impact of climate events is particularly pronounced in European markets. By employing both the Unexpected Media Coverage (UMC) measure and a Twitter-based index (TBI), we provide a clearer understanding of the short-term dynamics of green asset pricing. Our analysis of positive and negative shocks reveals a degree of instability in investor preferences, raising questions about the long-term reliability of green preferences as a stable funding channel.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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[10] The size of natural disasters in our European dataset is on average smaller than in the U.S. (1.3 billion vs. 7.9 billion). Note that our dataset contains only 69 European events with damages estimation.

[11] We find similar results for the U.S. when using UMC.