Adaptation Finance for Emerging Markets*

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ABSTRACT

A substantial investment gap exists in financing climate change adaptation in emerging markets. Governments could mobilize private capital through the green bond market to help close the gap. However, the relative cost of adaptation capital facing emerging markets remains unclear. To understand this, we analyze the green premium (Greenium) of 444 green bonds issued by governments and public agencies across 35 countries globally, spanning 17 currencies. Our results indicate that, among green bonds from emerging markets, the Greenium of adaptation bonds (green bonds whose use of proceeds includes climate change adaptation) is larger than that of non-adaptation bonds. The former is even larger if these adaptation bonds are from countries with higher physical risk exposure or stronger governance capacity. Notably, even among countries with above-median physical risk exposure, the Greenium of adaptation bonds from emerging markets is still larger than that from developed markets. Indeed, this cost of capital advantage is driven by institutional investors. Our results highlight the potential for emerging markets to mobilize more private capital in the green bond market to supplement public finance in supporting climate change adaptation.

KEYWORDS

Adaptation finance; Emerging market; Climate change; Green bond; Institutional investors

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1. Introduction

According to the Global Risk Report 2024, climate change-related risks, particularly extreme weather events, are anticipated to be the top-ranked global risks in the coming decade (World Economic Forum, 2024). Climate change adaptation is increasingly urgent for reducing current and future climate-related losses by enhancing the coping capacity of the ecological, social, or economic systems. The demand for adaptation investments is growing (New et al., 2022), especially in resource-dependent and vulnerable regions (United Nations Framework Convention on Climate Change, 2015). Estimates for adaptation costs in emerging markets this decade range from US$215 billion to US$387 billion per year (UNEP, 2023).

However, climate finance has been prioritizing mitigation over adaptation globally (UNEP, 2021). As a result, the investment gap in adaptation finance is estimated to be 10-18 times larger than the international public capital flows to adaptation projects at present (UNEP, 2023). The shortage of adaptation finance is particularly concerning for emerging markets (Khan et al., 2020).

Given the inadequacy of public funding, governments are beginning to leverage private capital from the green bond market to help fill this gap. Green bonds are attractive to socially responsible investors due to their commitment to finance environmentally friendly projects contributing to climate change adaptation and mitigation. The green bond market has experienced substantial growth in recent years, with cumulative green bond issuances rising from US$100 billion in 2015 to over US$3 trillion in 2023 (Climate Bonds Initiative, 2024).

The additionality[1] of adaptation finance for emerging markets should appeal to climate-conscious investors. However, many emerging markets have been facing difficulties in raising capital from the financial market due to their poorly developed banking systems and weak regulatory frameworks (Berensmann et al., 2015). As such, little is understood about the relative cost of adaptation capital facing emerging markets. To address these research gaps, this study aims to answer the following research questions:

Research Question: Do projects dedicated to climate change adaptation proposed by emerging markets face a higher or lower cost of capital?

To address the above question, this study categorizes green bonds into two types: adaptation bonds (green bonds whose use of proceeds includes climate change adaptation) and non-adaptation bonds (green bonds whose use of proceeds does not include climate change adaptation). We focus on green bonds issued by governments and public agencies (public issuers) globally over the period 2014-2023 to explore the green premium of adaptation bonds.

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[1] The term of "additionality" refers to directing capital toward green assets and projects that would not otherwise secure financing.

The green premium, i.e., the Greenium, is defined as the difference between the yield of a green bond and that of a comparable conventional bond (Agliardi & Agliardi, 2019). A larger Greenium means that a green bond faces a lower financing cost. Following Zerbib (2019), we generate a sample of 444 matched bond pairs covering 35 countries and regions and 17 currencies.

Our results indicate that the Greenium of adaptation bonds is 6.7 basis points (bps) larger if their public issuers are from emerging markets rather than developed markets. This means that emerging markets actually have a cost of capital advantage in financing adaptation compared to developed markets. Furthermore, we show that investors seem to be more enthusiastic about supporting climate change adaptation than other green projects in emerging markets. The Greenium of adaptation bonds is 9.5 bps larger than that of non-adaptation bonds for emerging markets. The differential is only 0.3 bps for developed markets.

To further understand whether public issuers with a stronger need for climate change adaptation actually incur a lower cost of adaptation capital, we examine how country-level physical risk exposure affects the Greenium conferred to adaptation bonds.

We find that the Greenium of adaptation bonds is 31.4 bps larger if they are issued by emerging markets with above-median rather than below-median physical risk exposure. Interestingly, even among countries with above-median physical risk exposure, the Greenium of adaptation bonds from emerging markets is still 18.3 bps larger than that from developed markets. Moreover, this cost of capital advantage for adaptation projects in emerging markets is driven by institutional investors. Additionally, our results indicate that governance capacity can significantly reduce the cost of capital disadvantage of emerging markets.

This study makes the following three contributions. First, this paper innovatively reveals investors' attitude towards climate change adaptation investments in emerging markets. To the best of our knowledge, this study is the first to examine the cost of financing climate change adaptation in different countries and physical risk exposure scenarios.

Second, our findings provide new insights into the determinants and inequalities of adaptation finance allocation. While existing literature suggests that climate vulnerability is not the primary driver of the accessibility and allocation of adaptation finance—instead emphasizing the role of institutional capacities, financial interests, and political considerations (Venner et al., 2024)—our results reveal a contrasting dynamic in the green bond market. Specifically, we demonstrate that investors take into account the additionality of adaptation bonds when conferring Greenium, as evidenced by the pricing of physical risk exposure. This pricing mechanism operates primarily through institutional investors.

The third contribution is that this study is essential to enhance the effectiveness of climate change adaptation efforts in emerging markets. Our results provide guidance for emerging markets to consider mobilizing more private capital in the green bond market to supplement public finance in supporting climate change adaptation. We also suggest governments of emerging markets build institutional strength to attract cross-border green capital flows.

The remainder of the paper is organized as follows: Section 2 provides a review of previous studies. Section 3 explains our hypothesis development. Section 4 describes the research design, including our data sources and sample selection process. Section 5 presents our regression models and discusses the results along with their implications for theory and practice. Finally, we conclude the paper in Section 6.

2. Literature review

Our paper is related to three strands of literature. First, it is related to the literature on the challenges of boosting international capital flows for sustainable investment to emerging markets. Barua and Aziz (2022) reveal that due to insufficient financial and economic capacity, emerging markets rely on overseas development assistance and public sources to promote green finance, with minimal private sector involvement. Hafner et al., (2019) identify the lack of information on climate change risks in emerging markets as a key barrier. Another significant factor is the inherent bias of international investors against the risks in emerging markets beyond their credit ratings, leading to “unjustifiably” higher borrowing costs (Gbohoui et al., 2023). Similarly, Gadanecz et al. (2014) highlight exchange rate risks as a major determinant of local currency sovereign bond yields. Collectively, these studies emphasize that major challenges in scaling up sustainable investments in emerging markets.

Second, this paper is related to the literature on adaptation finance. Previous research has predominantly focused on the allocation of adaptation finance across nations, highlighting challenges faced by vulnerable regions. For instance, Garschagen and Doshi (2022) show many of the most vulnerable countries, particularly the Least Developed Countries (LDCs) in Africa, struggle to access the Green Climate Fund, the largest climate change fund. Saunders (2019) finds a concave relationship between a country’s climate vulnerability and the adaptation finance it receives, with diminishing and even negative returns to higher vulnerability. Other studies analyze barriers to acquiring and utilizing adaptation finance. Stadelmann et al. (2014) argue that the allocation mechanisms of the Adaptation Fund (AF), which stands out for its non-governmental funding sources and direct access for developing countries, are simplistic and fail to address the needs of the most vulnerable countries. They also highlight challenges such as the inconsistency in ranking methodologies for vulnerable countries and the limited availability of funds. By and large, previous studies on adaptation finance primarily analyze public adaptation funds, overlooking other financing mechanisms such as private capital raised through the green bond market.

Our work also relates to the rapidly growing literature on the climate investment strategies of institutional investors. Flammer et al. (2021) demonstrate that institutional investors enhance corporate carbon emissions reduction through governance channels by promoting climate-related information disclosures. Similarly, Ilhan et al. (2023) find that institutional investors' demand for climate information increases corporate disclosure probability, with emissions declining significantly. This underscores institutional investors' oversight as a catalyst for climate actions. In the green bond markets, Tang and Zhang (2020) show that institutional investors increase equity holdings in issuers after their green bond issuance, interpreting the latter as signals of the issuers' environmental commitment. Ghitti et al. (2023) further analyze the impact of the shades of green and reveal that UN-PRI signatories significantly prefer holding dark-green and medium-green bonds. However, existing studies have yet to adequately address how institutional investors incorporate physical risks into their asset screening criteria and how they weigh risk exposure in capital allocation decisions.

To the best of our knowledge, this study is the first to examine the cost of financing climate change adaptation across countries, with a particular focus on emerging markets. We further contribute to the literature by exploring two key determinants of the cost of adaptation capital for emerging markets: physical risk exposure and governance capacity. Finally, we assess how a reduction in institutional holdings could impact the cost of adaptation capital.

3. Hypotheses

The section motivates four hypotheses to address our research questions.

The main focus of climate change adaptation is to reduce climate-related losses. Goldsmith-Pinkham et al. (2023) show that sea-level rise exposure risk is priced in the municipal bond markets, implying that investors incorporate expected losses from physical risks into yields. Adaptation bonds uniquely mitigate such losses, generating a premium unavailable for non-adaptation bonds. Additionally, investors prioritizing environmental impact are willing to compromise on potential financial returns (Höchstädter and Scheck, 2015). As such, investors' willingness to promote adaptation investments may lead them to accept higher prices for adaptation bonds. Accordingly, we hypothesize:

Hypothesis 1: The Greenium of adaptation bonds is larger than that of non-adaptation green bonds.

Investment in emerging markets poses a series of risks beyond that in developed markets. For instance, investors encounter risks of higher political instability, greater currency fluctuations, inadequate climate risk disclosure, and insufficient metrics for sustainable investment ranking. These risks may prompt investors to seek higher risk compensation when investing in green bonds from emerging markets. Accordingly, we hypothesize:

Hypothesis 2: Green bonds from emerging markets suffer a green discount.

Developed markets account for the majority of historical cumulative emissions and possess stronger fiscal capacity (Sundaram & Adnan, 2022). Yet, emerging markets bear the brunt of climate change impacts with limited resources, despite being the least responsible for global warming (Popovich & Plumer, 2021). According to the Intergovernmental Panel on Climate Change (2021), regions with the least resources have the lowest capacity to adapt and are the most vulnerable to climate change impacts. Thus, emerging markets require strong financial support for climate change adaptation compared to mitigation. Consequently, although emerging market bonds carry higher risks, investors may still accept lower risk premia for adaptation bonds due to their additionality. Accordingly, we hypothesize:

Hypothesis 3: The Greenium of adaptation bonds is larger than that of non-adaptation bonds for emerging markets.

Income losses in emerging markets which can be attributed to climate impacts are about five times larger than those in developed markets (Center for Global Development, 2024). This underscores the urgent need to implement adaptation bond projects in emerging markets facing high physical risks over those facing lower risks. Given the high demand and urgency for the execution of adaptation projects, investors demonstrate higher preference in investing in them. Meanwhile, developed markets are less directly affected by extreme climate events and possess well-developed infrastructure systems (e.g., flood control projects, early warning systems). Moreover, adaptation projects in developed nations, such as climate insurance and resilience infrastructure, attract significantly higher private capital participation compared to emerging markets (OECD, 2025). Thus, the effect of physical risk exposure on the Greenium is more significant for adaptation bonds from developed markets than emerging markets. Accordingly, we hypothesize:

Hypothesis 4: Physical risk exposure moderates the Greenium of adaptation bonds from emerging markets.

Now, we subject these hypotheses to empirical analysis.

4. Research design and data

Our sample consists of global green bonds issued over the period 2014-2023 by governments and public agencies, which we collectively term ‘public issuers’, together with conventional bonds with similar characteristics for matching the former.

4.1 Green bond data sources

The green bond data is sourced from Bloomberg. All the green bonds issued from 2014 to 2023 are screened as follows. (i) Based on Bloomberg Industry Classification Standard, only bonds issued by public issuers, including government-backed agencies, development banks, local authorities, and sovereign governments, are included. The focus on public issuers is motivated by their dominant role in the adaptation bond market. (ii) Supranational green bonds are excluded to focus on national-level issuers, as the former complicates pricing effect attribution and precise exposure measurement for individual economies. (iii) Bonds without an International Securities Identification Number (ISIN) are excluded. (iv) Collateralized or option-embedded green bonds are excluded, due to the lack of available collateral information and the practical challenge of finding matched bonds with identical option-embedded features (Lau et al., 2022).

4.2 Sample matching process

Existing literature (Zerbib, 2019; Bachelet et al., 2019; Hyun et al., 2020; Lau et al., 2022) estimate the Greenium through matching green bonds with comparable conventional bonds. Following these studies, we generate a sample of matched green and conventional bonds that are almost identical, except for the green label as well as negligible differences in their issuance amounts and maturity dates.

Specifically, for each government green bond issued between 2014 and 2023, we search for a conventional bond from the same issuer, with the same currency, rating, and bond structure. The matched bonds should have close maturity dates, with a difference of no more than two years. The difference between the issue dates and maturity dates of the matched bonds must not exceed six years. The issuance amount of the matched conventional bond must be between one-fourth and four times the issuance amount of the green bond. After excluding samples with missing ask prices, bid prices, and yield data, we ultimately obtained 444 matched bond pairs covering 35 countries and regions and 17 currencies (see Figure 1).

Figure 1. The origin of public issuers in our sample

Source: compiled by the authors based on the definition of emerging and developed markets from the International Monetary Fund (IMF).

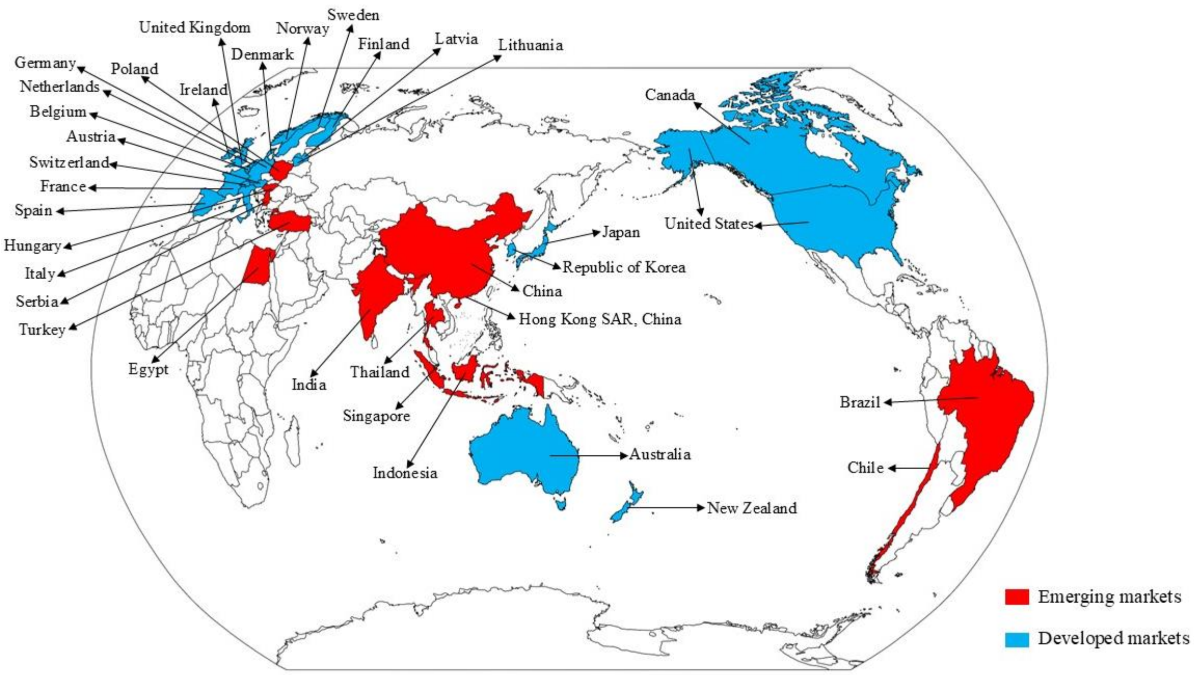


Table 1 presents the characteristics for the 444 matched green and conventional bond pairs. The maturity, issue amount, and coupon rate distributions between green bonds and their conventional counterparts are closely aligned, with nearly identical means and medians. This shows that our approach ensures the comparability between the matched green and conventional bonds in factors that may influence bond prices.

Table 1. Characteristics of the matched government bond pairs.

Table 1 presents the bond-level characteristics for the 444 pairs of bonds in the matched sample. GB denotes green bonds. CB denotes the matched conventional bonds.

Variable	Obs	Mean	SD	Min	Max	P50
Coupon GB (%)	444	1.788	1.645	0.000	9.125	1.192
Coupon CB (%)	444	1.773	1.665	0.000	9.375	1.322
Issue Amount GB (bn USD)	444	1.024	3.334	0.003	37.530	0.204
Issue Amount CB (bn USD)	444	1.551	4.971	0.007	47.830	0.217
Maturity GB (in years)	444	9.797	8.265	0.200	100.000	7.000
Maturity CB (in years)	444	10.150	8.425	0.000	100.000	9.350

4.3 Data sources of key variables

(1) Bond-level data

For these 444 matched pairs, we retrieve from Bloomberg the daily observational data of ask prices, bid prices, and yields from the bond issuance date up to 29 February 2024. We also gather data on the issuance amounts, currency, and maturities of the green bonds from Bloomberg. Yield spread, which is calculated as the difference between the ask yield of a green bond and that of its matched conventional bond, is trimmed at the 1st and 99th percentiles to mitigate the impact of outliers. The final sample includes 254,476 unbalanced bond-day observations.

We classify the green bonds in our sample based on the use of proceeds categories provided by Bloomberg. Specifically, we categorize green bonds as adaptation bonds if their use of proceeds includes projects aimed at climate change adaptation. Otherwise, the green bonds are classified as non-adaptation bonds. Within our sample of 444 green bonds, 195 are identified as adaptation bonds, and 249 are categorized as non-adaptation bonds.

The descriptive statistics of key variables within the sample of 444 green bonds and their matched conventional bonds can be found in Table 2. The statistics show that the average yield spread for the full sample is 1.3 bps, which implies that the ask yields of green bonds are on average higher than those of their paired conventional bonds in our sample. The median yield spread of the matched bond pairs is 0.5 bps. In terms of bond characteristics, on average, green bonds are more liquid than their matched conventional bonds, as indicated by an average liquidity difference of -0.015. However, at the median level, the liquidity of green bonds does not differ from that of matched conventional bonds. Besides, the average issuance amount of green bonds is 1,024 million USD. On average, adaptation bonds have a larger issuance amount (1,292 million USD) compared to non-adaptation bonds (815 million USD). Finally, the green bonds have maturities ranging from 3 months to a maximum of 100 years, indicating substantial maturity diversity within our sample.

Table 2. Descriptive statistics.

Table 2 presents the descriptive statistics for the variables used in the regressions, containing 254,476 unbalanced daily observations. Green bonds are categorized as *Adaptation bonds* if their use of proceeds includes projects aimed at climate change adaptation. Otherwise, the green bonds are classified as *Non-adaptation bonds*. The definition of variables can be found in Table 5.

Variable	Obs	Mean	SD	Min	Max	P50
Panel A: time-variant						
Adaptation bonds						
Yield Spread	114,289	0.019	0.174	-0.570	0.699	0.008
ΔLiquidity	114,289	-0.019	0.190	-5.697	3.193	0.000
Non-adaptation bonds						
Yield Spread	140,187	0.009	0.160	-0.570	0.699	0.002
ΔLiquidity	140,187	-0.012	0.214	-3.284	3.974	0.000
All green bonds						
Yield Spread	254,476	0.013	0.166	-0.570	0.699	0.005
ΔLiquidity	254,476	-0.015	0.204	-5.697	3.974	0.000
Panel B: time-invariant						
Adaptation bonds						
Issue amount (bn USD)	195	1.292	4.463	0.003	37.530	0.146

Maturity (in years)	195	9.865	7.529	0.200	31.800	6.900
Non-adaptation bonds						
Issue amount (bn USD)	249	0.815	2.043	0.008	16.080	0.236
Maturity (in years)	249	9.744	8.814	1.500	100.000	7.000
All green bonds						
Issue amount (bn USD)	444	1.024	3.334	0.003	37.530	0.204
Maturity (in years)	444	9.797	8.265	0.200	100.000	7.000

Some institutional investors incorporate climate change mitigation into their investment decisions, for instance by requiring portfolio-level net-zero targets, yet it remains unclear whether they give attention to adaptation. Thus, we further investigate the engagement of institutional investors in funding adaptation projects. We source the quarterly percentage of green bonds outstanding owned by institutional investors from Bloomberg. The institutional ownership data is available for 314 of the 444 green bonds in our sample[2]. Of these 314 green bonds, 134 (42.7%) have fewer than 10 institutional investors. 88 (28.0%) green bonds have 3 or fewer institutional investors, and 54 (17.2%) have only 1 institutional investor.

Table 3 reports the descriptive statistics for the quarterly green bond ownership data. Institutional investors hold a median of 8.5% of the green bonds outstanding. Notably, on average, adaptation bonds have lower institutional ownership than non-adaptation bonds in both developed and emerging markets, with a smaller difference in emerging markets (0.023%) than in developed markets (0.434%).

Table 3. Descriptive statistics of green bonds ownership data.

Table 3 presents the descriptive statistics of the total percentage of green bonds outstanding owned by institutional investors. Data are in percentage. Quarterly ownership data are available for 314 green bonds in our sample. Green bonds are categorized as *Adaptation bonds* if their use of proceeds includes projects aimed at climate change adaptation. Otherwise, the green bonds are classified as *Non-adaptation bonds*. *EM* denotes emerging markets. *DM* denotes developed markets.

Obs	Min	1st Quart	Median	3rd Quart	Max	Mean	SD
All 314 green bonds							
4,256	0.000	0.037	0.085	0.179	30.800	0.574	2.644
EM adaptation bonds							
266	0.000	0.029	0.073	0.116	0.396	0.088	0.082
EM non-adaptation bonds							
294	0.000	0.018	0.082	0.139	1.067	0.111	0.137
DM adaptation bonds							

[2] This 70.7% data coverage of institutional ownership is consistent with existing studies. For instance, Ghitti et al. (2023) obtain 705 bonds with available institutional ownership data from an initial sample of 3,093 green bonds from Bloomberg. Ghitti et al. (2023) have a lower coverage rate because they include only green bonds with ownership data available for the top 20 owners.

1700	0.000	0.043	0.100	0.250	17.860	0.412	1.558
DM non-adaptation bonds							
1996	0.000	0.030	0.080	0.157	30.800	0.846	3.561

(2) Country-level data

We classify the domiciles of green bond issuers into developed or emerging markets based on the definitions from the International Monetary Fund (IMF)[3] to estimate differences in cost of capital between the two market categories. Specifically, issuers in the IMF's "Advanced Economies" list are classified as developed market issuers, whereas issuers in the "Emerging Market and Developing Economies" list are classified as emerging market issuers. We source data on the GDP per capita and annual GDP growth rates of the markets from the World Bank.

To understand the efficiency of adaptation capital allocation, we study whether the Greenium of adaptation bonds is positively correlated with their additionality. In other words, we are interested in whether public issuers with a stronger need for climate change adaptation actually incur a lower cost of adaptation capital. Following previous studies (Beirne et al., 2021; Cevik & Miryugin, 2023; Cevik & Jalles, 2022; Cheema-Fox et al., 2022; Jia & Li, 2020; Kling et al., 2021; Wen et al., 2023), we use the exposure indicator from the Notre Dame Global Adaptation Initiative's (ND-GAIN) Country Index[4] to measure country-level physical risk exposure.

The ND-GAIN exposure indicator covers 182 countries and assesses the projected impact of climate change risks on six sectors (ecosystem services, food, human habitat, health, infrastructure and water) with higher values indicating greater exposure (Chen et al., 2023). Based on this indicator, we categorize the country-level physical risk exposure of the issuers into above and below the global median, which remains constant over the sample period.

To supplement the ND-GAIN exposure indicator, we further employ time-varying and weather event-related exposure data for robustness tests. This data is sourced from the Global Climate Risk Index (CRI)[5], which ranks annual impacts of weather-related loss events (such as storms, floods, and heat waves) across countries and regions. Due to data unavailability for 2020-2022, we utilize the 2014-2019 annual exposure metrics. Similarly, we categorize the country-level exposure and vulnerability to extreme weather events as above- or below-median based on the global ranking for each year.

Finally, we adopt the time-varying governance readiness indicator from the ND-GAIN Country Index to measure the governance capacity of each country annually. The ND-GAIN governance readiness indicator assesses the political stability, control of corruption, rule of law, and

[3] https://www.imf.org/en/Publications/WEO/weo-database/2023/April/groups-and-aggregates

[4] https://gain.nd.edu/our-work/country-index/download-data/.

[5] https://www.germanwatch.org/en/17307

regulatory quality of a country. We categorize the governance capacity of the issuers' countries or regions into above and below the global median for each year.

Of the 195 adaptation bonds in our sample, 11.8% are from emerging markets, while 47.7% are from countries or regions with above-median physical risk exposure. Interestingly, countries or regions with high physical risk exposure tend to have below-global median governance capacity (Table 4). As expected, emerging markets have weaker governance capacities than developed markets on average. Within our sample, 100% of developed markets have above-median governance capacity; meanwhile, 54.5% of the adaptation bonds issued by emerging markets are from the ones with below-median governance capacity.

Table 4. Correlation Matrix.

Table 4 presents the Correlation analysis for the 444 paired bonds in our sample, containing 254,476 unbalanced daily observations. The definition of variables can be found in Table 5.

Variable	EM	Exposure	Governance
Exposure	0.124***		
Governance	-0.718***	-0.238***	
ΔLiquidity	-0.004**	0.073***	-0.059***

5. Regressions and implications

This section presents the empirical estimation of our hypotheses proposed in section 3. The definition of the variables in the following regression models can be found in Table 5. Robustness tests, as detailed in the appendix, are conducted through: alternative physical risk measurement, different observation frequencies for the dependent variable, and full controls for non-adaptation use-of-proceeds categories.

Table 5. Definitions of variables.

Variable	Definition	Source
Dependent variable		
$Yield\ Spread_{i,t}$	The difference (expressed in percentages) of the green bond ask yield over the matched conventional bond ask yield in bond pair i on trading date t.	Bloomberg
Independent variables		
$Adaptation_i$	Equals 1 if the use of proceeds of a green bond in bond pair i includes adaptation project, and 0 otherwise.	Bloomberg
EM_i	Equals 1 if the issuer in bond pair i is from an emerging market, and 0 otherwise.	International Monetary Fund
$Exposure_i$	Equals 1 if the physical risk exposure of the country or region of the issuer of bond pair i is above the global median, and 0 otherwise.	ND-GAIN Index

$CRI_{i,k-1}$	Equals 1 if the exposure of the country or region of the issuer of bond pair i to extreme weather events is above the global median in year $k-1$, and 0 otherwise.	Global Climate Risk Index
$Governance_{i,k-1}$	Equals 1 if the country or region of the issuer of bond pair i has above-global median governance capacity in year $k-1$, and 0 otherwise.	ND-GAIN Index
Other variables		
$IO_{i,q}$	The percentage of outstanding amounts of green bonds in bond pair i owned by institutional investors in quarter q.	Bloomberg
$\Delta Liquidity_{i,t}$	The difference between the liquidity indicator of a green bond and its matched conventional bond in bond pair i on the same trading date t.	Bloomberg
$Ln\ Issue\ Amount_i$	The natural logarithm of the issue amount (in millions of dollars) of the green bond in bond pair i.	Bloomberg
$Ln\ (1 + Maturity_i)$	The natural logarithm of one plus the maturity at issuance (in years) of the green bond in bond pair i.	Bloomberg
$Ln\ GDP\ per\ capita_{i,k-1}$	The natural logarithm of the GDP per capita (in USD) of the country or region of the issuer of bond pair i in year $k-1$.	World Bank
$Ln\ GDP\ growth_{i,k-1}$	The annual percentage growth rate of GDP at market prices in constant local currency of the country or region of the issuer of bond pair i in year $k-1$.	World Bank
$Currency_i$	The fixed effects of the currency denomination of the green bond in bond pair i.	Bloomberg
$Year_k$	The fixed effects of the year k.	Bloomberg

5.1 Adaptation bonds and Greenium

We start our empirical analysis by testing Hypothesis 1. To do so, we estimate the following equation:

$$Yield\ Spread_{i,t} = \beta_0 + \beta_1 Adaptation_i + Controls + \varepsilon_{i,t} \quad (1)$$

The dependent variable is $Yield\ Spread_{i,t}$. A lower yield spread means that the 'greenness' of a green bond has led investors to accept a lower yield than otherwise, suggesting a larger Greenium. Following Simeth (2022), $Controls$ includes $\Delta Liquidity_{i,t}$, $Ln\ Issue\ Amount_i$, $Ln\ (Maturity_i + 1)$, $Ln\ GDP\ per\ capital_{i,k-1}$, $Ln\ GDP\ growth_{i,k-1}$, $Governance_{i,k-1}$, $Currency_i$, and $Year_k$. Following previous studies (Beber et al., 2009; Chen et al., 2007; Dick-Nielsen et al., 2012; Zerbib, 2019), we use the bid–ask spread (i.e., price bid minus price ask) as the proxy for the bond's liquidity indicator in constructing $\Delta Liquidity_{i,t}$. Finally, $\varepsilon_{i,t}$ is the error term.

Table 6 presents the estimation results of equation (1). When examining green bonds globally, the Greenium of adaptation bonds is 0.5 bps larger than that of non-adaptation bonds, and is statistically significant at the 5% level (column 3).

These findings support Hypothesis 1, demonstrating that, in the green bond market, investors exhibit a slightly higher preference for adaptation projects compared to non-adaptation projects. This reflects investors' stronger willingness to contribute to climate change adaptation initiatives.

Table 6. Adaptation bonds and Greenium.

Table 6 reports the results of equation (1) with the yield spread as the dependent variable. All the variables are defined in Table 5. Robust standard errors are reported. Standard errors are in parentheses. Significance levels: * p < 0.1, ** p < 0.05, *** p < 0.01.

	(1)	(2)	(3)
Adaptation	0.005^{***}	0.006^{***}	-0.005^{***}
	(0.001)	(0.001)	(0.001)
ΔLiquidity	0.016^{***}	0.016^{***}	0.009^{***}
	(0.002)	(0.002)	(0.002)
Governance			-0.159^{***}
			(0.003)
Ln(amount)	-0.007^{***}	-0.007^{***}	-0.009^{***}
	(0.000)	(0.000)	(0.000)
Ln(maturity)	0.001^{*}	0.002^{***}	-0.001^{**}
	(0.001)	(0.001)	(0.001)
Ln(GDP) lag		-0.007^{***}	0.042^{***}
		(0.001)	(0.001)
GDP growth lag		-0.001^{***}	-0.001^{***}
		(0.000)	(0.000)
Constant	-0.017^{***}	0.061^{***}	-0.307^{***}
	(0.002)	(0.010)	(0.011)
Currency FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Observations	252893	252893	252893
Adjusted R^2	0.055	0.055	0.067

5.2 Emerging markets and Greenium

To test Hypothesis 2, we estimate the regression model in equation (2) to examine the cost of capital faced by green bonds issuers in emerging markets.

$$Yield\ Spread_{i,t} = \beta_0 + \beta_1 EM_i + Controls + \varepsilon_{i,t} \quad (2)$$

All variables except the dependent variable EM_i are the same as those described for equation (1).

Table 7 presents the estimation results of equation (2). In column (1), we find a positive association between emerging markets and yield spread, with the full set of fixed effects. The Greenium of green bonds is 1.9 bps smaller if their public issuers are from emerging markets rather than developed markets. This result is robust when adding various combinations of control variables, namely GDP per capita, GDP growth (column 2), and the governance capacity of the countries or regions where the public issuers are domiciled (column 3).

The results reported in Table 7 indicate that emerging markets generally face a higher cost of capital when seeking funds for green projects, aligning with the literature.

Table 7. Emerging markets and Greenium.

Table 7 reports the results of equation (2) with the yield spread as the dependent variable. All the variables are defined in Table 5. Robust standard errors are reported. Standard errors are in parentheses. Significance levels: * p < 0.1, ** p < 0.05, *** p < 0.01.

	(1)	(2)	(3)
EM	0.019***	0.033***	0.030***
	(0.002)	(0.003)	(0.003)
ΔLiquidity	0.015***	0.015***	0.009***
	(0.002)	(0.002)	(0.002)
Governance			-0.153***
			(0.003)
Ln(amount)	-0.008***	-0.008***	-0.009***
	(0.000)	(0.000)	(0.000)
Ln(maturity)	0.002***	0.002***	-0.002***
	(0.001)	(0.001)	(0.001)
Ln(GDP) lag		0.007***	0.052***
		(0.001)	(0.002)
GDP growth lag		-0.002***	-0.002***
		(0.000)	(0.000)
Constant	-0.015***	-0.084***	-0.423***
	(0.002)	(0.016)	(0.017)
Currency FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Observations	252893	252893	252893
Adjusted R^2	0.055	0.056	0.068

5.3 Adaptation bonds, emerging markets, and Greenium

We further test Hypothesis 3 to investigate the Greenium of adaptation bonds issued by public issuers from emerging markets. To do so, we include the interaction term for $Adaptation_i$ and EM_i based on equations (1) and (2), as depicted below:

(3)

$$Yield\ Spread_{i,t} = \beta_0 + \beta_1 Adaptation_i + \beta_2 EM_i + \beta_3 Adaptation_i * EM_i + Controls + \varepsilon_{i,t}$$

Table 8 presents the estimation results of equation (3). Columns (1), (2), and (3) correspond to observations of the total sample. As depicted in column (3), the Greenium of non-adaptation bonds is 3.1 bps smaller if their public issuers are from emerging markets rather than developed markets.

Nevertheless, the picture reverses when we focus on adaptation bonds. The Greenium of adaptation bonds is 6.7 bps (-3.1+9.8) larger if their public issuers are from emerging markets rather than developed markets. This means that emerging markets actually have a cost of capital advantage in financing adaptation compared to developed markets.

Indeed, investors seem to be more enthusiastic about supporting climate change adaptation than other green projects in emerging markets. The Greenium of adaptation bonds is 9.5 bps (-0.3+9.8) larger than that of non-adaptation bonds for emerging markets. The differential is only 0.3 bps for developed markets.

Institutional investors play a significant role in climate finance in light of their sophisticated capabilities in research and analysis. As such, we further examine their influence by dividing the sample based on institutional ownership levels. Columns (4) and (5) in Table 8 present evidence that a reduction in institutional holdings affects the cost of adaptation capital in emerging markets.

When institutional investors play a smaller role (column 4), adaptation bonds in emerging markets actually face a cost of capital disadvantage – the Greenium of adaptation bonds is 3.2 bps (-(-8.6+5.4)) smaller if their public issuers are from emerging markets rather than developed markets. However, when the participation of institutional investors increases, the situation reverses. Columns (5) corresponds to observations with institutional ownership above the sample median – the Greenium of adaptation bonds is 12.9 bps (1.6+11.3) larger if their public issuers are from emerging markets rather than developed markets (column 5). This implies that institutional investors actively amplify the capital of cost advantage for adaptation projects in emerging markets.

The results in Table 8 also highlight that institutional investors have a preference for supporting climate change adaptation over other green projects in emerging markets. When institutional ownership is below the sample median (column 4), the Greenium of adaptation bonds is 5.9 bps (0.5+5.4) larger than that of non-adaptation bonds for emerging markets. Notably, the differential inflates to 10.4 bps (-0.9+11.3) for observations with institutional ownership above the sample median (column 5).

Table 8. Adaptation, emerging markets, and Greenium.

Table 8 reports the results of equation (3) with the yield spread as the dependent variable. Columns (1) to (3) correspond to observations of the total sample. Columns (4) corresponds to observations with below-median institutional ownership. Columns (5) corresponds to observations with above-median institutional ownership. All the variables are defined in Table 5. Robust standard errors are reported. Standard errors are in parentheses. Significance levels: * p < 0.1, ** p < 0.05, *** p < 0.01.

	(1) Total sample	(2) Total sample	(3) Total sample	(4) $IO_{i,q}$ < Median	(5) $IO_{i,q}$ > Median
Adaptation	0.008***	0.009***	0.003***	-0.005***	0.009***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
EM	0.032***	0.032***	0.031***	0.086***	-0.016***
	(0.002)	(0.003)	(0.003)	(0.005)	(0.004)
EM*Adaptation	-0.029***	-0.030***	-0.098***	-0.054***	-0.113***
	(0.003)	(0.003)	(0.004)	(0.005)	(0.007)
ΔLiquidity	0.016***	0.016***	0.010***	-0.030***	0.017***
	(0.002)	(0.002)	(0.002)	(0.005)	(0.002)
Governance			-0.201***	-0.231***	-0.153***
			(0.004)	(0.005)	(0.007)
Ln(amount)	-0.008***	-0.008***	-0.009***	-0.004***	-0.011***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Ln(maturity)	0.001**	0.001**	-0.003***	0.003***	-0.009***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Ln(GDP) lag		-0.002	0.041***	0.065***	0.020***
		(0.002)	(0.002)	(0.003)	(0.002)
GDP growth lag		-0.001***	-0.001**	-0.004***	0.001***
		(0.000)	(0.000)	(0.000)	(0.000)
Constant	-0.015***	0.008	-0.258***	-0.491***	0.087***
	(0.002)	(0.017)	(0.018)	(0.028)	(0.025)
Currency FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Observations	252893	252893	252893	91602	161291
Adjusted R^2	0.056	0.057	0.073	0.136	0.076

5.4 Emerging markets, physical risks, and Greenium: Adaptation bond subsample

To test whether the Greenium adaptation bonds issued by emerging markets is moderated by physical risk exposure (Hypothesis 4), we estimate a regression model using a subsample in which the green bond in each pair is an adaptation bond:

$$Yield\ Spread_{i,t} = \beta_0 + \beta_1 Exposure_i + \beta_2 EM_i + \beta_3 Exposure_i * EM_i + Controls + \varepsilon_{i,t} \quad (4)$$

Table 9 presents the estimation results of equation (4). As shown in column (3), the Greenium of adaptation bonds is 31.4 bps (-5.8+37.2) larger if they are issued by emerging markets with above-median rather than below-median physical risk exposure (see Figure 2). Interestingly, even among countries with above-median physical risk exposure, the Greenium of adaptation bonds from emerging markets is still 18.3 bps (-18.9+37.2) larger than that from developed markets (see Figure 3).

Moreover, columns (4) and (5) reveal a significant divergence in how physical risk exposure is priced in adaptation bonds under different institutional ownership levels. When institutional ownership is below the sample median (column 4), the Greenium of adaptation bonds is 24.3 bps (5.4+18.9) larger if they are issued by emerging markets with above-median rather than below-median physical risk exposure. This differential inflates to 42.1 bps (-13.1+55.2) when institutional ownership is above the sample median (column 5).

The pricing difference of adaptation bonds from emerging and developed markets is also affected by institutional ownership. For observations with a smaller relative importance of institutional investors (column 4), among countries with above-median physical risk exposure, the Greenium of adaptation bonds from emerging markets is16.0 bps (-2.9+18.9) larger than that from developed markets. This differential inflates to 30.0 bps (-25.2+55.2) when institutional ownership is above the sample median (column 5).

The above results suggest that this cost of capital advantage for adaptation projects in emerging markets with high additionality is driven by institutional investors. Although institutional investors contribute less than 3% of global adaptation finance[6], our findings highlight the potential to mobilize private capital for adaptation investments.

Lastly, our estimations show that governance capacity can significantly reduce the cost of capital disadvantage of emerging markets. Among adaptation bonds from emerging markets, the Greenium conferred by investors is 7.1 bps larger if the governance capacity of the issuers' countries is above-median rather than below-median (column 3). Interestingly, a reduction in institutional holdings could impact the effect of governance capacity on Greenium of adaptation bonds. For observations with a smaller relative importance of institutional investors (column 4), the Greenium of adaptation bonds from emerging markets is only 5.1 bps larger if the governance capacity of the issuers' countries is above-median rather than below-median. In contrast, this differential is 23.2 bps for adaptation bonds from emerging markets when the participation of institutional investors increases (column 5).

Table 9. Emerging markets, physical risks, and Greenium: Adaptation bonds.

Table 9 reports the results of equation (4) with the yield spread as the dependent variable. All the variables are defined in Table 5. Robust standard errors are reported. Standard errors are in parentheses. Significance levels: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

	(1)	(2)	(3)	(4)	(5)

[6] https://www.bakermckenzie.com/en/insight/publications/resources/climate-adaptation-finance

	Adaptation subsample	Adaptation subsample	Adaptation subsample	Adaptation subsample: $IO_{i,q}$<Median	Adaptation subsample: $IO_{i,q}$>Median
EM	0.241***	0.198***	0.189***	0.029***	0.252***
	(0.005)	(0.005)	(0.005)	(0.008)	(0.006)
Exposure	0.065***	0.060***	0.058***	-0.054***	0.131***
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)
EM*Exposure	-0.348***	-0.351***	-0.372***	-0.189***	-0.552***
	(0.006)	(0.006)	(0.007)	(0.020)	(0.009)
ΔLiquidity	0.045***	0.044***	0.042***	0.038***	0.059***
	(0.003)	(0.003)	(0.003)	(0.008)	(0.003)
Governance			-0.071***	-0.051***	-0.232***
			(0.006)	(0.012)	(0.012)
Ln(amount)	-0.004***	-0.005***	-0.005***	-0.012***	-0.003***
	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)
Ln(maturity)	-0.017***	-0.017***	-0.017***	-0.000	-0.006***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Ln(GDP) lag		-0.017***	-0.001	-0.074***	0.049***
		(0.002)	(0.002)	(0.004)	(0.003)
GDP growth lag		0.005***	0.005***	0.006***	0.002***
		(0.000)	(0.000)	(0.001)	(0.001)
Constant	0.045***	0.231***	0.131***	0.957***	-0.294***
	(0.003)	(0.027)	(0.025)	(0.058)	(0.032)
Currency FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Observations	112706	112706	112706	37890	74816
Adjusted R^2	0.181	0.183	0.184	0.202	0.246

Figure 2. Yield spread distribution for adaptation bonds from emerging markets with different levels of physical risk exposure

Notes: Lower yield spread means larger Greenium, i.e., lower financing costs. In our sample, only 5 bonds are from emerging markets with below-median physical risk exposure.

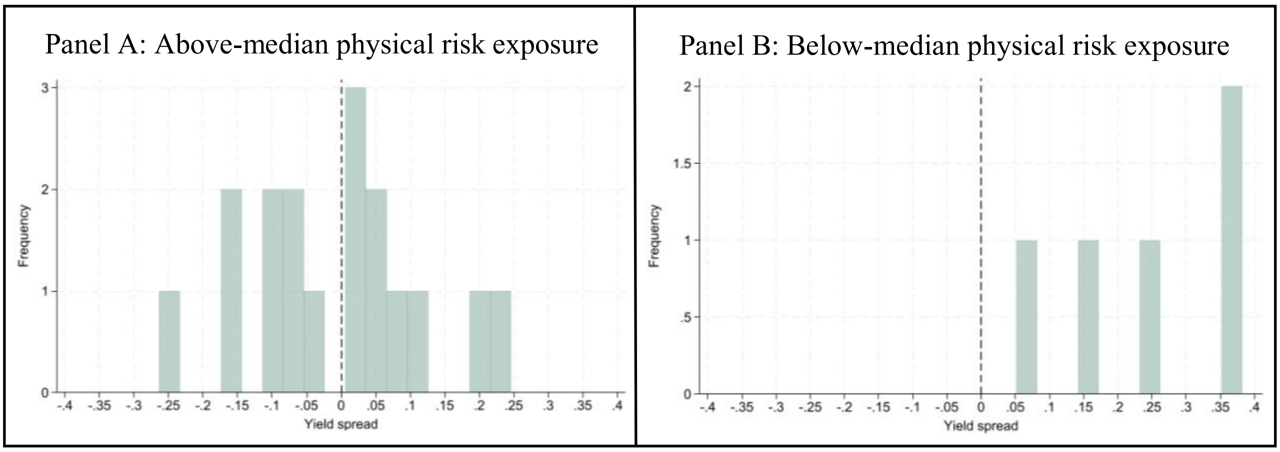
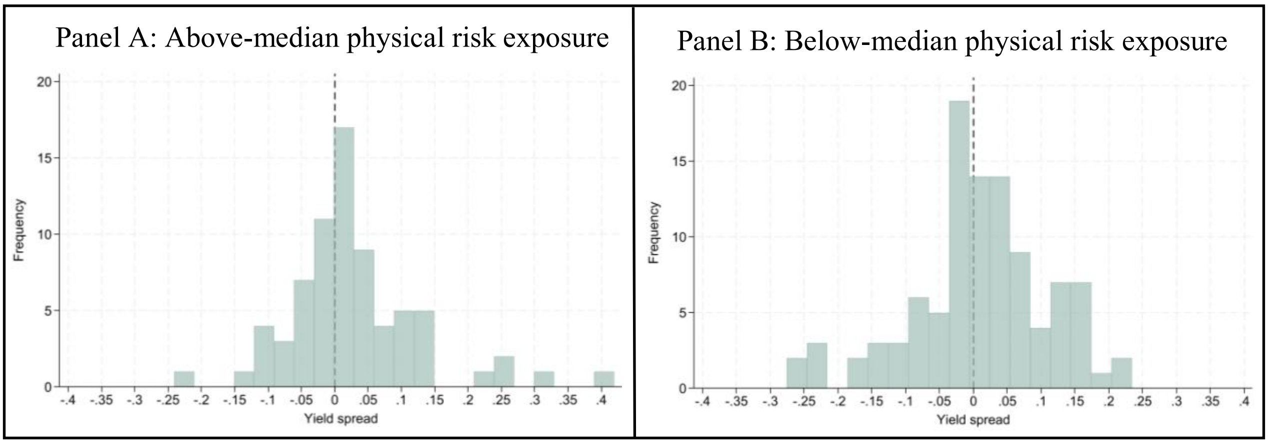


Figure 3. Yield spread distribution for adaptation bonds from developed markets with different levels of physical risk exposure.



6. Conclusions

By estimating the Greenium of adaptation bonds issued by governments and public agencies around the world, we show that emerging markets actually have a cost of capital advantage in financing climate change adaptation compared to developed markets. As such, emerging markets could consider mobilizing more private capital in the green bond market to supplement public finance in supporting climate change adaptation.

Attesting the efficiency of adaptation capital allocation, our research shows that investors actually take into account the additionality of adaptation bonds when conferring Greenium. In fact, even among countries with above-median physical risk exposure, the Greenium of adaptation bonds from emerging markets is still larger than that from developed markets. We also show this cost of capital advantage for adaptation bonds in emerging markets with high additionality is driven by institutional investors.

Finally, our findings highlight that the cost of climate finance for emerging markets can be significantly lowered if they have higher governance capacity. This speaks to the importance of building institutional strength to attract cross-border green capital flows.

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Appendix: Robustness tests

We examine the robustness of our main results in three ways.

First, given investors may consider both current and past physical climate risks when investing in adaptation bonds, we use the Global Climate Risk Index as an alternative measurement of physical risk exposure to re-run equation (4). The Global Climate Risk Index provides time-varying data on country-level extreme weather exposure. We categorize the countries or regions as having above- or below-median exposure based on the index's annual global rankings. Table A1 presents results qualitatively similar to those in Table 9.

Table A1. Alternative physical risk measure: Global Climate Risk Index.

Table A1 reports the results of using CRI as alternative measurement of physical risk exposure. Yield spread is the dependent variable. All the variables are defined in Table 5. Robust standard errors are reported. Standard errors are in parentheses. Significance levels: * p < 0.1, ** p < 0.05, *** p < 0.01.

	(1) Adaptation subsample	(2) Adaptation subsample	(3) Adaptation subsample
EM	0.326***	0.429***	0.364***
	(0.007)	(0.012)	(0.008)
CRI	0.032***	0.044***	0.048***
	(0.003)	(0.003)	(0.003)
EM*CRI	-0.324***	-0.345***	-0.406***
	(0.008)	(0.009)	(0.011)
ΔLiquidity	0.020***	0.022***	0.021***
	(0.006)	(0.006)	(0.006)
Governance			-0.173***
			(0.012)
Ln(amount)	-0.003***	0.001	0.000
	(0.001)	(0.001)	(0.001)
Ln(maturity)	-0.049***	-0.045***	-0.045***
	(0.002)	(0.002)	(0.002)
Ln(GDP) lag		0.023***	0.043***
		(0.004)	(0.004)
GDP growth lag		-0.012***	-0.013***
		(0.001)	(0.001)
Constant	0.191***	-0.059	-0.096**
	(0.008)	(0.043)	(0.041)
Currency FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Observations	21363	21363	21363
Adjusted R^2	0.433	0.437	0.440

Second, we consider whether daily yield spread variations are driven by the conventional bonds rather than the green bonds in the matched sample. Furthermore, to isolate bond-specific yield effects from reference rate fluctuations, we re-run equations (1)-(4) using month-end yield spread as the alternative dependent variable. Table A2 reports qualitatively similar results.

Table A2. Alternative dependent variable: Monthly yield spread.

Table A2 reports the results using month-end yield spread as the dependent variable. All the variables are defined in Table 5. Robust standard errors are reported. Standard errors are in parentheses. Significance levels: * p < 0.1, ** p < 0.05, *** p < 0.01.

	(1) Total sample	(2) Total sample	(3) Total sample	(4) Adaptation subsample	(5) Adaptation subsample
Adaptation	-0.006^{*}		0.003		
	(0.003)		(0.003)		
EM		0.037^{***}	0.039^{***}	0.201^{***}	0.350^{***}
		(0.012)	(0.013)	(0.022)	(0.037)
EM*Adaptation			-0.103^{***}		
			(0.019)		
Exposure				0.064^{***}	
				(0.010)	
EM*Exposure				-0.363^{***}	
				(0.035)	
CRI					0.051^{***}
					(0.014)
EM*CRI					-0.380^{***}
					(0.048)
ΔLiquidity	0.010	0.010	0.010	0.041^{***}	0.015
	(0.010)	(0.010)	(0.010)	(0.015)	(0.025)
Governance	-0.166^{***}	-0.158^{***}	-0.209^{***}	-0.079^{***}	-0.147^{***}
	(0.015)	(0.014)	(0.019)	(0.029)	(0.053)
Ln(amount)	-0.009^{***}	-0.009^{***}	-0.010^{***}	-0.006^{***}	0.000
	(0.001)	(0.001)	(0.001)	(0.002)	(0.004)
Ln(maturity)	-0.002	-0.003	-0.004	-0.018^{***}	-0.049^{***}
	(0.003)	(0.003)	(0.003)	(0.003)	(0.008)
Ln(GDP) lag	0.044^{***}	0.057^{***}	0.046^{***}	0.009	0.038^{*}
	(0.005)	(0.008)	(0.008)	(0.010)	(0.020)
GDP growth lag	-0.001	-0.002^{*}	-0.001	0.004^{**}	-0.011^{***}
	(0.001)	(0.001)	(0.001)	(0.002)	(0.003)
Constant	-0.321^{***}	-0.467^{***}	-0.301^{***}	0.029	-0.156
	(0.049)	(0.077)	(0.082)	(0.119)	(0.204)
Currency FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Observations	11908	11908	11908	5284	984

Adjusted R^2	0.066	0.066	0.072	0.172	0.413

Lastly, we re-run equations (1)-(4) with full controls for non-adaptation use of proceeds categories to assess the robustness of the effect of adaptation projects on Greenium. The categories of use of proceeds are sourced from Blomberg. Results in Table A3 remain qualitatively unchanged.

Table A3. New control sets: including other categories of use of proceeds.

Table A3 reports the results incorporating control variables for all non-adaptation use of proceeds categories: Renewable energy, Energy efficiency, Clean transportation, Green buildings, Sustainable water, Pollution control, Agriculture forestry, Terrestrial biodiversity, Eco-efficient product. Each categorical control variable equals 1 if a green bond's use of proceeds includes the corresponding category. The dependent variable is yield spread. All the variables (except non-adaptation use of proceeds variables) are defined in Table 5. Robust standard errors are reported. Standard errors are in parentheses. Significance levels: * p < 0.1, ** p < 0.05, *** p < 0.01.

	(1) Total sample	(2) Total sample	(3) Total sample	(4) Adaptation subsample
Adaptation	-0.015***		-0.007***	0.255***
	(0.001)		(0.001)	(0.005)
EM		0.038***	0.038***	
		(0.003)	(0.003)	
EM*Adaptation			-0.090***	
			(0.004)	
Exposure				0.065***
				(0.002)
EM*Exposure				-0.424***
				(0.007)
Renewable energy	0.026***	0.021***	0.018***	-0.025***
	(0.001)	(0.001)	(0.001)	(0.002)
Energy efficiency	0.007***	0.009***	0.012***	0.014***
	(0.001)	(0.001)	(0.001)	(0.002)
Clean transportation	-0.029***	-0.029***	-0.026***	0.004***
	(0.001)	(0.001)	(0.001)	(0.001)
Green buildings	-0.032***	-0.028***	-0.029***	0.041***
	(0.001)	(0.001)	(0.001)	(0.001)
Sustainable water	0.002***	-0.003***	-0.000	-0.041***
	(0.001)	(0.001)	(0.001)	(0.001)
Pollution control	0.029***	0.029***	0.033***	-0.023***
	(0.001)	(0.001)	(0.001)	(0.001)
Agriculture forestry	-0.004***	-0.011***	-0.005***	0.007***
	(0.001)	(0.001)	(0.001)	(0.001)
Terrestrial biodiversity	-0.024***	-0.026***	-0.023***	-0.006***
	(0.001)	(0.001)	(0.001)	(0.001)

Eco-efficient product	0.020***	0.020***	0.024***	-0.002
	(0.002)	(0.002)	(0.002)	(0.002)
ΔLiquidity	0.009***	0.009***	0.011***	0.053***
	(0.002)	(0.002)	(0.002)	(0.003)
Governance	-0.148***	-0.131***	-0.182***	-0.075***
	(0.003)	(0.003)	(0.004)	(0.006)
Ln(amount)	-0.007***	-0.006***	-0.008***	-0.005***
	(0.000)	(0.000)	(0.000)	(0.000)
Ln(maturity)	-0.002***	-0.004***	-0.004***	-0.015***
	(0.001)	(0.001)	(0.001)	(0.001)
Ln(GDP) lag	0.035***	0.044***	0.038***	0.014***
	(0.001)	(0.002)	(0.002)	(0.002)
GDP growth lag	-0.002***	-0.003***	-0.002***	0.006***
	(0.000)	(0.000)	(0.000)	(0.000)
Constant	-0.264***	-0.375***	-0.256***	-0.033
	(0.011)	(0.017)	(0.018)	(0.026)
Currency FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	252893	252893	252893	112706
Adjusted R^2	0.083	0.083	0.088	0.196