Investor Preferences Under Uncertainty and the Cross-Country Green Bond Premium

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Abstract

Green bond premia vary widely across countries and instruments, yet most explanations focus on liquidity, certification, issuer, or bond characteristics. We ask whether national culture helps explain this heterogeneity. Using 417 green bonds matched to synthetic conventional bonds across 30 countries, we relate the green bond premia to long-term orientation and uncertainty avoidance dimensions of national culture, controlling for liquidity, credit risk, rating, maturity, and macroeconomic conditions. Both dimensions are negatively and significantly related, implying that higher levels of long-term orientation and uncertainty avoidance result in larger green bond premia. The evidence supports a preference-based account in which culture shapes willingness to pay for credible green claims.

Keywords: Green bonds, greenium, national culture, long-term orientation, uncertainty avoidance, asset pricing
JEL: G12, G15, Q56, Z10

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1. Introduction

Green bonds frequently trade at lower yields than comparable conventional bonds, a gap known as the greenium. Yet the size and even the visibility of that premium vary sharply across markets and samples. Estimates range from about two basis points (Zerbib, 2019) to twenty or thirty (Kapraun et al., 2021), with estimates for China in between (Li et al., 2022). Existing explanations emphasize bond and issuer characteristics, liquidity, external review, and the credibility of the green label (Ehlers and Packer, 2017; Hachenberg and Schiereck, 2018; Nanayakkara and Colombage, 2019; Dorfleitner et al., 2022; Koziol et al., 2022; Caramichael and Rapp, 2024). The extant greenium literature generally explains cross-country heterogeneity through institutional or market dynamics. However, asset-pricing models with tastes or green-investor clienteles show that preferences can affect equilibrium prices (Heinkel et al., 2001; Fama and French, 2007), and green-bond evidence links pro-environmental preferences to bond prices (Zerbib, 2019). We therefore posit that the greenium is also a preference equilibrium, and that national culture systematically shifts investor demand.

The question matters because green bonds are not only fixed-income instruments. They bundle a conventional cash-flow claim with a labelled environmental claim, and the price of that bundle depends on what investors value. If the greenium were driven only by institutional quality, regulation, liquidity, or certification, national culture would add little to our understanding of green bond pricing. If, instead, culture helps explain greenium heterogeneity after these financial channels are controlled for, then the premium is also a preference-based equilibrium object. This reframes culture from a background country attribute into a source of demand-side variation in the price of credible green claims.

We focus on two of Hofstede's (2001) cultural dimensions with direct asset-pricing interpretations. Long-term orientation captures the weight a culture places on future versus present outcomes, and should raise the value of long-horizon environmental benefits and transition resilience. Uncertainty avoidance captures discomfort with ambiguity, and should raise the value of the green label's structure: use-of-proceeds restrictions, external verification, and reporting commitments make the issuer's environmental exposure more rule-bound and interpretable. This mechanism builds on evidence that culture shapes financial choices (Guiso et al., 2006; Li et al., 2011; Eun et al., 2015;

Aggarwal et al., 2016), environmental performance (Dangelico et al., 2020), and green bond issuance (Mertzanis and Tebourbi, 2024). We argue that existing explanations overlook an important equilibrium object: investor preferences (Heinkel et al., 2001; Fama and French, 2007; Zerbib, 2019). National culture shapes how investors value long-term environmental benefits and the credibility of green claims, so culture can affect demand for labelled green assets and produce systematic differences in equilibrium green premia.

Using 417 green bonds matched to conventional bonds across 30 countries, we examine the relation between the green-minus-conventional yield spread and national culture (long-term orientation and uncertainty avoidance), controlling for liquidity, credit risk, coupon, rating, maturity, market size, and income. We find that the spread and culture are negatively and significantly related, meaning that green bonds issued in countries with higher long-term orientation or uncertainty avoidance exhibit a stronger greenium. The findings are consistent across a battery of robustness checks. The study makes two important contributions. First, we show that the greenium is not solely an instrument- or institution-level phenomenon but also a preference-based equilibrium outcome. National culture systematically shapes investors' willingness to pay for credible green claims, generating persistent cross-country differences in green bond pricing. Second, we show that long-term orientation and uncertainty avoidance account for systematic cross-country variation in the greenium, thereby providing a behavioural explanation for an empirical regularity that financial characteristics alone do not fully explain.

2. Data and methodology

2.1. Sample

We begin with 8,725 green bonds labelled by the Climate Bonds Initiative and issued by March 2023. Because exact conventional-bond matches are rarely available, we build comparison yields by matching and interpolation (below) and drop green bonds with fewer than twenty monthly observations. After applying the matching criteria and data-availability filters, the final sample is 417 green bonds across 30 countries. Bond-level data, namely yields, bid–ask spreads, coupons, issue sizes, ratings, maturities, and credit default swap (CDS) spreads, come from Bloomberg and Refinitiv Eikon; national culture scores come from Hofstede (2001).

2.2. Matching and the synthetic conventional bond

We use two matching regimes. For the daily yield-spread panel (Sample A), each green bond is paired with conventional bonds of the same currency and credit rating, issued within six years and with an issue amount between one-quarter and four times that of the green bond. We use the liquidity-adjusted bond-level premium (Sample B) as an alternative measure of the greenium. Sample B imposes a stricter matching design than Sample A. In addition to the Sample A requirements on currency, credit rating, issuance within six years, and issue amount, Sample B requires same-issuer conventional bonds. For each green bond, we select the two conventional bonds from the same issuer with residual maturities closest to that of the green bond, within a two-year maturity window, and linearly interpolate their yields to construct a synthetic conventional bond (SCB) with the same residual maturity as the green bond. This stricter same-issuer interpolation follows Zerbib (2019) and reduces issuer-level differences in default risk and seniority while removing the remaining term-structure mismatch before the green-minus-conventional yield gap is estimated. Sample B remains in Appendix B because it is a robustness design rather than the main daily panel.

2.3. Yield spread, liquidity, and specification

The green bond yield spread is

$$\Delta y_{it} = y_{it}^{GB} - y_{it}^{SCB}. \tag{1}$$

Here i indexes the green bond, t indexes the observation date, y_{it}^{GB} is the green bond yield, and y_{it}^{SCB} is the yield on the matched synthetic conventional bond. A negative Δy_{it} means the green bond yields less than its conventional benchmark and therefore trades with a larger greenium. Raw spreads can be biased by liquidity differences (Dorfleitner et al., 2022). An autoregressive distributed-lag regression confirms the concern: a one-percentage-point rise in the relative bid–ask spread widens Δy by 6.90 basis points in an ADL specification estimated on 189,657 daily observations. We then relate spreads to culture,

$$\Delta y_{it} = \alpha + \gamma\, BAS_{it} + \Gamma' X_{it} + \theta\, Culture_{j(i)} + \varepsilon_{it}, \tag{2}$$

where $j(i)$ denotes the issuer country, X_{it} collects CDS, coupon, rating, maturity, market capitalization, and GDP per capita, and $Culture_{j(i)} \in$

$\{\text{UAI}_{j(i)}, \text{LTO}_{j(i)}\}$ enters one at a time because the two dimensions are country-level and correlated. These controls cover credit risk, cash-flow timing, liquidity, and the macroeconomic environment, so the cultural term is estimated conditional on the standard determinants of matched bond spreads. We estimate (2) by OLS and report weighted least squares (WLS) robustness estimates with heteroskedasticity-robust standard errors.

3. Results

Table 1 reports descriptive statistics for the matched daily panel.

Table 1: Descriptive statistics

Variable	Mean	SD	Q1	Median	Q3
Δy (yield spread, %)	0.29	0.75	−0.17	0.15	0.60
BIDASK ($\times 10^{-3}$)	3.99	4.69	1.95	3.16	4.89
CDS (bps)	63.98	52.90	29.01	51.63	80.81
COUP (coupon, %)	1.04	0.92	0.38	0.88	1.50
RATING (1 = AAA)	5.21	3.41	1.00	4.00	8.00
MAT (maturity, years)	10.68	7.22	7.00	9.91	12.00
ISSUE (size, USD 100m)	12.55	28.56	5.31	7.92	10.58

Notes. Statistics are for the matched daily panel (Sample A). $\Delta y = y^{GB} - y^{SCB}$ is the green-minus-synthetic-conventional yield spread. Q1 and Q3 are the first and third quartiles. RATING is an ordinal scale increasing in credit risk (1 = AAA). Bond-level data are from Bloomberg and Refinitiv Eikon; culture scores from Hofstede (2001).

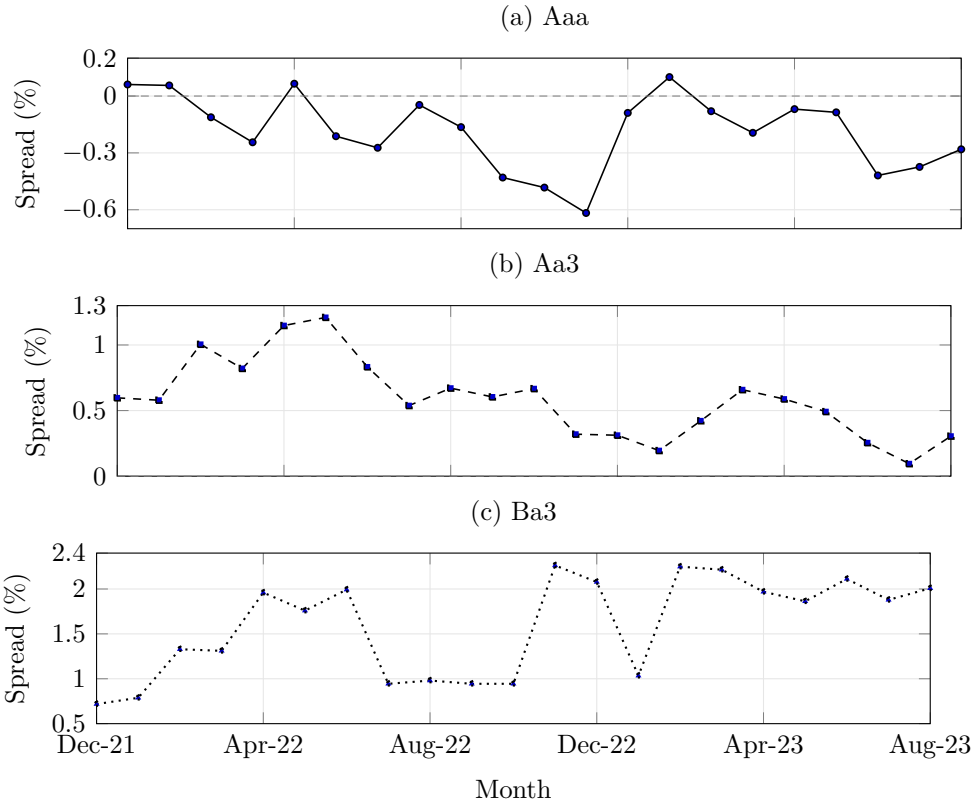

Figure 1: Green-minus-conventional yield spreads by Euro-bond rating class

Notes. Panels plot monthly Euro-bond rating-class premia for Aaa, Aa3, and Ba3 bonds from December 2021 to August 2023. The spread is measured as $y^{GB} - y^{SCB}$ in percent, using the paper's sign convention; negative values indicate that green bonds yield less than matched synthetic conventional bonds and therefore carry a larger greenium. The dashed horizontal line marks zero, and each panel uses a rating-specific vertical scale to show within-class variation.

The matched daily spread Δy has a small positive median (0.15) and wide dispersion. This does not contradict the greenium interpretation. The table is unconditional and mixes rating classes, while the regressions condition on rating, CDS spreads, liquidity, maturity, and other financial characteristics. Figure 1 illustrates the same point in the Euro-bond rating series: the Aaa line is mostly negative over the sample, while lower-rated series are positive and more dispersed. Since RATING is coded to increase with credit risk and enters positively and significantly in both the daily and bond-level specifications, lower credit quality is associated with wider green-minus-conventional spreads and can mask the conditional yield concession that the regression is designed to estimate. Credit quality is therefore part of the object being conditioned away, not a rival explanation left unaddressed; recent work also treats credit rating as central to greenium estimation (Arat et al., 2023). Throughout, recall the sign convention: the dependent variable is $y^{GB} - y^{SCB}$, so a negative coefficient denotes a *lower* green yield and hence a *larger* greenium.

Liquidity matters, and ignoring it biases the premium. The bid–ask spread enters positively and significantly in every column of Table 2 (2.50 under OLS, 40.19 under WLS), confirming that less liquid bond-days carry wider spreads. The larger WLS coefficient shows that the liquidity adjustment is sensitive to the weighting scheme, which is precisely why the culture estimates should be interpreted after controlling for liquidity. Controlling for the bid–ask spread, and constructing the bond-level premium net of the bid–ask differential, reduces the risk that liquidity is mistaken for a green-label effect.

Long-term orientation is associated with a larger greenium. In Table 2, LTO enters negatively and significantly under both OLS (-0.001) and WLS (-0.004). The bond-level premium regressions (Appendix B) tell the same story (-0.008), as does the nested country specification (-0.005). The pattern is consistent with an intertemporal preference channel: investors in long-term-oriented cultures place more weight on the deferred environmental benefits and transition resilience that green projects promise, and are correspondingly willing to accept lower current yield. This is the demand-side counterpart to Mertzanis and Tebourbi (2024), who find that long-term orientation predicts greater green bond issuance.

Uncertainty avoidance shows the same sign and is, if anything, more robust. UAI is negative and significant under OLS (-0.003) and WLS (-0.006) in Table 2, in the bond-level premium (-0.025), and in the nested model (-0.005). We read this through an ambiguity-reduction channel rather

than simple risk aversion. A green label is not merely a riskier instrument; its use-of-proceeds restrictions, external review, and reporting commitments make the issuer's climate exposure more rule-bound and interpretable. Investors in uncertainty-avoiding cultures value that structure and pay for it, compressing green yields. That CDS and rating enter significantly indicates the result is not the credit channel in disguise; the cultural traits add explanatory power beyond credit risk and liquidity. This is consistent with the broader point that, when a clientele has tastes for certain assets, equilibrium prices adjust and pure risk-based pricing no longer fully explains returns (Fama and French, 2007; Heinkel et al., 2001).

The appendix checks the result using the same-issuer approach of Zerbib (2019). This Sample B exercise asks whether the culture result survives when the green yield is compared to an interpolated same-issuer synthetic conventional yield and the liquidity-adjusted premium p_{it} replaces the raw daily spread. Appendix B reports the full estimates: the cultural coefficients keep their sign and significance in the 18,963-observation monthly premium panel and the 409-observation nested model, so the main result is not an artifact of the Sample A spread construction.

The results are stable across estimators, samples, and aggregation. They hold in the 182,760-observation daily panel, the monthly premium panel, and the nested model; OLS and WLS agree in sign and significance; and both traits matter when entered separately. Economic magnitudes are modest, from a few to low-tens of basis points across the cross-country range of Hofstede scores, comparable to greenium estimates in the literature (Zerbib, 2019; Caramichael and Rapp, 2024). Several controls switch sign across estimators or samples, yet UAI and LTO are negative in every specification, supporting a demand-side interpretation.

Table 2: Culture and the green bond yield spread (daily, Sample A)

	OLS		WLS	
Dependent variable: Δy_{it}	(1)	(2)	(3)	(4)
BIDASK	2.499***	2.209***	40.188***	41.166***
	(0.801)	(0.782)	(1.003)	(1.028)
CDS	0.003***	0.003***	−0.001***	−0.001***
	(0.000)	(0.000)	(0.000)	(0.000)
COUP	0.034***	0.034***	−0.102***	−0.130***
	(0.002)	(0.002)	(0.003)	(0.003)
RATING	0.051***	0.055***	0.088***	0.090***
	(0.001)	(0.001)	(0.001)	(0.001)
MAT	0.018***	0.018***	0.043***	0.040***
	(0.000)	(0.000)	(0.000)	(0.000)
MKTCAP	0.023***	0.049***	−0.057***	0.011***
	(0.003)	(0.002)	(0.003)	(0.003)
PERCAP	−0.212***	0.001	−0.590***	−0.256***
	(0.015)	(0.012)	(0.017)	(0.013)
UAI	−0.003***		−0.006***	
	(0.000)		(0.000)	
LTO		−0.001***		−0.004***
		(0.000)		(0.000)
Constant	0.420***	−1.056***	2.984***	0.468***
	(0.104)	(0.077)	(0.120)	(0.089)
Observations	182,760	182,760	182,760	182,760
R^2	0.227	0.225	0.472	0.469

Notes. Dependent variable: the daily green bond yield spread $\Delta y_{it} = y_{it}^{GB} - y_{it}^{SCB}$. A *negative* culture coefficient denotes a *lower* green yield, i.e., a *larger* greenium. UAI (uncertainty avoidance) and LTO (long-term orientation) are Hofstede country scores entered separately. Controls: bid–ask spread (BIDASK), CDS spread, coupon (COUP), rating (RATING), maturity (MAT), market capitalization (MKTCAP), and GDP per capita (PERCAP). Columns (1)–(2) are OLS; (3)–(4) are WLS. Heteroskedasticity-robust standard errors in parentheses; entries shown as 0.000 are below 0.0005. $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$.

4. Discussion and conclusion

National culture helps explain heterogeneity in green bond premia. After matching to conventional bonds and adjusting for liquidity, credit risk, rating, maturity, and macroeconomic conditions, long-term orientation and uncertainty avoidance are negatively related to the green-minus-conventional yield spread and therefore positively related to the greenium. The result is not simply that another country variable is significant. It says that green bond pricing reflects the preference environment in which credible green claims are placed, even after the usual financial determinants are taken into account.

The two channels are economically distinct. Long-term orientation operates on the time dimension of preferences, raising the value of deferred environmental payoffs and transition resilience. Uncertainty avoidance operates on the information dimension, raising the value of a label whose use-of-proceeds restrictions, verification, and reporting reduce ambiguity about the issuer's environmental intent. Appendix A formalizes both channels: when cultural willingness to pay raises the green price premium, the price–yield relation converts that premium into a negative yield-spread coefficient. The negative sign is therefore not evidence against a greenium; it is the greenium expressed in yields.

Taken together, the results point to two contributions. First, they show that the greenium is not solely an instrument- or institution-level phenomenon but also a preference-based equilibrium outcome shaped by national culture. Second, they identify long-term orientation and uncertainty avoidance as cultural dimensions that account for systematic cross-country variation in green bond pricing beyond liquidity, credit risk, rating, maturity, and macroeconomic conditions. The same green label can therefore command different prices because societies differ in how they value long-horizon environmental benefits and rule-bound credibility. For issuers, investors, and regulators, the implication is that sustainable-finance policy and green bond supply need not translate into uniform pricing effects across countries.

CRediT authorship contribution statement

Aryan Ayyar: Conceptualization, Data curation, Formal analysis, Methodology, Software, Writing – original draft.

Durga Prasad: Data curation, Validation, Writing – review & editing.

Krishna Prasad: Conceptualization, Methodology, Supervision, Writing – review & editing.

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.

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Data availability

Bond-level data are sourced from Bloomberg and Refinitiv Eikon under licence and cannot be redistributed; Hofstede culture scores are publicly available. Derived data supporting the findings are available from the corresponding author on reasonable request.

Declaration of generative AI and AI-assisted technologies in the manuscript preparation process

During the preparation of this work the authors used OpenAI ChatGPT/Codex and Anthropic Claude to assist with language editing, LaTeX formatting, and reference formatting. After using these tools, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

Appendix A. A simple equilibrium model of culture and green bond premia

This appendix gives a parsimonious asset-pricing rationale for the empirical sign pattern. Higher long-term orientation and higher uncertainty avoidance raise investors' willingness to pay for a green label. Market clearing converts that willingness to pay into a price premium; the bond price–yield relation converts the price premium into a lower green yield.

Setup. Consider a green bond and the matched synthetic conventional bond used in the empirical design. Let i index the green bond and j its issuer country. The two bonds have the same promised financial payoff X_i, credit risk, currency, and maturity profile. Let P_{ij}^G and P_i^C denote the green and matched conventional prices, and define the green price premium

$$\Pi_{ij} \equiv P_{ij}^G - P_i^C. \tag{A.1}$$

There is a unit mass of investors and a normalized green bond supply $\varrho_i \in (0,1)$. Let λ_j denote country j's long-term orientation score (LTO_j), and let υ_j denote its uncertainty avoidance score (UAI_j). Investor h's incremental valuation of the green label, in date-0 price units, is

$$\chi_{hij} = \omega_i + \varphi_L \lambda_j + \varphi_U \upsilon_j + \xi_h, \qquad \varphi_L > 0, \quad \varphi_U > 0, \tag{A.2}$$

where ω_i captures issue-specific label salience, certification quality, and other green-bond attributes; ξ_h has a continuous, strictly increasing cdf Φ. The two cultural coefficients have different interpretations: $\varphi_L > 0$ is an intertemporal-preference channel, while $\varphi_U > 0$ is an ambiguity-reduction channel.

Equilibrium. Investor h holds the green bond instead of the conventional bond when $\chi_{hij} \geq \Pi_{ij}$. By (A.2), this is equivalent to

$$\xi_h \geq \Pi_{ij} - \omega_i - \varphi_L \lambda_j - \varphi_U \upsilon_j.$$

Since ξ_h has cdf Φ, aggregate green-bond demand is the investor mass above this cutoff:

$$\mathcal{Q}^G(\Pi_{ij}, i, j) = 1 - \Phi(\Pi_{ij} - \omega_i - \varphi_L \lambda_j - \varphi_U \upsilon_j)\,. \tag{A.3}$$

Proposition A.1 (Equilibrium price premium)**.** *The unique equilibrium green price premium is*

$$\Pi_{ij} = \omega_i + \varphi_L \lambda_j + \varphi_U \upsilon_j + \Phi^{-1}(1 - \varrho_i). \tag{A.4}$$

Consequently,

$$\frac{\partial \Pi_{ij}}{\partial \lambda_j} = \varphi_L > 0, \qquad \frac{\partial \Pi_{ij}}{\partial \upsilon_j} = \varphi_U > 0.$$

Proof. Market clearing requires $\mathcal{Q}^G(\Pi_{ij}, i, j) = \varrho_i$, so

$$\Phi(\Pi_{ij} - \omega_i - \varphi_L \lambda_j - \varphi_U \upsilon_j) = 1 - \varrho_i.$$

Since Φ is continuous and strictly increasing, the inverse is well defined at $1 - \varrho_i$ and

$$\Pi_{ij} - \omega_i - \varphi_L \lambda_j - \varphi_U \upsilon_j = \Phi^{-1}(1 - \varrho_i).$$

Rearranging gives the stated equilibrium. The comparative statics follow immediately from $\varphi_L, \varphi_U > 0$. □

From prices to yield spreads. Let $\Delta y_{ij} \equiv y_{ij}^G - y_i^C$. For a differentiable bond price function $P_i(y)$, a first-order expansion around y_i^C gives

$$P_{ij}^G - P_i^C \simeq P_i'(y_i^C)(y_{ij}^G - y_i^C).$$

Because $P_i'(y_i^C) = -D_i^* P_i^C$, with D_i^* denoting modified duration, define dollar duration $\vartheta_i \equiv D_i^* P_i^C > 0$. Then

$$\Delta y_{ij} \simeq -\frac{\Pi_{ij}}{\vartheta_i}. \tag{A.5}$$

Corollary A.1 (Yield-spread implication)**.** *In equilibrium,*

$$\Delta y_{ij} \simeq -\frac{\varphi_L}{\vartheta_i}\lambda_j - \frac{\varphi_U}{\vartheta_i}\upsilon_j - \frac{\omega_i + \Phi^{-1}(1 - \varrho_i)}{\vartheta_i}. \tag{A.6}$$

Hence

$$\frac{\partial \Delta y_{ij}}{\partial \lambda_j} < 0, \qquad \frac{\partial \Delta y_{ij}}{\partial \upsilon_j} < 0.$$

Proof. Substitute the equilibrium price premium from Proposition A.1 into (A.5). Since $\vartheta_i, \varphi_L, \varphi_U > 0$, both cultural derivatives are negative. □

Implication. The issue-specific term $\omega_i + \Phi^{-1}(1 - \varrho_i)$ captures non-cultural variation in label credibility, salience, and scarcity; empirically, it is absorbed by matching quality, bond controls, liquidity adjustment, or the residual. The cultural comparative statics are unambiguous: when the dependent variable is $\Delta y = y^G - y^C$, higher LTO and UAI predict lower green yields relative to matched conventional yields. Equivalently, defining $\text{Greenium}_{ij} \equiv -\Delta y_{ij}$ gives

$$\frac{\partial \text{Greenium}_{ij}}{\partial \text{LTO}_j} > 0, \qquad \frac{\partial \text{Greenium}_{ij}}{\partial \text{UAI}_j} > 0.$$

Thus the negative regression coefficients are not evidence against a greenium; they are the yield-spread expression of a culture-driven price premium.

Appendix B. Robustness: bond-level greenium

Table B.1 re-estimates the cultural relation using the liquidity-adjusted bond-level premium p_{it} from the Sample B same-issuer matching procedure. Columns (1)–(2) use the monthly premium panel; columns (3)–(4) use the bond-level nested specification. These WLS regressions use issue-size weights. The cultural coefficients keep their sign and significance, confirming that the daily-panel result is not an artifact of the spread construction.

Table B.1: Culture and the liquidity-adjusted greenium (Sample B)

	Monthly premium		Nested (bond-level)	
Dependent variable: p_{it}	(1)	(2)	(3)	(4)
COUP	−0.074	−0.111*	0.006	−0.000
	(0.063)	(0.062)	(0.030)	(0.030)
MAT	0.056***	0.040***	0.462***	0.489***
	(0.004)	(0.004)	(0.084)	(0.084)
MKTCAP	0.124**	0.234***	−0.111	−0.131*
	(0.058)	(0.064)	(0.072)	(0.070)
PERCAP	0.357**	0.829***	0.637**	0.405
	(0.179)	(0.210)	(0.266)	(0.278)
RATING	0.367***	0.351***	0.164***	0.164***
	(0.016)	(0.015)	(0.013)	(0.013)
UAI	−0.025***			−0.005**
	(0.002)			(0.002)
LTO		−0.008***	−0.005*	
		(0.003)	(0.002)	
Constant	−2.859**	−7.279***	−1.793	−0.661
	(1.362)	(1.573)	(1.906)	(1.876)
Observations	18,963	18,963	409	409
R^2	0.071	0.066	0.332	0.334

Notes. Dependent variable: the liquidity-adjusted bond-level premium p_{it} from Sample B, constructed by interpolating the two same-issuer conventional bonds closest in residual maturity to the green bond. It is in green-minus-synthetic-conventional yield-spread units, so a *negative* culture coefficient denotes a *larger* greenium. Columns (1)–(2) are issue-size-weighted WLS on the monthly premium panel; (3)–(4) are the issue-size-weighted bond-level nested model. UAI and LTO are entered separately. Standard errors in parentheses. $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$.

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