Individualistic Cultures' Pro Environmental Preferences in Green Financing

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1. Introduction

GLOBAL WARMING AND CLIMATE CHANGE pose formidable risks to our planet, driven primarily by the escalating concentrations of greenhouse gases in the Earth's atmosphere(see Ledley et al. ,2011). Existing Literature on the Green Bond Market examines the yield differential between green bonds and corresponding conventional bonds. Zerbib (2019) demonstrates a slight negative premium, indicating pro-environmental preferences among "Green Investors" who prioritize sustainable investments over higher returns. A long standing debate has also raised into the causes and explanations of this green premium commonly known as *greenium*.

The rest of this paper is organised as follows: Section 2 presents the arguments and Literature Review, Section 3 presents the Data , Variables used and Matching Method, Section 4 empasizes on the methodology , Section 5 is on discussion, Section 6 presents robustness checks and Section 7 concludes.

2. Prior Literature and Arguments

The recognition of culture as a determinant in constraining opportunistic behaviours and moulding the cognitive landscape of economic actors lends weight to the argument that cultural factors play a substantive role in influencing bond yield spreads (correspondingly the green premia). North (1990) argues that both bounded rationality and opportunism contribute to positive transaction costs, encompassing expenses related to measurement and enforcement, along with an uncertainty discount that accounts for imperfect measurement and enforcement. With an emphasis on bounded rationality and opportunism as contributors to positive transaction costs , this argument underscores the impact of culture on cognitive frameworks, not only influencing cost dynamics but also shaping the subjective perceptions of economic agents. Culture achieves this discount by shaping investors' incentives and subjective perceptions of the external world. Williamson (2000) introduces an analytical framework underscoring the pivotal role of culture in shaping economic decision-making. Based on this framework, X. Zheng et al. (2012) demonstrate that within domains not comprehensively governed by formal rules, informal constraints emanating from culture—such as codes of conduct, norms, and business conventions—play a decisive role in moulding agents' behaviours during market exchanges. Furthermore, in line with our current arguments Hofstede and Bond (1988) and Licht et al. (2005) contend that culture, embedded in the psyche of individuals during their formative socialization, serves as a motivating and justifying force for their choices and conduct, aligning with the foundational values of a specific society.

Uncertainty avoidance pertains to the extent of cultural conditioning influencing individuals' comfort or discomfort in unstructured scenarios, characterized by novelty(Hofstede 2001) , unfamiliarity, surprise, or deviation from established norms. The term *uncertainty avoidance* delineates how individuals in uncertainty-avoidant cultures exhibit a bias toward short-term, immediate feedback-driven responses, prioritizing the resolution of pressing issues rather than formulating enduring strategies to navigate long-term uncertainty.

Simultaneously, individuals in cultures characterized by low uncertainty avoidance manifest a subdued sense of urgency when confronted with ambiguous, surprising, or unstructured situations. Conversely, counterparts in high uncertainty-avoidance cultures experience heightened anxiety in such contexts, prompting rapid interventions to reduce ambiguity. Rieger et al. (2015) further substantiate that risk attitudes are contingent not solely on economic circumstances but are influenced by cultural elements such as individualism and uncertainty avoidance. Uncertainty avoidance has a behavioural origin as emphasized by Y. Chen et al. (2015). They argue that cultural factors contribute to shaping behavioural characteristics, notably risk aversion in gains and risk-seeking tendencies in losses, as delineated by prospect theory.

Applying a similar framework to the context of pressing concerns today such as Global Warming and Climate Change, cultures inclined towards avoiding uncertainty are likely to seek certainty by directing investments into instruments such as Green Bonds thereby being willing to pay a premia for it. This strategic and caution based approach aligns with their cultural predisposition to address immediate challenges and reduce uncertainty in the face of complex, unpredictable scenarios in return for giving up potential upside gains in the market. This enhanced understanding not only enriches our comprehension of bond yield spreads and green premia but also underscores the imperative of considering cultural factors in devising effective strategies for navigating the landscape of economic decision-making.

In the face of these global climate risks and the premise of culture influencing economic decision making , we bridge the gap in literature by posing and substantiating on the following two arguments :

1. Cultures with higher uncertainty avoidance behaviour which naturally is concerned with alleviating inherent anxieties stemming from uncertainty of future events are inclined to sacrifice potential returns on green bonds to mitigate climate-induced risks.

2. Within the realm of these formidable risks posed to mankind, a compelling argument emerges concerning the inherent interdependence of pro-environmental objectives with a long-term orientation stemming naturally from inherent national culture. We argue that the symbiotic relationship between long-term orientation and environmental concern is given as follows: cultures that prioritize future-oriented perspectives and establish long-term goals inherently align with a heightened inclination towards sustainability practices. In the current context, it follows that cultures exhibiting predispositions like forward-looking perspectives and long-term planning are more likely to manifest a parallel inclination towards realization of green premia. (Cite papers)

3. Data and Methodology

Our dataset encompasses all available green bonds sourced from Bloomberg and Eikon, and the time series data for relevant variables are obtained from Refivitiv Eikon, as detailed in the Appendix.

3.1 Credit Rating

Agencies such as S&P, Moody's and Fitch offer credit ratings to bonds based on extensive data on bond default probability and severity. We collect the ratings data from Eikon and assign a ranking to each rating i.e. a rating of 1 refers to the highest rated which is Aaa rated and 21 refers to the lowest rated bond which is C (Moody's ratings are used in our study as a majority of our bonds are listed by the same ratings agency). Other ratings such as Distance to Default or the Credit Default Spread (Longstaff et al., 2005) are also used to measure default risk but since this information is available only for a limited number of green bonds, we use the CDS Spread for only the preliminary results. For our liquidity analysis, we use only bonds which are rated as the primary aim for the study in this paper is to evaluate the risk pertaining to the green bond and default risk or credit risk is an invaluable feature of the risk characteristics for a green bond.

3.2 Culture Variables

Geert Hofstede conducted a cross-country psychological survey between 1967 and 1973 on over 88,000 respondents from 72 different countries all working for IBM. Since then Hofstede's culture variables have been regarded as a good measure of culture in different countries. We collect Hofstede's cultural dimensions scores for all countries in our sample from Geert Hofstede's website[1] . Several studies have used Hofstede's Cultural dimensions such as power distance, individualism ,masculinity and so on. Notable ones include Chui et al. (2010), Zheng et al. (2012) and Geiger et al. (2006).

[1] Link for the website :www.geerthofstede.com/research-and-vsm/dimension-data-matrix

4. Present Biases

4.1 Liquidity Bias

Liquidity has become an indispensable part of the bond market. It is referred to as the ease with which the bonds can be traded. Several theories such as the one by Amihud and Mendelson (1986) show that investors demand higher rates of return for bonds that are thinly traded. This is due to the inability of the investor to hedge against risks due to infrequent trading. This has given rise to the Bid-Ask spread being used as a proxy for liquidity in many studies, for example Chen et al. (2007) which uses the bid-ask spread as a measure of liquidity to measure the corporate yield spread.

The existing body of literature extensively explores the impact of liquidity on asset prices, with a examination provided by Amihud, Mendelson, and Pedersen (2005). The existing "credit spread puzzle" refers to the observation that yield spreads on corporate bonds surpass what can be attributed to default risk alone, as documented by Huang and Huang (2003), Elton, Gruber, Agrawal, and Mann (2001), and Collin-Dufresne, Goldstein, and Martin (2001).

Early studies showing liquidity proxies to be explanatory include Downing, Underwood, and Xing. (2005), Houweling, Mentink, and Vorst (2005), Sarig and Warga (1989), de Jong and Driessen (2006) and Covitz and Downing (2007). J. Dick-Nielsen et al.(2012) find corporate bond illiquidity to rise extensively during the onset of the subprime crises and develop an alternative liquidity measure from the existing ones. Mahanti, Nashikkar, Subramanyam, Chacko, and Mallik (2008) explore bond investor's portfolios, coming up with a measure known as latent liquidity. Since it is not possible to calculate portfolios given the illiquid nature of Green Bonds, we don't use this measure.

Following Chen et al. (2007), we believe that a substantial liquidity bias can have an effect on the yield spread of the bonds and hence it is import to eliminate the existing liquidity bias. This restriction as shown in Table 2., helps us in controlling the residual liquidity bias using different liquidity proxies namely (i) Bid-Ask spread, (ii) Roll's rolling 21 day Liquidity measure and (iii) Bao's rolling 21 day liquidity measure as given by . Utilizing liquidity proxies serves the purpose of mitigating bias in our analysis, offering a suitable gauge of the yield spread Δy_{it} This adjustment accounts for the inherent liquidity disparity between the the GB and CB.

We use the closing percentage of the Quoted Bid-Ask spread as a measure of the liquidity for the GB. The fact that green bonds are thinly traded as compared to corporate bonds gives rise to a bias in the daily returns and prices. Since, the proxies of liquidity risk used by Roll (1984) include estimating the first-order serial covariance of price changes, we instead use the Bid-Ask spread as a liquidity measure for our primary results. Later, we reexamine the results using Roll's measure as a proxy for illiquidity using Roll's and Bao's measure over a 21 day rolling period as intra-day data is not available for on these bonds. Roll(1984) finds that with certain assumptions, the Bid-Ask spread can be given as two times the square root of minus the covariance between consecutive returns:

$$Roll_t = 2\sqrt{-cov(R_i, R_{i-1})}$$

In the context of our measurement periods, denoted by t, we employ a rolling 21-day metric as a proxy for liquidity as used by J. Dick-Nielsen et al. The rationale behind this choice lies in the recurring oscillation of bond prices between bid and ask prices. Specifically, a heightened proportion of bid-ask spreads results in a negative covariance between consecutive returns.

[Insert Table 4]

4.2 Issue Amount Bias

In addition to the maturity and liquidity biases, substantial differences in yield spread variances exist among green bonds of varying issue sizes. To elucidate this discrepancy, we partition the bonds into two sub-samples, Q1 and Q2, based on the median issue amount each month, with Q1 representing bonds with issue amounts greater than the median (and Q2 less than the median amount) . The difference in monthly variances in yield spreads is depicted in Figure 1. This bias becomes more pronounced from the year 2020 onward, marked by a continuous escalation in the variance components. To address this bias systematically, we adopt a Weighted Least Squares approach in lieu of the Ordinary Least Squares regressions employed in existing literature.

[Insert Fig. 1]

5. Matching Method

The empirical approach involves employing regressions with suitable specifications applied to bond data to assess the specified property. Given the specialized nature of green bonds, we implement the matching method, also known as the model-free or direct approach, to analyse the intrinsic value of these financial instruments. This method entails identifying conventional bonds with properties closely resembling those of a given green bond, except for their environmental characteristics. The selection of the bonds is achieved through this method.

Our variable construction methodology aligns with the approach utilized by Helwege et al. (2014), who employed a similar method to assess the impact of liquidity on corporate yield spreads. In the face of a smaller Green Bond market size compared to that of Corporate Bonds, we utilize the same bond Corporate Bond (CB henceforth) to match multiple Green Bonds (henceforth GB) in a one-to-many matching approach. A subsequent analysis enhances this method by applying a more stringent matching criterion, akin to the one used by Zerbib (2019) outlined in Table 1.

We set up this matching method with a total of 8,725 green bonds and 166,933 conventional bonds which meet the Green Bond Principles as of March 2023. Aligning with our specific focus on culture , the analysis is confined only to countries for which Hofstede's cultural variables, those pertinent to this study are available and applicable. We create two samples A and B based on the rigour of the matching and methodology. Sample A is created by matching the green bond to a conventional bond having the same (a) Currency and (b) Rating. Since it is difficult to find a suitable match for Non-Euro currency bonds, we restrict our sample to only Euro currency bonds. However, we also present results for green bonds from other currencies in Sample B which includes a more restrictive matching criterion. The summary statistics of the entire Sample is presented in **Table 2**.

5.1 Sample A

Each green bond is systematically paired with corresponding conventional bonds based on specified criteria as in (a) and (b). Bonds exhibiting fewer than 10 observations for our designated liquidity proxies are subsequently excluded from the analysis. Within Sample A , we create subsamples A1 and A2.

Sample A1

Sample A1 is designated for the comprehensive analysis of the yield spread, encompassing 417 green bonds. As the dependent variable in Sample A1, we use the i^{th} bond's yield spread on day t given as $\Delta y_{it.}$., Following Sarig and Warga (1989), Houweling, Mentink, and Vorst (2005), and Longstaff, Mithal, and Neis (2005), we add bond age, time-to-maturity, and size of coupon to the regressions. To control for rating[2], we assign numerical rankings from 1 to 23, with 1 denoting an Aaa rated bond and 23 indicating a C rated bond. The following regression model has been specified:

$$\Delta yit = \alpha + \gamma L_{it} + \beta_1 CDS + \beta_2 COUP + \beta_3 RATING + \beta_4 MAT + \beta_5 MKTCAP + \beta_6 PERCAP + \beta_7 CULTURE$$

with i representing the bond issue, t denoting the daily observation, and L_{it} encompasses one of the liquidity proxies as per the defined specifications. Given the panel data on yield spreads, where each issuer may have multiple bonds outstanding, we compute White robust standard errors (refer to ?) to account for time-series effects, and heteroskedasticity in the residuals.

Sample A2

The primary purpose of Sample A2 is to calculate and analyse the green premia. In addition to the criteria used for Sample A1, Sample A2 includes only countries that have issued a minimum of 5 green bonds. Moreover, months presenting fewer than 20 premia are excluded to mitigate potential influences on inconsistent results. In this Sample following Zerbib (2019), the premium for the bond i in month T is given as the intercept in the regression of the bond's yield spread on the residual difference in liquidity between the green and the conventional bond. That is , in each month T , Δy_{it}^{T} representing the i^{th} bond's yield spread on day t within month T is regressed on ΔL_{it}^{T} *which is* the difference in daily liquidity between the green and the conventional bond; the intercept of this monthly regression gives us p_i^T , which is the monthly premium for bond i. Equation ? illustrates the premium generating process.

$$\Delta y_{it}^{T} = p_i^T + \beta_i^T \Delta L_{it}^{T} \qquad (1)$$

$$\Delta L_{it}^{GB} = L_{it}^{GB} - L_{it}^{CB} \qquad (2)$$

[2] If for a given bond, Moody's Rating is unavailable, we resort to using the S&P Rating, and if the latter is also unavailable, we employ the corresponding Fitch Rating.

Where GB is the green bond i matched to appropriate conventional bond CB satisfying conditions (a) and (b), L_{it} refers to the liquidity of the bond on day t of month T.

The obtained intercept signifies the absence of any liquidity bias between conventional and green bonds. The premium has been trimmed at 1% and 99% respectively towards concern for any possible outliers. We have now controlled for three factors that are known to affect the green premium namely Currency, Rating and Liquidity. In a pursuit to find other factors affecting this monthly premia like Culture and Macroeconomic Variables , we use the following model:

$$p_{it} = \alpha + \beta_2 COUP_i + \beta_3 RATING_i + \beta_3\, MAT_i + \beta_4\, MKTCAP_j + \beta_5\, PERCAP_j + \beta_7\, CULTURE_j$$

Where $COUP_i$ is the i^{th} bond issued in country j's coupon, $RATING_i$ is the numeric rating, MAT_i is the term length of the bond, $MKTCAP_j$ is the issuing country j's Equity Market Capitalization, $PERCAP_j$ is the country's Per-Capita GDP and $CULTURE_j$ is the country's longterm orientation or uncertainty avoidance score as given by Hofstede's cultural dimensions Refer to (?) .

5.2 Sample B

We set up Sample B using an enhanced matching criteria as given by Zerbib (2019). This method consists of evaluating the yield spread between a green bond and an equivalent synthetic conventional bond. For this, we take matched pairs of green and conventional bond having similar properties except for their greenness.

To build the synthetic conventional bond, we first search for the two conventional bonds with the closest maturity from the same issuer and having exactly the same characteristics namely currency, maturity and bond structure. Since the maturities can't be equal, we search for the bonds with maturity which is in the range of +/- two years from the maturity of the green bond.

A synthetic bond comprising of the two closest conventional bond matched with each green bond as per the criterion in **Table 3**. We now make a panel of three bonds namely green (GB), conventional bond (CB) and synthetic bond (SB) . We use the ask yield of the GB and CB as this shows the investor's demand in a more precise manner. Since the synthetic conventional bonds are based on the two closest conventional bonds, the conventional bond's bid-ask spread is defined as the distance-weighted average of CB1's and CB2's bid-ask spreads.

$\Delta BA^{SB}{}_{i,t} = BA^{GB}{}_{i,t} - BA^{CB}{}_{i,t}$ (2)

We now proceed to control the residual liquidity bias present in the matched pairs of synthetic and conventional bonds. We take the closing percent of the bid-ask spread as the proxy for liquidity and the time-distance weighted average of the maturity of the bond as a means for offsetting the maturity bias [3]. The ask yield of the synthetic bond is given as the interpolation (or extrapolation) of the two conventional bonds' yields on the maturity of the green bond. For example, if the maturity and yields of the conventional bonds A and B are t_a , y_a and t_b , y_b, the maturity and yield of the green bond is t_g and y_g, then we linearly interpolate y_a and y_b on t_g to find the corresponding yield of the synthetic bond at the green bond's maturity. Let $y^{GB}{}_{i,t}$ $\tilde{y}^{CB}{}_{i,t}$ be the respective yields of the green bond and conventional bond on day t. Further, the bid-ask spread has been shown to be a measure of illiquidity for bonds as used by Beber et al.

, $f(\tilde{y}_{i,t}) = y^{GB}{}_{i,t} - y^{SB}{}_{i,t}$ represents the yield spread between the green and the synthetic bonds at time t and is the variable we are interested in. This approach helps us in eliminating the liquidity bias present in the bonds.

The premium after controlling for liquidity and maturity bias can be obtained as the intercept of the yield spread of the conventional and synthetic bonds regressed on the residual liquidity difference of the synthetic bond. The obtained intercept signifies the absence of maturity as well as liquidity biases. Given the complexity of the premium generating process, we find bond level premiums (i.e. one premium per bond).

$y_{i,t} = p_i + \beta \ \Delta L_{i,t} + \epsilon_{i,t}$, with $\epsilon_{i,t}$ being the error.

In the next stage, we regress the premiums found from the previous equation according to the model:

$$p_{it} = \alpha + \gamma L_{it} + \beta_1 CDS + \beta_2 COUP + \beta_3 MAT + \beta_4 MKTCAP + \beta_5 PERCAP \ \beta_6 NR + \beta_7 CULTURE$$

[3] The empirical methodology used in literature is to find the residual liquidity difference of the green and the conventional bond. However, since intraday data in not available, we can not use this methodology and have use this alternate method as described by Fong et. al (2017)

with i representing the bond issue, t denotes the daily observation, and L_{it} encompasses one of the liquidity proxies as defined. We use the dummy NR to signify 1 if the bond is not rated and 0 if it is rated[4]

.

6. Discussion

Fama and French (2007) illustrate that in instances where a group of investors exhibit a preference for specific asset types, there is a corresponding adjustment in equilibrium prices, leading to a breakdown in the explanatory power of the Capital Asset Pricing Model (CAPM) for asset returns. Similarly, in the context of equities, Heinkel et al. (2001) demonstrate that green investors, through the deliberate exclusion of environmentally harmful assets from their portfolios, exert upward pressure on the cost of capital for polluting companies. The average -x bps premium obtained in Aaa bonds shows the yield that investors are willing to give up to fund sustainable projects. This premium however is not large enough to discourage investors from investing in Green Assets. Our results are consistent with the findings of Zerbib (2019) who argues that investors' pro-social and pro-environmental inclinations increase inflows to socially responsible investments (Hong and Kacperczyk, 2009; Riedl and Smeets, 2017; Hartzmark and Sussman, 2018) have identified factors influencing investor behavior, with social pressure (DellaVigna et al., 2012) being potential psychological origins. We further argue that social pressure inherent through culture can influence bond prices , Chui et al. (2010) show how individualism affects momentum profits due to the overconfidence biases associated with a particular cultural group. Hence we find suitable evidence of cultural factors affecting asset prices. In conjunction with this, we find National Culture to be significantly affecting the green bond premium as well as the yield spread having statistical significance.

We present results for the change in yield spread of the GB (measured w.r.t a corresponding matched CB for Sample A1) in Table 5. Our empirical analysis reveals an inverse relationship between the uncertainty avoidance score of the issuing bond country and yield spread, wherein a one-point escalation in the former correlates with a 0.6 bps reduction in the latter. This relationship persists even when accounting for other factors at the bond, firm, and country levels. Additionally, a reduction in yield spread, albeit to a lesser extent of 0.4 bps is observed with a one-point increment in the long-term orientation score. These findings underscore the incorporation of cultural factors into the pricing dynamics of bond yield spreads. Notably, while these cultural factors exert a measurable influence, their impact is not of a magnitude sufficient to dissuade investors from engaging in green investments.

[Insert Table 5]

We compute similar results from an OLS regression analysis . Specifically, we observe a persistent effect on yield spreads, with a 1-point increase in the uncertainty avoidance score translating to a 0.6 bps reduction and a corresponding 0.4 bps decrease in yield spread for each 1-point elevation in the long-term orientation score of the underlying country. The findings remain robust to a change in the methodology and has been presented in Table 6.

[Insert Table 6]

To enhance the power of our tests, we conducted regressions utilizing monthly bond premiums from Sample A2, as presented in Table 7. The outcomes exhibit strength , revealing a noteworthy impact of cultural factors on yield spreads. Specifically, a 1-point escalation in the uncertainty avoidance score is associated with a substantial 2.5 basis points reduction in yield spread, while a corresponding 1-point increase in the long-term orientation score of the underlying country corresponds to an 0.8 basis point decrease in yield spread. The results remain robust to various checks presented in Section Y of this paper.

[Insert Table 7]

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Table 1.

Green Bond matching criteria as given by (1) relaxed criteria and (2) a more stringent criteria		
(1)		The green and conventional bond must be of the same currency and rating
(2)	(a)	The green and conventional bond must have the same issuer
	(b)	The difference in issue date between the green and conventional bond must be a maximum of six years
	(c)	The difference in Issue Date between the Green and Conventional bond must be a maximum of two years
	(d)	The Issue Amount of the conventional bond must in the range of one-fouth to four times the issue amount of the green bond

Table 2.

Panel A: Comparison of the Entire Sample Bonds		
	Green	Conventional
Issue Period	2007-2023	1906-2021
Total Currencies	48	69
Total Countries	83	40

Table 3.

Descriptive Statistics of the Entire Sample of Green Bonds

	Count	Mean	Std.	Min.	1st Quartile	Median	3rd Quartile	Max.
ISSUE(USD 100 Million)	528436	12.55	28.56	0.052	5.308	7.919	10.58	33007.48
Δy_{it}	438300	0.29	0.75	-24.08	-0.17	0.15	0.60	11.21
ΔL^1_{it} *(10)*$^{-3}$	438300	0.15	6.79	-2004	-2.11	0.56	2.58	2005.00
ΔL^2_{it} *(10)*$^{-6}$	187414	0.07	19.62	-968.30	-1.40	0.13	3.16	266.34
ΔL^3_{it}*(10)*$^{-3}$	187414	0.29	3.43	-12.51	-0.93	0.00	1.42	61.89
BIDASK *(10)*$^{-3}$	528058	3.99	4.69	-2000	1.95	3.16	4.89	72.42
ROLL *(10)*$^{-3}$	190102	1.84	3.07	0.00	0.00	0.73	2.59	62.24
BAO *(10)*$^{-5}$	190102	-0.12	1.94	-96.83	-0.17	-0.01	0.11	26.12
CDS	242357	63.98	52.90	0.03	29.01	51.63	80.81	582.52
MAT	528436	10.68	7.22	2.00	7.00	9.91	12.00	100.00
COUP	528436	1.04	0.92	0.00	0.38	0.88	1.50	12.00
RATING	528436	5.21	3.41	1.00	1.00	4.00	8.00	16.00

Table 4

This table uses an Autoregressive Distributed Lag Model for comparing the yield spread (taken as the difference as y_{GB} – y_{CB}) to corresponding daily liquidity variables. Lagged variables , CDS spread, Δy_{it} and Bid-Ask have been used to explain $\Delta y_{it.}$ A 1 % increase in the bid-ask spread leads to a corresponding 6.9 bps increase in the yield spread.

Dependent variable: Δy_t	
CONS	0.0276***
	(0.002)
YLD_{t-1}	0.7067***
	(0.002)
CDS_{t-1}	0.0003***
	(0.000)
$BIDASK_{t-1}$	6.9434***
	(0.295)
No. Observations:	1,89,657
Log Likelihood	-1,24,405.127

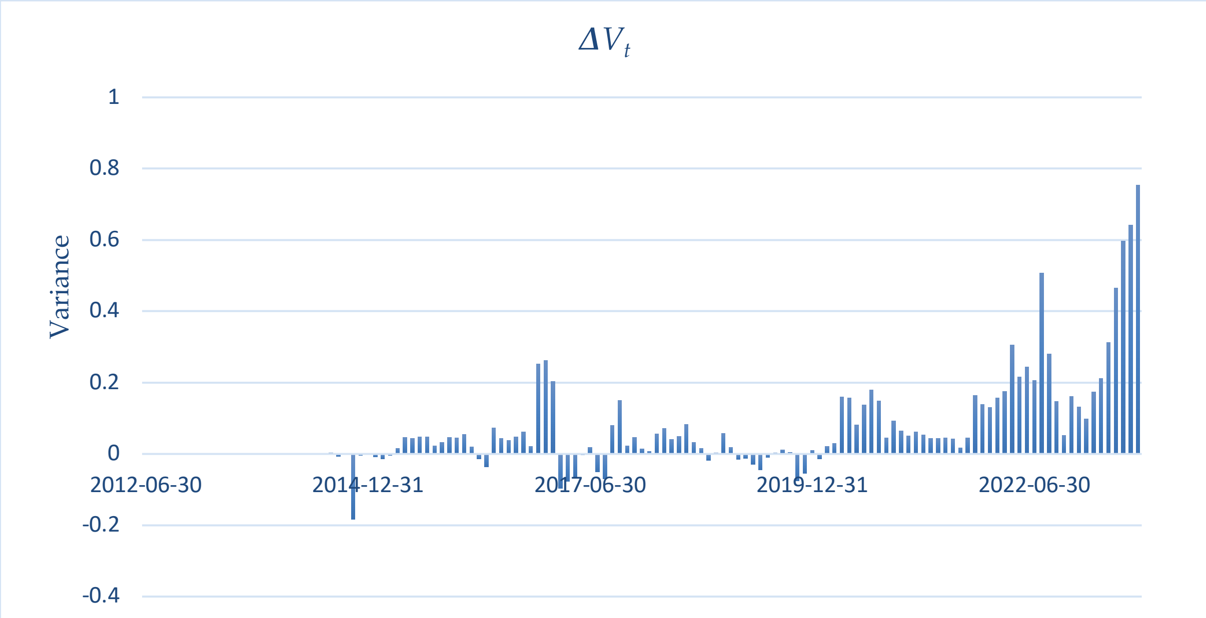
Table 5.

Yield Spread in Relation to Culture, Controlling for CDS Spread. The table depicts the results of a OLS regression examining the yield spread in relation to the cultural variables long-term orientation and uncertainty avoidance, controlling for the credit risk and liquidity using the Bid-Ask spread. The cultural dimensions are sourced from Hofstede's Cultural Dimensions. White Robust (HAC) errors have been used. Standard errors are indicated in parenthesis.

	Dependent variable: Δy_{it}		
	(1)	(2)	(3)
CONST	-1.146***	0.420***	-1.056***
	(-0.073)	(0.104)	(-0.077)
BIDASK	1.810**	2.499***	2.209***
	(0.786)	(0.801)	(0.782)
CDS	0.003***	0.003***	0.003***
	(0.000)	(0.000)	(0.000)
COUP	0.036***	0.034***	0.034***
	(0.002)	(0.002)	(0.002)
RATING	0.056***	0.051***	0.055***
	(0.001)	(0.001)	(0.001)
MAT	0.018***	0.018***	0.018***
	(0.000)	(0.000)	(0.000)
MKTCAP	0.051***	0.023***	0.049***
	(0.002)	(0.003)	(0.002)
PERCAP	0.005	-0.212***	0.001
	(0.012)	(-0.015)	(0.012)
UNCERTAIN		-0.003***	
		(-0.000)	
LONGTERM			-0.001***
			(-0.000)
Observations	1,82,760	1,82,760	1,82,760
R^2	0.225	0.227	0.225
Adjusted R^2	0.224	0.227	0.225
Residual Std. Error	0.596 (df=182752)	0.595 (df=182751)	0.596 (df=182751)
F Statistic	7343.482*** (df=7; 182752)	6483.573*** (df=8; 182751)	6522.677*** (df=8; 182751)

Note: *p<0.1; **p<0.05; ***p<0.01

Fig 1.



In each month t, the bonds have been split into two equal samples based on the issue amount (with Q1 (Q2) having issue amount greater (less) than the median issue amount). The time-series difference in variance has been illustrated in the figure. This clearly indicates the presence of heteroskedasticity among bonds with different issue characteristics. Hence, Weighted Least Squares with Issue Amount as the weight shall be preferred for our analysis.

Table 6.

Yield Spread in Relation to Culture, Controlling for CDS Spread. The table depicts the results of a Weighted Least Squares regression with the bond level issue size (in USD) as the weights. We examine the yield spread in relation to the cultural variables long-term orientation and uncertainty avoidance, controlling for the credit risk, and liquidity using the Bid-Ask spread . The cultural dimensions are sourced from Hofstede's Cultural Dimensions. White Robust (HAC) errors have been used. Standard errors are indicated in parenthesis.

	Dependent variable: Δy_{it}		
	(1)	(2)	(3)
CONST	-0.309***	2.984***	0.468***
	(-0.089)	(0.12)	(0.089)
BIDASK	40.754***	40.188***	41.166***
	(1.022)	(1.003)	(1.028)
CDS	-0.001***	-0.001***	-0.001***
	(-0.000)	(-0.000)	(-0.000)
COUP	-0.115***	-0.102***	-0.130***
	(-0.003)	(-0.003)	(-0.003)
RATING	0.096***	0.088***	0.090***
	(0.001)	(0.001)	(0.001)
MAT	0.040***	0.043***	0.040***
	(0.000)	(0.000)	(0.000)
MKTCAP	0.018***	-0.057***	0.011***
	(0.003)	(-0.003)	(0.003)
PERCAP	-0.170***	-0.590***	-0.256***
	(-0.013)	(-0.017)	(-0.013)
UNCERTAIN		-0.006***	
		(-0.000)	
LONGTERM			-0.004***
			(-0.000)
Observations	1,82,760	1,82,760	1,82,760
R^2	0.464	0.472	0.469
Adjusted R^2	0.464	0.472	0.469
Residual Std. Error	0.006 (df=182752)	0.006 (df=182751)	0.006 (df=182751)
F Statistic	11719.977*** (df=7; 182752)	10947.094*** (df=8; 182751)	10227.541*** (df=8; 182751)

Note: *p<0.1; **p<0.05; ***p<0.01

Table 7.

Robustness Check I: Yield Spread in Relation to Culture, Controlling for CDS Spread. The table depicts the results of a Weighted Least Squares regression with the bond level issue size (in USD) as the weights. We examine the yield spread in relation to the cultural variables long-term orientation and uncertainty avoidance, controlling for the credit risk, and liquidity using Roll's Illiquidity Measure . The cultural dimensions are sourced from Hofstede's Cultural Dimensions. White Robust (HAC) errors have been used. Standard errors are indicated in parenthesis.

	Dependent variable: Δy_{it}		
	(1)	(2)	(3)
CONST	-0.952***	-0.326**	-0.606***
	(-0.119)	(-0.150)	(-0.120)
ROLL	-9.829***	-9.659***	-9.963***
	(-0.587)	(-0.588)	(-0.578)
CDS	0.007***	0.007***	0.008***
	(0.000)	(0.000)	(0.000)
COUP	-0.016***	-0.017***	-0.027***
	(-0.003)	(-0.003)	(-0.003)
RATING	0.072***	0.071***	0.063***
	(0.001)	(0.001)	(0.001)
MAT	0.025***	0.026***	0.023***
	(0.000)	(0.000)	(0.000)
MKTCAP	-0.027***	-0.038***	-0.016***
	(-0.004)	(-0.004)	(-0.004)
PERCAP	0.088***	0.001	0.055***
	(0.017)	(0.022)	(0.017)
UNCERTAIN		-0.001***	
		(-0.000)	
LONGTERM			-0.004***
			(-0.000)
Observations	87,133	87,133	87,133
R^2	0.476	0.477	0.481
Adjusted R^2	0.476	0.477	0.481
Residual Std. Error	0.006 (df=87125)	0.006 (df=87124)	0.006 (df=87124)
F Statistic	6053.713*** (df=7; 87125)	5524.076*** (df=8; 87124)	5390.171*** (df=8; 87124)

Note: *p<0.1; **p<0.05; ***p<0.01

Table 8.

Robustness Check II: Yield Spread in Relation to Culture, Controlling for CDS Spread. The table depicts the results of a Weighted Least Squares regression with the bond level issue size (in USD) as the weights. We examine the yield spread in relation to the cultural variables long-term orientation and uncertainty avoidance, controlling for the credit risk, and liquidity using the illiquidity measure described by Bao et al.. The cultural dimensions are sourced from Hofstede's Cultural Dimensions. White Robust (HAC) errors have been used. Standard errors are indicated in parenthesis.

	Dependent variable: Δy_{it}		
	(1)	(2)	(3)
CONST	-0.974***	-0.345**	-0.630***
	(-0.118)	(-0.149)	(-0.119)
BAO	2294.800***	2262.636***	2303.335***
	(148.344)	(147.251)	(147.984)
CDS	0.007***	0.007***	0.008***
	(0.000)	(0.000)	(0.000)
COUP	-0.016***	-0.016***	-0.027***
	(-0.003)	(-0.003)	(-0.003)
RATING	0.073***	0.072***	0.064***
	(0.001)	(0.001)	(0.001)
MAT	0.023***	0.025***	0.022***
	0.000	0.000	0.000
MKTCAP	-0.028***	-0.039***	-0.016***
	(-0.004)	(-0.004)	(-0.004)
PERCAP	0.094***	0.007	0.061***
	(0.017)	(0.022)	(0.017)
UNCERTAIN		-0.001***	
		(-0.000)	
LONGTERM			-0.004***
			(-0.000)
Observations	87,133	87,133	87,133
R^2	0.477	0.477	0.481
Adjusted R^2	0.477	0.477	0.481
Residual Std. Error	0.006 (df=87125)	0.006 (df=87124)	0.006 (df=87124)
F Statistic	6085.696*** (df=7; 87125)	5551.014*** (df=8; 87124)	5414.982*** (df=8; 87124)
Note:	*p<0.1; **p<0.05; ***p<0.01		

Table 9.

Green Premiums on Long-term Orientation and Uncertainty Avoidance. In each month t, the dependent variable p_i is given as the intercept of the regression of Δy_{it} on ΔL_{it}. . This table presents the outcomes of time-series WLS regressions on monthly green premiums for X green bonds on the cultural variables long-term orientation and uncertainty avoidance. The issue size I_{it} has been used as weights. The analysis controls for residual liquidity bias using the Bid-Ask spread. White Robust (HAC) errors have been used. Standard errors are indicated in parenthesis.

	Dependent variable $:p_{it}$		
	(1)	(2)	(3)
CONST	-2.859**	-7.279***	-1.591
	(-1.362)	(-1.573)	(-1.493)
COUP	-0.074	-0.111*	0.793***
	(-0.063)	(-0.062)	(0.060)
MAT	0.056***	0.040***	-0.007
	(0.004)	(0.004)	(-0.005)
MKTCAP	0.124**	0.234***	0.401***
	(0.058)	(0.064)	(0.061)
PERCAP	0.357**	0.829***	-0.675***
	(0.179)	(0.210)	(-0.189)
RATING	0.367***	0.351***	
	(0.016)	(0.015)	
UNCERTAIN	-0.025***		
	(-0.002)		
LONGTERM		-0.008***	
		(-0.003)	
Observations	18,963	18,963	18,963
R^2	0.071	0.066	0.027
Adjusted R^2	0.071	0.066	0.027
Residual Std. Error	0.285 (df=18956)	0.286 (df=18956)	0.292 (df=18958)
F Statistic	160.521*** (df=6; 18956)	156.097*** (df=6; 18956)	111.503*** (df=4; 18958)
Note:	*p<0.1; **p<0.05; ***p<0.01		

Table 10.

Robustness Check I: Green Premiums on Long-term Orientation and Uncertainty Avoidance. In each month t, the dependent variable p_i is given as the intercept of the regression of Δy_{it} on ΔL_{it}. . This table presents the outcomes of time-series Least Squares regressions on monthly green premiums for X green bonds on the cultural variables long-term orientation and uncertainty avoidance. The analysis controls for residual liquidity bias using the Bid-Ask spread. White Robust (HAC) errors have been used. Standard errors are indicated in parenthesis.

	Dependent variable :p_{it}		
	(1)	(2)	(3)
CONST	1.276	-4.314**	2.143
	(2.065)	(-2.054)	(2.029)
COUP	0.114	0.115*	0.908***
	(0.069)	(0.069)	(0.068)
MAT	0.056***	0.047***	-0.006
	(0.006)	(0.006)	(-0.006)
MKTCAP	0.098	0.11	0.325***
	(0.083)	(0.084)	(0.084)
PERCAP	-0.286	0.501	-1.148***
	(-0.310)	(0.307)	(-0.294)
RATING	0.481***	0.458***	
	(0.019)	(0.019)	
UNCERTAIN	-0.043***		
	(-0.003)		
LONGTERM		-0.014***	
		(-0.003)	
Observations	18,963	18,963	18,963
R^2	0.061	0.052	0.016
Adjusted R^2	0.061	0.051	0.015
Residual Std. Error	6.957 (df=18956)	6.993 (df=18956)	7.125 (df=18958)
F Statistic	152.332*** (df=6; 18956)	152.984*** (df=6; 18956)	67.473*** (df=4; 18958)
Note:	*p<0.1; **p<0.05; ***p<0.01		

Table 11.

Robustness Check II: Green Premiums on Long-term Orientation and Uncertainty Avoidance. In each month t, the dependent variable p_i is given as the intercept of the regression of Δy_{it} on ΔL_{it}. . This table presents the outcomes of time-series WLS regressions on monthly green premiums for X green bonds on the cultural variables long-term orientation and uncertainty avoidance. The issue size I_i has been used as weights. The analysis controls for residual liquidity bias using the Roll's Illiquidity Measure. White Robust (HAC) errors have been used. Standard errors are indicated in parenthesis.

	Dependent variable :p_{it}		
	(1)	(2)	(3)
CONST	-2.130***	-1.232**	4.859***
	(-0.497)	(-0.489)	(0.492)
COUP	0.016**	0.012	0.207***
	(0.008)	(0.008)	(0.011)
MAT	0.016***	0.017***	-0.012***
	(0.001)	(0.001)	(-0.001)
MKTCAP	-0.019	-0.021	-0.087***
	(-0.016)	(-0.017)	(-0.019)
PERCAP	0.358***	0.231***	-0.802***
	(0.073)	(0.068)	(-0.069)
RATING	0.132***	0.126***	
	(0.003)	(0.003)	
UNCERTAIN	0.001*		
	(0.001)		
LONGTERM		-0.003***	
		(-0.001)	
Observations	7,885	7,885	7,885
R^2	0.365	0.368	0.113
Adjusted R^2	0.364	0.367	0.113
Residual Std. Error	0.027 (df=7878)	0.027 (df=7878)	0.032 (df=7880)
F Statistic	460.649*** (df=6; 7878)	474.745*** (df=6; 7878)	174.273*** (df=4; 7880)
Note:	*p<0.1; **p<0.05; ***p<0.01		

Table 12.

Robustness Check III: Green Premiums on Long-term Orientation and Uncertainty Avoidance. In each month t, the dependent variable p_i is given as the intercept of the regression of Δy_{it} on ΔL_{it}. . This table presents the outcomes of time-series WLS regressions on monthly green premiums for X green bonds on the cultural variables long-term orientation and uncertainty avoidance. The issue size I_{it} has been used as weights. The analysis controls for residual liquidity bias using the liquidity measure given by Bao et al. . White Robust (HAC) errors have been used. Standard errors are indicated in parenthesis.

	Dependent variable :p_{it}		
	(1)	(2)	(3)
CONST	-2.058***	-1.220**	4.736***
	(-0.491)	(-0.483)	(0.485)
COUP	0.015*	0.011	0.201***
	(0.008)	(0.008)	(0.011)
MAT	0.015***	0.016***	-0.012***
	(0.001)	(0.001)	(-0.001)
MKTCAP	-0.019	-0.02	-0.085***
	(-0.015)	(-0.017)	(-0.018)
PERCAP	0.349***	0.230***	-0.780***
	(0.072)	(0.068)	(-0.068)
RATING	0.129***	0.123***	
	(0.003)	(0.003)	
UNCERTAIN	0.001*		
	(0.001)		
LONGTERM		-0.003***	
		(-0.001)	
Observations	7,885	7,885	7,885
R^2	0.36	0.364	0.111
Adjusted R^2	0.36	0.363	0.111
Residual Std. Error	0.027 (df=7878)	0.027 (df=7878)	0.031 (df=7880)
F Statistic	456.203*** (df=6; 7878)	469.798*** (df=6; 7878)	172.288*** (df=4; 7880)

Note: *p<0.1; **p<0.05; ***p<0.01

Table 13.

Green Premiums on Long-term Orientation and Uncertainty Avoidance using Hierarchical Linear Modelling. In each month t, the dependent variable p_i is given as the intercept of the regression of Δy_{it} on ΔL_{it}. . This table presents the outcomes of the multi-level regressions on monthly green premiums for X green bonds in Y different countries on the cultural variables long-term orientation and uncertainty avoidance.. The analysis controls for residual liquidity bias using the liquidity measure using the Bid-Ask spread. Standard errors are indicated in parenthesis.

Dependent variable :p_{it}				
	(1)	(2)	(3)	(4)
CONST	1.412***	4.464	5.665	3.878
	(0.389)	(6.715)	(5.421)	(6.474)
ISSUE		-0.239***	-0.227***	-0.235***
		(-0.073)	(-0.073)	(-0.073)
MAT		0.045***	0.045***	0.044***
		(0.010)	(0.010)	(0.010)
COUP		0.133	0.125	0.131
		(0.081)	(0.081)	(0.081)
RATING		0.507***	0.508***	0.507***
		(0.026)	(0.026)	(0.026)
MKTCAP		0.122	0.14	0.144
		(0.431)	(0.337)	(0.413)
PERCAP		-0.552	-0.517	-0.303
		(0.898)	(-0.718)	(-0.884)
UNCERTAIN			-0.03***	
			(-0.011)	
LONGTERM				-0.016
				(-0.013)
Group Var	2.257	1.096	0.628	0.995
	0.094	0.05	0.034	0.046
No. Observations:	18963	18963	18963	18963
No. Groups:	16	16	16	16

Table 14.

Step 2 results with Stringent Criterion - Cultural Characteristics' Influence on Green Bond Premium in Entire Sample. This table presents the outcomes of the step 2 regression conducted on the complete sample, employing a rigorous criterion. The analysis focuses on explaining the green bond premium by incorporating the cultural characteristics of the issuing country, long-term orientation and uncertainty avoidance. The green premiums are adjusted for existing liquidity and maturity biases using synthetic bond construction and are trimmed at 2.5% and 97.5%.

	Dependent variable: p_i		
	(1)	(2)	(3)
CONST	1.199	1.734	-2.821
	(-2.127)	(-2.487)	(-2.49)
COUP	0.002	0.004	-0.023
	(-0.035)	(-0.036)	(-0.036)
EUR	-0.099	-0.117	-0.041
	(-0.137)	(-0.144)	(-0.137)
SWK	-0.099	-0.094	-0.033
	(-0.299)	(-0.299)	(-0.296)
USD	-0.363**	-0.406*	-0.131
	(-0.183)	(-0.211)	(-0.197)
MAT	0.019	0.019	0.019
	(0.012)	(0.012)	(0.012)
ISSUE	0.024	0.023	0.008
	(0.029)	(0.029)	(0.029)
MKTCAP	0.008	-0.026	0.333**
	(0.123)	(-0.147)	(0.163)
PERCAP	-0.170*	-0.188*	-0.073
	(-0.098)	(-0.106)	(-0.102)
NR	-0.190***	-0.188***	-0.183***
	(-0.061)	(-0.061)	(-0.06)
UNCERTAIN		0.001	
		(0.003)	
LONGTERM			-0.010***
			(-0.003)
Observations	301	301	301
R^2	0.066	0.067	0.094
Adjusted R^2	0.037	0.035	0.063
Residual Std. Error	0.478 (df=291)	0.479 (df=290)	0.472 (df=290)
F Statistic	2.291** (df=9; 291)	2.073** (df=10; 290)	3.017*** (df=10; 290)

Note: *p<0.1; **p<0.05; ***p<0.01

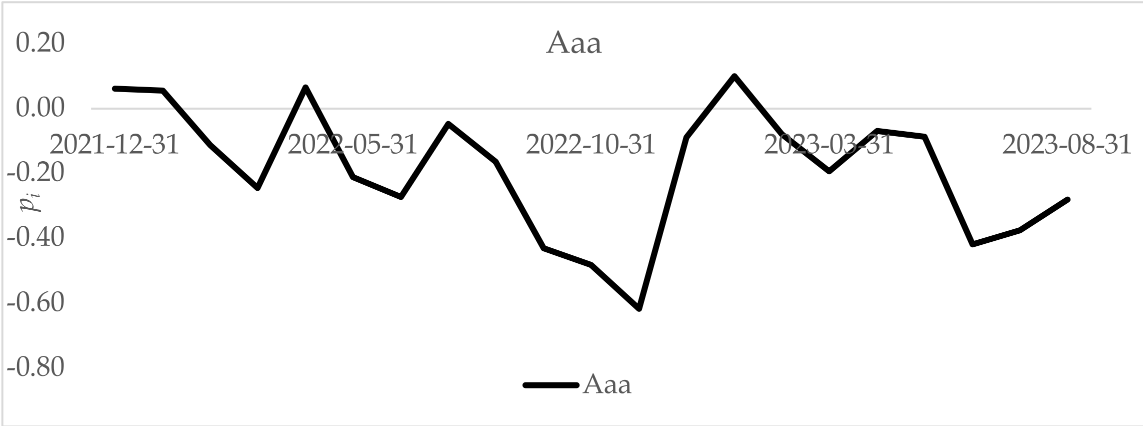
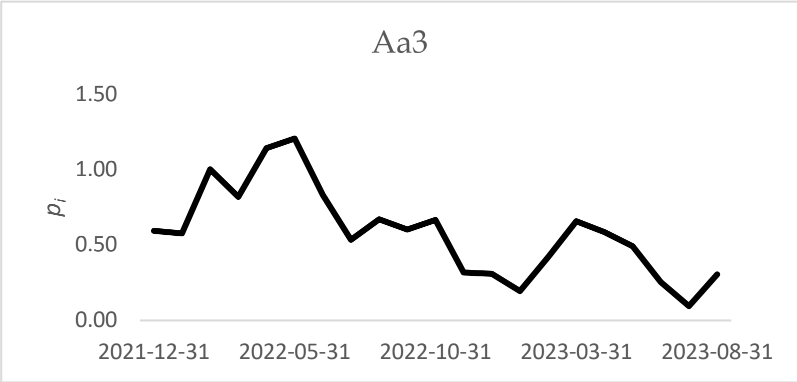


Fig 2: Time-series *premia* of the Aaa rated Euro bonds. We observe the premia to be negative on an average. This is consistent with our argument for investors giving up gains for financing sustainable projects.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0.50
0.00
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2022-05-31
2022-10-31
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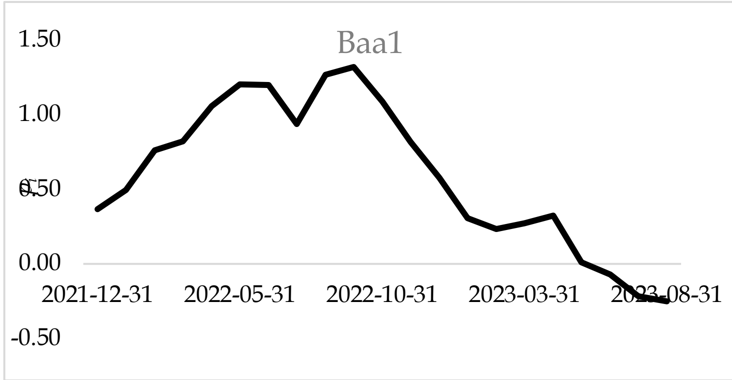
2023-08-31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2022-05-31
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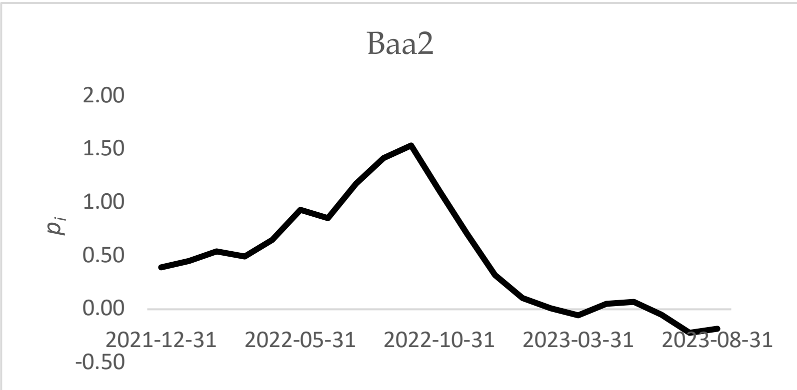
2023-08-31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1.00
0.50
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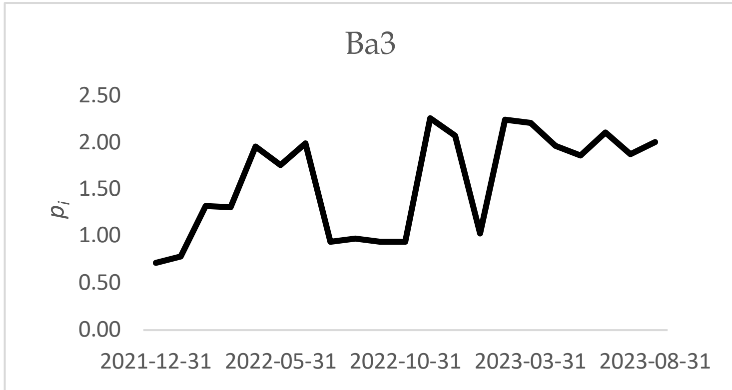
2022-05-31
2022-10-31
2023-03-31
2023-08-31


Ba3
p_i
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2.00
1.50
1.00
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0.00
2021-12-31
2022-05-31
2022-10-31
2023-03-31
2023-08-31