

# Green Bonds and External Reviews

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# Introduction and Motivation

## Definition (1/4)

International Capital Market Association (ICMA) defines “*any type of bond instrument where the proceeds will be exclusively applied to finance or re-finance, in part or in full, new and/or existing eligible Green Projects*” as a green bond (ICMA, 2018).

**Common features:** coupon payment, principal amount, repayment obligation, default risk, etc.

**Difference:** the proceeds of green bonds should be used for climate related projects.

# Introduction and Motivation

## Definition (2/4)

Currently, the green bond market is not under governmental regulation, but there are two voluntary standards to reduce the chance of greenwashing (Climate Bond Initiative, 2019).

**Green Bond Principles (GBP):** 1) the use of proceeds, 2) process for project evaluation and selection, 3) managing of the proceeds, and 4) reporting

**Climate Bond Standard (CBS):** the CBS is more practical and provides sector specific eligibility criteria.

# Introduction and Motivation

## Definition (3/4)

In principle, issuers are free to label their bonds as "green" or conventional. But they can choose to conduct external reviews to increase transparency and credibility.

**Second Party Opinion (SPO):** an assessment of the issuer's "green" objective, policy and process, as well as a detailed evaluation of the "green" credentials of the underlying projects.

**Third Party Assurance:** generally, audit firms provide third party assurances to check the alignment with internal, external standards and issuer claims, respectively.

# Introduction and Motivation

## Definition (4/4)

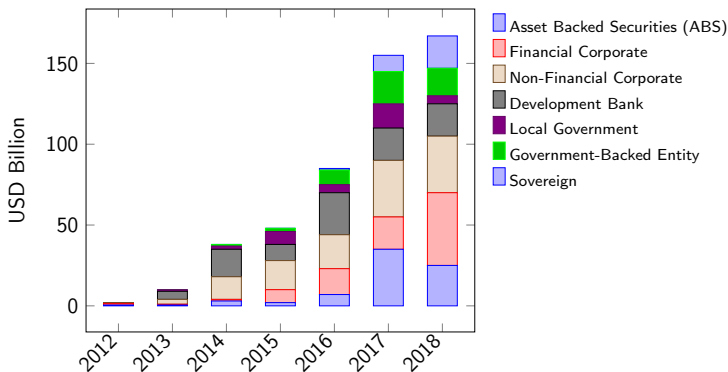
**Green Bond Rating:** Traditional credit rating agencies, e.g. Moody's and S&P, provide green bond rating services for issuers. They analyze issuers' environmental performance data quantitatively.

**Certification:** CBI's certification scheme includes pre-issuance checking, post-issuance verification and ongoing reporting, which covers the whole life-cycle of the green bond issuance.

# Introduction and Motivation

## Market conditions

According to the newest statistics from the Climate Bonds Initiative (2020), green bonds' total amount of issuance has reached \$265.4bn at the end of 2019.





# Introduction and Motivation

## Research gap (1/2)

Previous studies focus on detecting the green bond premium and its determinants.

**Green bond premium:** the results on the question of whether green bonds are enjoying a negative premium (Hachenberg and Schiereck, 2018; ?), suffering from a positive premium (Karpf and Mandel, 2018), or are indifferent from conventional bonds concerning yield to maturity (Climate Bond Initiative, 2019), are inconclusive.

**The determinants:** credit rating, issuer type, industry, denominated currency, and liquidity (Zerbib, 2019).

# Introduction and Motivation

## Research gap (2/2)

In summary, very limited literature has yet taken into account the impact of external reviews on the green bond premium. Moreover, as green bonds are designated to address environmental issues, it would be intuitive to further check the mediating effect of the issuers' environmental performance.

- (1) Is there a green bond yield premium?
- (2) To what extent does the Second Party Opinion (SPO) influence the green premium?
- (3) Does the Second Party Opinion impact the green bond premium, subject to the firms' level of sustainability?

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# Theoretical Positioning

## Hypothesis 1

We base our hypotheses on neo-classic economic theories.

**Asymmetric information:** Sellers who have insider knowledge tend to sell bad-quality cars at the average market price, which leads to market failure (Akerlof, 1970).

**Signaling:** Sellers can offer signals about the quality of products to buyers to alleviate the information asymmetry (Spence and Zeckhauser, 1971).

**Hypothesis 1:** Green Bonds have a lower yield compared to their conventional counterparts.

**Screening:** Buyers can perform a screening process to evaluate the quality of the seller's signalling (Stiglitz, 1975).

**Transaction cost theory:** the transaction cost will arise when a good or service is transferred to another company (Coase, 1937; Williamson, 1979).

**SPO costs:** the average cost of an SPO is 0.4 to 0.6 basis points of the amount issued (Hachenberg and Schiereck, 2018).

**Hypothesis 2:** The Second Party Opinion influences the green bond premium negatively.

# Theoretical Positioning

## Hypothesis 3&4

**ESG and risk:** ESG engagement helps companies to reduce the downside risk, idiosyncratic and systematic risk (Husted, 2005; Oikonomou et al., 2012).

**ESG and asymmetric information:** ESG plays a positive role in reducing information asymmetry (Cho et al., 2013).

**Hypothesis 3:** The Second Party Opinion has no impact on the green bond premium when the issuer has a high environmental pillar score.

**Hypothesis 4:** The Second Party Opinion has a significant negative impact on the green bond premium when the issuer has a low environmental pillar score.

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# Research Design

## Data description

Our green bond sample is based on the data from the Climate Bond Initiative.

**Initial quantity:** 5106 green bonds.

**Time period:** from March 2010 to December 2019 (daily data).

**Cleansing:** we exclude 3272 asset-backed securities and 554 municipal bonds.

We retrieve all the bond-related return and characteristic data from the Thomson Reuters Refinitiv database.

**Final sample size:** 162 green bonds.

**ESG data:** Asset4 database.



## Research Design

Matching method: primary liquidity and maturity difference control

We first try to pair each green bond with the most similar conventional bonds, based on the following criteria:

- (1) From the same issuer, have the same bond structure, seniority, collateral, currency, and coupon type.
- (2) With an amount issued between four times smaller and one quarter bigger than the issuing amount of the green bond.
- (3) With a date of issuance between six years earlier and six years later than the green bond's issue date.

The initial matching paired each green bond with **2 to 13** conventional bonds.

## Research Design

Matching method: further liquidity and maturity difference control (1/3)

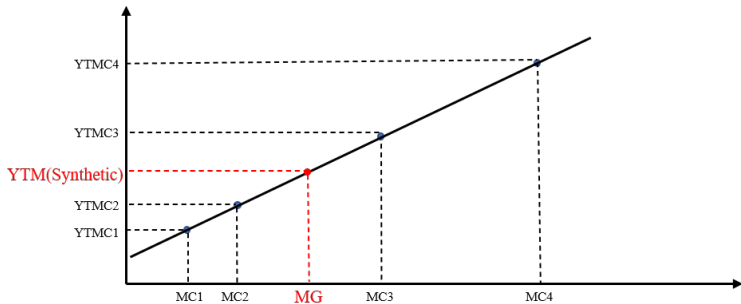
The second step matching tries to minimize the maturity and liquidity difference.

**Regression:** construct the synthetic conventional bond yield to maturity through a series of daily OLS regressions.

**Specifications:** the dependent and the independent variables are yield to maturity and years to maturity of the matched conventional bonds, respectively.

# Research Design

Matching method: further liquidity and maturity difference control (2/3)



**Figure:** Visualization for the regression design

$$\text{Equation: } y^{SCB} = a * \text{Maturity}_{GB} + b$$

# Research Design

Matching method: further liquidity and maturity difference control (3/3)

As the preparation for the following liquidity control, we apply a **distance-weighted average technique** to extract the bid-ask spread of the synthetic conventional bond.

$$BA_{i,t}^{SCB} = \frac{d_1}{d_1+d_2+\dots+d_{13}} BA_{i,t}^{CB1} + \frac{d_2}{d_1+d_2+\dots+d_{13}} BA_{i,t}^{CB2} + \dots + \frac{d_{13}}{d_1+d_2+\dots+d_{13}} BA_{i,t}^{CB13}$$

where the weights are calculated as  $d_1 = \text{Maturity}_{GB} - \text{Maturity}_{CB1}$ .

# Research Design

## Regression analyses (1/2)

The following panel regression aims to control for the latent liquidity bias left from the data selection and matching phase, as well as extract the green bond premium from the yield spread of each bond pair.

$$\Delta y_{i,t} = p_i + \Delta Liquidity_{i,t} + \xi_{i,t}$$

where  $\Delta y_{i,t} = y_{i,t}^{GB} - y_{i,t}^{SCB}$  and  $\Delta Liquidity_{i,t} = Liquidity_{i,t}^{GB} - Liquidity_{i,t}^{SCB}$ . Meanwhile,  $p_i$  represents the green bond premium and is the dependent variable in the following OLS regression.

# Research Design

## Regression analyses (2/2)

The second step aims to investigate the determinants of the green bond premium based on the SPO variable and the five bond specific characteristics.

$$p_i = \alpha_0 + \beta_1 SPO_j + \beta_2 Sector_j + \beta_3 Currency_j + \beta_4 Maturity + \beta_5 \log(IssueAmount) + \beta_6 Rating_j + \psi_j$$

# Research Design

## ESG strategy

To address the propositions raised by hypotheses 3 and 4, we group green bonds by issuers' environmental pillar score.

- (1) High-, medium-, and low- environmental performance groups which correspond to top, middle, and bottom tertiles of the environmental pillar scores.
- (2) The medium group is removed to avoid potential ambiguous effects.
- (3) Redo the second step regression for the high- and low-groups.

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# Preliminary Results

## Descriptive statistics (1/2)

Statistic	Pctl(25)	Median	Mean	Pctl(75)	St. Dev.
Yield to maturity of the GB ( $y_{i,t}^{GB}$ )	0.34	0.85	1.35	2.52	1.24
Yield to maturity of the synthetic SCB ( $y_{i,t}^{SCB}$ )	0.38	0.96	1.44	2.60	1.35
Yield to maturity of the CB1 ( $y_{i,t}^{CB1}$ )	0.33	0.93	1.45	2.51	1.39
Yield to maturity of the CB2 ( $y_{i,t}^{CB2}$ )	0.37	1.16	1.48	2.47	1.32
Yield difference % ( $\Delta y_{i,t}$ )	-0.07	-0.01	-0.09	0.02	0.46
Green bond maturity on Dec. 31. 2019	1.92	3.61	4.43	5.56	4.33
Conventional bond 1 maturity	3.44	5.20	6.06	7.37	4.56
Conventional bond 2 maturity	3.99	5.90	6.79	8.35	4.74
Green bond issue amount (USD bn)	0.40	0.50	0.84	1.00	1.12
Conventional bond 1 issue amount	0.20	0.50	0.66	0.80	0.97
Conventional bond 2 issue amount	0.20	0.50	0.66	0.75	1.00

**Table:** Descriptive statistics of green and conventional bonds

# Preliminary Results

## Descriptive statistics (2/2)

Statistic	Pctl(25)	Median	Mean	Pctl(75)	St. Dev.
$\Delta Liquidity$ %	-0.03	0.03	0.06	0.12	0.20

**Table:** Descriptive statistics of the liquidity measurement

This table shows the statistical distribution of the liquidity measurement. The liquidity differential ( $\Delta Liquidity$ ) is measured through the difference between the green bonds' bid-ask spread and the synthetic conventional bonds' bid-ask spread.

# Preliminary Results

## Regression results (1/7)

Dependent variable: yield difference	
	Within
$\Delta Liquidity_{i,t}$	0.087*** (0.005)
Firm FE	Yes
Year FE	Yes
Observations	58,965
R <sup>2</sup>	0.004
Adjusted R <sup>2</sup>	0.002
F Statistic	261.882*** (df = 1; 58827)

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

**Table:** Results of the first step regression

# Preliminary Results

## Regression results (2/7)

Statistic	Pctl(25)	Median	Mean	Pctl(75)	St. Dev.
$p_i$ %	-0.04	-0.01	-0.08	0.02	0.54

**Table:** Distribution of the green bond premium

This table shows the statistical distribution of the green bond premium, which is estimated by the constant term ( $p_i$ ) in the first step regression.

# Preliminary Results

## Regression results (3/7)

		Mean	P-value	Observations
Total		-0.08	*	162
Sector	<i>FC</i>	0.01		40
	<i>NFC</i>	-0.05		70
	<i>GBE</i>	-0.34	**	36
Currency	<i>USD</i>	0.09		38
	<i>EUR</i>	-0.17	**	60
	<i>SEK</i>	-0.06		43
Credit rating	<i>AAA</i>	-0.36		24
	<i>A</i>	0.02		35
	<i>BBB</i>	-0.02		29

Note:

\* $p < 0.1$ ; \*\* $p < 0.05$ ; \*\*\* $p < 0.01$

**Table:** Green bond premium disentangled by sector, currency, and credit rating

# Preliminary Results

## Regression results (4/7)

	Dependent variable: green bond premium				
	(1)	(2)	(3)	(4)	(5)
SPO				-0.085 (0.108)	-0.052 (0.120)
Maturity	-0.027** (0.011)				-0.028** (0.012)
LIA	0.269* (0.144)				0.260* (0.146)
AA	-0.197 (0.142)	-0.252* (0.143)	-0.286** (0.133)		-0.197 (0.143)
A	0.103 (0.130)	0.150 (0.131)	0.071 (0.119)		0.099 (0.131)
BBB	0.073 (0.151)	0.142 (0.153)	0.038 (0.130)		0.070 (0.152)
FC	0.089 (0.174)	-0.022 (0.175)	-0.113 (0.164)		0.066 (0.183)

Note:

\* $p < 0.1$ ; \*\* $p < 0.05$ ; \*\*\* $p < 0.01$

**Table:** Results of the second step regression (full sample)

# Preliminary Results

## Regression results (5/7)

Dependent variable: green bond premium					
	(1)	(2)	(3)	(4)	(5)
NFC	0.030 (0.197)	-0.203 (0.186)	-0.215 (0.155)		0.022 (0.198)
GBE	-0.192 (0.193)	-0.390** (0.186)	-0.455*** (0.164)		-0.204 (0.195)
USD	0.086 (0.188)	0.161 (0.176)			0.081 (0.189)
EUR	-0.250 (0.184)	-0.091 (0.157)			-0.232 (0.189)
SEK	0.103 (0.178)	0.147 (0.176)			0.112 (0.180)
Constant	-0.577 (0.384)	0.037 (0.204)	0.160 (0.140)	-0.020 (0.094)	-0.509 (0.416)
Observations	137	137	137	137	137
R <sup>2</sup>	0.214	0.155	0.121	0.004	0.215
Adjusted R <sup>2</sup>	0.144	0.096	0.080	-0.003	0.139

Note:

\*p<0.1; \*\*p<0.05; \*\*\*p<0.01

**Table:** Results of the second step regression (full sample)

# Preliminary Results

## Regression results (6/7)

Dependent variable: green bond premium				
	(1)	(2)	(3)	(4)
SPO	-0.312** (0.142)	-0.098 (0.207)	0.225 (0.164)	0.225 (0.195)
AA		0.172 (0.306)		-0.438* (0.246)
A		0.307 (0.219)		-0.094 (0.217)
BBB		-0.105 (0.229)		0.031 (0.244)
FC		0.390 (0.249)		0.317 (0.241)

Note:

\* $p < 0.1$ ; \*\* $p < 0.05$ ; \*\*\* $p < 0.01$

**Table:** Results of the second step regression (grouped sample)



# Preliminary Results

## Regression results (7/7)

NFC		-0.109 (0.199)		0.282 (0.222)
USD		0.107 (0.255)		-0.118 (0.339)
EUR		-0.159 (0.319)		-0.624* (0.328)
SEK		0.067 (0.275)		0.331 (0.344)
Maturity		-0.009 (0.017)		-0.046 (0.044)
LIA		-0.008 (0.225)		0.893*** (0.252)
Constant	0.216* (0.117)	0.004 (0.547)	-0.299** (0.139)	-2.292*** (0.672)
Observations	46	46	46	46
R <sup>2</sup>	0.098	0.279	0.041	0.485
Adjusted R <sup>2</sup>	0.078	0.045	0.019	0.318

Note:

\* p<0.1; \*\* p<0.05; \*\*\* p<0.01

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## Conclusion (1/2)

Our primary results suggest the following:

- (1) A small but evident negative green bond premium of -8 basis points.
  - (i) Green bond issuers have the opportunity to exploit the investors by offering them a lower yield in comparison with the equivalent risk conventional bonds.
  - (ii) The green bond premium is still too trivial to alter the investors' asset allocation.

## Conclusion (2/2)

(2) ESG performance plays a crucial role in moderating and enhancing, respectively, the impact of the external review on the green bond premium.

(i) SPO has a significant negative impact on the green bond premium when the issuers environmental performance is low.

(ii) We interpret the results such that the SPO label and the ESG score are competing monitoring channels.

## References I

- Akerlof, G. A. (1970). The Market for "Lemons": Quality Uncertainty and the Market Mechanism. *The Quarterly Journal of Economics*, 84(3):488–500.
- Cho, S. Y., Lee, C., and Pfeiffer, R. J. (2013). Corporate social responsibility performance and information asymmetry. *Journal of Accounting and Public Policy*, 32(1):71–83.
- Climate Bond Initiative (2019). Green Bonds - The State of the Market 2018.
- Coase, R. H. (1937). The Nature of the Firm. *Economica*, 4(16):386–405.
- Hachenberg, B. and Schiereck, D. (2018). Are green bonds priced differently from conventional bonds? *Journal of Asset Management*, 19(6):371–383.

## References II

- Husted, B. W. (2005). Risk Management, Real Options, Corporate Social Responsibility. *Journal of Business Ethics*, 60(2):175–183.
- ICMA (2018). Green Bond Principles - Voluntary Process Guidelines for Issuing Green Bonds.
- Karpf, A. and Mandel, A. (2018). The changing value of the 'green' label on the US municipal bond market. *Nature Climate Change*, 8(2):161–165.
- Oikonomou, I., Brooks, C., and Pavelin, S. (2012). The Impact of Corporate Social Performance on Financial Risk and Utility: A Longitudinal Analysis. *Financial Management*, 41(2):483–515.
- Spence, A. M. and Zeckhauser, R. (1971). Insurance, Information, and Individual Action. *American Economic Review*, 61(2):380–87.

## References III

- Stiglitz, J. E. (1975). The Theory of "Screening," Education, and the Distribution of Income. *The American Economic Review*, 65(3):283–300.
- Williamson, O. E. (1979). Transaction-Cost Economics: The Governance of Contractual Relations. *The Journal of Law & Economics*, 22(2):233–261.
- Zerbib, O. D. (2019). The effect of pro-environmental preferences on bond prices: Evidence from green bonds. *Journal of Banking & Finance*, 98:39–60.

Thank you!