Green bonds as a tool against climate change

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Motivation

- Green bonds are debt instruments that differ from conventional bonds only in that the issuer pledges to use the proceeds to finance environmentally friendly projects

- Green bonds are becoming increasingly popular, but … are issuers effectively engaging in green investments, or rather 'greenwashing', i.e. only claiming to invest green while in practice engaging in investment that has little environmental value?

- If greenwashing prevails, green bonds are unlikely to have any real impacts that are beneficial to the environment.

- By contrast, if green bonds are issued to truly finance green projects, we should observe an improvement in the environmental performance of the companies raising funds on the green segment.

Research questions & Preview of the results

- Are **green bonds associated to** improved environmental performance (specifically, **reduced emissions**)?

    Green issuers display a decrease in GHG/CO2 – both total and direct (scope 1) - emissions after the green bond issuance compared to conventional bond issuers, all other things being equal

    The reduction is larger in case of green bonds with external review

- Are green bonds issued to finance new green projects more effective than those refinancing existing projects?

    More pronounced decrease of emissions when we exclude green bonds issued for refinancing purposes

    → Consistent with additionality for non-refinancing green bonds

- Additional results:

    The reduction in emissions is long-lasting, particularly when we exclude non-refinancing bonds

    Effects are more pronounced for green bonds issued after the Paris agreement

    → *Green bonds are a credible signal for companies' climate engagement*
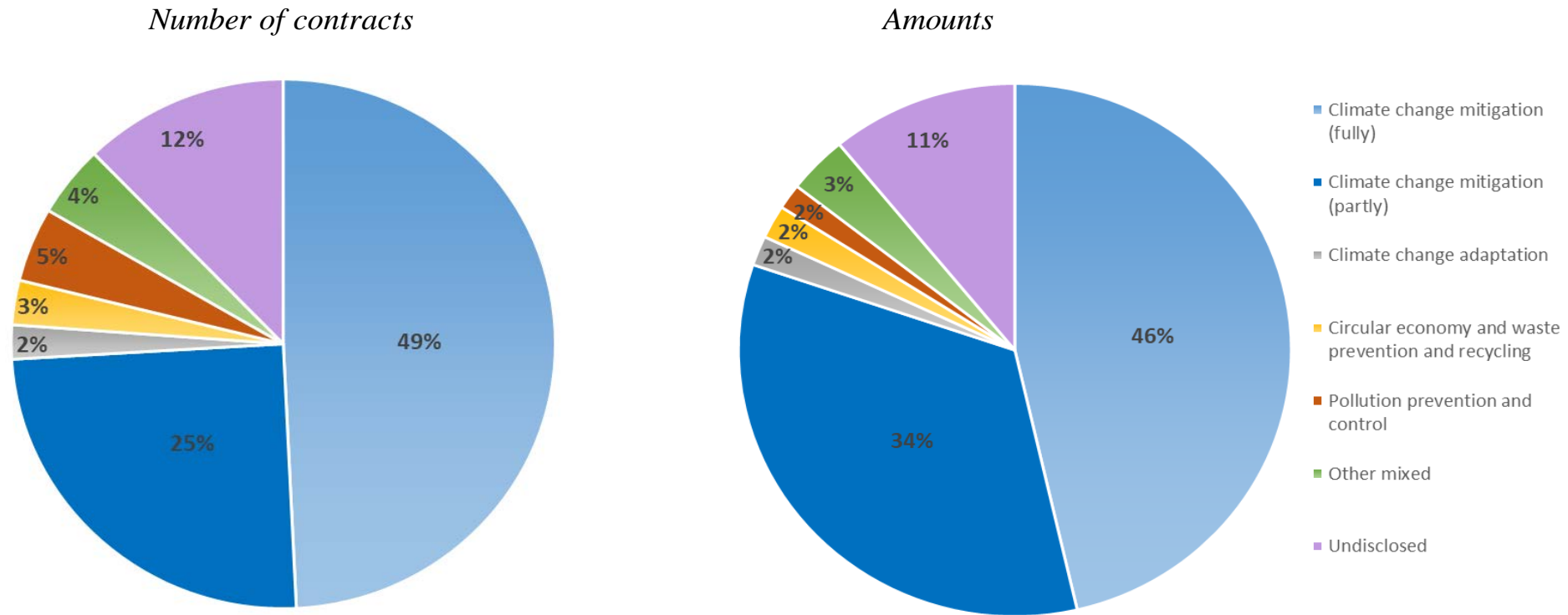
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Literature

Pricing of green bonds:

- Focus on municipal (and sovereign) securities (Baker et al., 2018; Karpf and Mandel, 2018)

- Negative premium is motivated by non-pecuniary motives, specifically pro-environmental preferences (Zerbib, 2019) and materializes among corporate issuers only in favour of non-financial green issuers (Fatica, Panzica and Rancan 2019)

Effects of green bond issuance on company outcomes:

- Green bond issuance is followed by a positive stock market reaction (Tang and Zhang, 2018) and better operating performance of the issuer (Flammer, 2019)

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Green Bonds: breakdown by scope of the project

Number of contracts

Amounts

Legend:
- Climate change mitigation (fully)
- Climate change mitigation (partly)
- Climate change adaptation
- Circular economy and waste prevention and recycling
- Pollution prevention and control
- Other mixed
- Undisclosed

The sheer majority of green bonds are (fully or partly) issued to finance projects intended to mitigate climate change

Roadmap of the presentation

- Data

- Model

- Results

- Conclusion

Data

- We link bond and corporate issuer data.

  - **Bond data**: details on bond tranches (primary market), including date of issuance (source: DCM Dealogic)

  - **Company level data** (source: Refinitiv Datstream) on:

    - Total and direct (scope 1) emissions

    - Environmental score (in the ESG metric)

    - Financial variables (Total Debt,Total Asset, Return on assets,Tobin Q...)

- Sample period: 2007-2019

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The econometric model

- Specification in first differences:

$$\Delta y_{ijct} = \alpha_j + \alpha_c + \beta \times Green\ Bond_{ijct} + \gamma \times \Delta \boldsymbol{x}_{it} + \Delta \varepsilon_{ijct}$$

- Dependent variable: Emission intensity (=emissions/TA) of corporate issuer *i* in industry j in country c at time t

- Independent variables:

  $\boldsymbol{x}_{it}$ vector of control variables

  α_j Industry fixed effects, α_c Country fixed effects

  Green $\boldsymbol{Bond}_{ijct}$ *is a dummy variable equal to one in the year in which a green bond is issued, and zero otherwise*

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Matching procedure

- To minimize concerns of endogeneity, we compare the climate perfomance of green issuers with that of similar conventional issuers → two-step matching

First step

- For each green bond issuer, select of companies that have issued at least one conventional bond in the same industry, country and time period;

- Exclude from the potential control group conventional issuers that have borrowed also on the green market.

Second step

- Pick conventional issuers similar to the green bond issuers based on economic and financial characteristics (E score, Size, Leverage, Tobin Q), measured in the year before the bond issuance applying Coarsened Exact Matching (CEM) methodology (Iacus, King and Porro, 2012)

Coarsened Exact Matching (CEM)

CEM reduces the imbalance in the empirical distribution of the confounders between the treated and control group, thereby minimizing concerns of biased statistical inferences and model dependence (King and Nielsen, 2019)

	L_j1	Δmean	Δmin	Δp25	Δp50	Δp75	Δmax
Panel A: Coarsened exact matched data							
Multivariate L1 distance: 0.79							
E score	0.077	0.672	-5.000	0.470	0.330	-0.540	-0.710
Size	0.083	0.079	0.024	0.107	0.117	-0.022	0.104
Leverage	0.121	0.001	-0.025	0.013	0.006	-0.006	-0.014
Tobin Q	0.097	0.002	0.004	0.000	0.000	0.007	0.014
Panel B: Unmatched data							
Multivariate L1 distance: 0.99							
E score	0.329	15.837	4.110	23.840	19.430	11.240	1.750
Size	0.300	0.846	2.100	0.864	0.807	0.620	0.000
Leverage	0.172	-0.002	0.089	-0.013	0.012	0.002	-0.292
Tobin Q	0.195	-0.010	0.000	-0.003	-0.006	-0.007	-0.286

The CEM reduces the global imbalance of 20% (L1 metric)

Lj1 measures the imbalance for each variable j separately (E score, Size, etc…). 'Local' imbalances are also minimized

Results: Baseline

Panel A: Including green bonds issued for refinancing purposes

	Total emissions		Direct emissions	
	(1)	(2)	(3)	(4)
green_bond	-0.0821**	-0.0832**	-0.0234*	-0.0252**
	(0.037)	(0.035)	(0.013)	(0.012)
Observations	1,506	1,506	827	827
R-squared	0.0186	0.0361	0.0295	0.0380
Country FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Firm-level controls	No	Yes	No	Yes

Green bonds are associated with a reduction in GHG/CO2 emissions.

Panel B: Excluding green bonds issued for refinancing purposes

	Total emissions		Direct emissions	
	(1)	(2)	(3)	(4)
green_bond	-0.1277***	-0.1250***	-0.0598***	-0.0549***
	(0.037)	(0.036)	(0.003)	(0.007)
Observations	1,314	1,314	740	740
R-squared	0.0192	0.0369	0.0393	0.0484
Country FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Firm-level controls	No	Yes	No	Yes

Stronger effect when we exclude green bonds issued for refinancing purposes → new green projects

Results: The role of external review

We include an interaction dummy for certified/verified green bonds.

Panel A: Including green bonds issued for refinancing purposes

	Total emissions		Direct emissions	
	(1)	(2)	(3)	(4)
green_bond	-0.0987**	-0.1011**	-0.0137	-0.0192
	(0.044)	(0.041)	(0.015)	(0.015)
green_bond*external review	-0.0401**	-0.0379**	-0.0376*	-0.0339*
	(0.016)	(0.017)	(0.018)	(0.018)
Observations	1,506	1,506	827	827
R-squared	0.0187	0.0363	0.0295	0.0381
Country FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Firm-level controls	No	Yes	No	Yes

Panel B: Excluding green bonds issued for refinancing purposes

	Total emissions		Direct emissions	
	(1)	(2)	(3)	(4)
green_bond	-0.1502**	-0.1463**	-0.0501***	-0.0432***
	(0.053)	(0.053)	(0.004)	(0.004)
green_bond*external review	-0.0629***	-0.0637***	-0.0727***	-0.0703***
	(0.003)	(0.007)	(0.005)	(0.007)
Observations	1,314	1,314	740	740
R-squared	0.0194	0.0371	0.0394	0.0484
Country FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Firm-level controls	No	Yes	No	Yes

External review has an additional effect on climate performance → costly certification/verification implies a stronger green commitment, which shows up in emission reduction

In line with expectations, the effect is stronger for non-refinancing green bonds

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Results: Paris agreement

Panel A: Including green bonds issued for refinancing purposes

	Total emissions		Direct emissions	
	(1)	(2)	(3)	(4)
Post Paris agreement		0.0287**		0.0261***
		(0.011)		(0.006)
green_bond	-0.0824*	-0.0771**	-0.0231**	-0.0338
	(0.040)	(0.033)	(0.011)	(0.025)
green_bond* Post Paris agreement		-0.0724*		-0.0060
		(0.037)		(0.010)
Observations	1,301	1,506	673	827
R-squared	0.0189	0.0209	0.0227	0.0312
Country FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Firm-level controls	No	No	No	No

Panel B: Excluding green bonds issued for refinancing purposes

	Total emissions		Direct emissions	
	(1)	(2)	(3)	(4)
Post Paris agreement		0.0325***		0.0253***
		(0.011)		(0.006)
green_bond	-0.1271***	-0.1210***	-0.0467***	-0.0848***
	(0.042)	(0.036)	(0.012)	(0.003)
green_bond*Post Paris agreement		-0.1161**		-0.0371***
		(0.040)		(0.009)
Observations	1,132	1,314	608	740
R-squared	0.0186	0.0218	0.0219	0.0408
Country FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Firm-level controls	No	No	No	No

We test the effects of the PA in the alternative ways:

1) Considering only bonds issued after December 2015 (columns 1 and 3)

2) Using a diff-in-diffs strategy with an interaction dummy for the post-PA time span (columns 2 and 4)

→ There is evidence of more pronounced effectiveness of green bonds for decarbonisation after the PA, particularly for non-refinancing bonds

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Conclusions

- We investigate whether corporate green bonds are associated to improved company climate performance

- Companies borrowing on the green segment show a decrease in the GHG/CO2 emissions intensity (total and direct) after issuing a green bond w.r.t. similar conventional bond issuers

- More marked decrease in emissions by considering green bonds:
  - issued to finance new climate-friendly projects
  - having an external review
  - issued after the Paris Agreement

→ green bonds are a credible signal for companies' climate engagement

Thank you

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Anticipation and dynamic Effects

Panel A: Including green bonds issued for refinancing purposes

	Total emissions		Direct emissions	
	(1)	(2)	(3)	(4)
T_{-2}	0.0068	0.0054	0.0127	0.0139
	(0.009)	(0.010)	(0.013)	(0.014)
T_{-1}	0.0114	0.0099	0.0332**	0.0357**
	(0.007)	(0.006)	(0.015)	(0.016)
T	-0.0810**	-0.0828**	-0.0197	-0.0217*
	(0.037)	(0.035)	(0.015)	(0.012)
T_1	-0.0003	-0.0115	0.0027	-0.0077
	(0.002)	(0.009)	(0.004)	(0.011)
T_2	-0.0043	-0.0033	-0.0563*	-0.0546*
	(0.006)	(0.006)	(0.031)	(0.030)
Observations	1,506	1,506	827	827
R-squared	0.0186	0.0361	0.0303	0.0389
Country FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Firm-level controls	No	Yes	No	Yes

Panel B: Excluding green bonds issued for refinancing purposes

	Total emissions		Direct emissions	
	(1)	(2)	(3)	(4)
T_{-2}	0.0108	0.0049	0.0178	0.0136
	(0.017)	(0.019)	(0.024)	(0.028)
T_{-1}	0.0171**	0.0104	0.0447**	0.0442**
	(0.007)	(0.008)	(0.019)	(0.020)
T	-0.1273***	-0.1254***	-0.0587***	-0.0539***
	(0.038)	(0.037)	(0.003)	(0.006)
T_1	-0.0190**	-0.0211***	-0.0205***	-0.0194***
	(0.007)	(0.007)	(0.004)	(0.004)
T_2	-0.0183***	-0.0164***	-0.0955***	-0.0930***
	(0.005)	(0.005)	(0.030)	(0.027)
Observations	1,314	1,314	740	740
R-squared	0.0193	0.0370	0.0406	0.0496
Country FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Firm-level controls	No	Yes	No	Yes

We find evidence of some pre-trends, and strong evidence of a long-lasting reduction in emissions after the green bond issuance for non-refinancing green bonds.

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