

Everything You Always Wanted to Know About Green Bonds (But Were Afraid to Ask)

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- 1 Introduction
- 2 Global Supply
- 3 Italian Residents' Holdings
- 4 The Greenium Puzzle

1 Introduction

2 Global Supply

3 Italian Residents' Holdings

4 The Greenium Puzzle

An official register of ESG bonds does not exist. We used three main components for our list:

- 1 ESG debt securities which are quoted on dedicated bond markets ;
- 2 available information published by providers such as CBI, Environment Finance (EF) and ICMA ;
- 3 composition of some of the main green indexes and previous reports.

Other components from **official statistics micro-data**:

- 1 Bank of Italy Security Data Base ;
- 2 Bank of Italy supervisory statistics on individual banks', mutual funds' and insurance corporations balance-sheets;
- 3 Bank of Italy Security Holdings Statistics (SHS);
- 4 Harmonized statistics on sectoral financial accounts compiled by the Bank of Italy.

1 Introduction

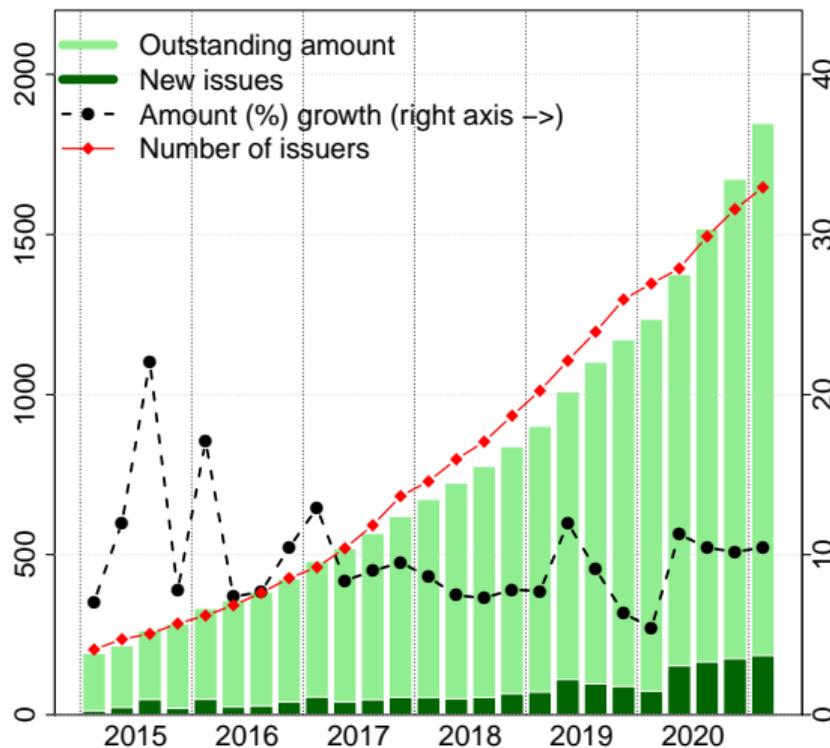
2 Global Supply

3 Italian Residents' Holdings

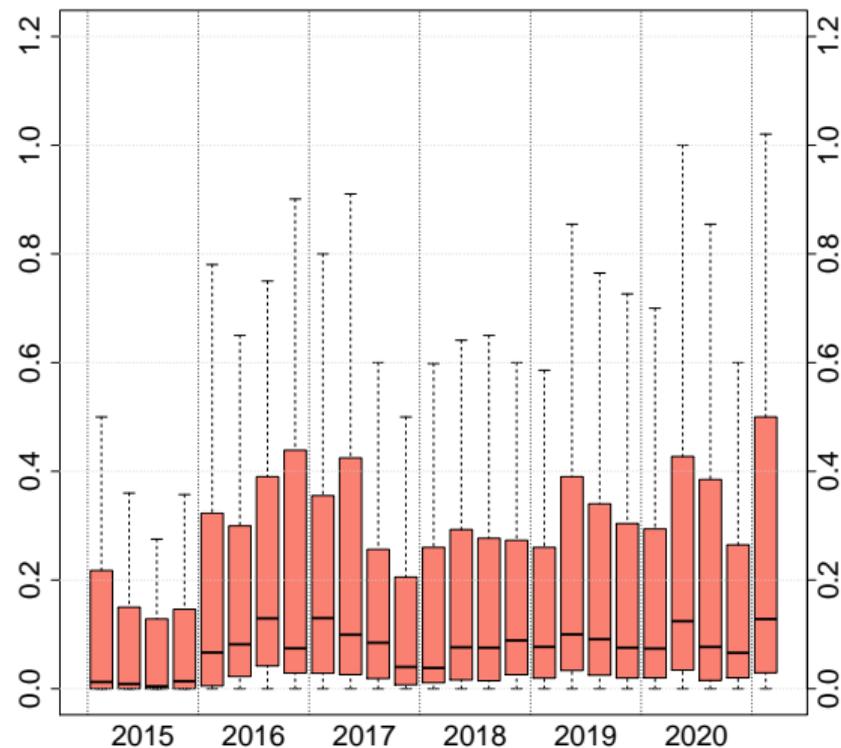
4 The Greenium Puzzle

ESG Bond Supply Expansion

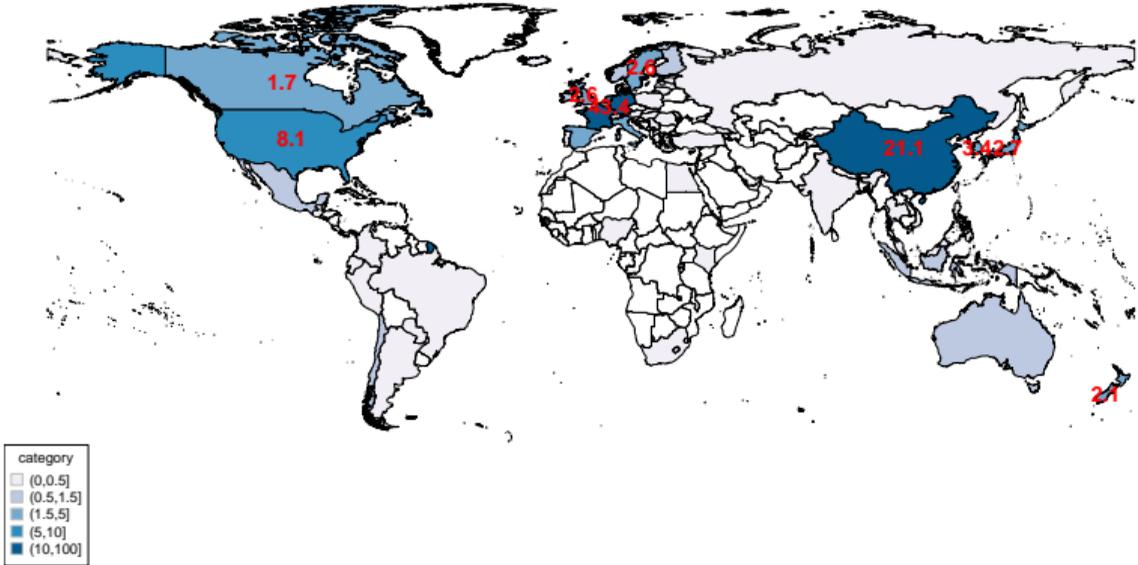
ESG bond supply growth



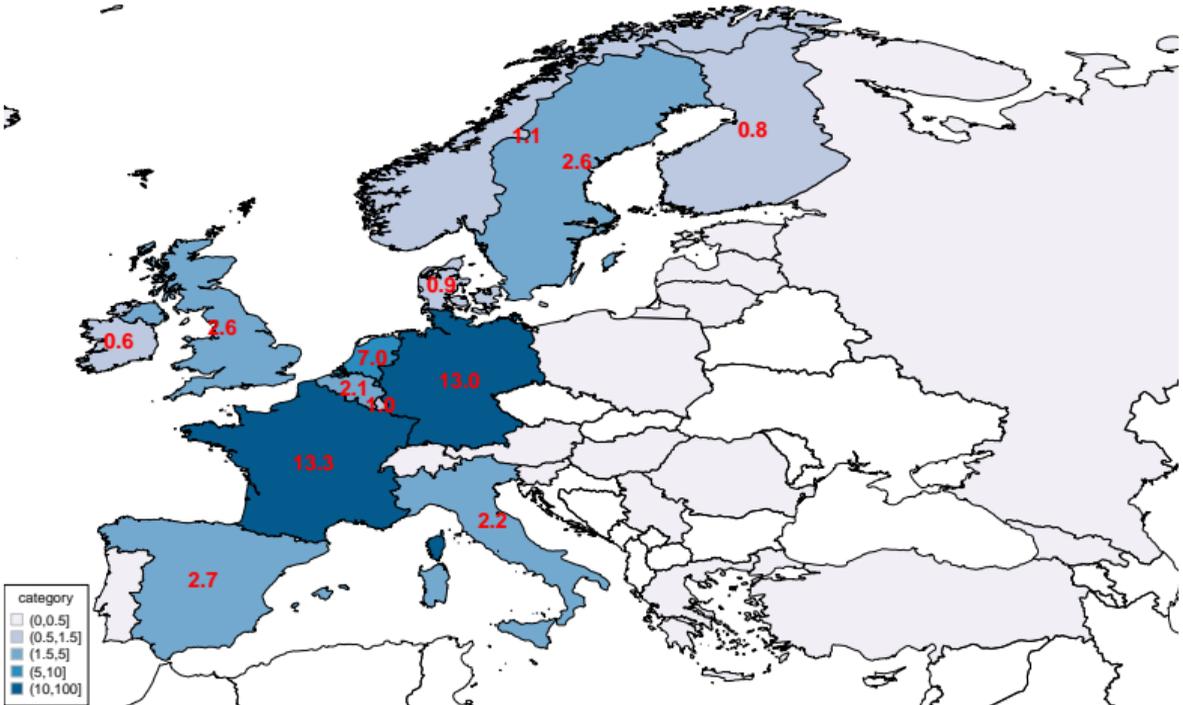
Distribution of the individual issues amounts



Share of ESG Bonds Supply by Country - Amount issued



Share of ESG Bonds Supply by Country - Amount issued

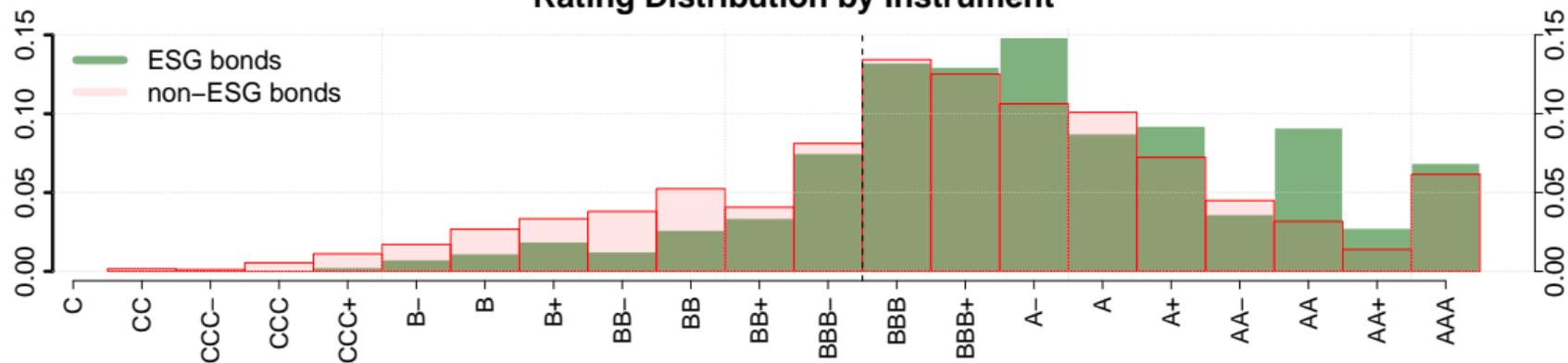


ESG Bond Supply by Country and Sector of the Issuer

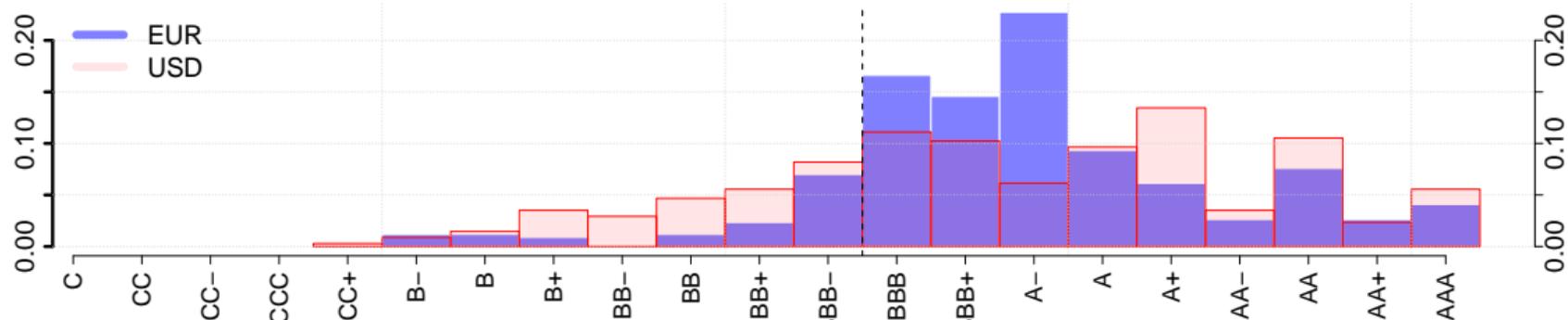
Country	Non-financial Corporations S.11	Deposit-taking Institutions S.122	OFI S.125	Financial Auxiliaries S.126	Captive Institutions S.127	Insurance Corporations S.128	General Government S.13
CN	238	43	17.4	10.1	0	0	19.6
FR	35.7	30.6	1	1	0	0.8	137.7
DE	16.5	56.6	0	0.1	0.6	1.2	127.2
US	68	8.4	35.4	6.9	1.2	0.8	5.3
NL	16	42.1	4.7	6.5	29.1	0	10.7
KR	17	17.6	16.7	0.5	0	1.2	0.4
JP	17.9	5.1	12.8	1.2	0.4	0	4.9
ES	15	17.6	0	0	0	0	9.4
SE	18.4	12.9	0	0	0.2	0	9
GB	9.4	8.5	16.3	0.1	4.5	0.3	0.6
IT	14.3	9.1	0	1	0	1.4	8.5

ESG Bonds' Ratings

Rating Distribution by Instrument



Rating Distribution of ESG Bonds by Currency



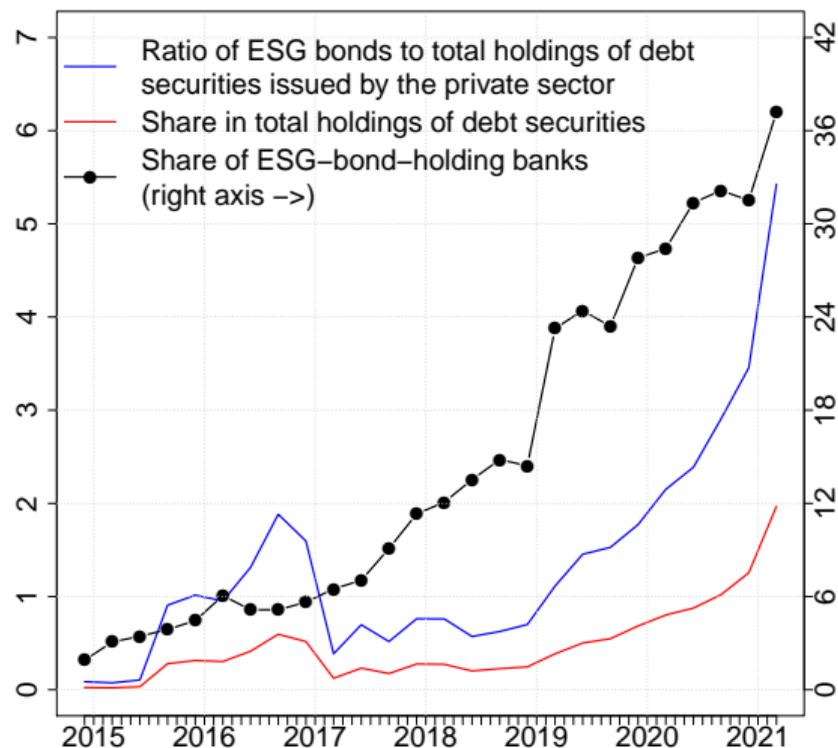
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ESG security holdings - Italian residents

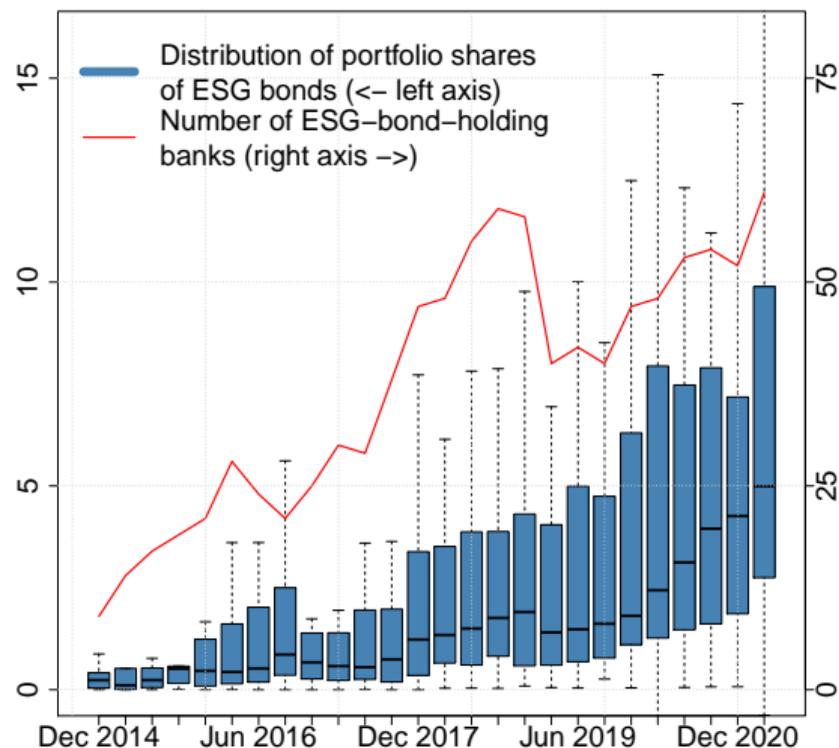
Reference date	Outstanding amount	Number of			Maturity		Currency share		Listed share
		securities	issuers	countries	original	residual	EUR	USD	
2015 Q4	2.7	134	68	25	10.5	8.5	85.5	5.6	98.9
2016 Q4	5.7	194	95	31	10.5	8.2	89.6	4.4	99.5
2017 Q4	6.3	318	161	44	9.8	7.9	82.6	10.0	96.0
2018 Q4	8.6	432	211	47	8.9	6.8	82.4	9.8	92.9
2019 Q4	16.6	634	302	54	9.3	7.3	88.5	6.9	90.1
2020 Q1	17.8	700	322	52	9.5	7.5	89.2	6.3	89.6
2020 Q2	20.9	781	349	56	9.6	7.6	89.8	5.8	87.1
2020 Q3	24.5	871	391	58	9.6	7.5	91.2	5.1	87.3
2020 Q4	28.6	958	417	61	9.6	7.6	91.5	4.9	88.0
2021 Q1	37.4	1,090	471	66	12.1	10.1	92.5	4.5	88.4

Reference date	Outstanding amount	Non-financial corporations S.11	Deposit-taking institutions S.122	Investment funds S.124	Insurance corporations S.128	Pension funds S.129	General Government S.13	Households and NPISH S.14+S.15	Other
2016 Q4	5.7	1.7	50	8.5	24.6	4.9	0.6	9.3	0.4
2017 Q4	6.3	1.8	22.7	14	41.5	4.6	2.2	12.5	0.6
2018 Q4	8.6	1.5	16.2	12.6	50.2	5	1.8	12.1	0.7
2019 Q4	16.6	0.8	25.4	15.9	41.5	5.1	1.9	8.6	0.7
2020 Q1	17.8	0.8	28.3	14.2	41.2	5.2	1.7	7.9	0.7
2020 Q2	20.9	0.8	28.9	15.5	40.7	5	1.3	7.1	0.7
2020 Q3	24.5	0.7	29.2	15.6	41.3	5.2	1.2	6.1	0.6
2020 Q4	28.6	0.6	28.6	16.2	42.1	5.4	1.1	5.6	0.5
2021 Q1	37.4	1.8	35.1	15	36.7	4.6	1.1	5.2	0.5

ESG bonds portfolio share

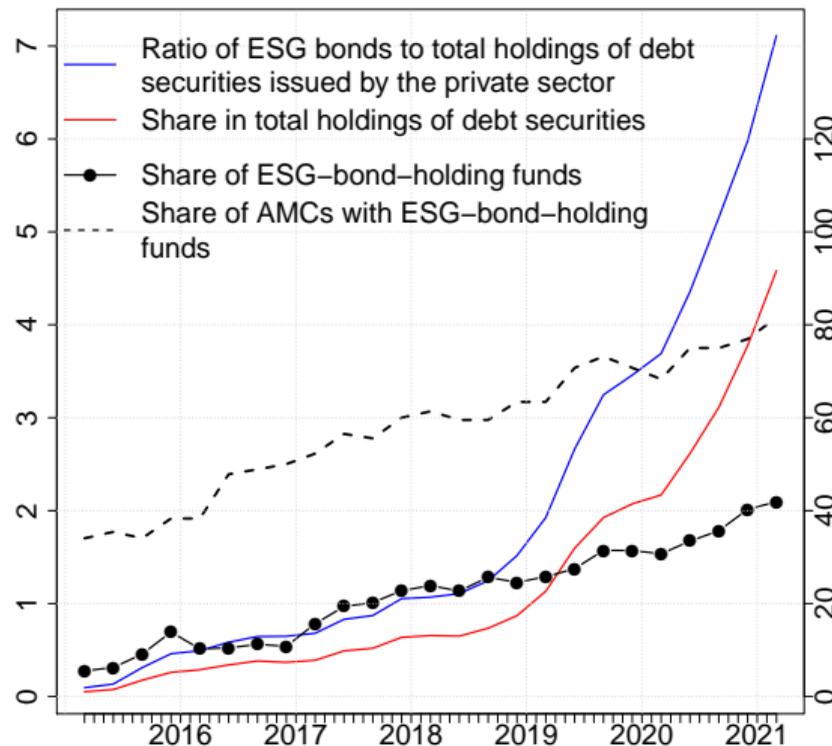


Distribution of ESG bonds portfolio shares

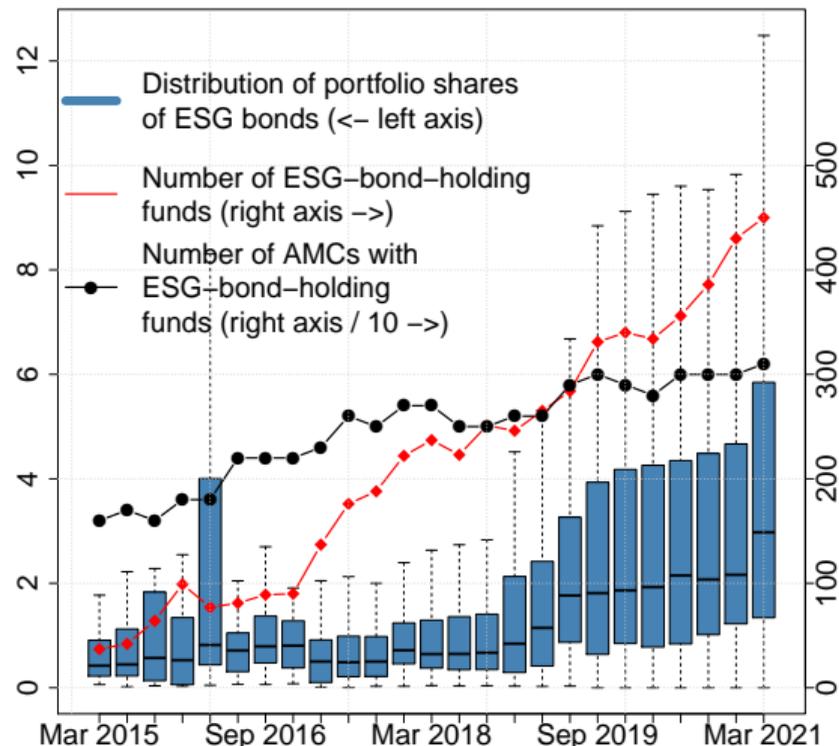


Investment funds' holdings

ESG bonds portfolio share

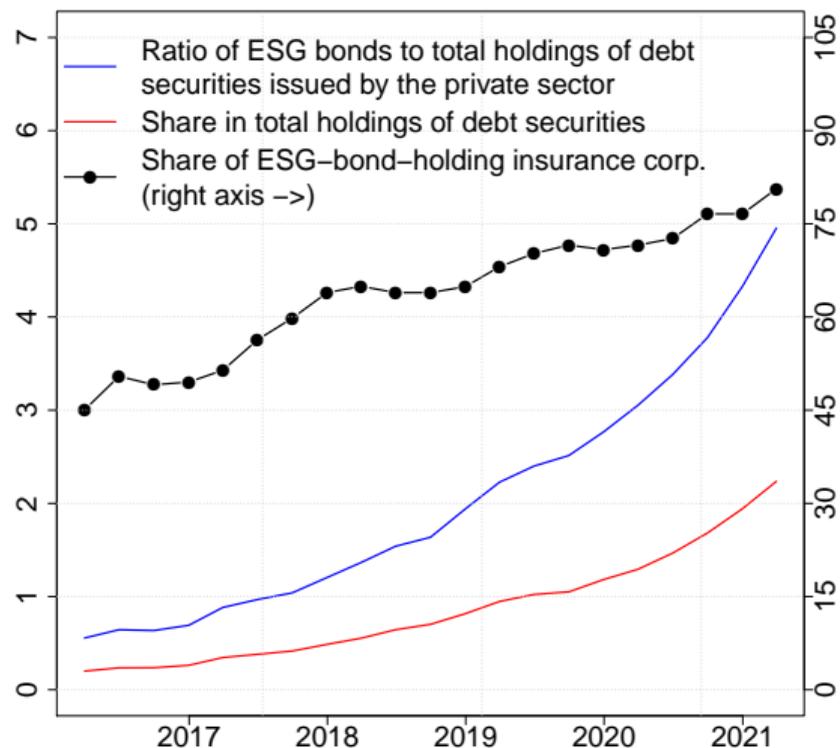


Distribution of ESG bonds portfolio shares

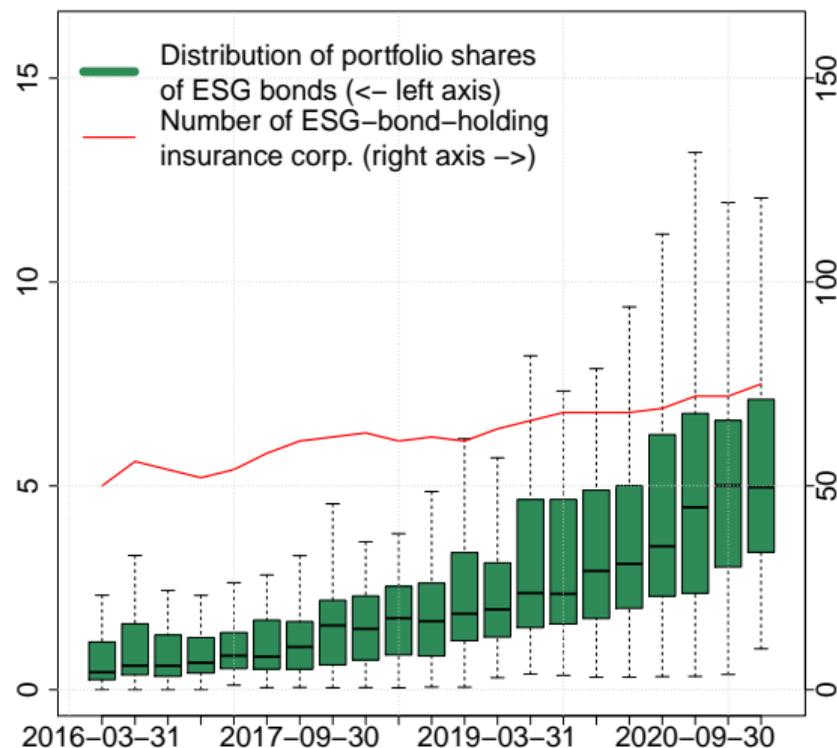


Insurance corporations' holdings

ESG bonds portfolio share



Distribution of ESG bonds portfolio shares



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What is the *greenium*?

Previous findings and anecdotal evidence

- Negative yield spread between ESG and conventional bonds on the primary and secondary market
- Size of the premia ranges between 1 and 69 bps
- A few studies show a positive spread

Possible explanations

- Socially responsible investing → not only portfolio payoffs but tastes for assets as consumption goods (Fama and French 2007).
- Asset pricing theory (Fama, 1998): green bonds with lower risks due to:
 - 1 regular monitoring → higher transparency
 - 2 conventional bonds exposed to long-term climate-change risks (carbon tax or physical risks)

Yield Curve Estimation - Nelson-Siegel (1987) model

$$y_t^{NS}(\tau_s) = \beta_{1,t} - \beta_{2,t} \left[\frac{1 - \exp(-\lambda_t \tau_s)}{\lambda_t \tau_s} \right] - \beta_{3,t} \left[\frac{1 - \exp(-\lambda_t \tau_s)}{\lambda_t \tau_s} - \exp(-\lambda_t \tau_s) \right]$$

$$\text{minimize}_{\{\beta_{1,t}, \beta_{2,t}, \beta_{3,t}, \lambda_t\}} \text{Med} (|y_t(\tau_s) - y_t^{NS}(\tau_s)|)$$

$$s.t. \quad \beta_{1,t} > 0$$

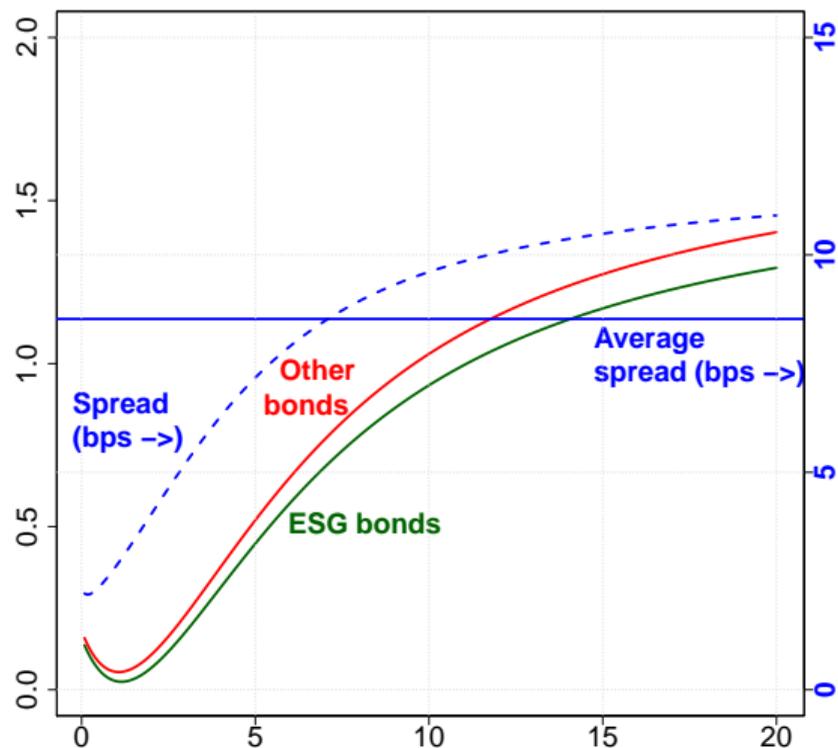
$$\beta_{1,t} + \beta_{2,t} > 0$$

$$\lambda_t > 0$$

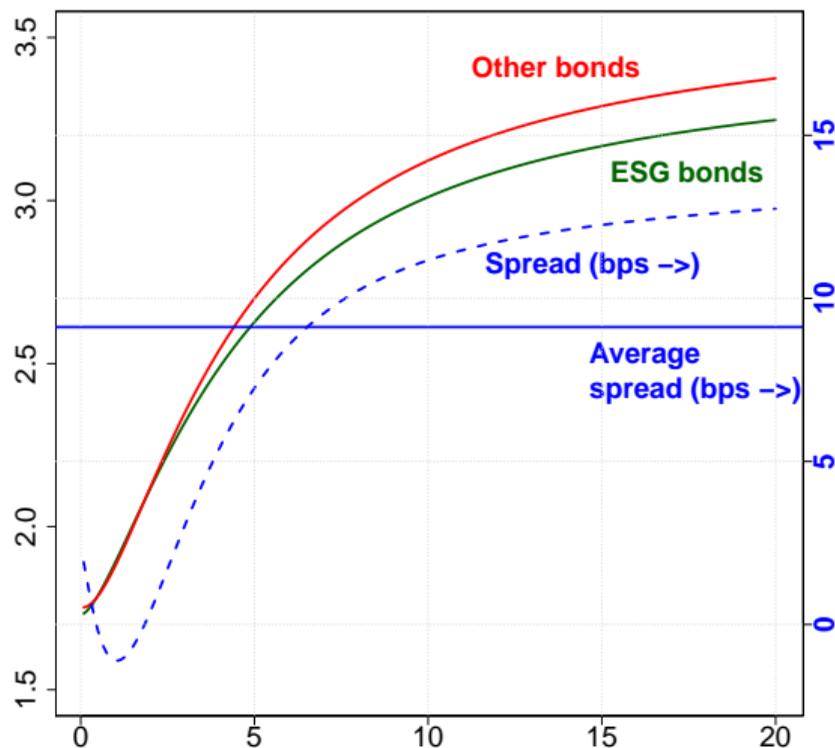
- In each monthly reference date between June 2017 and March 2021 we run the estimation on the original **sample of investment grade securities**
- We subsequently draw **250 samples of securities** belonging to 8 categories based on the disaggregation by ESG/non-ESG, currency of denomination (euro and USD) and institutional sector of the issuer (non-financial and financial corporations).

Yield Curve Analysis - Non-financial corporations

Euro area (Euro-denominated)

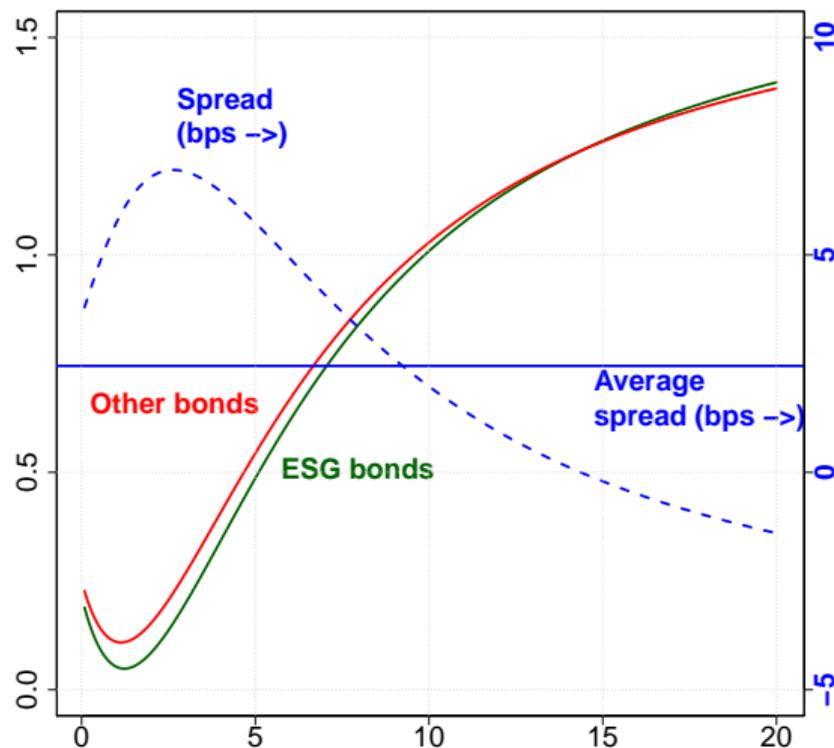


Rest of the world (USD-denominated)

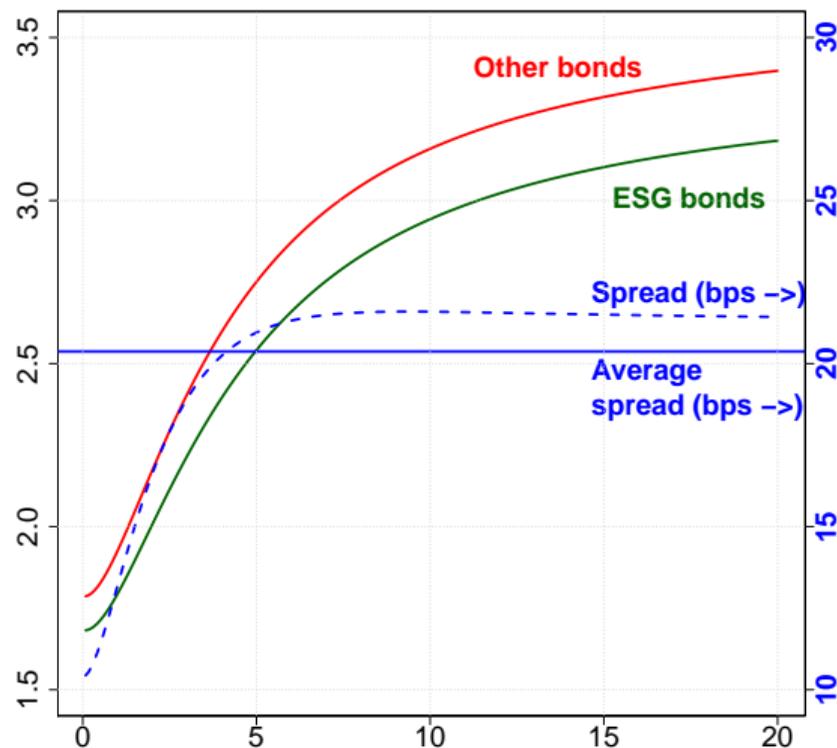


Yield Curve Analysis - Financial sector

Euro area (Euro-denominated)



Rest of the world (USD-denominated)



We carefully selected our subsamples for the yield curves estimation but...

- ESG securities could be on average **more liquid** and the lower yields may reflect such feature
- ESG bonds are characterized by **higher ratings** even within the investment grade subsample
- Security listing on an **exchange market**

The yield $y_{s,t}$ of security s in month t is regressed on:

$$y_{s,t} = \gamma ESG_{s,t} + \theta^T X_{s,t} + \eta_{i,t} + \eta_{c,t} + \eta_{u,t} + \varepsilon_{s,t}$$

- *ESG* indicator variable
- $X_{s,t}$ vector of time-varying control variables at security level
- $\eta_{i,t}$ issuer-time fixed effects
- $\eta_{c,t}$ country-time fixed effects
- $\eta_{u,t}$ currency-time fixed effects

Security-level Estimation Results

	Corporations		Government	Corporations		Government
	Non-financial	Financial		Non-financial	Financial	
ESG	-0.098*** (0.0093)	-0.1574*** (0.0091)	-0.0532*** (0.0195)	-0.0461*** (0.0131)	-0.1280*** (0.0122)	-0.0451* (0.0253)
ESG x COVID				-0.1035*** (0.0185)	-0.0663*** (0.0182)	-0.0201 (0.0397)
LISTED	-0.0645*** (0.0030)	-0.0350*** (0.0038)	-0.0367*** (0.0070)	-0.0646*** (0.0030)	-0.0351*** (0.0038)	-0.0367*** (0.0070)
RATING	-0.3750*** (0.0031)	-0.2477*** (0.0009)	-0.2256*** (0.0025)	-0.3749*** (0.0031)	-0.2477*** (0.0009)	-0.2256*** (0.0025)
AMOUNT	-0.0220*** (0.0008)	-0.0935*** (0.0011)	-0.0113*** (0.0006)	-0.0219*** (0.0008)	-0.0935*** (0.0011)	-0.0113*** (0.0006)
MATURITY	0.1237*** (0.0022)	0.1035*** (0.0027)	0.0840*** (0.0050)	0.1239*** (0.0022)	0.1036*** (0.0027)	0.0840*** (0.0050)
MATURITY ²	0.0044*** (0.0003)	0.0059*** (0.0004)	0.0069*** (0.0006)	0.0044*** (0.0003)	0.0059*** (0.0004)	0.0069*** (0.0006)
MATURITY ³	-0.0003*** (0.0000)	-0.0003*** (0.0000)	-0.0004*** (0.0000)	-0.0003*** (0.0000)	-0.0003*** (0.0000)	-0.0004*** (0.0000)
Issuer x Time FE	Yes	Yes	No	Yes	Yes	No
Country x Time FE	Yes	Yes	Yes	Yes	Yes	Yes

- ① Dramatic **rise of the global supply**
- ② Analogous weight increase in Italian residents' portfolios
- ③ Negative premia → **greenium does exist**
- ④ **Heterogeneity** across sectors
- ⑤ Covid-19 pandemic effect (**wake-up call** on climate change risks?)