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Green bond market:

## **Green regulation and stock price reaction to green bond issuance**

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# Outline

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# 1. Main Findings

- There is a positive and significant abnormal return around a green bond issuance announcement
- This abnormal return is higher than the one for conventional bond issuers (0.3% for the same day)
- After controlling for firm and issuance characteristics this positive abnormal return still holds (premium goes up to 1.9%)
- On the full sample of green bond issuers we find that the Paris Agreement had a positive effect on this reaction
- Taking a sample of U.S. green bond announcements we find a positive and significant effect of the Paris Agreement and a negative and significant effect after the 2016 US presidential election

## 2. Background

Green bond definition:

- *“Green Bonds are 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” (ICMA 2014)*

Green bond market evolution:

- Green bonds annual issuance: from about \$3bn in 2012 to \$167.6bn in 2018 (CBI 2019)
- Cumulative green bond issuance since 2007 reached \$521bn

# 2. Background



Source: CBI (2019)

## 2. Background

Progressive market and regulatory pressure:

- Assets managed under Socially Responsible Investment (SRI) strategies went up from \$13.6tr in 2012 to \$22.9tr in 2016 (GSIA 2016)
- The EU the Directive 2014/95/EU on non-financial reporting (2014)
- China's National Development and Reform Commission (NDRC) green bond guidelines (2015)
- In France the « *Loi sur la transition écologique pour la croissance verte* » (2015)
- The EU Green Bond Standards (2019)

## 2. Background

Key literature on green bonds :

### 1. Focused on green bonds market characteristics

- Kapraun (2019), Zerbib (2018), Schmitt (2017), Ehlers & Packer (2017) on green bond premia
- Baker et al. (2018) and Karpf & Mandel (2017) on US municipal bond premia
- Febi et al. (2018) on green bonds liquidity
- Reboredo (2018) diversification benefits of green bonds to investors

### 2. Focused on firm characteristics

- Flammer (2018) green bonds and firm performance

## 2. Background

Literature on conventional bonds:

### **Stock prices react to conventional bond issuance**

- Existence of an information channel (Eckbo, 1986; Fungáčová, Godlewski, and Weill, 2015; Spiess and Affleck-Graves, 1999)
- Credit rating downgrades when it conveys information other than an increase in leverage (Goh and Ederington, 1993)
- Stock returns react negatively to a Sukuk issuance (Godlewski, Turk-Ariss, and Weill, 2013)



## 3. Motivation

- Key question in the research community:
  - What pushes firms to invest in Corporate Social Responsibility (CSR)? (Benabou and Tirole, 2010)
- Key question for policy makers:
  - How equity investors change their behaviour following increased/decreased regulatory pressure?

## 3. Motivation

- Bénabou and Tirole (2010) explaining why firms would invest in Corporate Social Responsibility (CSR):
  - Value creation perspective
  - Delegated philanthropy
  - Agency issue

## 4. Data and methods

### Sample:

- All firms in the sample are green bond issuers
- 780 corporate green and conventional bonds

### Models:

- Event-study on stock price at announcement date
- Regressions with controls for alternative explanations
- Difference-in-differences

### Timing:

- Regressions before and after year of the Paris Agreement
- Difference-in-differences with Paris Agreement and US election as event date

## 4. Data and methods

- Abnormal return computation (Campbell et al. 2010)

$$AR_{it} = Ret_{it} - (\hat{\alpha}_i + \hat{\beta}_i Ret_{mt})$$

- Regression computation (Godlewski et al. 2013)

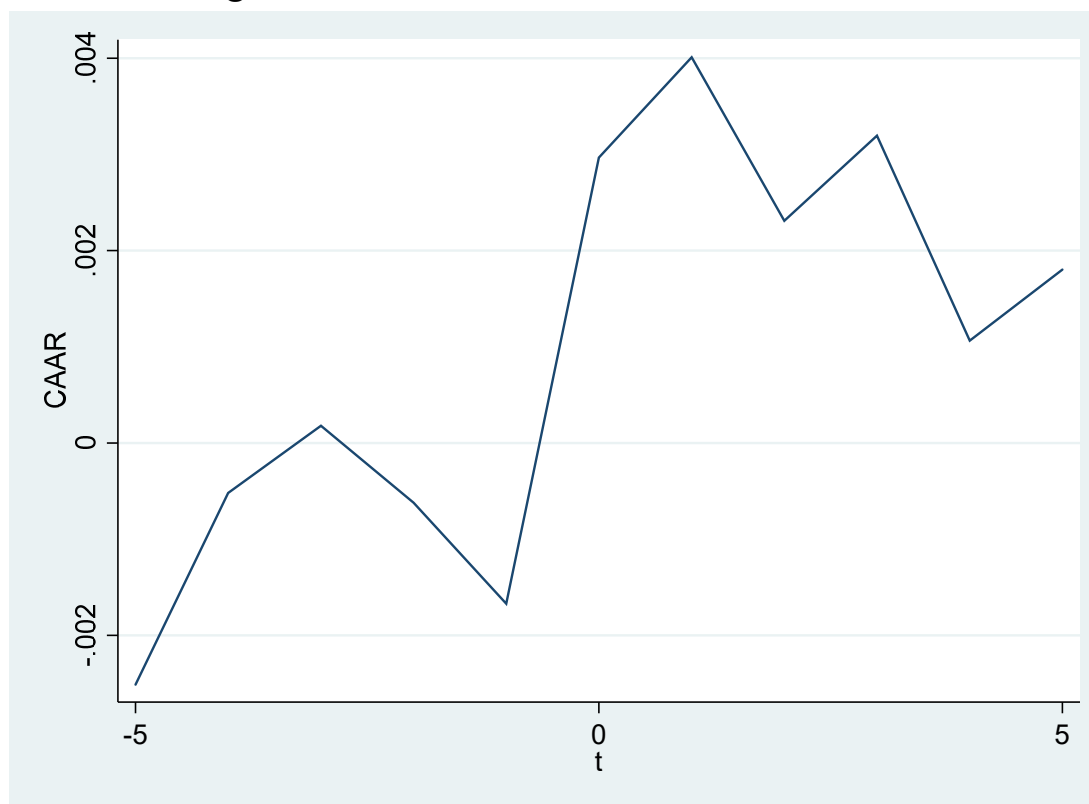
$$CAR_{ij}(t_1, t_2) = \alpha_i + \beta_{ij} \times Green + Controls_{ij} + \varepsilon_{ij}$$

- Difference-in-differences computation (Antanasov and Black 2016)

$$CAR_{it}(t_1, t_2) = \beta_1 \times Green_i \times post_t + \beta_2 \times Green_i + \beta_3 \times post_t + \beta_4 \times Controls_{it} + \varepsilon_{ij}$$

## 5. Results

Cumulative Average Abnormal Return 5 days around green bond issuance announcement



# 5. Results

**Table II : Cumulative Average Abnormal Returns around announcement date**

The table below shows the Cumulative Average Abnormal Return (CAAR) around green and conventional bond issuance announcement dates. The event windows are of 0 to 3 days with the event date being the bond issuance announcement date. We show the number of observations and the CAAR in percentage. We then show the event-study test statistics as well as their significance level.

Event window	Type of announcement	N	CAAR(%)	t-stat	p-value
[-1,1]	Conventional bond	327	0.37%	1.96	0.05
	Green Bond	157	0.46%	1.58	0.12
[0,1]	Conventional bond	327	0.20%	1.28	0.20
	Green Bond	157	0.57%	2.38	0.02
[0,0]	Conventional bond	327	0.14%	1.24	0.22
	Green Bond	157	0.46%	2.74	0.01

## 5. Results

**Table VI : Regression results before and after the Paris Agreement**

The sample is based on issuances before and after 2015, the year of the Paris Agreement. Results below show regressions with robust standard errors. The dependent variable is the Cumulative Abnormal Return (CAR) in all models. Models (1)-(3) are computed before the Paris Agreement. In the model (1), we follow Godlewski et al. (2013). Model (3) is the same model with firm and year fixed effects to which we add dummy variables for Callable, Putable and Sinkable provisions as controls. Models (4)-(6) replicate models (1)-(3) but after the Paris Agreement.

Variables	(1)	(2)	(3)	(4)	(5)	(6)
	Before Paris Agreement			After Paris Agreement		
	CAAR	CAAR	CAAR	CAAR	CAAR	CAAR
Green	0.009	-0.001	0.007	0.018**	0.017***	0.019**
	(0.006)	(0.005)	(0.006)	(0.008)	(0.006)	(0.008)
Firm Controls	Yes	Yes	Yes	Yes	Yes	Yes
Bond controls (excl. call, size and rank)	Yes	Yes	Yes	Yes	Yes	Yes
Bond controls (incl. call, size and rank)	No	No	Yes	No	No	Yes
Observations	173	173	173	350	350	350
R-squared	0.52	0.43	0.58	0.45	0.39	0.46
Firm FE	Yes	No	Yes	Yes	No	Yes
Industry FE	No	Yes	No	No	Yes	No
Country FE	No	Yes	No	No	Yes	No
Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

# 5. Results

**Table V : Difference-in-differences before and after the Paris Agreement**

We display the difference-in-difference estimators before and after the Paris Agreement day (12/12/2015) which we take as the day of the exogenous shock. The dependent variable is the Cumulative Abnormal Return (CAR) in all models. We report robust standard errors.

	(1) CAR	(2) CAR
Difference-in-difference estimator	0.015*** (0.005)	0.017*** (0.005)
Controls	Yes	Yes
Industry FE	Yes	No
Country FE	Yes	No
Firm FE	No	Yes
Observations	741	741
R-squared	0.11	0.13

Robust standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1



# 5. Results

**Table VII: Difference-in-differences and U.S. election**

The dependent variable is the Cumulative Abnormal Return (CAR) in all models. Model (1) the event date is the Paris Agreement. Model (2) is the same model with the election day in the U.S. (November 8, 2016) as the event day.

	(1)	(2)
	USA	USA
	CAR	CAR
Difference-in-difference estimator	0.015*** (0.005)	-0.017** (0.008)
Controls	Yes	Yes
Firm FE	Yes	Yes
Observations	314	65
R-squared	0.14	0.64

Robust standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

# 5. Results

**Table VIII: Difference-in-differences placebo trials and matching**

The dependent variable is the Cumulative Abnormal Return (CAR) in all models. In model (1) and (2), we compute the same difference-in-differences analysis as model (1) in Table V. The difference is that in model (1) we simulate a placebo exogenous shock exactly one calendar year prior to the Paris Agreement day (i.e. the December 12, 2014 instead of the December 12, 2015). We then exclude all data after the December 12, 2015. In model (2) we simulate a placebo exogenous shock exactly one calendar year following to the Paris Agreement day (i.e. the December 12, 2016 instead of the December 12, 2015). We then exclude all data before the December 12, 2015. In model (3) we show the difference-in-differences analysis after kernel propensity score matching on control variables.

	(1) Placebo test CAR	(2) Placebo test CAR	(3) Matched sample CAR
Difference-in-difference estimator	0.007 (0.006)	0.008 (0.006)	0.036*** (0.009)
Controls	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Observations	377	364	629
R-squared	0.06	0.21	0.11

Robust standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

## 6. Discussion

### Findings:

- We find that the value creation hypothesis hold on green bonds
- Regulatory pressure seems to play a key role on how equity investors perceive value creation by green bonds

### Future research:

- Test other regulatory settings
- We expect to have more qualitative ideas on how this new financial product is perceived by equity investors
- We expect to find more behavioural elements on equity investors

# APPENDICES

# APPENDIX I – Descriptive statistics

**Table I : Descriptive statistics of green and conventional bond issuances**

The table below provides the number of observations, the mean, median, standard deviation, minimum and maximum of a set of issued bonds. Amounts issued are in millions of US dollars, maturity is computed in years, the coupon is reported in percentage and callable/puttable/sinkable are dummy variables. The rank has been transformed into a count variable where 1 is senior unsecured and first lien, 2 is senior secured and 3 is subordinated.

Variable	N	Mean	Median	Standard deviation	Minimum	Maximum
<i>Conventional bonds</i>						
Amount Issued	478	464	127	699	1.3	5,690
Maturity	456	10.6	7.0	11.8	0.2	100.0
Coupon	477	3.4	3.3	2.4	0.0	11.3
Callable	478	0.2	0.0	0.4	0.0	1.0
Puttable	478	0.0	0.0	0.2	0.0	1.0
Sinkable	478	0.0	0.0	0.2	0.0	1.0
Rank	478	1.2	1.0	0.5	1.0	3.0
<i>Green bonds</i>						
Amount Issued	302	186	10	365	0.0	1,930
Maturity	295	10.8	6.0	58.0	1.0	1,000.0
Coupon	298	3.7	3.6	1.9	0.0	9.0
Callable	302	0.1	0.0	0.4	0.0	1.0
Puttable	302	0.0	0.0	0.2	0.0	1.0
Sinkable	302	0.0	0.0	0.1	0.0	1.0
Rank	302	1.1	1.0	0.3	1.0	3.0

# APPENDIX I – Descriptive statistics

**Table II : Industry and international split of bond issuances**

Variable	N	Frequency
<i>Industry</i>		
Mining	2	0%
Construction	37	5%
Manufacturing	370	47%
Transportation & Public Utilities	272	35%
Wholesale trade	11	1%
Services	88	11%
Total	780	100%
<i>Country</i>		
Austria	2	0%
Australia	1	0%
Brazil	9	1%
Switzerland	2	0%
China	98	13%
Germany	3	0%
Denmark	3	0%
Spain	25	3%
France	55	7%
United Kingdom	14	2%
Greece	1	0%
Indonesia	14	2%
India	40	5%
Italy	26	3%
Japan	74	9%
Korea	18	2%
Malaysia	37	5%
Norway	2	0%
New Zealand	4	1%
Sweden	4	1%
Taiwan	27	3%
USA	321	41%
Total	780	100%

# References

1. Agreement, Paris, 2015, United nations framework convention on climate change, Paris, France.
2. Atanasov, Vladimir, and Bernard Black, 2016, Shock-Based Causal Inference in Corporate Finance and Accounting Research, *Critical Finance Review* 5, 207–304.
3. Baker, Malcolm, Daniel Bergstresser, George Serafeim, and Jeffrey Wurgler, 2018, Financing the Response to Climate Change: The Pricing and Ownership of US Green Bonds, Working paper.
4. Bauer, Rob, and Daniel Hann, 2010, Corporate Environmental Management and Credit Risk, *SSRN Electronic Journal*.
5. Bénabou, Roland, and Jean Tirole, 2010, Individual and corporate social responsibility, *Economica* 77, 1–19.
6. Binder, John, 1998, The event study methodology since 1969, *Review of Quantitative Finance and Accounting* 11, 111–137.

# References

1. Boehmer, Ekkehart, Jim Masumeci, and Annette B Poulsen, 1991, Event-study methodology under conditions of event-induced variance, *Journal of Financial Economics* 30, 253–272.
2. Bradshaw, Mark T., Scott A. Richardson, and Richard G. Sloan, 2006, The relation between corporate financing activities, analysts' forecasts and stock returns, *Journal of Accounting and Economics* 42, 53–85.
3. Brown, Stephen J, and Jerold B Warner, 1985, Using daily stock returns: The case of event studies, *Journal of Financial Economics* 14, 3–31.
4. Campbell, Cynthia J., Arnold R. Cowan, and Valentina Salotti, 2010, Multi-country event-study methods, *Journal of Banking & Finance* 34, 3078–3090.
5. Campbell, John Y, Andrew W Lo, and Archie Craig MacKinlay, 1997, *The Econometrics of Financial Markets. Vol. 2* (Princeton University Press), Princeton, NJ.



# References

1. CBI, 2014, Explaining green bonds, Retrieved from Climate Bond Initiative's website: <https://www.climatebonds.net/market/explaining-green-bonds>.
2. CBI, 2017, China issues special green bonds guidelines for listed companies + New China Local Govt green bond policy recommendations, Retrieved from Climate Bond Initiative's website: <https://www.climatebonds.net/2017/05/china-issues-special-green-bonds-guidelines-listed-companies-new-china-local-govt-green-bond>.
3. CBI, 2018, Green Bond Highlights 2017, Climate Bonds Initiative Retrieved from Climate Bond Initiative's website: <https://www.climatebonds.net/files/reports/cbi-green-bonds-highlights-2017.pdf>.
4. CBI, 2018, Green Bond Pricing in the Primary Market: October - December 2017, Retrieved from Climate Bond Initiative's website: <https://www.climatebonds.net/resources/reports/green-bond-pricing-primary-market-october-december-2017>.

# References

1. Ehlers, Torsten, and Frank Packer, 2017, Green bond finance and certification, BIS Quarterly Review, 89.
2. Fama, Eugene F, Lawrence Fisher, Michael C Jensen, and Richard Roll, 1969, The adjustment of stock prices to new information, International Economic Review 10, 1–21.
3. Febi, Wulandari, Dorothea Schäfer, Andreas Stephan, and Chen Sun, 2018, The impact of liquidity risk on the yield spread of green bonds, Finance Research Letters.
4. Flammer, Caroline, 2018, Corporate Green Bonds, SSRN Electronic Journal.
5. Fremeth, Adam R., and J. Myles Shaver, 2014, Strategic rationale for responding to extra-jurisdictional regulation: Evidence from firm adoption of renewable power in the US: Strategic Rationale for Responding To Extra-Jurisdictional Regulation, Strategic Management Journal 35, 629–651.
6. Fungáčová, Zuzana, Christophe Godlewski, and Laurent Weill, 2015, Does the type of debt matter? Stock market perception in Europe, Bank of Finland.

# References

1. McWilliams, Abigail, and Donald Siegel, 2000, Corporate social responsibility and financial performance: correlation or misspecification?, *Strategic Management Journal* 21, 603–609.
2. Morel, Romain, and Cécile Bordier, 2012, Financing the transition to a green economy: their word is their (green) bond, *Climate Brief Paris*, CDC Climate Research.
3. OECD, 2017, Mobilising Bond Markets for a Low-Carbon Transition. *Green Finance and Investment* (OECD Publishing).

# References

1. Agreement, Paris, 2015, United nations framework convention on climate change, Paris, France.
2. Atanasov, Vladimir, and Bernard Black, 2016, Shock-Based Causal Inference in Corporate Finance and Accounting Research, *Critical Finance Review* 5, 207–304.
3. Baker, Malcolm, Daniel Bergstresser, George Serafeim, and Jeffrey Wurgler, 2018, Financing the Response to Climate Change: The Pricing and Ownership of US Green Bonds, Working paper.
4. Bauer, Rob, and Daniel Hann, 2010, Corporate Environmental Management and Credit Risk, *SSRN Electronic Journal*.
5. Bénabou, Roland, and Jean Tirole, 2010, Individual and corporate social responsibility, *Economica* 77, 1–19.
6. Binder, John, 1998, The event study methodology since 1969, *Review of Quantitative Finance and Accounting* 11, 111–137.

# References

1. Boehmer, Ekkehart, Jim Masumeci, and Annette B Poulsen, 1991, Event-study methodology under conditions of event-induced variance, *Journal of Financial Economics* 30, 253–272.
2. Bradshaw, Mark T., Scott A. Richardson, and Richard G. Sloan, 2006, The relation between corporate financing activities, analysts' forecasts and stock returns, *Journal of Accounting and Economics* 42, 53–85.
3. Brown, Stephen J, and Jerold B Warner, 1985, Using daily stock returns: The case of event studies, *Journal of Financial Economics* 14, 3–31.
4. Campbell, Cynthia J., Arnold R. Cowan, and Valentina Salotti, 2010, Multi-country event-study methods, *Journal of Banking & Finance* 34, 3078–3090.
5. Campbell, John Y, Andrew W Lo, and Archie Craig MacKinlay, 1997, *The Econometrics of Financial Markets. Vol. 2* (Princeton University Press), Princeton, NJ.

# References

1. CBI, 2014, Explaining green bonds, Retrieved from Climate Bond Initiative's website: <https://www.climatebonds.net/market/explaining-green-bonds>.
2. CBI, 2017, China issues special green bonds guidelines for listed companies + New China Local Govt green bond policy recommendations, Retrieved from Climate Bond Initiative's website: <https://www.climatebonds.net/2017/05/china-issues-special-green-bonds-guidelines-listed-companies-new-china-local-govt-green-bond>.
3. CBI, 2018, Green Bond Highlights 2017, Climate Bonds Initiative Retrieved from Climate Bond Initiative's website: <https://www.climatebonds.net/files/reports/cbi-green-bonds-highlights-2017.pdf>.
4. CBI, 2018, Green Bond Pricing in the Primary Market: October - December 2017, Retrieved from Climate Bond Initiative's website: <https://www.climatebonds.net/resources/reports/green-bond-pricing-primary-market-october-december-2017>.

# References

1. Ehlers, Torsten, and Frank Packer, 2017, Green bond finance and certification, BIS Quarterly Review, 89.
2. Fama, Eugene F, Lawrence Fisher, Michael C Jensen, and Richard Roll, 1969, The adjustment of stock prices to new information, International Economic Review 10, 1–21.
3. Febi, Wulandari, Dorothea Schäfer, Andreas Stephan, and Chen Sun, 2018, The impact of liquidity risk on the yield spread of green bonds, Finance Research Letters.
4. Flammer, Caroline, 2018, Corporate Green Bonds, SSRN Electronic Journal.
5. Fremeth, Adam R., and J. Myles Shaver, 2014, Strategic rationale for responding to extra-jurisdictional regulation: Evidence from firm adoption of renewable power in the US: Strategic Rationale for Responding To Extra-Jurisdictional Regulation, Strategic Management Journal 35, 629–651.
6. Fungáčová, Zuzana, Christophe Godlewski, and Laurent Weill, 2015, Does the type of debt matter? Stock market perception in Europe, Bank of Finland.

# References

1. McWilliams, Abigail, and Donald Siegel, 2000, Corporate social responsibility and financial performance: correlation or misspecification?, *Strategic Management Journal* 21, 603–609.
2. Morel, Romain, and Cécile Bordier, 2012, Financing the transition to a green economy: their word is their (green) bond, *Climate Brief Paris*, CDC Climate Research.
3. OECD, 2017, Mobilising Bond Markets for a Low-Carbon Transition. *Green Finance and Investment* (OECD Publishing).