Green bond market:
How Do Stock Prices React to Green Bond Issuance Announcements?

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Outline

1. Main Findings
2. Background
3. Motivation
4. Methods
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1. Main Findings

• There is a positive and significant abnormal return the day a green bond issuance is announced

• This positive stock abnormal return is 0.3% higher for green bond issuance announcements as compared to the abnormal return of conventional bond issuance announcements

• After controlling for firm and issuance characteristics this positive stock abnormal return still holds (premium goes up to 1.9%)

• The difference is not significant before the Paris Agreement but becomes positive and significant after the Paris Agreement
1. Main Findings

Cumulative Average Abnormal Return 5 days around green bond issuance announcement
2. Background

- Paris Agreement (2015) with a commitment of 195 state-parties to keep the increase in global average temperature well below two degrees Celsius

- Investment needed to achieve the Sustainable Development Goals (SDGs) is estimated to be USD5–7tr / year globally (Almassy et al., 2015, UN, 2014)

- Several financial mechanisms already exist (ex: cap-and-trade and carbon taxes)

- Green bonds are a recently created climate-related funding instrument that exists since 2007

- We intend to have a better knowledge of this instrument
The green bond market has been dynamic:

• “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 bonds annual issuance: from about $3bn in 2012 to $155.5bn in 2017 (CBI 2018)

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)

• In the EU the Directive 2014/95/EU on non-financial reporting

• French « Loi sur la transition écologique pour la croissance verte »
2. Background

Literature on green bonds:

• **Focused on green bonds market characteristics**
  • Zerbib (2018) and Schmitt (2017) on green bond premia
  • Baker et al. (2018) and Karpf & Mandel (2017) on US municipal bond premia
  • Ehlers & Packer (2017) on green bonds certification and premia
  • Febi et al. (2018) on green bonds liquidity
3. Motivation

- Key question in the research community:
  - What pushes firms to invest in Corporate Social Responsibility (CSR)? (Benabou and Tirole, 2010)

- Key question in the practitioners community:
  - What are the benefits to issue a green bond from an issuer perspective?

- Key question for policy makers:
  - How equity investors change their behaviour following a international agreement on climate?
4. 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 as event date
4. 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)

\[
CAR_{ij}(t_1, t_2) = \alpha_i + \beta_{ij} \times Green + Controls_{ij} + \epsilon_{ij}
\]

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

\[
CAR_{it}(0,0) = \beta_1 \times Green_i \times post_t + \beta_2 \times Green_i + \beta_3 \times post_t + \beta_4 \times Controls_{it} + \epsilon_{ij}
\]
Table I: Cumulative Average Abnormal Returns around announcement date

The table below shows the Cumulative Average Abnormal Returns (CAAR) around green and conventional bond issuance announcement date. 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 described in detail in Appendix I as well as their significance level. The two parametric test statistics are the t-test and the Patell Z test (Patell, 1976). The two non-parametric test statistics are the Boehmer t-test (Boehmer et al., 1991) and the Cowan Sign test (Cowan, 1992).

<table>
<thead>
<tr>
<th>Event window</th>
<th>Type of announcement</th>
<th>N</th>
<th>CAAR(%)</th>
<th>t-test p-value</th>
<th>Patell Z test p-value</th>
<th>Boehmer test p-value</th>
<th>Cowan Sign test p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>[0,0]</td>
<td>Conventional bond</td>
<td>327</td>
<td>0.14%</td>
<td>0.217</td>
<td>0.555</td>
<td>0.620</td>
<td>0.372</td>
</tr>
<tr>
<td></td>
<td>Green Bond</td>
<td>157</td>
<td>0.46%</td>
<td>0.007</td>
<td>0.016</td>
<td>0.015</td>
<td>0.049</td>
</tr>
</tbody>
</table>
5. Results

Table II
Regression results Corporates sample 2013-2014

Results below show regressions with robust standard errors. The dependent variable is the Cumulative Abnormal Return (CAR) in all models. In the model (1) we follow Godlewksi et al. 2013, the independent variable (Green) is the dummy equal to one when the announcement of the CAR is a green bond announcement and 0 for a conventional bond announcement. We then add the control variables: Size equal to logarithm of total assets, the equity-to-assets ratio equal to shareholder's equity divided by total assets, the Operating margin equal to operating income divided by sales, Return on Assets (ROA) equal to earnings divided by total assets, the coupon of the bond issued and the maturity in years. Model (2) is the same model with firm and year fixed effects. Model (3) is the same model with industry, country and year fixed effects. Model (4) is the same model with firm and year fixed effects to which we add dummy variables for Callable, Putable and Sinkable provisions as controls. In this last model, we add as well the bond payment rank (Rank) as a count variable where 1 is senior unsecured and first lien, 2 is senior secured and 3 is subordinated. Finally, we add the bond size (Bond Size) computed as natural logarithm of the amount issued.

<table>
<thead>
<tr>
<th>Variables</th>
<th>(1) CAR</th>
<th>(2) CAR</th>
<th>(3) CAR</th>
<th>(4) CAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td>0.00203</td>
<td>0.00875</td>
<td>-0.000711</td>
<td>0.00729</td>
</tr>
<tr>
<td>Firm controls</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Bond controls (excl. call, size and rank)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Bond controls (incl. call, size and rank)</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Observations</td>
<td>173</td>
<td>173</td>
<td>173</td>
<td>173</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.038</td>
<td>0.524</td>
<td>0.434</td>
<td>0.575</td>
</tr>
<tr>
<td>Firm FE</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Industry FE</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Country FE</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Year FE</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Robust standard errors in parentheses</td>
<td>*** p&lt;0.01, ** p&lt;0.05, * p&lt;0.1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
5. Results

Table III

Regression results Corporates for the period 2016-2018

Results below show regressions with robust standard errors. The dependent variable is the Cumulative Abnormal Return (CAR) in all models. In the model (1) we follow Godlewksi et al. 2013, the independent variable (Green) is the dummy equal to one when the announcement of the CAR is a green bond announcement and 0 for a conventional bond announcement. We then add the control variables: Size equal to logarithm of total assets, the equity-to-assets ratio equal to shareholder's equity divided by total assets, the Operating margin equal to operating income divided by sales, Return on Assets (ROA) equal to earnings divided by total assets, the coupon of the bond issued and the maturity in years. Model (2) is the same model with firm and year fixed effects. Model (3) is the same model with industry, country and year fixed effects. Model (4) is the same model with firm and year fixed effects to which we add dummy variables for Callable, Putable and Sinkable provisions as controls. In this last model, we add as well the bond payment rank (Rank) as a count variable where 1 is senior unsecured and first lien, 2 is senior secured and 3 is subordinated. Finally, we add the bond size (Bond Size) computed as natural logarithm of the amount issued.

<table>
<thead>
<tr>
<th>Variables</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td>0.00909**</td>
<td>0.0181**</td>
<td>0.0165***</td>
<td>0.0187**</td>
</tr>
<tr>
<td></td>
<td>(0.003)</td>
<td>(0.006)</td>
<td>(0.005)</td>
<td>(0.006)</td>
</tr>
<tr>
<td>Firm controls</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Bond controls (excl. call, size and rank)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Bond controls (incl. call, size and rank)</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Observations</td>
<td>350</td>
<td>350</td>
<td>350</td>
<td>350</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.127</td>
<td>0.446</td>
<td>0.389</td>
<td>0.464</td>
</tr>
<tr>
<td>Firm FE</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Industry FE</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Country FE</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Year FE</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
5. Results

Table IV: 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. In model (1) the difference-in-differences analysis is computed with the same control variables as previous models: Size (logarithm of total assets), Equity-to-Asset ratio (shareholder's equity divided by total assets), EBIT to interest expense ratio (earnings before interest and taxes divided by interest expense), Operating margin (operating income divided by sales), Return on Assets or ROA (earnings divided by total assets), Coupon (in percentage), Maturity (in years), dummy variables for the call/put/sink features, payment rank (count variable where 1 is senior unsecured and first lien, 2 is senior secured and 3 is subordinated) and Bond Size (natural logarithm of the amount issued). In model (2) we add Standard Industrial Classification (SIC) two digit code and country as controls to the model (1). We report robust standard errors.

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Difference-in-difference estimator</td>
<td>0.015***</td>
<td>0.017***</td>
</tr>
<tr>
<td></td>
<td>(0.00449)</td>
<td>(0.00452)</td>
</tr>
<tr>
<td>Observations</td>
<td>741</td>
<td>741</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.11</td>
<td>0.13</td>
</tr>
<tr>
<td>Mean control before</td>
<td>0.036</td>
<td>0.051</td>
</tr>
<tr>
<td>Mean treated before</td>
<td>0.035</td>
<td>0.046</td>
</tr>
<tr>
<td>Difference before</td>
<td>-0.001</td>
<td>-0.005</td>
</tr>
<tr>
<td>Mean control after</td>
<td>0.036</td>
<td>0.053</td>
</tr>
<tr>
<td>Mean treated after</td>
<td>0.050</td>
<td>0.065</td>
</tr>
<tr>
<td>Difference after</td>
<td>0.014***</td>
<td>0.012**</td>
</tr>
</tbody>
</table>

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1
5. Results

Table V: 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 VII. 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 12 december 2014 instead of the 12 december 2015). We then exclude all data after the 12 december 2015. In model (2) we simulate a placebo exogenous shock exactly one calendar year following to the Paris Agreement day (i.e. the 12 december 2016 instead of the 12 december 2015). We then exclude all data before the 12 december 2015. In model (3) we show the difference-in-differences analysis after kernel propensity score matching on: firm identification number (count variable), coupon (in percentage), Maturity (in years), callable/putable/sinkable feature (dummy variable), payment rank (count variable), bond size (logarithm of amount issued), country code (count variable), Standard Industrial Classification (SIC) two digit code (count variable) and issuance announcement year (in years).

<table>
<thead>
<tr>
<th></th>
<th>(1) CAR</th>
<th>(2) CAR</th>
<th>(3) CAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Difference-in-difference estimator</td>
<td>0.007</td>
<td>0.008</td>
<td>0.036***</td>
</tr>
<tr>
<td></td>
<td>(0.00603)</td>
<td>(0.00553)</td>
<td>(0.00875)</td>
</tr>
</tbody>
</table>

Observations | 377 | 364 | 629 |
R-squared     | 0.06 | 0.21 | 0.11 |
Mean control before | -0.033 | 0.114 | 0.026 |
Mean treated before | -0.033 | 0.122 | 0.002 |
Difference before | 0.000 | 0.007 | -0.023*** |
Mean control after | -0.038 | 0.105 | 0.001 |
Mean treated after | -0.030 | 0.120 | 0.014 |
Difference after | 0.008 | 0.015** | 0.012*** |

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
• These results show an impact of the Paris Agreement on equity investor perception of new financial products

Future research:

• We expect to dig more into country / regional heterogeneity of the stock price reaction
• 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
References


References


References


1. McWilliams, Abagail, 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.