Journal of Corporate Finance 61 (2020) 101427

Contents lists available at ScienceDirect

Journal of Corporate Finance

journal homepage: www.elsevier.com/locate/jcorpfin

Do shareholders benefit from green bonds?☆

Dragon Yongjun Tang, Yupu Zhang*

Faculty of Business and Economics, The University of Hong Kong, Hong Kong

ARTICLE INFO

Keywords:
Green bonds
Corporate social responsibility
Environmental social and governance (ESG)
Institutional ownership
Stock liquidity
Investor attention

JEL classifications:
G14
G32
G38
M14

ABSTRACT

The green bond market has been growing rapidly worldwide since its debut in 2007. We present the first empirical study on the announcement returns and real effects of green bond issuance by firms in 28 countries during 2007–2017. After compiling a comprehensive international green bond dataset, we document that stock prices positively respond to green bond issuance. However, we do not find a consistently significant premium for green bonds, suggesting that the positive stock returns around green bond announcements are not fully driven by the lower cost of debt. Nevertheless, we show that institutional ownership, especially from domestic institutions, increases after the firm issues green bonds. Moreover, stock liquidity significantly improves upon the issuance of green bonds. Overall, our findings suggest that the firm's issuance of green bonds is beneficial to its existing shareholders.

1. Introduction

Environmental, social, and governance (ESG) considerations are increasingly incorporated into corporate policies.[1] Hart and Zingales (2017) appeal for the maximization of shareholder welfare instead of stock returns. Magill et al. (2015) provide a stakeholder model to show that when managers maximize the total value of the firm rather than that of shareholders only, a more sustainable equilibrium is achieved. However, empirical evidence on whether firms can benefit from improving the non-financial aspects of corporate activities, including ESG, is still lacking. In this paper, we fill the gap in the literature by empirically examining the nascent but fast-growing green bond market.

Green bonds are newly developed financial instruments with the specific goals of improving environmental impacts and social welfare. Similar to traditional fixed income securities, firms can issue green bonds to raise capital to finance their valuable investments. Besides, green bonds are intended to have a positive environmental benefit such as reducing CO_2 emissions and preventing pollution. Moreover, green bonds are certified by third parties. For first-time issuers, the process of issuing green bonds can be cumbersome and costly. Therefore, it is important to ask whether existing shareholders of the issuing firms can benefit from the

☆ We are grateful to an anonymous reviewer, Warren Bailey, Jay Cao, Sudheer Chava, Alex Edmans, Paul Fisher, Gianfranco Gianfrate, Stuart Gillan, Paul Griffin, Wenxuan Hou, Ron Kaniel, Alan Kwan, Dan Li, Chen Lin, Tse-Chun Lin, Pedro Matos, Roni Michaely, Vinh Nguyen, Thomas Schmid, Andrew Sinclair, Laura Starks, Philip Strahan, Sheridan Titman, Albert Tsang, Stefan Zeume, Bohui Zhang and Hong Zou for helpful comments and discussions. This paper has also benefited from the comments of conference and seminar participants at the University of Hong Kong, 2017 HK PolyU/Journal of Corporate Finance Special Issue Conference, 2018 Shanghai Green Finance Conference, 2018 China International Conference in Finance (CICF), 2018 UN PRI Academic Network Conference, and the 2018 Conference on “Scaling up Green Finance: The Role of Central Banks” at Deutsche Bundesbank. We thank Climate Bonds Initiative (CBI) for kindly providing the data.

* Corresponding author.
E-mail addresses: yjtang@hku.hk (D.Y. Tang), yupu@hku.hk (Y. Zhang).

[1] See, e.g., Bénabou and Tirole (2006, 2010), Renneboog et al. (2008), Eccles et al. (2014), Flammer and Kacperczyk (2016), Cao et al. (2018).

https://doi.org/10.1016/j.jcorpfin.2018.12.001
Received 1 March 2018; Received in revised form 15 November 2018; Accepted 6 December 2018
Available online 08 December 2018
0929-1199/

issuance of green bonds. The answer to this question is useful for the further development of green bond market and impact investing.

We provide the first comprehensive empirical study on green bonds. In spite of the recent boom in the green bond market, there is still no universal definition of green bonds.[2] Broadly speaking, green bonds are fixed income securities issued by capital raising entities to fund their environmentally friendly projects, such as renewable energy, sustainable water management, pollution prevention, climate change adaptation and so on. Although the proceeds from green bonds are earmarked for green projects, the bonds are backed by the issuer's whole balance sheet. We compile the most comprehensive international green bond dataset for our empirical analysis. We start our data construction from the Climate Bonds Initiative (hereafter, CBI). CBI is a not-for-profit international organization with the mission of promoting capital solutions via green bonds for environment-related projects. CBI plays a prominent role in the green bond market and its Climate Bond Standard is adopted by many countries. Moreover, CBI approves the qualifications of third-party green bond verifiers such as KPMG, Deloitte, and Sustainalytics.[3]

Bloomberg has also launched initiatives and compiled data on green bonds. We augment the CBI dataset with Bloomberg's labeled green bond data.[4] There are several advantages to combining CBI with Bloomberg to build a comprehensive green bonds dataset. First, they have closely related and consistent definitions of green bonds. Thus, we can cross-validate the accuracy of our data. Second, Bloomberg provides adequate information about corporate bonds, including announcement date, issue amount, coupon, and maturity, that can be missing from the CBI data. Such data are important for our event study analysis.

We find from this dataset that the stock prices of issuers react positively to green bond issuance announcements. Specifically, there is a 1.4% cumulative abnormal return for the $[-10, +10]$, 21-day event window around green bond issuance announcements. Moreover, the announcement returns are larger for first-time issuers than for repeat issuers. This announcement effect is both statistically significant and economically meaningful. Our results are consistent with prior literature on the relationship between corporate environmental performance and firm value, especially research examining the information content of corporate news on environmental issues using event studies.[5] Thus, issuing green bonds can improve firm value in the short run.

We explore three potential sources for this positive green bond announcement return: (1) The "*financing cost*" channel: socially responsible funds or investors with a green mandate may seek to hold green bonds to boost their ESG scores. As a result, those investors could push up the bond price and green bond issuers can benefit from a lower cost of debt, leading to a positive reaction by the stock market. (2) The "*investor attention*" channel: when firms label their green bonds, increasing media exposure can attract investors' attention and the visibility of the issuing firms can potentially increase, leading to more demand for their shares and a larger investor base. (3) The "*firm fundamental*" channel: green bonds demonstrate the firm's dedication to sustainable development, and investing in such projects can be valuable to firms in the long run, including by helping them survive adverse situations.

We examine green bond yield, institutional ownership, and stock market liquidity to understand the channels and mechanisms underlying positive announcement effects. In a broad sample, we find a green premium, that is, green bonds are issued at a yield spread that is 6.94 basis points lower than corporate bonds issued by similar firms. However, if we compare yield spread within the same issuing firm in the same year, we do not find any significant pricing difference. Overall, we do not have strong evidence supporting the "financing cost" channel. In other words, the positive stock market reaction is beyond the direct benefits of the lower cost of debt, if any, to the issuers.

When investigating the institutional ownership after green bond issuance compared with firms that issue conventional corporate bonds, we find a 7.9% increase in the institutional ownership (mostly driven by investment advisers and pension funds) of the green bond issuers. Interestingly, we find that hedge funds reduce their holdings in those firms after green bond issuance. Furthermore, the increase in institutional ownership comes mainly from domestic institutions. Such evidence is supportive of the "investor attention" channel of green bond effects.

We find that stock turnover increases significantly in relation to green bond issuance. Google search volume also spikes around event days. Such evidence suggests that the market does indeed pay attention to a firm's green bond development. Moreover, we find a significant improvement in stock liquidity in terms of bid-ask spreads and the Amihud measure after green bond issuance compared with matching firms issuing conventional corporate bonds. This result suggests that more media attention attract more investors and generate more trades in the stock market. It supports "investor attention" channel rather than the "firm fundamental" channel because if investors believe the long-term high valuation of the green bond issuers, they will hold the stock rather than realize the gain such that stock liquidity will decline.

Our paper provides first evidence on the impact of green bond issuance on shareholders. Our findings contribute to the literature analyzing the effect of corporate social responsibility (CSR) or ESG on firm performance and firm value.[6] Margolis et al. (2008) find a positive but weak relationship between corporate social performance and corporate financial performance revealed in 167 studies over the past 35 years. However, the prior literature does not draw any conclusions about the positive effect of conducting CSR and environmental issues. There are also concerns that socially responsible firms suffer more from agency problems and that managers

[2] See discussion in https://www.ft.com/content/ef9a02d6-28fe-11e7-bc4b-5528796fe35c.

[3] https://www.climatebonds.net/certification/approved-verifiers.

[4] CBI is working with Bloomberg to enrich the green bond database. Their data coverage is slightly different. For example, Bloomberg requires 100% use of proceeds to be aligned with green activities.

[5] For example, Klassen and McLaughlin (1996) find that when firms receive environmental awards, their stock prices react significantly positively.

[6] Other contemporary studies on green bonds include Baker et al. (2018), Flammer (2018), Reboredo (2018), and Febi et al. (2018). The broad literature includes Sharfman and Fernando (2008), Hong and Kacperczyk (2009), Edmans (2011), El Ghoul et al. (2011), Goss and Roberts (2011), Hong and Kostovetsky (2012), Servaes and Tamayo (2013), Chava (2014), Bhandari and Javakhadze (2017), and Edmans et al. (2017).

extract private benefits at the expense of existing shareholders (see, e.g., Jensen (2001) and Cheng et al. (2016)).

An emerging strand of literature related to our study analyzes CSR or ESG from the perspectives of institutional investors (e.g., Dyck et al. (2018) and Chen et al. (2018)). Dimson et al. (2015) show that active institutional investors engaging in environmental or social issues benefit firm from improved accounting performance and increased institutional ownership. Hoepner et al. (2018) examine institutional investor engagement in ESG issues and find that such engagements can benefit the firm by reducing the downside risk. Additionally, investors with a longer investment horizon prefer to hold high ESG firms and behave more patiently when incurring a loss (Starks et al. (2018)). Our findings are consistent with the above studies that institutional investors pay attention to and value firms' ESG performance.

Our study on green bonds can be useful for impact investing. Impact funds can hold green bonds to enhance their impact metrics, which measure their significant influence on the environment and society. The United Nations Principles for Responsible Investment (UNPRI, 2017) lists more than 1200 organizations representing $70 trillion assets under management as their signatories committing to socially responsible and sustainable investments.[7] Bialkowski and Starks (2016) suggest that SRI fund flow is different from conventional funds in terms of higher growth and more persistence. Geczy et al. (2018) find that the PE/VC industry adopts those impact investing features and addresses agency problems by contracting. Moreover, Barber et al. (2018) show that impact funds derive utility from non-pecuniary benefits while earning a lower rate of return.

Our study of green bonds also adds to the media attention literature. Grullon et al. (2004) show that the firm's visibility to investors has significant consequences for the stock market. In particular, firms that increase their capital expenditure on advertisement tend to have a larger number of institutional investors. Similarly, Frieder and Subrahmanyam (2005) find that individual investors prefer to invest in stocks with easily recognized products. Ben-Rephael et al. (2017) documents that post-earnings announcement drifts are driven by investor inattention to announcements and that institutional attention responds more quickly to major news events, leading retail attention. We also show that investors pay attention to the firm's green activities.

The remainder of this paper is organized as follows. Section 2 describes the background and presents the hypothesis development. Section 3 describes the data construction. Section 4 presents the results from event studies. Section 5 compares yield spread, institutional ownership and liquidity changes after issuing a green bond. Section 6 concludes the paper.

2. Background and hypothesis development

2.1. Green bond market

The first green bond was called a “climate awareness bond” and was issued by the European Investment Bank (EIB) in 2007. Since then, the green bond market has continued to rise not only in total issue amount but also in other respects. For instance, the geographic base is expanding.[8] Moreover, bond types are also broadening. Poland became the first country to issue a green sovereign bond in December 2016, followed by France in January 2017. The United States government agency Fannie Mae issued the largest up-to-date $24.9 billion USD green mortgage-backed securities (MBS) in 2017. In June 2017, Malaysia launched the world's first green Islamic bond, “green Sukuk,” to finance climate-resilient growth.[9] Furthermore, issuer types are also enlarging meaningfully, including supranational organizations (i.e., World Bank and IFC), development banks (i.e., ADB and AfDB), commercial banks (i.e., Bank of America and HSBC), non-bank financial institutions (i.e., REITs such as Regency Centers Corporation and Link REIT) and corporations (i.e., Apple, Inc., and Tesla). According to Thomson Reuters, the annual issuance amount of green bonds reached $155.5 billion in 2017 and gained momentum to meet the $1 trillion target in 2020.[10] The green bond market continued to grow in the year of 2018. In the first three quarters of 2018, 963 green bonds from 35 countries are issued. Both financial firms and corporations are actively using green bonds. Several governments, especially those in Asia, such as Hong Kong and Singapore are providing strong support for further market development.

Despite the fact that the green bond market is growing rapidly, there are still disputes regarding definitions, guidelines and green taxonomy. In general, there are two green bond “standards”: Green Bond Principles (GBP) and the Climate Bond Initiative (CBI).[11] GBP is a voluntary guideline established in 2014 by investment banks, including Bank of America Merrill Lynch, Citi, JPMorgan, BNP Paribas, and HSBC.[12] GBP requires transparency and disclosure and its four green bond components (use of proceeds, process of project evaluation and selection, management of proceeds, and reporting) are widely accepted by the market. Regardless of the generality of GBP, CBI provides eligible criterion and a detailed green taxonomy by sector that third parties can adopt to assess the qualification of a green bond. Therefore, we select the CBI database as a baseline to construct our international green bond database.

Our main focus in the paper is publicly listed green bond issuers. In our dataset, the first public green bond issuer is Nedbank, one of the largest banks in South Africa. Nedbank issued 4 billion ZAR in 2012 from a green savings bond program, which was used to

[7] https://www.unpri.org/pri/about-the-pri.

[8] Although the US, China and France lead the market, issuance is broadening, with first-time issuers from Argentina, Singapore, Chile, Fiji, Lithuania, Malaysia, Nigeria, the United Arab Emirates, Slovenia and Switzerland in 2017.

[9] https://www.worldbank.org/en/news/infographic/2017/09/19/malaysia-green-sukuk.

[10] See, e.g., https://www.reuters.com/article/greenbonds-issuance/global-green-bond-issuance-hit-record-155-5-billion-in-2017-data-idUSL8N1P5335.

[11] https://www.bis.org/publ/qtrpdf/r_qt1709h.pdf.

[12] https://www.climatebonds.net/market/best-practice-guidelines.

finance renewable energy projects in South Africa.[13] The public green bond issuers were followed by Regency Centers Corp, a real estate investment trust (REIT), and Credit Agricole CIB, a diversified banking institution. Financial institutions and corporations are the major constituents among all the public green bond issuers. However, the designs of their green bonds are different: corporate green bonds are used to finance the issuers' own projects and as shown in Internet Appendix IA.1, project eligibility criteria are clearly specified; in contrast, financial institutions, including commercial banks, diversified banking institutions, investment companies and insurance companies, issue green bonds to make green loans to and invest in other firms to finance other firms' projects and as shown in Internet Appendix IA.2, they will only define general criteria to select green projects.

From the issuers' perspective, green bonds can expand the breadth of ownership, enlarge their investor base and potentially obtain a lower cost of capital and longer tenor compared with straight corporate bonds. For the investors, green bonds may satisfy their green mandate and boost their ESG score. However, green bond issuers suffer from more information disclosures, upfront costs for certification and personnel, and reputation risk. Furthermore, there are no unified green bond standards to identify a green bond and limited enforcement of the law for supervising green integrity. Therefore, it is not a straightforward decision for corporations to issue green bonds.

Critics say that this fragmentation of standards and labeling creates uncertainty for investors and will slow the future growth of the market. However, a uniform standard to assess greenness, for example, a widely accepted criterion to evaluate green bonds, is difficult to implement. Furthermore, due diligence on environmental impacts is crucial to debt financing.[14] In other words, investors know little about the environmental impact of green loans and green bonds and the only information they can obtain is through voluntary disclosure or third-party verification. Overall, all the above discussions enlighten us on the firm's incentive to issue green bonds and their real impact on firm performance after issuance.

2.2. Testable hypotheses

While there can be benefits from green bond issuance, there are also potential costs. One such cost is the fees paid to third-party certifiers and auditors to perform annual reviews. Indeed, the governments of Hong Kong and Singapore provide subsidies to issuers to cover such costs to encourage firms to issue green bonds in their domiciles. Therefore, given the broad-based support and government stimulus, we expect the following:

Hypothesis 1. (Green Benefits). Stock prices increase after firms' green bond announcement.

To understand the channels of and mechanism for the green bond issuance effect, we provide three hypotheses on the sources of the potential positive stock market reaction when firms announce their green bond issuance: the “investor attention” channel, the “fundamental” channel and the “financing cost” channel.

Investors have limited attention to corporate announcements (Ben-Rephael et al. (2017)), and a firm's visibility matters to stock market investors (Grullon et al. (2004)). When a firm announces its green bond issuance, media exposure will increase dramatically compared with conventional corporate bond issuance. Green bond issuers will issue formal press releases and declare that they have successfully labeled their newly issued bonds “green”, which sends a good signal to the market.

Therefore, labeling green is a certificate or proof such that a firm's green projects and internal sustainable plans have been verified by a second party. In other words, the “label effect” will play a significant role when firms issue green bonds. Not only will bond investors discover this fact, but stock investors will also notice. More investor attention could potentially expand the investor base for issuers, which is good news for firms, and hence a positive announcement return.

If media attention plays a pivotal role inducing positive announcement return, then the market will only respond to first-time green bond issuance rather than every time a bond is labeled green. Green bond issuance will draw people's attention, attract more investors and we expect to see an increase in institutional ownership, which generates more trades on the stock market. Henceforth, stock liquidity improves after green bond issuance.

Hypothesis 2a. (Investor attention). Green bond issuance attracts investors' attention and it will improve visibility and enlarge the investor base.

An alternative explanation is the “fundamental channel”, suggesting that green bond issuance contains more information about valuable investment opportunities (Myers and Majluf (1984), Kang and Stulz (1996)), which reduces information asymmetry and leads to the positive announcement effect. In particular, green bond issuers explicitly indicate their use of proceeds in the prospectus (see Appendix A) and show their ongoing or future environmental beneficial projects. Those statements will be examined externally by a second party to further address their green promise (see Appendix B). Under normal circumstances, when firms issue straight corporate bonds, they will not disclose information as much as they do when issuing green bonds. As a result, investors will benefit from additional information that the green bond issuer discloses when issuing a green bond so that the stock market will react positively to the announcement.

The fundamental mechanism suggests that every green bond issuance will contain valuable information and presumably the stock market will respond in every case. Meanwhile, because the investors believe in the firm's long-term high valuation, they will hold the stock rather than realize the gain in the short run so that stock liquidity may either shrink or hold steady. In sum, the liquidity test can

[13] https://www.climatebonds.net/2014/05/sas-nedbank-490m-retail-green-bonds-offer.

[14] See “green finance environmental impact is hard to measure” by Todd Cort and Cary Krosinsky, *Financial Times*, November 4, 2015.

differentiate “investor attention” channel from “fundamental” channel.

Hypothesis 2b. (Fundamental). Green bond issuance reveals valuable investment opportunities and illustrates the firm's dedication to sustainable development, which can help the issuing firm survive in the long run.

Recently, researchers have shown that corporate social responsibility (CSR) exerts a significantly positive impact on firm value and financial performances both in the short run and in the long term. For example, among others, Sharfman and Fernando (2008), El Ghoul et al. (2011), Goss and Roberts (2011) and Chava (2014) show that CSR and better environmental, social and governance (ESG) performances are associated with a lower cost of loans, a lower cost of capital, an improved credit rating and superior financial performance.

Green bonds normally face oversubscription, and investors warm to those issuances.[15] From the stakeholder theory point of view, green bonds can be regarded as internalizing environmental externalities and catering to the appetite of a certain type of investor, especially investors with a green mandate. Thus, investors with a green mandate, who consider sustainable growth and environmentally friendly projects in addition to traditional risk and return, will appeal to the green bond market and push up the price. Investors have been analyzing green bonds because of increasing demand and recently, there has been some anecdotal evidence suggesting that new green bond issuers charge a premium because of that demand.[16]

Barber et al. (2018) analyze 5000 VC funds and find that impact funds have a 14.1% higher probability of attracting investment, a phenomenon they attribute to growing market demand. Growing demand for green bonds indicates the lower cost of capital of issuing firms. Therefore, based on the financing cost mechanism, we expect green bonds to be priced at a premium (lower yield) in the primary market.

Hypothesis 2c. (Financing cost). Green bond issuance attracts investors with a green mandate and socially responsible funds, which will push up the bond price and lower the cost of capital for the firm.

3. Green bond market data

3.1. Sample construction

We construct the most comprehensive international green bond dataset augmenting the Climate Bond Initiative (CBI) with Bloomberg labeled green bonds. Among all the available data sources, these are the most inclusive sources and have a similar green bond selection criterion, including the use of proceeds, the selection of projects, eligibility verification, and reporting. We choose CBI because it has a larger coverage. For example, the first green bond widely accepted by the green bond market, the climate awareness bond issued by the European Investment Bank (EIB) in 2007, is covered in the CBI database but not in the Bloomberg green bond database. Nonetheless, there are several advantages of augmenting with Bloomberg, including an adequate amount of bond characteristics; furthermore, Bloomberg provides announcement dates, enabling us to conduct event study analysis.

Our CBI dataset cover the period from June 2007 to July 2017 and our Bloomberg data cover the period from March 2010 to December 2017. CBI defines green bonds as instruments created to fund projects that have positive environmental and/or climate benefits.[17] Proceeds from these bonds are earmarked for green projects but are backed by the issuers' entire balance sheet. They also include green “use of proceeds” revenue bonds, green project bonds, and green securitized bonds.[18] Due to data limitations, the CBI dataset only contains ISIN, issuer name, issue date, maturity date, amount issued, currency, bond type and domicile of the issuer. As of July 25, 2017, the total number of green bonds we obtained from CBI is 1181. The outstanding amount from their sources is USD 248 billion. The mean issue amount is approximately USD 211 million. Approximately 42.8% of bond issuances are denominated in US dollars, and 14% of bonds are denominated in Euros.[19]

The second data source we use is Bloomberg, which includes four types of green bonds: the Green Use of Proceeds Bond, the Green Use of Proceeds Revenue Bond, the Green Project Bond, and the Green Securitized Bond. Bloomberg's definitions of green bonds are instruments for which the proceeds are *exclusively* applied (either by specifying the use of proceeds, direct project exposure, or securitization) toward new and existing green projects, defined as projects and activities that promote climate or other environmental sustainability purposes. After cross-check and validation, we supplement the CBI data with Bloomberg bond information. The mean issuance amount is USD 285 million and the average coupon is 3.26%. The merged dataset contains 1510 bonds worldwide during the 2007–2017 sample period.

We collect stock prices and market index prices from DataStream and firm financial data from Worldscope. We obtain matching sample data from WRDS Compustat Global financial and security prices. Institutional ownership is from FactSet Ownership (“Lionshares”), and we follow Ferreira and Matos (2008) to categorize different types of institutional investors. The green bond yield spread data and matched firm conventional bonds data are from the SDC Platinum New Issues database.

[15] https://www.wsj.com/articles/investors-warm-to-green-bonds-1491790201.

[16] https://www.ft.com/content/9396fb28-ca2b-11e7-ab18-7a9fb7d6163e.

[17] The majority of green bonds in CBI are green “use of proceeds” or asset-linked bonds.

[18] https://www.climatebonds.net/market/explaining-green-bonds.

[19] We have also conducted a cross-validation with the Bloomberg data source to confirm the reliability of unique ISIN, issuer, and issue date. We dropped duplicates or other problematic bond entries from our final sample.

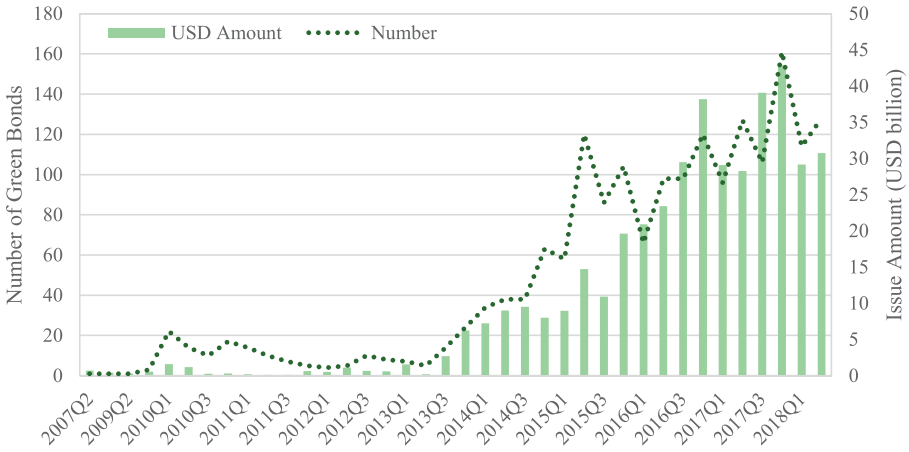

Fig. 1. Global green bond issuance over time.
This figure shows the number and USD amount of green bond issuance on a quarterly basis from 2007Q2 (issuance of the first green bond by EIB) to 2018 Q2. We merge the Climate Bond Initiative (CBI) database with the Bloomberg green bond dataset to construct an international green bond dataset.

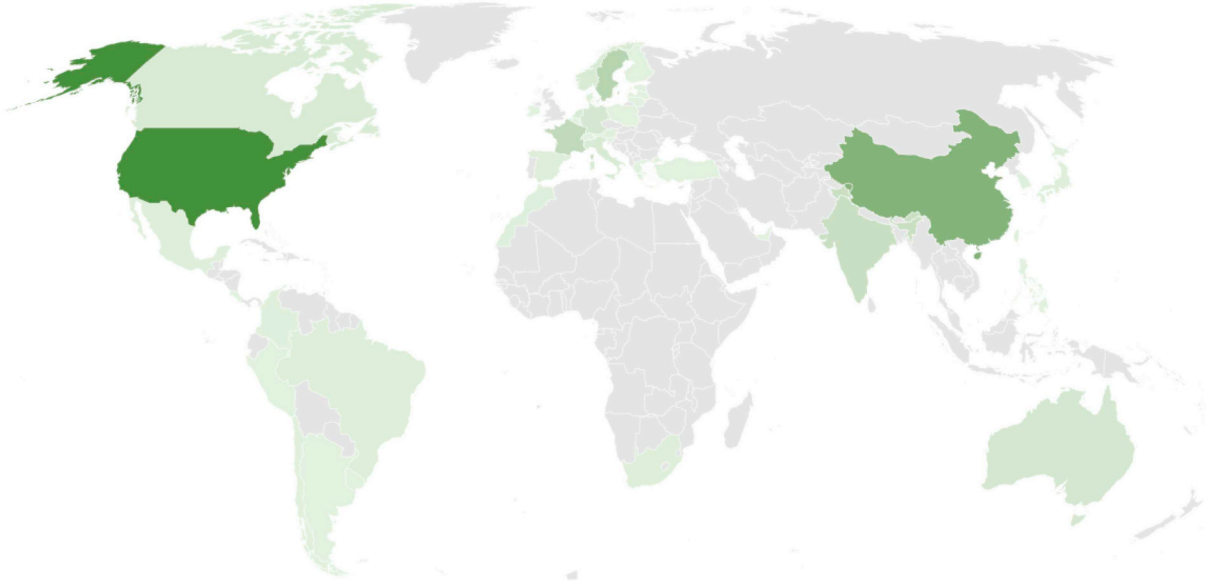

Fig. 2. Geographical distribution of green bonds.
This figure shows that countries around the globe have been issued green bonds until 2018 Q2. We merge the Climate Bond Initiative (CBI) database with the Bloomberg green bond dataset to construct an international green bond dataset. The darker the green, the more issuances of green bonds in a country.

3.2. Descriptive statistics

The first green bond is issued by the European Investment Bank on June 28, 2007 and the issue amount is EUR 600 million. The largest amount is a sovereign green bond issued by the Republic of France and the issue amount is EUR 7 billion.

Fig. 1 displays the green bond global market issuance over time. Whereas the first green bond was issued in 2007, the issue number and amount remain low in the first 5 years because development banks and supranational organizations are the only issuers of green bonds before 2013. Green bond market experiences a skyrocketing boom in 2014 both in amount and in the number of issuances due to commercial banks and corporations. After 2015, the market grows steadily and continue to expand in 2016 and double in 2017. The CBI projects that the green bond market is expected to reach 250 billion annual issuances in 2018.

Fig. 2 shows that green bond issuers' geographical distribution, which is widely spread around the world and beneficial for green investors, especially institutional investors. According to Standard & Poor's estimation, green bonds are one of the best instruments to

Table 1
Green bond sample.

Panel A: Green bond by issuer type and by year

	Development bank	Municipal	Commercial bank	Corporation	State backed	ABS	Sovereign	All
2007	1	0	0	0	0	0	0	1
2008	1	0	0	0	0	0	0	1
2009	4	0	0	0	0	0	0	4
2010	57	5	0	0	0	0	0	62
2011	33	3	0	0	0	0	0	36
2012	23	3	2	0	0	0	0	28
2013	29	4	11	3	2	1	0	50
2014	65	24	28	43	3	7	0	170
2015	105	46	21	178	2	13	0	365
2016	80	59	62	103	9	41	1	355
2017	91	82	85	129	25	23	3	438
Total	489	226	209	456	41	85	4	1510

Panel B: Green bond by country

COUNTRY	Full Sample	# of bonds issued by public issuers	Unique public issuers
SUPRANATIONAL	261	N.A.	N.A.
CHINA	242	54	32
UNITED STATES	195	21	17
SWEDEN	163	32	8
FRANCE	121	28	9
MALAYSIA	54	0	0
GERMANY	64	6	2
NETHERLANDS	43	14	3
NORWAY	35	8	2
CANADA	18	6	3
INDIA	17	9	8
AUSTRALIA	15	7	5
JAPAN	15	9	6
SPAIN	14	7	2
TAIWAN	14	5	5
BRITAIN	13	5	4
SINGAPORE	12	2	2
SOUTH KOREA	12	1	1
HONG KONG	11	5	3
MEXICO	11	1	1
Others	180	21	19
Total	1510	241	132

Panel A shows the issuers' type decomposition of green bonds. The first green bond issuer in the world is the European Investment bank, which is classified as a development bank in our sample. The bonds are issued at a face value of €100 each and pay no coupons during the term. The bonds have full capital protection. At maturity, the bonds have full redemption of the face value plus a minimum payment of 5% – i.e., a minimum redemption of €105 per bond. The first three corporate green bonds are issued in November 13 by Bank of America, Vasakronan, and EDF, a French electricity-generating giant. In this paper, we focus only on public listed firms. Panel B shows the final sample construction and illustrates that we finalize our sample to 132 unique public issuers.

invest in green and sustainable projects.[20] Panel A of Table 1 shows that our initial sample includes 1510 unique observations of green bond issuance globally and includes 209 commercial banks, 456 corporations, 489 development banks, 41 state-backed entities, 209 municipal bonds, 4 sovereigns and 85 green asset-backed securities. Panel B shows that supranational organizations, including IFC, World Bank, EIB, and ADB, are among the most frequent issuers. China, US, and the European countries are the leading issue countries in the green bond market.

We only consider financials and industrial corporations, which accounted for 665 issuances. Then, we select those issuers that are public listed companies. Among those public issuers, we differentiate repeated issues from first-time issues because our media attention hypothesis suggests that when a firm announces its first green bond issuance, it will attract investors' attention. After first-time issuance, the media exposure effect will no longer exist because the firms have already been disclosed to the public. Finally, excluding subsequent issuance, our final sample is reduced to 132 unique public issuers.

Table 2 shows summary statistics for green bond characteristics. Among all green bonds, the average coupon is 3.3%, maturity is 7.6 years and average issue amount per bond is 286 million USD. The subsample of public issuers' green bonds, which are used for our

[20] https://www.spglobal.com/our-insights/Beyond-Green-Bonds-Sustainable-Finance-Comes-of-Age.html.

Table 2
Summary statistics.

Panel A. Bond characteristics

	Mean	Median	Std.	N
All green bonds				
Coupon (percent)	3.3	2.8	2.4	1510
Maturity (year)	7.62	5	6.45	1510
Amount (million)	286	75	575	1510
Public issuers' green bonds				
Coupon (percent)	3.2	2.9	2.2	241
Maturity (year)	6.56	5	4.21	241
Amount (million)	369	153	552	241

Panel B. Firm characteristics

Variable names	Mean	Median	Std.
Leverage	0.375	0.335	0.214
Total asset (ln)	16.93	16.65	2.482
Profitability	0.010	0.014	0.185
Tangibility	0.329	0.212	0.342
Book leverage	0.375	0.335	0.214
Market leverage	0.315	0.288	0.186
Market to book	1.250	1.035	0.589
Cash to asset	0.101	0.073	0.099

This table reports summary statistics for green bonds, public issuers and liquidity measures key variables. Public issuer characteristics use the three-year average of all the accounting data from Compustat Global. The sample consists of all unique firms and the sample period is from 2007Q2 to 2017Q4.

regression analysis, however, have on average a shorter maturity but a larger issue amount.

4. Stock price reaction to green bond announcement

4.1. Event selection

We obtain the announcement date for green bond issuance from Bloomberg and/or reliable news reports (e.g., exchange announcements or official press releases); alternatively, the date is provided directly by the lead manager. For other green bonds whose announcements dates are not provided by Bloomberg, we manually search official company websites, press conferences, and news, whichever is earliest, to identify the closest announcement date. To alleviate the concern that bond issuance has some information linkage, we follow Krüger (2015) to conduct 10- and 21-day event windows. We then match the adjusted stock prices data from Datastream and company financial data from WorldScope. The final sample size is 132 unique public firms.[21]

To conduct our analysis, we exclude asset-backed green bonds and private placement. The reasons for this exclusion are that asset-backed green bond structures are different from normal green bonds, private placement green bonds' detailed financial information is not disclosed, and we cannot easily measure market reactions to a private placement. To obtain public issuers of green bonds, we first check whether the green bond issuer itself is a public listed company. If it is not, we consider whether the parent company of that bond issuer is a publicly listed firm. If the bond is issued in the same country in which the public stock is listed, then we include that stock. If not, we use the primary stock market in that firm's country. The findings are robust for different definitions of green bonds and sample selection. For example, when we use the CBI-only sample, our results are similar.

4.2. Event study analysis

To study stock reaction to bond issuance, we first use the CAPM model to estimate abnormal returns. Because our samples include the international green bond market, we must use data from different stock markets. We decide to use the index of the stock market on which the firm's stock is listed.

We first estimate the beta of each firm using estimation windows starting from 300 trading days to 50 trading days before the announcement date. Then, we use event windows from 10 days before and 10 days after the announcement. In addition, we run a robust check for event windows from 5 days before and 10 days after the announcement. We use index return minus treasury bond yield for market premium and stock return premium in the following regression, and abnormal returns for firm i and event day t are defined as follows:

[21] We list all the public issuers in our Internet Appendix IA.5.

Table 3
Stock market reaction to green bond issuance announcement.

Panel A: First-time vs. subsequent issues

	First-time issue		Subsequent issues	
	(1)	(2)	(3)	(4)
Event window	[−10,10]	[−5,10]	[−10,10]	[−5,10]
CAPM_CAR (%)	1.39**	1.04**	0.12	0.61
	(2.36)	(2.12)	(0.21)	(0.99)
P(Sign-test)	0.0171**	0.0303**	0.5661	0.8667
FF3_CAR (%)	1.41**	1.06**	0.10	0.31
	(2.42)	(2.24)	(0.14)	(0.60)
P(Sign-test)	0.0247**	0.0225**	0.7723	0.7846
FF5_CAR (%)	1.29**	1.01**	0.50	0.23
	(2.19)	(2.07)	(0.76)	(0.40)
P(Sign-test)	0.0513*	0.0492**	0.3014	0.7253
Observations	132	132	109	109

Panel B: Corporates vs. financials

	Corporate		Financial	
	(1)	(2)	(3)	(4)
Event window	[−10,10]	[−5,10]	[−10,10]	[−5,10]
CAPM_CAR (%)	1.88**	1.51**	0.44	0.15
	(2.40)	(2.22)	(0.55)	(0.26)
P(Sign-test)	0.0132**	0.0264**	0.5962	0.5962
FF3_CAR (%)	1.96**	1.59**	0.36	0.09
	(2.54)	(2.42)	(0.45)	(0.15)
P(Sign-test)	0.0160**	0.0152**	0.6820	0.6114
FF5_CAR (%)	1.86**	1.53**	0.22	0.04
	(2.36)	(2.25)	(0.27)	(0.08)
P(Sign-test)	0.0302*	0.0342*	0.8741	0.8058
Observations	86	86	46	46

This table reports the CAR for green bond announcement return. We calculate the cumulative abnormal return (CAR) using the CAPM model. The stock price and market index are from Datastream and Bloomberg. We use the risk-free rate as the ten-year treasury bond yield provided by Bloomberg. We use a 250-day estimation window starting from 300 days before the announcement to 50 days before the announcement. We test for cross-sectional CAR significantly different from zero. P (Sign-test) is the P value for the sign-test and it is non-parametric. (Robust t statistics in parentheses *** $p < .01$, ** $p < .05$, * $p < .1$.)

$$R_{i,t} - R_{f,t} = a_i + \beta_i \times (R_{m,t} - R_f) + \epsilon_{i,t} \quad (1)$$

$$AR_{it} = R_{it} - \widehat{R}_{it} \quad (2)$$

where a_i and β_i are all estimated parameters from the CAPM model. Column (1) of Panel A of Table 3 shows the result for the market reaction for the 21-day event window. We find that the stock market reacts positively and statistically significant (1.39%, *t*-statistic 2.36) around the green bond announcement. In Column (2), the stock market reacts from 5 days before to 10 days after the announcement date, and the CAR is approximately +1.04% (*t*-statistic is 2.12).

To further confirm stock market positively reacts to the green bond issuance, we conduct a nonparametric Wilcoxon signed-rank test. In Column (1), from 10 days before the announcement to 10 days after the announcement, the stock market's cumulative abnormal returns sign rank test *P* value is 0.0171, so we can reject the null hypothesis that CAR is not different from 0. Column (2) shows that we can reject the −5- to 10-day event window CAR also not different from 0 (P value 0.0303). The way to interpret the results is as follows: an event study on green bond issuance can be considered as one way to examine the information content of corporate news regarding environmental issues. The positive stock market reaction represents the "green label" effect, indicating that the firm's green projects are certified to have an environmental impact. Thus, the market will reward the company with a higher firm value. A similar pattern has been shown by Klassen and McLaughlin (1996), who demonstrated that firms receiving environmental awards will have a significant positive abnormal return afterward. From Fig. 3, Google search volume peaked after Apple Inc. announced its green bond issuance on June 13, 2017, and search intensity remained high in the following week, which can also support our long event window arguments.

In comparison, in the straight bond issuance announcement literature, Eckbo (1985) find that the stock market reaction to a straight bond issuance is associated with a slightly negative return in the shorter window. We are cautious about this argument because we consider a green bond announcement to involve two important aspects: the bond announcement effect and the "green label" effect. Normally, when researchers consider bond issuance, they typically analyze a short window around the event date.

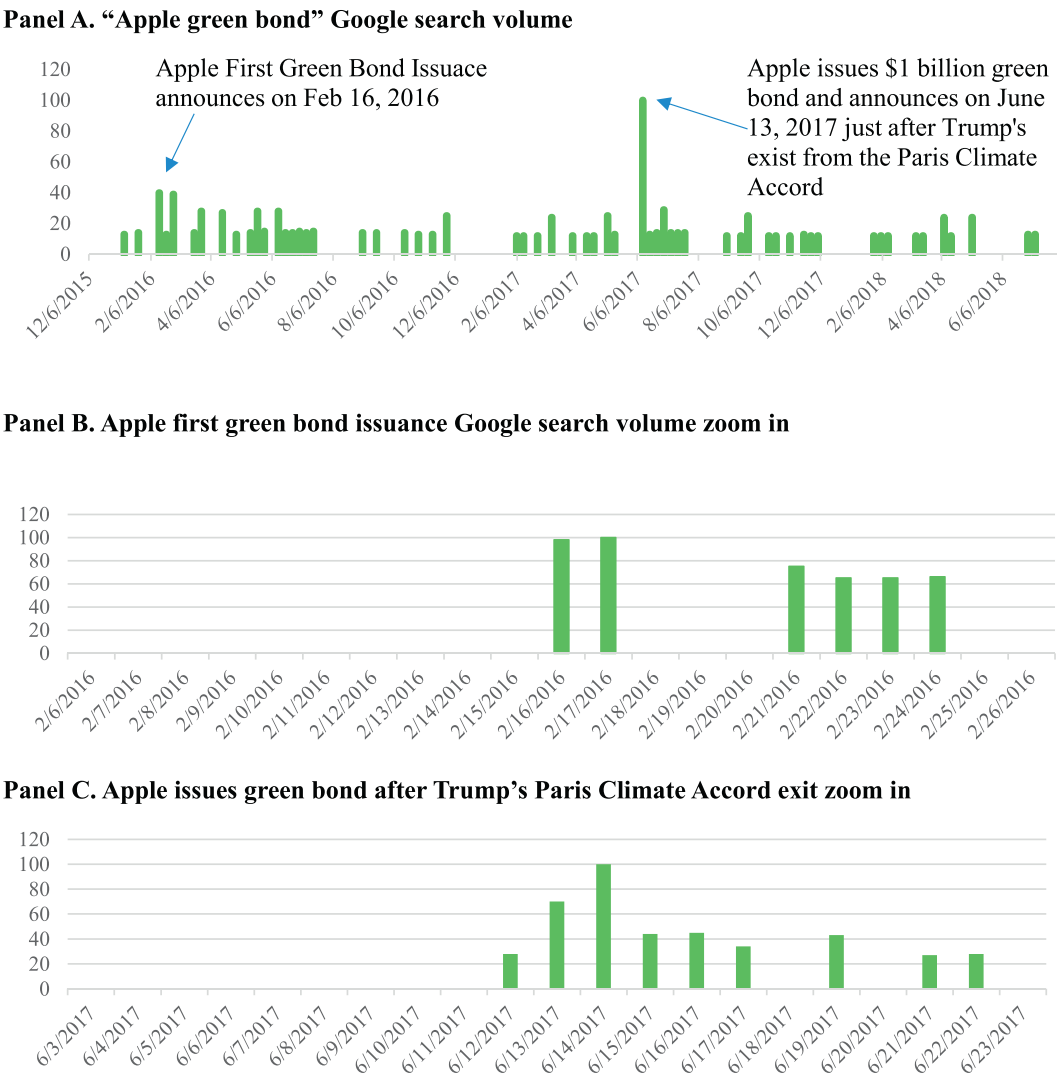

Fig. 3. Apple green bond Google search volume.
This figure shows search intensity of "Apple Green Bond" on Google. Time period is from Jan 1, 2016, to August 1, 2018.

However, when researchers study an information disclosure or announcement of the positive/negative event, they tend to pay attention to a longer period. In this way, we present both the results and the longer period as more significant, so that we believe that the label effect is more important in green bond setting, which suggests that green bond issuance can be treated as an environmental award to green bond issuers. In addition, to visualize the positive stock market reaction, we show stock returns around the announcement date in Fig. 4.

For robustness, we use multi-factor models to calculate the abnormal return. We use Fama and French 3-factor (Fama and French, 1993) and 5-factor models (Fama and French, 2015). We find that in the 21-day event window, FF3 and FF5 are associated with 1.41% (t stat 2.42) and 1.29% (t stat 2.19), respectively. From 5 days before to 10 days after the announcement date, the stock market reacts to 1.06% and 1.01% in the FF3 and FF5 models. All the results are robust to the sign rank test.

In Columns (3) and (4) in Panel A of Table 3, we consider subsequent green bond issuance. According to investor attention, green bond issuers should not benefit from the label effect after their first-time green bond issuance. The reason for this is that after the company has successfully labeled a bond green and disclosed it to all investors, we should not find any positive effect for subsequent green bond issuance. On the contrary, the "fundamental" channel suggests investment opportunities when firms issue green bonds and it will react every time firms announce their issuances. As shown in Columns (3) and (4) of Panel B, the stock market reaction is not significant (0.12% and 0.61%, respectively), indicating that the "fundamental" channel seems not to be the driving force of positive announcement return.

Which types of green bond issuers are more likely to be rewarded by the stock market? To answer this question, we further differentiate the business sectors of green bond issuers. The reasons we conduct this analysis are twofold. First, the mechanisms

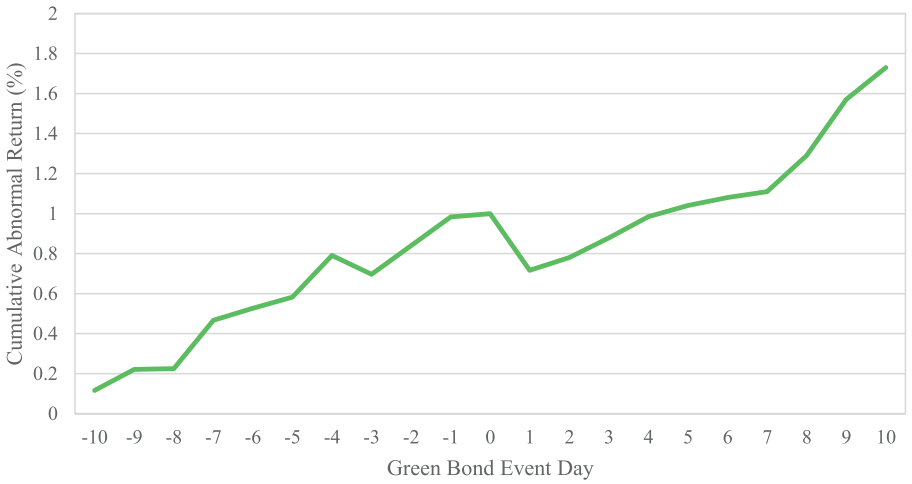

Fig. 4. Stock market reaction to green bond issuance announcement.
This figure illustrates the stock market reaction to the green bond announcement around a 20-day event window. We use CAPM to calculate abnormal return, and the estimation window is from $[-300, -50]$.

between two major types of green bond issuers are different. Corporations issue green bonds to finance their own green projects, which is the core competency of their business. Another type of issuer is financial institutions, who will issue green bonds to make green loans to their borrowers or invest in other firms' green projects. There are fewer financial issues, but their amounts are larger. Second, we argue there is a need for studies involving CSR and ESG to further analyze the cross-industry effect. For instance, renewable energy companies might be much more exposed to environmental issues and benefit more than financial institutions.

We report the results for the financials and corporates test in Columns (1)–(4) in Panel B of Table 3. Columns (1) and (2) show the event study analysis for corporates. In Column (1), the CAPM model is 1.88% and statistically significant (t statistics 2.40). The results are similar for the FF3 and FF5 models. However, we find an insignificant stock market reaction for financials issuing green bonds. The results suggest that only firms conducting green projects will benefit from increasing valuation.

5. Channels and mechanisms

In this section, we examine potential channels through which green bond issuance can affect the stock valuation of the issuers. We construct measures to examine those channels and then provide empirical evidence.

5.1. Green premium

The “financing cost” channel implies that socially responsible investors will pursue holding green bonds to boost their ESG scores and thus to increase demand for those bonds. Correspondingly, green bond issuers can benefit from lower cost of capital and thus, the stock market reacts positively to the green bond announcement.

A basic measure of the green bond pricing benefit is yield spread at issuance. We download data from the SDC Platinum New Issues database. We collected more information from Bloomberg and filling in missing data with bonds from the nearest issue date and maturity. Our sample includes all the normal corporate bonds issued by the green bond issuers from 2007 to 2017, and we can conduct a within-firm comparison between green bonds and conventional bonds issued by the same firm. Moreover, we match a similar firm according to size, market to book and stock liquidity because higher liquidity tends to issue corporate bonds (Butler and Wan, 2010). Additionally, we must ensure that matched firms also have conventional bond issuances in the same year as green bond issuers. The choice of yield spread determinants is largely based on Campbell and Taksler (2003), Chen et al. (2007) and Badoer and James (2016).

While there is anecdotal evidence suggesting a green bond premium,[22] the yield spread difference between and within firms is unclear. In Table 4, we regress the yield spread at the issuance date on the green bond dummy and control variables associated with bond characteristics and firm characteristics.

$$\begin{aligned} Yield\ Sprd_{i,t} = {} & \beta_1 + \beta_1 \times Green_{it} + \beta_2 \times Equity\ Volatility_{it} + \beta_3 \times Bond\ Rating_{it} + \beta_4 \times Maturiy_{it} + \beta_5 \times Issue\ Size_{it} \\ & + Firm\ Controls_{it} + Issuer\ FE + Issuer\ Year\ FE + \epsilon_{it} \end{aligned} \quad (3)$$

where yield spread is the issue yield spread from SDC Platinum Global Issue database and green is an indicator equal to 1 if the bond

[22] https://www.ft.com/content/9396fb28-ca2b-11e7-ab18-7a9fb7d6163e.

Table 4
Green bond yield spread.

	Yield Spread			
	(1)	(2)	(3)	(4)
Green	−0.0694**	−0.0639*	−0.0588	−0.008
	(−2.19)	(−1.81)	(−1.62)	(−0.02)
Equity volatility	45.365***	47.383***	19.707*	3.144
	(5.76)	(5.90)	(1.95)	(0.16)
Bond rating (BBB or worse)	0.274**	0.252**	0.058	−0.198
	(2.57)	(2.30)	(0.49)	(−1.63)
Maturity	0.057***	0.059***	0.059***	0.054***
	(6.97)	(7.14)	(6.59)	(5.98)
Issue size	−0.256***	−0.240***	−0.221***	−0.205***
	(−11.06)	(−9.67)	(−8.21)	(−7.67)
Firm size			−2.976***	−0.350
			(−7.73)	(−0.69)
Leverage			0.772***	−0.095
			(4.98)	(−0.47)
Profitability			0.150	−0.148
			(1.27)	(−0.98)
Tangibility			0.175	0.189
			(1.58)	(1.52)
Country FE	YES	NO	NO	NO
Issuer FE	NO	YES	YES	YES
Year by month FE	NO	NO	NO	YES
No. firms issue both bonds	41	41	41	41
R-squared	0.311	0.356	0.278	0.386
Observations	2435	2435	2435	2435

The table presents a yield spread analysis of green bond issuance. The dependent variable is yield spread in percentage at issuance date. The control pool includes matched control firms' issuance of normal green bonds and the same firms' issuance of normal corporate bonds. We collect all the bonds from SDC Platinum Global Issuance database. The sample starts in 2007 and ends in 2017. Size is the log of market capitalization of the firm. Leverage refers to the leverage ratio, calculated as the firm's total debt divided by the market value of total assets. Cash is the ratio of cash and short-term investments to total assets. Heteroscedasticity-consistent *t*-statistics clustered at the firm level are reported in brackets. *, **, and *** represent statistical significance at the 10%, 5%, and 1% level, respectively.

is a green bond and 0 otherwise. Bond rating equals 1 if the rating is lower than investment grade and 0 otherwise.

The fixed effects we consider include year by month, country, and issuer fixed effects. If we only add country fixed effects, we find a 6.9 bps premium, which is a very large pricing benefit for the firm, indicating that compared with other conventional bonds issued by the match firms, green bonds have pricing benefits. However, when we add firm fixed effect and year by month fixed effects, which only examine bond yield spread differences issued by the same issuer within the same year and month, the yield spread is no longer statistically significant. Therefore, the “financing cost” channel seems not to be the driving force of positive announcement returns. We note that only 41 firms have issued both regular corporate bonds and green bonds during our sample period. Such a relatively smaller sample may limit the power of the test.

5.2. Institutional ownership

The “investor attention” channel suggests increasing media exposure when firms announce their green bond issuance. This exposure will send a good signal to the market about such firms' green investment opportunities therefore enlarge their investor base. As shown in Fig. 5, there is a higher stock market turnover around the green bond issuance month.

Institutional ownership data are from the FactSet (LionShares) database for the period from 2007 to 2017. Institutional investors contained in the database can be classified into different sub-categories, including mutual funds, pension funds, hedge funds, banks and insurance companies. For equities traded in the United States, the stock holding data are from 13F mandatory filings required by SEC. For equities traded in countries other than the US, FactSet gathers all the information from company announcements, regulatory agencies and annual reports. We also collected more firm-level characteristics data by using Datastream to fill out the missing information. We also use a matching sample and conduct a diff-in-diff analysis, and the criterion is the same as in the previous section.

Our empirical test regarding institutional ownership includes both a green dummy, a post dummy and their interaction to analyze the institutional ownership change after green bond issuance compared with conventional corporate bond issuance. We follow Ferreira and Matos (2008) and Chung and Zhang (2011) in our empirical design. We include country and year fixed effects in all the specifications in Table 5. Our specification is as follows:

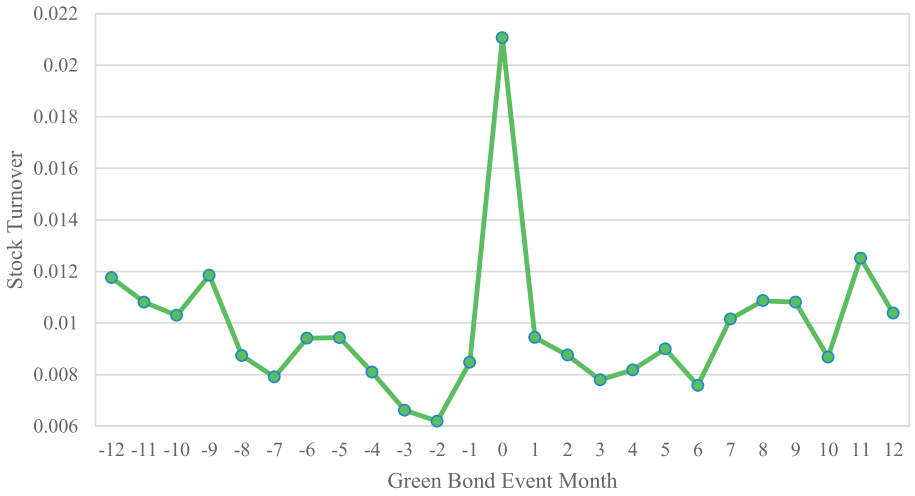

Fig. 5. Average daily turnover around issuance of green bonds.
This figure shows green bond public issuers' trading behavior. Vertical axis is average turnover by volume (VO from Datastream) in a given month scaled by total shares outstanding. Time period is from Jan 1, 2016, to August 1, 2018.

Table 5
Institutional ownership diff-in-diff analysis.

	(1)	(2)	(3)	(4)
	IO	IO	Log(IO_USD)	Log(IO_USD)
Green*Post	0.056*	0.079**	0.099***	0.097***
	(2.03)	(2.71)	(5.40)	(4.71)
Post	0.093***	0.085***	0.0843***	0.0973***
	(3.02)	(3.19)	(9.52)	(4.52)
Green	−0.034***	−0.020***	−0.0409***	−0.0134*
	(−10.85)	(−3.95)	(−8.73)	(−1.85)
Size		−0.018***		0.384***
		(−5.91)		(26.68)
Leverage		0.144***		1.981***
		(5.52)		(7.45)
ROA		0.512***		7.435***
		(4.36)		(11.57)
Cash		−0.127**		−2.299***
		(−2.22)		(−5.03)
Profitability		0.116***		0.006
		(10.59)		(0.05)
Dividend		−0.251***		−0.565**
		(−5.79)		(−2.50)
Country FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Robust	YES	YES	YES	YES
R-squared	0.042	0.195	0.100	0.267
Observations	7179	6739	7179	6739

This table presents the results of institutional investors' ownership change after firms have successfully labeled their bonds green. Following Ferreira, Miguel, and Pedro Matos, 2008, the data range from 2000 to 2017. Institutional ownership (IO) is defined as total institutional ownership in percentage of market capitalization. Institutional ownership dollar value is defined as log of total institutional ownership in dollar market capitalization. Size is the log of market capitalization of the firm. Leverage refers to the leverage ratio, calculated as the firm's total debt divided by the market value of total assets. Cash is the ratio of cash and short-term investments to total assets. Heteroskedasticity-consistent *t*-statistics clustered at the firm level are reported in brackets. *, **, and *** represent statistical significance at the 10%, 5%, and 1% level, respectively.

$$Inst\ own_{i,t} = \beta_0 + \beta_1 \times Green_{it} \times Post_{it} + \beta_2 \times Green_{it} + \beta_3 \times Post_{it} + \beta_4 \times Size_{it} + \beta_5 \times Leverage_{it} + \beta_6 \times Profitability_{it} + \beta_7 \times Cash_{it} + \beta_8 \times R\&D_{it} + \beta_9 \times Sale_{it} + \beta_{10} \times Dividend_{it} + Country\ FE + Year\ FE + \epsilon_{it} \quad (4)$$

In Table 5, all the specifications are positively significant. In Column 2, after green bond issuance, institutional ownership increases by 7.9% compared with conventional bonds issued by the match firms.

Moreover, there is a home bias for domestic investors (Coval and Moskowitz (1999), Schumacher (2018)) and they are more

Table 6
Institutional ownership: foreign vs. domestic investors.

	(1)	(2)	(3)	(4)
	io_dom	io_dom_indep	io_for	io_for_indep
Green*Post	0.085***	0.076**	−0.005	−0.019***
	(3.20)	(2.88)	(−1.65)	(−3.52)
Post	0.097***	0.094***	−0.012*	−0.017**
	(3.76)	(3.61)	(−1.76)	(−2.34)
Green	−0.007	−0.007	−0.013***	−0.024***
	(−1.55)	(−1.69)	(−7.31)	(−10.46)
Size	−0.018***	−0.018***	−0.000	0.005***
	(−7.57)	(−8.01)	(−0.04)	(2.92)
Leverage	0.186***	0.194***	−0.041**	−0.053*
	(8.65)	(9.90)	(−2.53)	(−2.06)
ROA	0.258**	0.285**	0.255***	0.229***
	(2.22)	(2.68)	(9.80)	(6.29)
Cash	−0.222***	−0.192***	0.095***	0.059***
	(−3.78)	(−3.43)	(4.86)	(3.35)
Profitability	0.095***	0.070***	0.022***	0.013**
	(7.06)	(6.02)	(3.46)	(2.36)
Dividend	−0.353***	−0.342***	0.102***	0.017
	(−9.92)	(−10.24)	(7.32)	(1.23)
Country FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Robust	YES	YES	YES	YES
R-Squared	0.197	0.201	0.183	0.562
Observations	6739	6739	6739	6739

This table presents the results of foreign and domestic institutional investors' ownership change after firms have successfully labeled their bonds green. Following Ferreira, Miguel, and Pedro Matos, 2008, the data range from 2000 to 2017. Institutional ownership is defined as total institutional ownership in percentage of market capitalization. Independent institutions include mutual funds and independent investment advisers. Size is the log of market capitalization of the firm. Leverage refers to the leverage ratio, calculated as the firm's total debt divided by the market value of total assets. Cash is the ratio of cash and short-term investments to total assets. Heteroskedasticity-consistent *t*-statistics clustered at the firm level are reported in brackets. *, **, and *** represent statistical significance at the 10%, 5%, and 1% level, respectively.

subject to the attention-driven effect than foreign investors. In Table 6, according to Ferreira, Miguel, and Pedro Matos (2008), we separate domestic institutional investors from foreign institutional investors. Columns 1 and 2 of Table 6 suggest that only domestic investors and domestic independent investors increase their holdings in firms that issue green bonds by 8.5% (robust t-statistics 3.20) and 7.6%, respectively, which is both statistically and economically significant.

5.3. Stock liquidity

The “firm fundamental” channel implies that green bonds illustrate the firm's valuable investment opportunities. Furthermore, green projects associated with future positive cash flow can help firms survive in the long run. We adopt stock liquidity tests to differentiate the “fundamental” channel from the “investor attention” channel.

We use the quoted bid-ask spread divided by the mid-point of the bid-ask price as a proxy for stock liquidity. In addition to the widely used quoted spread measure, we follow Amihud's (2002) methods to calculate stock liquidity and use the absolute return scaled by dollar trading volume and average among different periods to represent the illiquidity of stock. Fong et al. (2017) analyze the best liquidity proxy for global research and determine that the Amihud measure provides the best monthly cost-per-dollar-volume proxies. The detailed calculation method is as follows:

$$Illiquidity_i = \frac{1}{Days_i} \sum_{t=1}^{Days_i} \frac{|Return_{it}|}{Volume_{it}} \tag{5}$$

The Amihud illiquidity measure is a daily high-frequency measure, so we will take the arithmetic mean of all the trading days' daily illiquidity to obtain the monthly Amihud illiquidity. Through a simple univariate analysis, we find that liquidity increases after issuing a green bond. In our full sample analysis, both of our measures of liquidity increase after issuing green bonds.[23] Next, we construct a balanced sample for one year before and one year after issuing green bonds. We un-tabulated univariate test for which the results are available upon request.

5.3.1. Panel Regressions

Now we conduct a panel regression and control for firm characteristics, liquidity control variables and firm and year fixed effects.

[23] This means that both the quoted spread and the Amihud illiquidity measure decrease.

Table 7
Stock liquidity before and after issuing green bond.

	(1)	(2)	(3)	(4)
	Quoted spread	Quoted spread	Amihud	Amihud
Post	−0.0546***	−0.0830***	−0.152***	−0.127***
	(−2.96)	(−4.45)	(−2.61)	(−3.23)
Price		−0.00453***		−0.00673*
		(−3.13)		(−1.69)
Volume (log)		−0.112***		−0.610***
		(−6.36)		(−6.77)
Volatility		0.0414***		0.0987***
		(2.78)		(4.13)
Size		−0.135***		−0.304***
		(−2.64)		(−2.76)
Firm FE	YES	YES	YES	YES
Year FE	NO	YES	NO	YES
R-squared	0.03	0.48	0.015	0.461
Observations	2914	2792	2914	2792

Amihud illiquidity measure is calculated using absolute stock return divided by dollar trading volume on that day. We take a monthly average of all the available trading days in that calendar month. The higher the Amihud measure, the less liquid the stock. The quoted spread is calculated using bid price minus ask price divided by the average of bid price and ask price. The larger the quoted spread, the less liquid the stock. Because our liquidity measure is highly skewed, we take the logarithm. Heteroskedasticity-consistent *t*-statistics clustered at the firm level are reported in brackets. *, **, and *** represent statistical significance at the 10%, 5%, and 1% level, respectively.

The specification we use for a panel regression is as follows:

$$Liquidity_{it} = a + b \times Post_{it} + FirmCharacteristics_{it} + FE + \epsilon_{it} \quad (6)$$

Illiquidity is a log transferred measure: the larger the value, the less liquid the stock. The post dummy equals zero before bond issuance and one otherwise. FE includes firm fixed and year fixed effects. The results are shown in Table 7.

We use the Amihud method as a robustness check because Lesmond (2005) suggests that the Amihud method performs well in cross-country analysis. The reason we take the logarithm of Amihud is that the liquidity measures are highly skewed. Although this approach does not change our linear estimator, it will bias our statistical inference so that we take the logarithm to obtain a normal distribution of our dependent variable. We calculate the daily Amihud measure and take the average in that calendar month. After issuing green bonds, green bond issuers' stock liquidity improves significantly in the one-year horizon. Not only is this statistically significant, but we can also recognize that the result is economically meaningful. In the baseline result in Column 1 of Table 7, one year after green bond issuance, issuers' stock liquidity improves by 4.87% (exp(−0.0546)-1) compared with before. Next, we add firm fixed and year fixed effects to control for unobserved factors. Additionally, we calculate the heteroskedasticity-consistent robust standard error, and the results are consistent.

In Column 2 of Table 7, we add firms' characteristics as control variables and find out that after issuance, quoted spread liquidity measure decrease −8.3%, we take the exponential of that and interpret it as stock liquidity increases by 7.96%. In Column 4 of Table 7, we find that stock market liquidity improves 11.9% (exp(−0.127) − 1) after issuance.

5.3.2. Matching sample and diff-in-diff analysis

The results have already been addressed with some concerns about endogeneity; however, the liquidity trend could still bias our results if all firms' liquidity has improved in the green bond issue year. First, we argue that this is an international study, and we do not expect to see the same event occur at the same time and have a positive impact on stock liquidity. Second, to further alleviate this concern, we analyze a matching sample and test conditionally on whether liquidity improves and whether green bond issuers would benefit more than conventional bond issuers. We use a matching method and choose criteria according to their size, market-to-book, and previous year liquidity. We restrict the matching firm sample listed on the same exchange as green bond issuers.

We impose further restrictions on matching firms' criteria. There is no evidence to suggest that after corporate bond issuance, stock liquidity will increase. However, there could be some omitted variables that induce the firms with a higher propensity to issue bonds while leading to future stock liquidity increases. To tackle those issues, we not only match the sample according to size, market-to-book, previous year liquidity and in the same industry, same country, same exchange but also restrict the matching firm sample with bond issuances the same year.

In Fig. 6, we show that prior to green bond issuance, green bond issuers and match firms' stock liquidity trend are parallel and have no significant differences. Nevertheless, after green bond issuance, green bond issuers' liquidity increases much more than straight corporate bonds issued by the match firms. We further run a diff-in-diff analysis to confirm our hypothesis, and our regression model is as follows:

$$Liquidity_{it} = a + b \times Post_{it} + c \times Green_{it} + d \times Post_{it} \times Green_{it} + Firm\ Controls_{it} + Year\ FE + \epsilon_{it}$$

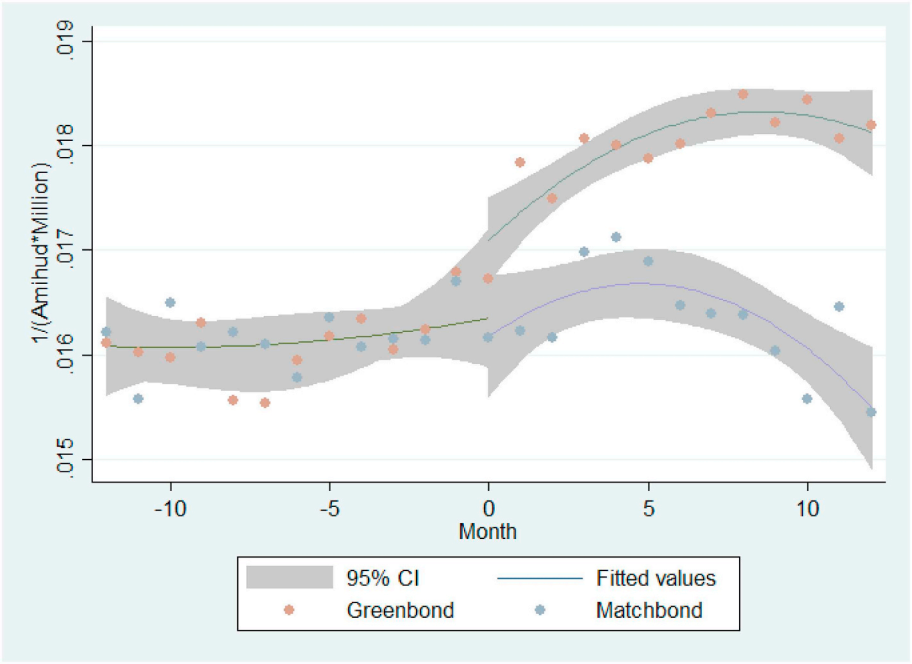

Fig. 6. Stock liquidity before and after green bond issuance.
This figure shows stock liquidity in terms of the Amihud measure (absolute return over trading volume) before and after the green bond issuance compared with matched firms. We match firms according to size, book to market, industry, and previous year stock liquidity. More importantly, we select matching firms that also issue normal corporate bonds in the same year as green bond issuers to alleviate the concern that bond issuance generally will improve stock liquidity.

Table 8
Stock liquidity before and after green bond issuance: matching sample analysis.

	Quoted Spread		Amihud	
	(1)	(2)	(3)	(4)
	All sample	All sample	All sample	All sample
Green*Post	−0.0672*	−0.01274**	−0.0110**	−0.022**
	(−1.96)	(−2.09)	(−1.96)	(−2.44)
Post	0.0122	−0.0141***	−0.0476***	−0.0119***
	(−0.37)	(−3.35)	(−12.57)	(−9.26)
Green	0.1091	−0.0835	0.0863	−0.0633
	(−1.34)	(−0.26)	(−0.48)	(−0.36)
Control	NO	YES	NO	YES
Year FE	YES	YES	YES	YES
Country FE	YES	YES	YES	YES
R-squared	0.012	0.246	0.024	0.483
Observations	5824	5442	5824	5442

Amihud illiquidity measure is calculated using absolute stock return divided by dollar trading volume on that day. We take a monthly average of all the available trading days in that calendar month. The higher the Amihud measure, the less liquid the stock. The quoted spread is calculated using bid price minus ask price divided by the average of bid price and ask price. The larger the quoted spread, the less liquid the stock. Because our liquidity measure is highly skewed, we take the logarithm. We match our sample according to size, market to book and previous year liquidity to control for the trend. We further restrict our matching sample to have a normal bond issued in the same year. Heteroskedasticity-consistent *t*-statistics clustered at the firm level are reported in brackets. *, **, and *** represent statistical significance at the 10%, 5%, and 1% level, respectively.

The post is a dummy and equals one after bond issuance; before issuance it is zero. Green is also a dummy that equals one for green bond issuers and zero for non-green bond issuers. We find that post-issuance liquidity is improving and green bond issuers' stock liquidity increases > 1.27% compared with match firms, as shown in Column 2 of Table 8. In the Amihud measure, we find a 2.2% stock liquidity increase for green bond issuers compared with match firms. To further confirm our hypothesis, we test on a

Table 9
Stock liquidity before and after green bond issuance: initial ESG condition.

	(1)	(2)	(3)	(4)
	Quoted_Spread	Quoted_Spread	Amihud	Amihud
Green_Post_ESG coverage	0.00345***	0.00120	0.00291*	0.00600**
	(2.84)	(0.60)	(1.81)	(2.45)
Green	0.0730	0.0332	0.0103	−0.0106***
	(0.09)	(1.01)	(0.13)	(−5.20)
Post	−0.0181**	0.0962	−0.0300***	0.01252
	(−2.34)	(1.24)	(−2.94)	(1.31)
ESG	−00.717	0.0857	−0.0219***	−0.0103**
	(−0.84)	(1.17)	(−2.62)	(−2.21)
Green_Post	−0.0195*	−0.0115	−0.0139	−0.0190*
	(−1.69)	(−1.41)	(−0.92)	(−1.95)
Size		−3.09		−2.16***
		(−1.37)		(−7.21)
Profitability		0.177		0.163
		(1.28)		(0.93)
Leverage		0.699***		0.400*
		(4.20)		(1.92)
Dividend		0.0518		−0.408***
		(0.78)		(−5.15)
Country FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
R-squared	0.031	0.063	0.122	0.158
Observations	5824	5442	5824	5442

The Amihud illiquidity measure is calculated using absolute stock return divided by dollar trading volume on that day. We take a monthly average of all the available trading days in that calendar month. The higher the Amihud measure, the less liquid the stock. The quoted spread is calculated using bid price minus ask price divided by the average of bid price and ask price. The larger the quoted spread, the less liquid the stock. Because our liquidity measure is highly skewed, we take the logarithm. ESG coverage is defined as this firm being covered by the RepRisk ESG database. We match our sample according to size, market to book and previous year liquidity to control for the trend. We further restrict our matching sample to have a normal bond issued in the same year. Heteroskedasticity-consistent *t*-statistics clustered at the firm level are reported in brackets. *, **, and *** represent statistical significance at the 10%, 5%, and 1% level, respectively.

shorter horizon for diff-in-diff methods. We study 3 months and 6 months before and after the announcement date, and the results are robust.[24]

5.3.3. Conditioning on initial ESG profiles

If the media attention channel leads to a positive abnormal return and subsequent stock liquidity improvement, then the firms' prior ESG profiles will have different effects. In particular, companies that have been already been exposed to ESG attention, that are under examination by a third party, or that have relatively high ESG profiles will benefit less from green bond issuance. Their ESG profiles have been understood by investors such that they will not attract as much attention as firms with less ESG coverage. To confirm this hypothesis, we interact ESG coverage with Green*Post term and analyze heterogeneous effects on prior ESG profiles status. The specification is as follows:

$$Liquidity_{it} = a + b \times Post_{it} \times Green_{it} \times ESG\ Coverage_{it} + b \times Post_{it} \times Green_{it} + c \times Post_{it} + d \times Green_{it} + e \times ESG\ Coverage_{it} + Firm\ Controls + Country\ FE + Year\ FE + \epsilon_{it}$$

ESG coverage equals 1 if the firm is covered by RepRisk ESG database at time t. In Columns (2) and (4) of Table 9, we include controls and fixed effects, and standard errors are clustered at the firm level. In Column (1), green bond issuance will increase the firm's stock liquidity by 1.95%; however, if the firm has already been covered by the ESG database, the liquidity improvement will be 0.34% less (*t*-statistic = 2.849). Additionally, the results are robust to the Amihud illiquidity measure.

6. Conclusion

In this paper, we construct a comprehensive dataset covering all corporate green bond issuance worldwide to provide the first empirical analysis of the market's reaction to firms' environmental, social, and governance (ESG) activities. Green bond issuance can be viewed as a proxy for firms to make environmentally friendly investments and change their ESG profiles. We find that the issuers' stock prices increase significantly around the announcement of green bond issuance. Stock market reactions are stronger for first-time issuers than for repeated issuers and stronger for corporate issuers than for financial institution issuers.

[24] See Internet Appendix IA.4 for the estimation results.

We explore three potential sources of positive announcement returns. We find little evidence that green bonds are issued at lower yields than regular corporate bonds from the same issuers, suggesting that the main advantage of green bonds is not cheaper debt financing. However, we find increased institutional ownership and improved stock liquidity after green bond issuance. Green bonds can help enlarge the investor base because issuing green bonds can attract more media exposure and be used by impact investors to satisfy their investment mandates. Overall, our findings suggest that existing shareholders derive net benefits from green bond issuance.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jcorpfin.2018.12.001.

References

Amihud, Y., 2002. Illiquidity and stock return: cross-section and time-series effects. J. Financ. Mark. 5, 31–56.
Badoer, D., James, C., 2016. The determinants of long-term corporate debt issuances. J. Financ. 71 (1), 457–492.
Baker, M., Bergstresser, D., Serafeim, G., Wurgler, J., 2018. Financing the Response to Climate Change: The Pricing and Ownership of U.S Green Bonds. (Unpublished working paper).
Barber, B., Morse, A., Yasuda, A., 2018. Impact Investing. (Unpublished working paper).
Bénabou, R., Tirole, J., 2006. Incentives and prosocial behavior. Am. Econ. Rev. 96 (5), 1652–1678.
Bénabou, R., Tirole, J., 2010. Individual and corporate social responsibility. Economica 77 (305), 1–19.
Ben-Rephael, A., Da, Z., Israelsen, R., 2017. It depends on where you search: institutional investor attention and underreaction to news. Rev. Financ. Stud. 30, 3009–3047.
Bhandari, A., Javakhadze, D., 2017. Corporate social responsibility and capital allocation efficiency. J. Corp. Financ. 43, 354–377.
Bialkowski, J., Starks, L., 2016. SRI Funds: Investor Demand, Exogenous Shocks and ESG Profiles. (Unpublished working paper).
Butler, A., Wan, H., 2010. Stock market liquidity and the long-run stock performance of debt issuers. Rev. Financ. Stud. 23 (11), 3966–3995.
Campbell, J., Taksler, G., 2003. Equity volatility and corporate bond yields. J. Financ. 58 (6), 2321–2350.
Cao, J., Liang, H., Zhan, X., 2018. Peer effects of corporate social responsibility. Manage. Sci (Forthcoming).
Chava, S., 2014. Environmental externalities and cost of capital. Manag. Sci. 60 (9), 2223–2247.
Chen, L., Lesmond, D., Wei, J., 2007. Corporate yield spreads and bond liquidity. J. Financ. 62 (1), 119–149.
Chen, T., Dong, H., Lin, C., 2018. Institutional shareholders and corporate social responsibility: evidence from two quasi-natural experiments. J. Financ. Econ (Forthcoming).
Cheng, I., Hong, H., Shue, K., 2016. Do Managers Do Good With Other Peoples' Money? (Unpublished working paper).
Chung, K., Zhang, H., 2011. Corporate governance and institutional ownership. J. Financ. Quant. Anal. 46 (1), 247–273.
Coval, J., Moskowitz, T., 1999. Home bias at home: local equity preference in domestic portfolios. J. Financ. 54 (6), 2045–2073.
Dimson, E., Karakaş, O., Li, X., 2015. Active ownership. Rev. Financ. Stud. 28 (12), 3225–3268.
Dyck, I., Lins, K., Roth, L., Wagner, H., 2018. Do institutional investors drive corporate social responsibility? International evidence. J. Financ. Econ (Forthcoming).
Eccles, R., Ioannou, I., Serafeim, G., 2014. The impact of corporate sustainability on organizational processes and performance. Manag. Sci. 60 (11), 2835–2857.
Eckbo, B., 1985. Valuation effects of corporate debt offerings. J. Financ. Econ. 15, 119–151.
Edmans, A., 2011. Does the stock market fully value intangibles? Employee satisfaction and equity prices. J. Financ. Econ. 101 (3), 621–640.
Edmans, A., Li, L., Zhang, C., 2017. Employee Satisfaction, Labor Market Flexibility, and Stock Returns Around the World. (Unpublished working paper).
El Ghoul, S., Guedhami, O., Kwok, C., Mishra, D., 2011. Does corporate social responsibility affect the cost of capital? J. Bank. Financ. 35 (9), 2388–2406.
Fama, E., French, K., 1993. Common risk factors in the returns on stocks and bonds. J. Financ. Econ. 33 (1), 3–56.
Fama, E., French, K., 2015. A five-factor asset pricing model. J. Financ. Econ. 116 (1), 1–22.
Febi, W., Schäfer, D., Stephan, A., Sun, C.C., 2018. The impact of liquidity risk on the yield spread of green bonds. Financ. Res. Lett. 27, 53–59.
Ferreira, M., Matos, P., 2008. The colors of investors' money: the role of institutional investors around the world. J. Financ. Econ. 88 (3), 499–533.
Flammer, C., 2018. Corporate Green Bonds. (Unpublished working paper).
Flammer, C., Kacperczyk, A., 2016. The impact of stakeholder orientation on innovation: evidence from a natural experiment. Manag. Sci. 62 (7), 1982–2001.
Fong, K., Holden, C., Trzcinka, C., 2017. What are the best liquidity proxies for global research? Rev. Financ. 21 (4), 1355–1401.
Frieder, L., Subrahmanyam, A., 2005. Brand perceptions and the market for common stock. J. Financ. Quant. Anal. 40 (1), 57–85.
Geczy, C., Jeffers, J., Musto, D., Tucker, A., 2018. Contracts With Benefits: The Implementation of Impact Investing. (Unpublished working paper).
Goss, A., Roberts, G., 2011. The impact of corporate social responsibility on the cost of bank loans. J. Bank. Financ. 35 (7), 1794–1810.
Grullon, G., Kanatas, G., Weston, J.P., 2004. Advertising, breadth of ownership, and liquidity. Rev. Financ. Stud. 17, 439–461.
Hart, O., Zingales, L., 2017. Companies should maximize shareholder welfare not market value. J. Law. Financ. Account. 2 (2), 247–275.
Hoepner, A., Oikonomou, I., Sautner, Z., Starks, L., Zhou, X., 2018. ESG Shareholder Engagement and Downside Risk. (Unpublished working paper).
Hong, H., Kacperczyk, M., 2009. The price of sin: the effects of social norms on markets. J. Financ. Econ. 93 (1), 15–36.
Hong, H., Kostovetsky, L., 2012. Red and blue investing: values and finance. J. Financ. Econ. 103 (1), 1–19.
Jensen, M., 2001. Value maximization, stakeholder theory, and the corporate objective function. J. Appl. Corp. Financ. 14 (3), 8–21.
Kang, J., Stulz, R., 1996. How different is Japanese corporate finance? An investigation of the information content of new security issues. Rev. Financ. Stud. 9 (1), 109–139.
Klassen, R., McLaughlin, C., 1996. The impact of environmental management on firm performance. Manag. Sci. 42 (8), 1199–1214.
Krüger, P., 2015. Corporate goodness and shareholder wealth. J. Financ. Econ. 115 (2), 304–329.
Lesmond, D., 2005. Liquidity of emerging markets. J. Financ. Econ. 77 (2), 411–452.
Magill, M., Quinzii, M., Rochet, J., 2015. A theory of the stakeholder corporation. Econometrica 83 (5), 1685–1725.
Margolis, D., Hillary, E., James, W., 2008. Do well by doing good? Don't count on it. Harvard Bus. Rev. 86 (1), 19.
Myers, S., Majluf, N., 1984. Corporate financing and investment decisions when firms have information that investors do not have. J. Financ. Econ. 13 (2), 187–221.
PRI Annual Report, 2017. Delivering an ambitious agenda.
Reboredo, J., 2018. Green bond and financial markets: Co-movement, diversification and price spillover effects. Energ. Econ. 74, 38–50.
Renneboog, L., Ter Horst, J., Zhang, C., 2008. Socially responsible investments: institutional aspects, performance, and investor behavior. J. Bank. Financ. 32 (9), 1723–1742.
Schumacher, D., 2018. Home bias abroad: domestic industries and foreign portfolio choice. Rev. Financ. Stud. 31 (5), 1654–1706.
Servaes, H., Tamayo, A., 2013. The impact of corporate social responsibility on firm value: the role of customer awareness. Manag. Sci. 59 (5), 1045–1061.
Sharfman, M., Fernando, C., 2008. Environmental risk management and the cost of capital. Strateg. Manage. J. 29 (6), 569–592.
Starks, L., Venkat, P., Zhu, Q., 2018. Corporate ESG Profiles and Investor Horizons. (Unpublished working paper).