Corporate Green bonds and value creation: An International evidence♣

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Abstract

This paper studies the potential consequences of the issuance of a Green bond on the issuer's financial performance. Using a sample of 2,079 Green bond issuances of 190 firms, from 2009 to 2018, we show that the market reacts negatively to the announcement of green bond issuances. We particularly show that the stock market reacts until 5 days after the green bond announcement date, and that the cumulative abnormal return is approximately -0.5%. This effect is particularly noticeable at the first Green Bond issuance, for a given issuer, and particularly in developed market. Moreover, we show that the reaction of the market is significantly the same between financial and non-financial issuers. Overall, the evidence in this paper suggests consistent results that green bond issues do not create value for issuing firms.

Keywords: Green Bonds, Environmental finance, Financial innovation, Sustainable investment, Readability, Capital cost, Event study

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Introduction

Post-industrialization societies are characterized by growing interconnections between all economic actors: an exponential increase in population during the last decades, the rise of internet and telecommunications, efficient and cheaper transportation for people, commodities and final products, make the world a place where production and consumption of any kind, products or services, is rapidly and globally growing.

The effects of such an economic development on the environment has been demonstrated by many scientific studies and cannot be denied anymore. From companies' perspective, any type of production takes resources: transport and exploitation of commodities, fossil fuel and water use, electricity consumption, air, soil, or water pollution are just a few examples of elements that are part of almost all corporate economic activities. The environment is also impacted, directly or indirectly, by consumers' behaviors through the intensity and the type of consumption of products or services. Eventually, regulators can influence this inevitable phenomenon by applying specific policies, such as sanctions or subventions, to limit harmful activities and promote environmental-friendly practices.

However, governments' decisions regarding climate change could, for now, be assimilated to the tragedy of the commons. This concept, developed in 1883 by William Forster Lloyd, exposes a situation characterized by a system where a resource is shared between a group of individuals, each of them acting for its own self-interest, in opposition with the common good of all individuals, by decaying that resource because of their collective action. This theoretical situation precisely matches with the actual situation on Earth, where each government is consuming world's common resources for its own economic development, trying to stay competitive compared to its peers, ignoring the dramatic consequences of such a behavior for, eventually, its own sustainable development.

In a globalized world where competition between companies becomes more intense overtime, a company taking the risk of reducing its profits in order to limit its environmental footprint would be, at least over the short and medium term, an economic non-sense. On the other side, a consumer will also try to maximize its utility for the lowest price, leaving environmental considerations out the decision process unless its financial capacities allow it to do so. However, even if money remains the first factor ruling the decision in an economic agent's behavior, environmental considerations are progressively considered.

Indeed, we observed that some companies started find interesting ways to limit their environmental impact while remaining competitive. This trend is particularly noticeable in sectors where the environmental footprint is important. For example, we observe a large number of public utilities, providing electricity to the population, that massively invest to reduce their carbon footprint by diversifying their energy mix from a carbon intensive one to a mix increasingly based on renewable energies. The recent decrease in cost on renewable energy-based power generation assets and the uncertainty of coal, oil and gas prices and availability makes this investment for energy transition a path for a more secured business strategy and, eventually, a profitable decision from a long-term's perspective. This phenomenon can also be seen in sectors like transportation, real estate, or even oil and gas. In a world where polluting activities, and especially fossil fuel-based ones, will become more and more unstable, investing in its own ecologic transition may be profitable for both the business and the environment.

However, such evolution requires capital expenditures that can be quite difficult to finance regarding the important amounts involved. According to the International Energy Agency and the International Renewable Energy Agency1, around 3.5 trillion US dollars would be required in energy sector investments each year until 2050 to make this energy transition possible. Consequently, financing needs from companies are sizeable, so sizeable that only loans from banks might not be sufficient to realize such a transition. Therefore, having this purpose, many companies progressively see financial markets as an interesting source of financing.

Finance, as its name suggests, is a field of the economy that consists in matching money supply (investors) and demand (entities or projects invested), through dedicated market places, aiming at financing economic project realization. Beyond simply serving economic development all over the world, the scope of its repercussion should not be neglected. Investor's behaviors, selecting specific companies to allocate their funds, will directly or indirectly contribute to the development of a business that can be either benefic or detrimental to the environment. Actually, depending on the sense taken by these capital flows, the supply side of financial markets either can be the most efficient driver for sustainable development or, blinded by financial returns, a tool for an economic growth as fast as it is doomed to failure.

The emergence of such norms and standards and the increasing investor's concerns related to social and environmental issues forced companies, and particularly the ones listed on stock markets, to be more and more transparent on how their activity affects, directly or indirectly, environment and society. This evolution of transparency and the availability of documentation and data on these aspects were accompanied by an increasing integration of extra-financial assessments and the rise of the first elaborated techniques of socially responsible investments.

Focusing on an environmental perspective, the orientation of investments to sustainable activities has also been possible thanks to the creation of a new debt instrument helping issuers to finance their path to ecological transition: Green bonds.

A Green bond is a debt instrument issued by a company (financial or non-financial) or a public entity (city, region, government, development bank, etc.) on the financial markets to finance solely projects or assets that positively contributes to the environment. The difference with conventional bonds lies in the commitments made by the issuer on the use of the proceeds, which has to have positive externalities on the environment.

The first Green Bond was issued by the World Bank under the "climate-aligned bond" appellation, in 2007. At this stage of the market, the Climate Bond Initiative (CBI), an international organization working to mobilize the capital market for climate change solutions, was the only entity recognized as able to certify a bond as "climate-aligned".

The number of such issuances, mainly from supranational entities, development bank and agencies, were very low in number and in amount for about 8 years, until the publication of the first version of the Green Bond Principles in 2014 by the International Capital Market Association.

[1] https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2017/Mar/Perspectives_for_the_Energy_Transition_2017.pdf

The Green Bond Principles (GBP) helped standardize the definition of a "Green" asset or project that can be financed thanks to a Green Bond issuance. The GBP also defined how the issuer must communicate on: its process to select and evaluate green projects and assets; how it manages the Green Bond proceeds during the lifetime of the bond; and on the periodic allocation of proceeds and the associated environmental impact(s).
Since the settlement of such a standard, Green Bonds have been more and more recognized has a serious and an interesting financing tool to finance environmental-friendly purposes.

In this paper, we consider a large sample of corporate green bonds to study the potential consequences of the issuance of a Green bond on the issuer's financial performance. Our work offers two main contributions. First, we give an empirical evidence that the financial market reacts negatively to the announcement of green bond issuances. We particularly show that the stock market reacts until 5 days after the green bond announcement date, and that the cumulative abnormal return is approximately -0.5%. Second, we extend the limited empirical financial literature about green bond market with an international study. The paper proceeds as follows: Section I provides literature review. Section II introduces the data sets used and the methodology applied. Section III summarizes the results of the empirical tests, and section IV presents main conclusions.

1. Literature review

In the history of financial markets, the Green Bond is still a very new instrument and its efficiency to help tackle climate change has been subject to debates into the financial actors' community. Since the beginning of this market, most of the research on Green Bonds has been led by private financial institutions.

The academic literature on Green Bonds is even more recent: almost all of the articles and working papers have been realized during the past two years, allowed by the growing availability of data and the increasing exchanges between professional and academic worlds on this new instrument. The work realized by Kila (2019) gives a detailed definition and description of the Green Bonds and explain how it could be a useful tool to finance climate change expenses. The lack of universally acceptable standards for defining "Green" and for measuring application of green bonds and the potential for self-regulation of issuers are some challenges to the effectiveness of green bonds today. Using a combination of case studies, analysis of existing literature, and semi-structured in-depth interviews with 24 experts, Dupont et al (2015) questioned the effectiveness of using Green Bonds for financing land conservation projects. The authors particularly find that projects linked to water and storm water management may be investment "sweet spots" for green bonds and land conservation.
In the existing literature, Green Bonds have been analyzed through different approaches. The large majority of research works analyze the financial interest for stakeholders that could potentially rise from Green Bonds. Zerbib (2017), through the combination of a match pair method combined with a fixed-effect regression model, tested if there is a negative premium which is specific to green bond issuances. Its findings showed that lower yields can be observed for Green Bonds, comparatively to equivalent conventional bonds, especially for Investment Grade credit-rated, USD- and EUR-denominated, and sized-bonds over USD 100 Millions. These findings helped clarify the potential financial implications of Green Bonds for both investors and issuers. Focusing only on the US bond market, Baker *et al.* (2018), based on a data sample including 2083 green muni bonds issued between 2010 and 2016 and 19 green corporate bonds issued between 2014 and 2016, observed that these bonds have been issued at a similar premium to conventional bonds.

Not assessing the Green Bond financial characteristics at the time of the issuance but during the bond's lifetime, Karpf and Mandely (2017) proposed a detailed decomposition of the spread between Green and non-Green bonds in the US muni bonds market. Using the Oaxaca-Blinder decomposition method for linear mixed-effects models with random intercepts, the authors conclude that the market penalizes green bonds to a higher degree than conventional non-Green Bonds when yield term structure evolution are compared. A year later, Karpf and Mandely (2018) observed that this positive and statistically significant spread between conventional bonds and green bonds can be explained by differences in the fundamental characteristics of the bonds: issuers of green bonds are in general more creditworthy and have more robust economic fundamentals.

Still focusing on US muni bond market, Partridge and Medda (2018) created bond indices specific to the green-labelled and climate-aligned municipal bond market, primarily to test the competitiveness of the green sector of the muni bond market against the overall US muni bond market. Their results, through the period 2014-2017, reflect that green and climate-aligned muni indices presents compound annual growth rates of 4.5%, compared with 3% for the S&P Investment Grade Municipal index, showing the outperformance of such green and climate-aligned financing tools.

Wulandari *et al.* (2018) focused their work more on the Green Bond issuer side by assessing the relation between liquidity risk and yield spread evolution. The findings show that both the "LOT" liquidity and the bid-ask indicators are positively related to the yield spread. Eventually, the probability of success of environmental-friendly projects could be increased by limiting the liquidity risk through reducing the source of adverse selection cost, such as transparency of green projects' financial performance, lowering consequently the yield spread and the final funding cost for the issuer.

Potential benefits for Green Bond issuer has also been treated into the research work of Tang and Zhang (2018) in which the authors found that issuers' stock prices increase significantly around the announcement of green bond issuance for firms in 28 countries during 2007-2017. The study also reveals that stock market reactions are stronger for first-time issuers than for repeated issuers and stronger for corporate issuers than for financial institution. However, the authors find that a Green Bond issuance cannot be considered as a cheaper financing tool (compared to conventional bond) in the sense that they are not issued at lower yields than regular corporate bonds from the same issuers.

Knowing that, three schemes of green certifications exist on the market today: the ICMA's Green Bond Principles, the Climate Bond Certification from the Climate Bond Initiative and the Green Bond Rating from Moody's. Katori (2018) investigated whether the nature of the green certification may have an influence on the financial characteristics of the bonds. The most significant result highlighted in this paper is that the value of the bond potentially increases due to the Climate Bond Standard's certification. This study is interesting in that issuing entities would be likely to select an issuing scheme depending on whether they want to increase the value of their bonds or only reduce the concern of investors about risks. This study has been, between other, inspired by the work realized by Rose (2018) that summarizes the creation of climate bonds and other forms of green investment and reviews the information intermediary role played by organizations like the Climate Bond Initiative. This article also describes the current legal and governance system that regulates this role and discusses enhancements to this regulation that will help ensure that climate bonds, and the intermediaries that certify them, fulfill their intended purposes.

Combining both economic and ethical aspects, Revelli and Paranque (2017) questioned the ability of Green Bonds to constitute an ethical action with a measurable impact creating ethical and sustainable value beyond economic and financial value. In this study, the authors

highlighted the importance of a well realization on the use of proceeds, with traceability and measurability in time by investors, to make the Green Bonds have a real ethical value.
Also considering both financial and environmental aspects but through a more empirical and quantitative approach, Flammer (2018) established a series of empirical facts pertaining to corporate green bonds and documented their increasing prevalence in the corporate landscape. Moreover, the author examined how the stock market responds to the issuance of corporate green bonds and studied the implications for firm-level outcomes. Her findings show that corporate green bonds are used by companies to invest the proceeds in projects that effectively improve the company's environmental footprint and ultimately contribute to long-term value creation. Another interesting finding suggests that companies are able to attract an investor clientele that values the long term and the environment.

Next to the financial performance analysis, which represents the largest part of the literature on Green Bonds, another side explores other dimensions inherent to Green Bonds. Glavas and Bancel (2018) tried to understand what the main drivers of a Green Bond issuance are by performing a panel data conditional logit and fixed effects regressions on a set of matched green bond issuers and non-issuers in 27 countries for the 2013 to 2017 period. Their findings suggest that, first, firms issuing green bonds partly suffer from agency issues given the consistency of the significant negative coefficient of cash dividend payout. Second, they highlighted the predominance of the state ownership in the decision to issue green bonds, which confirms the state-driven stakeholder motive.

Nevertheless, States, more and more present as issuers, do not play a decisive role as regulators in the Green Bond market. The governance of the Green Bond market in decentralized and has been naturally carried on by a constellation of private entities in relations to determine market adoptions. The recent study of Park (2018) explains how private governance is often faster to implement standards and more responsive to the needs of market participants but how it may suffer from a lack of legitimacy, accountability, and consistency and be susceptible to greenwashing. In that sense, the author proposes hybridity to explore when and how collaboration between private standards and public regulation may be desirable in the green bond market.

Except associations, agencies or organizations (such as the International Capital Market Association or the Climate Bond Initiative) that set up a framework and standards on the Green Bond market, another essential role is played by other private entities: the *second opinions* on Green Bond issuances. Mostly realized by ESG research companies (e.g. Sustainalytics, Vigeo-Eiris, ISS-Oekom) or environmental assessment experts (e.g. CICERO), such role consists in helping investors whom will to invest in such bonds by providing them with analyses of both the issuer and the framework of the issuance, and consequently assess the credibility of the Green Bond. When some entities run in-depth qualitative analysis of Green Bonds, some others also determine quantitative ratings to classify such bonds from the greener to the "browner", helping sustainable investors pick such bonds base on their level of "greenness". However, the heterogeneity and opacity of underlying assessment methodologies limits the potential help provided by these entities. Reed et al (2017) realized this pitfall and proposed a framework that tries to demonstrate how to achieve a sufficiently rigorous rating while keeping the cost of the rating process affordable. This proposition can be considered as one of the first tools to help guide investors' internal assessments of green bonds and better understand the strengths and gaps between emerging commercial ratings.

Upon the previous literature, our objective is to study the market reaction to the issuance of corporate green bonds using different asset pricing models and different event windows.

2. Data and variables

A bit of a historic context

Due to the absence of a commonly used definition of "Green" between 2007, the first climate-aligned bond issuance, and 2014, the publication of the Green Bond Principles from the International Capital Market Association (ICMA), helps precisely the identification of Green Bonds. Unlike regular bonds, green bonds have different financial characteristics, that's why they are not, even today, centralized in a commonly used database.

At the first stages of the development of the Green Bond market and still today, most of the market participants build their own Green Bonds databases. For example, institutional investors that present a strong appetite for Green Bonds have their own green bond datasets. Similarly, large commercial banks participating in green bond issuances, as underwriters, usually constitute their own listings of Green Bonds due to their decisive position in the primary bond market. These entities are considered as pioneers of the Green Bond data collection and exploitation.

Over the past several years, new entities that also work on such data collection have emerged. As of March 2019, we count five official Green Bond data providers, which differ from one another in different aspects including the accessibility, the coverage and the type of information provided. For more details on the different Green bond data providers, please refer to the appendix.

2.1. Green bond data

As described above, we can notice that there is a lack of a centralized Green Bond database and that the existing data sources differ from one another in several aspects. Accordingly, one major challenge in our study is to get the most exhaustive list of Green Bonds that were issued worldwide since the inception of the market, in order to represent the market status in the most exact way. Below are the different steps we followed to reach this objective.

Data aggregation

First, we centralize all the available databases on the market to compare their differences in terms of time coverage, nature of the bonds included and nature of financial and extra-financial indicators.

It is important to mention that, for some marginal cases, the number of Green Bond issuances from the same issuing entity differs from one database to another: in these cases, we first check that the biggest list of Green Bonds issued by the entity contains, at least, all the issuances that are present in the other database(s). After verification, we then kept the largest sample of Green Bond issuances from a unique issuer.

We also noticed that, depending on the scope considered by the different data providers mentioned above, sustainability bonds (bonds for which the proceeds are used for both environmental and social-related purposes) were also sometimes included in the green bond list, notably for Bloomberg and Dealogic[2].. Consequently, the final sample size is about 3,154 bond issuances.

[2] We identify 20 sustainable bonds into the final sample and removed them to only keep pure Green Bonds.

We then retrieve the financial characteristics associated with each of these 3,154 green bond issues (more details about the selected financial characteristics of the issuances can be found below, section Issuance characteristics selection). We restrict our sample to green bond issues with non-missing financial characteristics.

We also remove all the green asset-backed securities and mortgage-backed securities because we estimate that such securities are not considered as green bonds since they consist in securitizing loans related to low carbon assets. Overall, these sample selection restrictions result in a final sample of 2,079 Green Bonds issuances with a range of fully available financial data.

2.2. Firm-level data

Security data. We collect stock price information from the Center for Research in Security Prices (CRSP) for U.S. firms. We also use the security daily database of Compustat Global to obtain daily stock prices for non-U.S. firms. In doing so, we require each firm included in our sample to have (1) price data until at least one day after the event date, (2) available returns during the estimation window so that the estimated returns can be calculated, (3) available returns during the event window so that the cumulative abnormal returns (CAR) can be calculated. In addition to the firm-level stock price information, we also collect market index prices for each country. We use the S&P500 index for the U.S., and the country's leading market index for all other countries.

Accounting data. We supplement our database with financial and accounting information on green bond issuers that are included in our sample. We particularly use the Compustat North America and Compustat Global to construct the following variables: (1) *Size*, the natural logarithm of total assets; (2) *Leverage*, the ratio of debt in current liabilities plus total long-term debt to total assets; (3) *ROA*, the ratio of operating income before depreciation to total assets; (4) *TobinQ*, the sum of market value of equity plus book value of debt divided by total assets; (5) *MTB*, the ratio of book value of total assets less book value of equity plus market value of equity to the book value of total assets; (6) *Tangibility*, the ratio of net property, plant, and equipment to total assets; (7) *Loss*, a dummy variable that takes the value of one if the firm's ROA is negative; (8) *Age*, the difference (in years) between the current year and the IPO year of the company.

2.3.Descriptive statistics

The green bond market has grown significantly since its inception in the mid-2007. Indeed, more and more companies have entered the market after the European Investment Bank issued the first green bond that amounted about 674 million dollars. Figure 1 displays the evolution of the green bond market over time. We particularly plot the total amount of issued green bonds over the past few years based on our green bonds sample described above. In this graph, we show that the green bond market has grown slightly until 6 years after its debut in 2007. However, in 2013, the green bond market has seen phenomenal growth both in terms of the value and the number of issuances.[3] From 2014 and afterwards, the market starts expanding at a rapid pace reaching a total amount of about 513 billion dollars in 2018.

[3] The great surge in the green bond market is due to both the release of the ICMA's Green Bond Principles, which helped define a strong market standard used by issuers and investors, and the entry of financial and non-financial corporations. For instance, such corporations accounted for about 80% of the total number of issued green bonds in 2017 as opposed to less than 20% in 2010. These statistics are based on our total sample of green bonds.

[Insert Figure 1 about here]

In Panel A of Table 1, we further describe the distribution of our 2,079 sample green bonds across countries. Column (1) shows that the green bond market has become largely driven by China, which issued a total number of 677 green bonds over our sample period. This has even exceeded the number of green bonds issued by the supranational organizations which used to be considered as the most frequent issuers until 2013 when the market started growing rapidly. An additional important characteristic of the green bond market is that it is being dominated by the European countries and the United States, as well as Asian countries in recent years especially since 2015, year of the release of the Green Bond Endorsed Project Catalogue, a newly recognized local market standard for issuing Green Bonds.

In Column (2) of Table 1, we restrict the cross-country description to our main green bonds sample that is included in our study, i.e., green bonds issued by financial and non-financial corporations that are publicly listed. To obtain this sample, we apply the following data selection process. We start from the initial 2,079 green bonds described in section 3.1. Among those green bonds, we drop those that are issued by governmental institutions and select those issued by publicly-listed financial and non-financial firms.[4] We then match the resulting sample of green bond issuers with firm-level data (both security and accounting data) described in section 3.2. This selection process yields a final sample of 475 green bonds issued by 145 unique issuers. In Column (2) of Table 1, we show that the cross-country distribution of our final sample is quite similar to that of the original green bonds sample. Particularly, it can be seen that the bulk of our final sample is also concentrated in the hands of U.S., European, and Asian countries.

In Panel B, we provide summary statistics on the green bond amounts by industry. We show that both the original sample and the public issuers' sample are roughly similarly distributed across industries. For example, we find that, in both sample, corporate green bonds are commonly issued in the financial sector. More importantly, we show that green bonds issues are more prevalent in the transportation industry where the environmental issues are extremely relevant.

[Insert Table 1 about here]

In Table 2, we provide summary statistics at the bond-level (Panel A) and at the issuer-level (Panel B). In Panel A, we distinguish between the whole original sample and the sample of green bonds issued by publicly-listed firms included in our analysis. As can be seen, both samples exhibit similar characteristics, particularly in terms of coupon rate, bond maturity, and issued amount. Panel B displays descriptive statistics on the characteristics of green bond issuers. For example, we show that green bond issuers are large in size, exhibit an average leverage ratio of about 35%, and an average proportion of tangible assets of about 30% in total assets. These statistics are largely in line with those reported in previous literature (e.g., Tang and Zhang, 2018).

[Insert Table 2 about here]

[4] To identify publicly-listed issuers, we first select those that are listed in a stock exchange. For the remaining issuers, we check whether their parent company is publicly-listed.

3. Model and results

3.1.Event study methodology

In this section, we examine the capital market reaction, i.e. the stock price effects, to the announcement of corporate green bond issuances by implementing an event study methodology. Based on all the databases that we used to collect green bonds data, we also obtain information, from Bloomberg terminals, on the date on which the company announces that it will issue a green bond, i.e. *the announcement date*, which we consider as our event date. Indeed, this date is likely to convey more new information to the financial market, and is thus reasonably more relevant to our event study analysis than the issuance date.

In studying the shareholder wealth effects of the green bond announcement events, we focus on daily cumulative abnormal returns (CARs). CAR is equal to the sum of the daily abnormal returns, which are defined as the difference between the realized returns and the expected returns. We therefore start by estimating the expected returns using the CAPM model[5]. Specifically, we estimate the market model parameters, α_i and β_i, for each firm-event date pair using estimation windows of 250 trading days ending 50 days before the considered event date to ensure that the predictive factors are not affected by event-related information. We particularly estimate the following regression:

$$R_{it}= \alpha_i+ \beta_i*R_{mt}+\varepsilon_{it} \qquad (1)$$

where R_{it} is the daily (t) return of firm i, R_{mt} is the country-specific market return,[6] and ε_{it} is the residual term.

We then use the estimated market model parameters to predict the expected stock returns ($\hat{R}_i$) for each day t belonging to the event window as follows:

$$\hat{R}_{it}= \hat{\alpha_i}+ \hat{\beta_i}* \hat{R}_{mt} \qquad (2)$$

Next, we calculate the daily abnormal return by subtracting the estimated return from the realized returns for each day t around the event window as follows:

$$AR_{it}=R_{it}- \hat{R}_{it} \qquad (3)$$

In a last step, we calculate the daily CARs as the sum of abnormal returns over the event window.

3.2.Event study results

Table 3 displays the event study results for different event windows. We particularly focus on the two-day [0, 1] CARs around the announcement date (day 0). We further consider additional time intervals before and after our two-day event window as way to investigate whether there is any event-related pricing information that could influence stock prices prior to

[5] We consider also three factor model (see section 4).

[6] If the stock is listed in the same country where the green bond has been issued, we consider the leading stock market index of the issuance country. Otherwise, we consider the leading stock market index of the country in which the stock is listed.

or after the occurrence of the event. We particularly consider the following time intervals: [-20, -11], [-10, -6], [-5, -2], [1, 5], [6, 10], [11, 20].

Results presented in Table 3 indicate that, across different event windows, we find negative CARs suggesting that the market reacts negatively to the announcement of green bond issuances. We particularly show that only the average CARs around the two-day event window [0, 1] and the five-day event window [1, 5] are negative and statistically significant at the 5% level. This particular result indicates that the stock market reacts until 5 days after the green bond announcement date, and that the CAR is approximately -0.5%. Across the remaining event window, the stock market reaction is insignificant.

[Insert Table 3 about here]

4. Additional analysis and robustness tests

In additional analyses, we also investigate how the documented stock market reaction varies according to several characteristics of the green bond issues. In Panel A of Table 4, we distinguish between first-time issues from subsequent issues. Not surprisingly, we find that the CARs of the first issues are more than twice larger than those of the subsequent issues, indicating that investors would pay more attention to the first time a company announces its green bond issue that later times.

In Panel B, we also differentiate green bonds issued in developed markets from green bonds issued in emerging markets. Interestingly, the results show that developed market react more negatively to the green bond issues than emerging markets.

In Panel C, we split our sample into two groups according to the business sector of the green bond issuers: (1) green bonds issued by financial corporations and (2) green bonds issued by non-financial corporations. We show that, although financial green bonds issuers experience significantly lower CARs that do non-financial corporations, the magnitude of the difference is still very small. This result indicates that the market pays almost similar attention to financial institutions that issue green bonds to finance their borrowers' green projects, and financial corporations that use the green bonds' funds to directly finance their green projects.

We also test the robustness of these results to the use of an alternative model to estimate the abnormal returns, namely the Fama and French 3-factor model (Fama and French, 1993). We find that the results remain qualitatively the same, with more negative CARs for first-time green bond issues, more negative CARs for green bonds issued in developed markets, and almost no difference between green bonds issued by financial or non-financial corporations.

Overall, the evidence in this section suggests consistent results that green bond issues do not create value for issuing firms.

[Insert Table 4 about here]

5. Conclusion

The purpose of this article was to determine whether the issuance of a Green Bond could create value for issuing firms. The event study results presented above show that the markets react negatively to the announcement of a new Green Bond issuance.

A possible interpretation of such results would be that the announcement of a new Green Bond issuance, which is tantamount to the announcement of an upcoming evolution of operational and capital expenditures to make them more sustainable, might be interpreted by investors as an uncertainty as to whether this potential new business model would remain as profitable as it has been so far. Such consideration might, therefore, make profitability projections revised downwards, broadly leading to negative market reactions.

This interpretation might be relevant, regarding the results found here, to the extent that investors would rationally not review their expectations twice at the second issuance of a Green Bond, already being aware of the new strategic orientation of the issuer, and would not necessarily discriminate financial and non-financial issuers since sustainable and environmental-friendly business strategies involve the same evolution of companies' risk exposure and profitability expectations. For future research, it will be interesting to go in depth in understanding the disparity of market reactions between developed and emerging markets.

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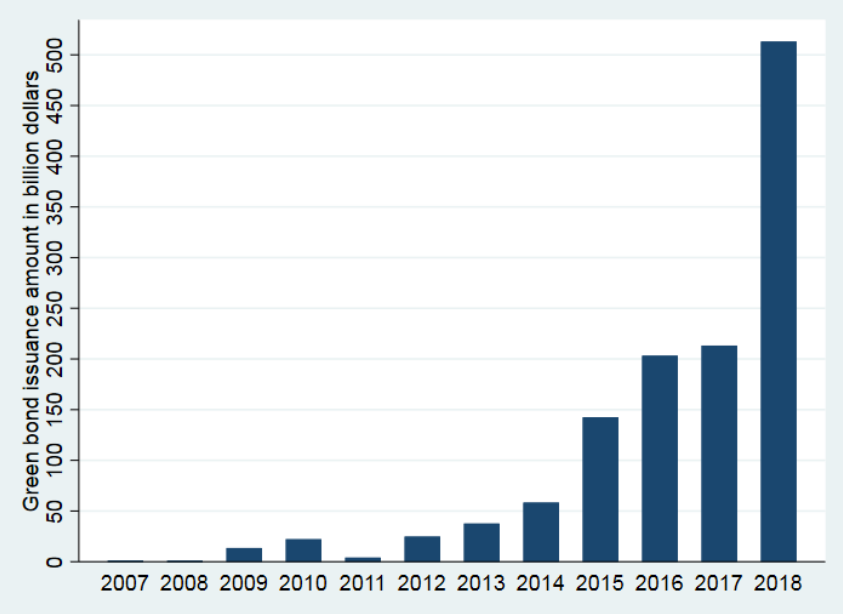
Figures and tables

Figure 1. Corporate green bonds over time



This figure plots the total issuance amount (in $B) of corporate green bonds on an annual basis, using our sample of corporate green bonds from 2007-2018.

Table 1. Green bond sample

Panel A. Green bonds by country		
Country	**Full sample**	**# of bonds issued by public issuers**
SNAT	348	N.A.
China	677	173
France	191	119
Japan	46	29
United States	164	27
Sweden	197	26
India	34	13
Spain	23	10
Australia	20	8
Brazil	13	8
Taiwan	13	8
Norway	31	7
Canada	31	4
Hong Kong	13	4
Italy	13	4
Netherland	37	4
New Zealand	5	4
Austria	5	3
Germany	50	3
United Kingdom	17	3
Korea	16	3
Mexico	11	3
South Africa	4	3
Belgium	4	2

Denmark	7	2
United Arab Emirates	1	1
Switzerland	7	1
Finland	11	1
Greece	1	1
Turkey	1	1
Others	37	0
Total	**2,079**	**475**

Panel B. Green bonds by industry		
Industry	**Amount for the full sample ($B)**	**Amount for the public issuers' sample ($B)**
Government	**686.119**	
Municipal	62.2863	
Multi-National	373.3085	
Sovereign	79.2216	
Regional (state/province)	171.3026	
Financial	**236.823**	**89.161**
Banks	210.477	
Investment Companies	1.721	79.707
REITS	6.572	4.283
Insurance	1.117	1.117
Private Equity	0.798	
Diversified Financial Services	5.265	1.043
Industrial	**225.710**	**182.673**
Environmental Control	3.406	0.531
Packaging & Containers	0.037	0.037
Machinery-Diversified	0.200	
Electronics	0.300	0.300
Electrical Components &Equipment	1.026	0.337
Transportation	193.809	180.152
Miscellaneous Manufacturing	0.248	0.030
Engineering & Construction	26.535	1.136
Metal Fabricate/Hardware	0.149	0.149
Utilities	**99.541**	
Water	3.827	
Electric	95.023	
Gas	0.691	
Energy	**17.944**	**6.895**
Energy-Alternate Sources	12.947	3.465
Oil & Gas	0.742	0.089
Coal	4.255	3.341
Consumer, Non-cyclical	**8.550**	**1.124**
Agriculture	0.119	
Healthcare-Services	0.689	
Commercial Services	6.409	
Food	1.171	1.124
Cosmetics/Personal Care	0.161	
Basic Materials	**5.777**	**2.972**
Iron/Steel	0.242	0.104
Forest Products & Paper	5.536	2.868
Consumer, Cyclical	**4.348**	**3.017**

Home Furnishings	0.107	
Airlines	0.089	0.089
Textiles	0.097	0.097
Home Builders	0.980	0.980
Retail	0.089	0.089
Distribution/Wholesale	0.045	0.045
Auto Manufacturers	2.939	1.716
Technology	**2.589**	**2.589**
Computers	2.589	2.589
Communications	**2.182**	
Telecommunications	2.182	
Diversified	**0.373**	
Holding companies divers	0.373	

Notes: This table shows the description of the green bond sample. In Panel A, we provide statistics on the distribution of the green bonds across countries. In Panel B, we provide statistics on the amount of green bond issues across industries.

Table 2. Summary Statistics

Panel A. Bond characteristics				
	Mean	**Median**	**STD**	**N**
All green bonds				
Coupon (percent)	3.307	3.422	2.145	2,062
Maturity (year)	6.878	5	4.638	2,039
Amount (million$)	619	149	3460	2,079
Public issuers' green bonds				
Coupon (percent)	3.624	3.855	2.266	466
Maturity (year)	6.259	5	3.478	467
Amount (million)	658	179	885	475

Panel B. Firm characteristics				
Variables names	**Mean**	**Median**	**STD**	**N**
Size	12.298	12.399	2.561	138
Leverage	0.347	0.331	0.197	131
ROA	0.056	0.054	0.041	134
TobinQ	1.151	1.010	0.756	137
MTB	1.583	1.054	2.885	137
Tangibility	0.297	0.144	0.330	115
Loss	0.007	0	0.086	134
Age	23.164	17	18.214	67

Notes: This table presents summary statistics for green bonds and green bond issuers. In panel A, we provide summary statistics separately for all corporate green bonds and green bonds issued by public issuers. In panel B, we provide summary statistics for public green bonds issuers in the year of their first green bonds issue.

Table 3. Stock market reaction to green bond issuance announcement

Event time	CAR	T-statistic	Nb. of events
[-20, -11]	-0.004259372	-1.31946	476
[-10, -6]	-0.002415032	-1.02454	476
[-5, -2]	0.000095874	0.051678	476
[0, 1]	-0.002400324**	-2.08468	475
[1, 5]	-0.005497024**	-2.26048	475
[6, 10]	-0.003294222	-1.59776	474
[11, 20]	-0.004125426	-1.28785	472[7]

Notes: This table reports the average cumulative abnormal return around the announcement of green bond issuances. CAR is calculated using the CAPM model over different event windows. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

[7] The decrease in the number of events from 476 to 472 is due to the fact that, for some specific green bond issuers, the security data are not available until 20 days after the event date.

Table 4. Heterogeneity in stock market response

Panel A. First-time vs. subsequent issues				
	First-time issues		Subsequent issues	
	CAR	T-statistic	CAR	T-statistic
CAPM_CAR	-0.00401038**	-2.10324	-0.001692872	-1.18377
Observations	145		330	
FF3_CAR	-0.00409096*	-2.01943454	-0.00101805	-0.66391258
Observations	145		330	

Panel B. Developed vs. emerging markets				
	Developed markets		Emerging markets	
	CAR	T-statistic	CAR	T-statistic
CAPM_CAR	-0.0037376***	-2.87087	-0.00002293	-0.01041771
Observations	304		171	
FF3_CAR	-0.00301816**	-2.23464787	-0.00006799	-0.0278764
Observations	304		171	

Panel C. Corporate vs. Financials				
	Financials		Corporate	
	CAR	T-statistic	CAR	T-statistic
CAPM_CAR	-0.00339803**	-2.07315	-0.00246644	-1.18979287
Observations	248		227	
FF3_CAR	-0.0018248	-1.570946752	-0.0020994	-0.93391138
Observations	248		227	

Notes: This table reports the average cumulative abnormal return around the announcement of green bond issuances for different subsamples. In Panel A, we distinguish between first-time green bond issues and subsequent issues. In Panel B, we distinguish between first-time green bond issues in developed markets and those in emerging markets. In Panel C, we distinguish between first-time green bond issues by financial and non-financial corporations. CAR is calculated using the CAPM model and the Fama and French 3-factor model. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Appendix: Definitions and sources of variables

Overview of the different Green Bond data sources

Bloomberg : As of today, Bloomberg can be considered as the first financial software tools provider in the world, massively used by almost of the market participants in financial markets, and also the most used tool to collect information on Green Bonds. In 2014, it develops its own listing of Green Bonds into its Bloomberg Terminal. Bloomberg labels bonds with "Green" use of proceeds when the issuer self-label its bond issuance as "Green" or officially commits to provide dedicated statements about the climate-aligned use of proceeds, in line with the categories mentioned in the ICMA's Green Bond Principles.

Bloomberg's Green Bond data coverage starts from the first Green Bond issuance in 2007. As of March 2019, the base counted 1125 bonds earmarked as "Green". The data base offers an interesting level of transparency by providing both financial bond documentation and status on the disclosed / follow-up allocation and environmental impact reporting.

Dealogic : Like Bloomberg, Dealogic is a financial markets platform that provides content and analysis via a service to financial firms. It launched a platform dedicated to Green Bonds in 2015. This data provider service covers 489 Green Bond issuances from 2007 and differs in the sense that Dealogic makes its own Green project categories to classify the different types of use of proceeds, depending on the nature of the underlying assets/projects financed through the Green Bond issuances. In a more marginal way, Dealogic also covers Social and Sustainability Bonds through this service.

Environmental Finance : Environmental-Finance.com, created in 1999, provides sustainable finance-related news and analysis services. The company recently started publishing qualitative information related to Green Bonds through detailed articles and in 2016, providing a Green Bond database. Like Bloomberg, Environmental Finance lists all bonds that are self-labelled as "Green" by the issuer, but differs in that in considers other standards than the ICMA's Green Bond Principles: The Climate Bonds Initiative (CBI)'s the Climate Bonds Certification, the People's Bank of China's Green Financial Bond Directive and the Green Bond-Endorsed Project Catalogue and also all the other self-labelled Green Bonds not aligned with any specific market standard. Such broad inclusions allow data users make their own opinion on what is considered as Green and what is not, depending on the standard considered. Environmental Finance's data base is particularly interesting in that it includes a detailed description of the use of proceeds and makes accessible all the related documentation of the Green Bond issuance: investor presentations, Green Bond frameworks, second opinion reports, and periodic allocation and environmental impact reporting. As of September 2018, the base was composed of 859 Green Bonds, also starting in 2007 with the first Green Bond issuance by the World Bank.

Climate Bond Initiative : The database from the Climate Bond Initiative (CBI) is probably the most common used source of data related to Green Bonds. A dedicated market team lists all bonds aligned with the ICMA's Green Bond Principles but also all the bonds aligned with their own taxonomy, which provides a view on what is considered as an "eligible use of proceeds" for green bonds. According to these eligibility criteria, the Climate Bond Initiative has, in parallel of this data service, a role of certifier recognized worldwide by the Green Bond market practitioners. The Green Bond database has been accessible since 2013 through an internet browser and contains 2025 Green Bonds as of January 2018, also starting in 2007 with the first Green Bond issuance by the world bank.

Trucost : Recently acquired by Standard & Poor's Global in 2016, Trucost's core activity is the assessment of companies' risks related to climate change, natural resource risk exposures and environmental, social, and governance (ESG) factors. It provides, through a dedicated tool accessible on internet, a large panel of environmental-related indicators linked to companies' activities and exposures and, more recently, a Green Bond database covering 178 Green Bonds issuances.

Despite this relatively small coverage, Trucost's approach is interesting in that it proposes, beyond usual financial and ESG-related information, both the carbon footprint of the issuers on several scopes, the classification of the use of proceeds by asset/project categories and from a geographical localization's perspective but also several environmental impact quantitative indicators to assess, Green Bond by Green Bond, the concrete impact of such use of proceeds.

Shenzhen Securities Information : Shenzhen Securities Information Company (SSIC), fully owned by the Shenzhen Stock Exchange (SSE), is a Chinese provider of financial market indices and financial information services.

Elaborated through the collaboration between the Shenzhen Securities Information (SSI), the International Institute of Green Finance (IIGF) and the Central University of Finance and Economics (CUFE), the Chinese CUFE-CNI High Grade Green Bond Total Return Index is designed to reflect the performance of a list of Green Bonds issued by Chinese entities only, whose proceeds are only used to fund environmentally friendly projects according to the definition of the Green Bond Support Project Catalogue. If the proceeds are not used to finance an asset or project in line with the catalogue, it can be considered as Green if, and only if, the proceeds are used for business-as-usual purposes and if, at least, 90% of the revenue of the issuer are coming from the an environmental-friendly activity.

This index is constituted by bonds RMB-denominated, considered as "Green" by the IIGF and issued and settled in either exchange or inter-bank bond market. Other integration selection rules are publicly accessible on http://www.cnindex.com.cn/docs/gz_CNB00013_e.pdf. As of February 2019, the index lists 1210 Green Bonds issued in the Chinese Green Bond market.

Amundi : As one of the main investors in Green Bond worldwide, Amundi's ESG research department progressively built its own Green Bond data base in order to centralize both financial and ESG-related information on Green Bonds. The purpose of such development is linked to the will to better understand the evolution of Green Bond issuer's practices overtime and report consequently at client's portfolios level.

Incrementally nourished with new issuances worldwide, Amundi's Green Bond database contains a panel of financial, ESG-related and carbon-related data assessing, as of March 2019, more than 350 Green Bond issuances. For confidentiality reasons, the names of the underlying data provider(s) and the nature of the related agreements cannot be publicly disclosed.

Issuance characteristics selection

Following are both the financial and extra-financial characteristics we chose to select in order to define and bring precision about the nature of the different Green Bond issuances.

- Announcement date: date on which the bond issue was officially announced by the issuer in the financial market platforms (e.g. Bloomberg),
- Issuance date: date on which the bond has been issued on the primary bond market,
- Maturity type: nature of the maturity of the bond determined by the issuer,
- Maturity date: date on which the principal of the bond becomes due and is repaid to the bondholder,
- Amount issued: amount of money raised by the issuer in the primary market through the bond issuance,
- Amount issued (USD equivalent): amount of money raised by the entity in the primary market through the bond issuance, expressed in USD with the exchange rate at the time of the issuance,
- Coupon: annual coupon payments paid by the issuer relative to the bond's face or par value,
- Currency: currency used by the issuer to raise funds on the primary market,

Issuer characteristics selection

Financial characteristics

- Issuer name: name of the entity that issued the Green Bond,
- Issuer type: nature of the issuer (it can be either a non-financial corporate, a financial institution or a SSA (Sovereign, Supranational and Agencies),
- Sector and sub-sector: sector and sub-sector (if relevant) to which the issuer belongs, according to Bloomberg's categorization,
- Credit rating: rating that a rating agency assigns to a borrower after assessing its ability to repay the principal and interest on any or all of its debts,
- Issuer's country: country to which the issuer belongs, identified with its Alpha-2 code, a two-letters country code defined by the International Organization for Standardization (ISO),

Extra-financials characteristics

Issuer's Green Bond documentation:

- Green Bond Framework: public document, released at the time of the issuance by the issuer, disclosing what are the expected use of proceeds, process for project selection and evaluation, management of proceeds and way of reporting. The framework also contains other relevant information related to the issuance or the issuer, such as the review from a second party opinion and/or a third-party verification, the sustainability objectives and practices of the issuer, some examples of potential projects to be financed, etc. This document is mandatory in respect of the ICMA's Green Bond Principles.
- Second Opinion Report: public document, released at the time of the issuance by the issuer itself or the entity that realized the second opinion, that certify the compliance of the issuer's framework with the ICMA's Green Bond Principles. Such document is usually realized through a collaborative work between the issuer and an entity specialized on ESG and/or environmental analysis. This document is mandatory in respect of the ICMA's Green Bond Principles.
- Investor Presentation: public or private document, released by the issuer before the time of the issuance and (usually) to potential investors, presenting both financial and extra-financial relevant information associated with the entity's activity and the upcoming bond issuance. This document is encouraged to be disclosed in respect of the ICMA's Green Bond Principles but is not mandatory.
- Green Bond Reporting: public document, released periodically (usually annually at the Green Bond issuance birthday) by the issuer, to report to investors on the allocation and on

the environmental impact of the use of proceeds. This document is mandatory in respect of the ICMA's Green Bond Principles.

- Environmental Impact Calculation Methodology: public or private document, usually incorporated into the Green Bond reporting, released by the issuer into which it explains how the environmental impact of the use of proceeds has been calculated. This document is encouraged but not mandatory in respect of the ICMA's Green Bond Principles.

Green Bond market standards: The very meaning of a "green" asset has, for years, been subject to debates and interpretations, splitting opinions and consequently avoiding the settlement of a market standard for a green definition. As of today, we acknowledge two internationally-recognized market standards to consider a bond as green : the Green Bond Principles disclosed by the International Capital Market Association (ICMA) and the Climate Bond Standard disclosed by the Climate Bond Initiative. Other marginal guidelines exist all over the world. We count around six other regional green standards, mainly in Asia (e.g. the China Green Bond Guidelines, the Hong Kong Green Bond Guidelines, the ASEAN Green Bond Standards or the Japan Green Bond Guidelines), Africa (the Nigeria Green Bond Guidelines) or in Latin America with the Mexican Green Bond Principles. Like most of the global investors and issuers of Green Bonds, we will only consider the first two ones, the ICMA's Green Bond Principles and the CBI's Climate Bond Standard as the references on the market today.