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Why do firms issue green bonds?

Dejan Glavas

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Ecole Doctorale de Management Panthéon-Sorbonne
ED 559

Why do firms issue green bonds?
Pourquoi les sociétés émettent-elles des obligations vertes ?

THESE

En vue de l'obtention du
DOCTORAT EN SCIENCES DE GESTION

Par

« **Dejan GLAVAS** »

Soutenance publique le « 25 septembre 2020 »

JURY

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But there must be the look ahead, there must be a realization of the fact that to waste, to destroy, our natural resources, to skin and exhaust the land instead of using it so as to increase its usefulness, will result in undermining in the days of our children the very prosperity which we ought by right to hand down to them amplified and developed.

Theodore Roosevelt's Seventh Annual Message to Congress Dec. 3, 1907

Climate change is the Tragedy of the Horizon. We don't need an army of actuaries to tell us that the catastrophic impacts of climate change will be felt beyond the traditional horizons of most actors – imposing a cost on future generations that the current generation has no direct incentive to fix.

Speech by Mark Carney, Governor of the Bank of England and Chairman of the Financial Stability Board, at Lloyd's of London, London, 29 September 2015.

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Résumé général

Cette thèse porte sur le marché des obligations vertes et les motivations qui poussent les entreprises à émettre cette nouvelle forme d'instruments financiers. Trois grandes hypothèses ont été émises pour expliquer les motivations des émetteurs d'obligations vertes. Selon la première hypothèse appelée « création de valeur à long-terme », les émetteurs d'obligations vertes cherchent à créer de la valeur actionnariale en investissant dans des technologies vertes. Selon la seconde hypothèse appelée « délégation de philanthropie », une entreprise émet une obligation verte pour répondre à la pression de ses parties prenantes. Selon la dernière hypothèse appelée « problèmes d'agence », un manager d'entreprise émettrice d'obligations vertes chercherait à servir ses intérêts propres plutôt que ceux de l'entreprise. Cette thèse vise à tester ces hypothèses par le biais de trois articles empiriques et d'un article de synthèse situé en annexe.

Le premier article s'intéresse à la gouvernance des entreprises émettrices d'obligations vertes et démontre que l'état-actionnaire joue un rôle important dans la décision d'émettre une obligation verte. Par ailleurs, cet article met en évidence que le lien entre état-actionnaire et probabilité d'émission d'une obligation verte est plus fort pour les états dont le cadre institutionnel est le plus faible. Ces résultats valident le fait que l'Etat est une partie prenante clé dans la décision d'émettre des obligations vertes.

Le second article porte sur la réaction du cours de bourse d'une entreprise à l'annonce d'une émission d'obligation verte. Nous analysons les conséquences pour les actionnaires de deux événements, l'un favorable et l'autre défavorable, à la mise en place d'une pression réglementaire sur la réduction des émissions carbone, que sont respectivement l'accord de Paris sur le climat et l'élection présidentielle américaine de 2016.

Le troisième article montre que les entreprises émettrices d'obligations vertes sont davantage contraintes financièrement et que cette contrainte augmente après la première émission d'obligation verte. Cet article démontre également que ces sociétés souffrent d'asymétrie d'information, ce qui expliquerait leur attrait pour les obligations vertes.

Enfin, en annexe nous avons ajouté un article qui présente d'une part un état de l'art de la recherche menée sur les obligations vertes et d'autre part la question centrale des régulations à mener pour développer le marché des obligations vertes.

General Abstract

This thesis topic is the green bond market and the incentives pushing firms into issuing this new type of security. Three key hypotheses were stated to explain the motive for a firm to issue a green bond. The first hypothesis (“long-term value creation”) asserts green bond issuers invest in green technologies to generate long-term value. The second hypothesis (“delegated philanthropy”), professes stakeholder pressure engenders the fundamental reason for a firm to issue green bonds. The third hypothesis (“agency view”) contends that managers of green bond issuing firms serve their own objectives. This thesis aims at testing these hypotheses through three empirical articles and a synthesis article added in the appendix.

The first article’s main topic deals with green bond issuer governance, reflecting the state as a shareholder vitally affects the decision to issue green bonds. Moreover, we find that the link between state ownership and the likelihood to issue green bonds is stronger in states with weak institutions. These results confirm that the state is a key stakeholder in the decision to issue green bonds.

The second article explores the stock price reaction to a firm’s green bond issuance announcement. We analyze the consequences for shareholders of two types of events. The first type of event is one of increasing regulatory pressure and the second type of event is one of decreasing regulatory pressure. To test the first type of event, we use the Paris Agreement and to test the second type of event we use the 2016 U.S. presidential election results.

The third article shows green bond issuers initially confront more financial constraints. These financial constraints increase after the first green bond issuance. These firms also suffer from information asymmetries which explains their interest in green bonds.

Finally, in the appendix, we have added an article that first provides an overview of the current research on green bonds. This article also tackles the key question of regulations that may help the development of the green bond market.

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General Introduction

A wide number of researchers consider that the ecological crisis may substantially impact social welfare in the coming decades (Carleton et al., 2018; Ciscar et al., 2011; Clark et al., 2016; Wheeler & Von Braun, 2013). While the effects of greenhouse gas (GHG) emissions on climate have been known for at least fifty years (Manabe & Wetherald, 1967), if not more than a century (Arrhenius, 1896), recent research shows that so far, our societies have not been able to curb climate change (Intergovernmental Panel on Climate Change, 2018). Some signs of firm-level misbehavior in regard to the ecological crisis have appeared, one illustration is the Volkswagen emissions scandal¹. Conversely, some firms voluntarily commit to track and reduce their environmental impact through green bond issuance (Flammer, 2018) or use of climate finance (Polzin, 2017).

To tackle the challenge of climate change, two views have emerged in the finance literature. The first view, based on the market efficiency hypothesis, considers climate change as a priceable risk (Aldy, 2015; Battiston & Monasterolo, 2019; Daniel, Litterman, & Wagner, 2016). Hence, asset allocation does not massively shift to green assets because of climate risk mispricing (Andersson, Bolton, & Samama, 2016; Liesen, 2015). This literature reveals price indication fundamentally influences firms' and investors' behavior. If they could price carbon and implement either a carbon market or a carbon tax, policymakers could send the right pricing signals (Fankhauser, Hepburn, & Park, 2010). The second view purports firms and investors prefer green assets (Baker, Bergstresser, Serafeim, & Wurgler, 2018). Considering such preference, Heinkel, Kraus, and Zechner (2001) built a theoretical framework explaining

¹ The prosecution of Volkswagen by the United States Environmental Protection Agency (EPA) for intentionally programming emission controls on their diesel cars. The programming was done in order to pass EPA emissions testing for polluting gases.

corporate behavior using investor green preference. We have, therefore, analyzed the green bond market through the investor preference lens rather than the pricing lens.

Green bonds comprise the section of the climate finance market developing with the fastest pace. This rapid market growth has sparked professional and academic interest in understanding the underlying motives leading firms to issue green bonds. Several green bond definitions exist. The most commonly used is the one from the International Capital Markets Association (ICMA) set in the Green Bond Principles (GBP). Based on this definition green bonds “enable capital-raising and investment for new and existing projects with environmental benefits” (ICMA, 2014)². The European Investment Bank (EIB) issued the first green bond (“climate awareness bond”) in 2007. Annual issuance has grown from the initial USD808m to USD155.5bn in 2017 (CBI, 2018). Issuers were initially mainly sovereigns, supranationals, and agencies (SSA), while corporates entered the market with first issuances in 2013. This funding instrument, due to its environment-oriented focus, is part of the firm’s Corporate Social Responsibility (CSR).

Our study focuses on green bonds as a financial instrument labeled as “green”. The “green” label in our manuscript refers to bonds that comply with the GBP. The study, therefore,

² Green bonds are bond instruments where the proceeds are applied exclusively “to finance or re-finance, in part or in full, new and/or existing eligible green projects” (ICMA 2014). These projects have to be aligned with the four core components of the Green Bond Principles (GBP) to be qualified as green by most international guidelines and labels (ICMA 2014). GBP are non-compulsory/voluntary guidelines for green bond issuers. In our study, we only consider green bond issuers that follow the GBP. This means that all green bond issuers in our database have committed to ensure that funds are used to finance green projects, to provide additional reporting on financed green projects and finally to have their issuance and reporting documents audited by third parties. All bonds that do not follow the GBP are considered as conventional bonds. Please note that state-owned firms do not have specific advantages or ability to fulfil the GBP criteria.

does not intend to analyze green investment and does not intend to discuss the “greenness” of projects financed. Two main reasons explain why labeled green financial instrument rather than the green investment angle was taken. First, to be able to define an investment as “green” or not we would need to be able to assess the physical properties of projects financed such as the life-cycle assessment and the biodiversity impact of such projects. To assess the “greenness” of an investment, more granular data than the one provided by green bond issuers would be necessary, this data is usually private and was not made available to us during the thesis. Second, investors do not have access to and do not have the analytical tools to screen the projects being financed by green bonds, they would therefore rely on the label as a signal of the “greenness” of the bond. We, therefore, analyze how investors perceive the “green” label of the bonds rather than investors’ opinion on the “greenness” of the underlying investments. The three chapters of this thesis, therefore, explore the underlying financial reasons for an issuer to decide to issue bonds labeled as “green” rather than traditional bond instruments.

Past literature on CSR has shown the benefits of commitments to the environment on firm financial performance. There are two main explanations to this link, first CSR reduces the information asymmetry between the firm and investors, therefore, reducing financing costs (Ge & Liu, 2015; Hoepner, Oikonomou, Scholtens, & Schröder, 2016; Jo & Harjoto, 2011, 2012). The second explanation posits that some investors would be ready to trade-off return for a higher CSR performance (Renneboog, Ter Horst, & Zhang, 2008).

The same discussion has emerged in the growing green bond literature (Baker et al., 2018; Flammer, 2018; Zerbib, 2018). Current green bond literature suggests that there is a slight green bond premium. Therefore, the second hypothesis of green bond investors being ready to lose return for additional CSR performance seems to hold. Still, the measured premium is small. Zerbib (2018) demonstrated a two basis points (bps) premium on the secondary market while the actual cost of green bond measures portrayed a 0.1 to 7.1 bps cost (Asian Development

Bank, 2018). Therefore, the direct cost-benefit analysis cannot be the only explanation to the decision to issue green bonds. This dissertation aims to explain why a firm would issue a green bond given that the premium is not the only explanation.

Bénabou and Tirole (2010) constructed three hypotheses displaying why firms engage in CSR. Under the first hypothesis, they expect that firms invest in CSR to generate long-term value. Mainly, pollution control allows firms to avoid future lawsuits and, therefore, avoid a long-term cost. The second hypothesis is called delegated philanthropy. This hypothesis relies on the idea that stakeholders, that do not have the ability to meet their own CSR commitments, would delegate this commitment to the firm. The third hypothesis is an agency view of investment in CSR, positing that managers use CSR to reach their personal objectives. For example, Masulis and Reza (2014) reflected CEOs use corporate giving to fund charities linked to independent directors, employing the Bénabou and Tirole (2010) framework.

Our chapters rely on the framework established by Bénabou and Tirole (2010). The first chapter measures to what extent states use their equity stakes to implement their agenda, testing the delegated philanthropy hypothesis. In the second chapter, we discuss how green bonds generate shareholder value and how the philanthropy delegation impacts this value generation. Due to limited data on management-shareholder relations within the green bond issuing firms, we could not entirely test the agency view of CSR as discussed in Bénabou and Tirole (2010). As a first approach of the question, in the third chapter, we explored the link between financial constraints and green bond issuance.

We, therefore, address the following three subquestions in each chapter:

1. Is state ownership a determinant of green bond issuance?
2. How do equity investors react to green bond issuance announcements?
3. Does financial constraint impact green bond issuance?

Each question, treated in a specific chapter of this dissertation, connects with the general theoretical framework and tests the three hypotheses Bénabou and Tirole (2010) established.

Researchers have generally focused on green bond market characteristics (Ehlers & Packer, 2017; Febi, Schäfer, Stephan, & Sun, 2018; Zerbib, 2018), green bond ex-post effects (Flammer, 2018), or diversification benefits of green bonds (Reboredo, 2018). In the first chapter, we study the ex-ante characteristics that drive firms to issue green bonds. This allows us to study the drivers rather than the consequences of green bond issuance. We also intend to contribute to the literature on CSR and state-ownership (Li et al. 2015; Li and Zhang 2010; Rodríguez Bolívar et al. 2015; Zhao 2012). While state-ownership usually negatively affects companies, regarding financial performance and excessive leverage (Dewenter & Malatesta, 2001), this chapter's findings propose state-ownership positively affects business environmental policy. Finally, we add to the existing literature on ownership type and CSR (Dam & Scholtens, 2012; Zhang, Rezaee, & Zhu, 2010). This literature seems to suggest that state-owned firms have a negative or neutral impact on CSR when compared to institutional investors. However, we find that state-ownership can have a positive impact on the environmental aspect of firm CSR.

The first chapter also explores how the country's institutional context influences the link between state ownership and green bond issuance. Previous scholars have postulated the country's institutional setting critically impacts firm governance (La Porta, Lopez-de-Silanes, & Shleifer, 2008; La Porta, Lopez-De-Silanes, Shleifer, & Vishny, 2002). More specifically, the institutional environment can influence CSR engagement (Di Giuli & Kostovetsky, 2014; Kim, Amaeshi, Harris, & Suh, 2013; Yin & Zhang, 2012). Boubakri et al. (2019) found that weaker institutions lead to a stronger link between CSR and state ownership.

Two primary factors explain the importance of the institutional context for the link between state ownership and green bond issuance. Firstly, in institutional contexts where

shareholder protection is low and institutions are weak, the government can more easily use its ownerships in firms to implement its political agenda (La Porta et al., 1999; Shleifer and Vishny, 1994). Secondly, in weak institutional contexts, firms need political legitimacy to ease their access to resources (Zimmerman & Zeitz, 2002). As a result, state ownership and institutional factors have been identified in this first chapter as key drivers of green bond issuance.

In the second chapter, we discuss how equity investors perceive future value generated following green bond issuance. This chapter looks at equity value generation following green bond issuance announcement to test the value generation hypothesis of Bénabou and Tirole (2010). As discussed previously, there seems to be a slight direct positive effect for green bond issuers. This effect has three limits. The first limit is that it has been measured so far on secondary market data, this secondary market premium may not directly translate into a lower cost of funding for issuers. The second limit is that these benefits seem thin as compared to the costs measured by the Asian Development Bank (2018) of 0.1 to 7.1 bps. The last limit shows that even if this issuer premium holds true, green bond investors should structurally suffer from a lower portfolio yield compared to other investors. This would mean that the market penalizes green bond investors as compared to conventional bond investors, which would seriously limit the existence of the green bond market. Therefore, issuers and investors would be expected to obtain other indirect benefits. Chapter 2 examines one indirect effect of green bond issuance, which is shareholder value generation.

Chapter 2 also discusses how political signals impact equity investor view of this value creation. The 2015 Paris Agreement, unprecedentedly signed by 195 United Nations Framework Convention on Climate Change (UNFCCC) member states, signals a clear consensus between member-states to fight climate change. This political event had a financial component. The specific financial component, Article 2(c) of the Paris Agreement (2015), outlined the objective,

“Making finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development”. In chapter 2, the authors test how the Paris Agreement changed the value creation perception of green bonds by equity investors. The stock price reaction to green bond issuance announcement remained positive and significant after the Paris Agreement, although it was not significant before it. Our key hypothesis to explain this result is that equity investors react to expected future regulations. To explore this hypothesis, we measure how stock prices respond to green bond issuance announcements before and after a positive regulation signal (Paris Agreement) and a negative regulation signal (2016 U.S. presidential election). Hence, equity investors use political indicators when valuing green bond issuance announcements.

In chapter 3, we explore how green bonds can be used to deal with financial constraints. As defined by Tirole (2006), financial constraints arise in situations of information asymmetry between firms and investors. Literature has considered financial constraints from the perspective consequences it has on firms (Caggese, Cuñat, & Metzger, 2018; Campello, Graham, & Harvey, 2010; B. H. Hall, 2002). There is growing literature on the ways firms deal with financial constraints. For instance, Erel, Jang, and Weisbach (2015) uncovered mergers and acquisitions (M&A) relieve target entity financial constraints. In the third chapter, we follow this second stream of literature.

In chapter 3, as explained by the theoretical framework, we demonstrate green bonds work the same way as financial covenants on debt obligations, therefore, limiting information asymmetry between green bond issuers and their investors (Jensen & Meckling, 1976). Green bonds can, therefore, allow firms to limit the information asymmetry they suffer from through three mechanisms. First, green bonds require more reporting than conventional bonds, giving details about the use of proceeds (ICMA, 2014). The legal documentation of conventional bonds in “the use of proceeds” section usually mentions “general corporate purposes,”

providing limited information on assets in which funds will be invested. Green bonds, therefore, reduce the structural information asymmetry between investors and the institution in terms of proceeds use.

The second mechanism is that green bonds limit underinvestment which arises when firms limit their investments in positive net present value (NPV) projects as any additional value would accrue to debtholders (Myers, 1977; Pour, 2017; Stulz & Johnson, 1985). The project's use of funds is better known to investors when funds are invested in green bonds as compared to conventional bonds (ICMA, 2014). This, therefore, explains why investors would more easily identify underinvestment in the case of green bond issuers. Finally, the asset substitution happens when investors lend funds to a firm with an expected risk, and this risk increases after funds are used (Green & Talmo, 1986; Jensen & Meckling, 1976). Again, the specificity of green bonds is that the assets being financed are known before funds are used. Indeed, investors must know well the projects to which the funds are allocated for the bond to be considered green. Therefore, green bonds limit asset substitution, as well.

In chapter 3, we first measure whether green bond issuers are more constrained as compared to conventional bond issuers. Hence, we investigate green bond issuance's impact on both financial constraints after the green bond issuance program has been launched within a firm. We first find that financial constraints increase after this launch. We then check whether these firms suffer from higher levels of information asymmetry. Using the bid-ask spread and cash flow volatility, we find that green bond issuers suffer from higher levels of information asymmetry. We can therefore conclude from these results that green bond issuers suffer from information asymmetry and that they try to limit consequences of such information asymmetry by using green bonds to fund their projects.

We added our last article *Les obligations vertes : un outil au service du financement de la transition écologique* in the Appendix section. In this article, we first summarize the literature

on green bonds and market developments of the green bond market. The prevailing perception of the green bond market is a strong need for regulation supporting these economically and ecologically beneficial instruments. One key idea encompassed bolstering green bonds through capital requirements incentives and central bank backing.

The remainder of this dissertation is organized as follows. The three first chapters correspond to the three articles described in this general introduction. We then present a general conclusion of our work in the last chapter.

Chapter 1: The Role Of State Ownership as a Determinant of Green Bond Issuance

Abstract

This study focuses on characteristics of green bond issuers, and more specifically on ownership as a driver of green bond issuance. We test the impact of firm ownership on green bond issuance from a sample of issuers of green and non-green bonds in 18 countries for the 2013–2017 period. We find that state ownership is a primary determinant of green bond issuance. Our results also show that the link between state ownership and green bond issuance is stronger in weak institutional frameworks. This confirms the view that the state is a key stakeholder favoring firms' environmental commitments, such as green bond issuance.

JEL: G30, G10, F65, Q50

Keywords: green bonds; green finance; climate finance; sustainable finance; corporate governance; ownership structure; corporate social responsibility

Status: Under Review at International Review of Financial Analysis

1. Introduction

Green bonds are defined by the International Capital Markets Association (ICMA) in the Green Bond Principles (GBP) as a debt instrument for which proceeds are used to finance or refinance projects with a positive impact on the environment (ICMA, 2014). Green bonds have become a key financial instrument for funding the transition to a low carbon economy (Ehlers & Packer, 2017; Morel & Bordier, 2012; OECD, 2017). Previous studies have mainly focused on the market characteristics of these new instruments (Baker et al., 2018; Febi et al., 2018; Kapraun & Scheins, 2019; Zerbib, 2018), while a few have looked at financial characteristics of issuing firms (Flammer, 2018). However, studies on green bonds are mainly interested in the financial benefits of such instruments as compared to conventional bonds. While properly describing the positive financial ex-post consequences of green bond issuance, they do not explore the underlying ex-ante reasons for a firm to issue green bonds. To our knowledge, the existing literature on green bonds does not consider how firm ownership and institutional context may impact the decision to issue green bonds. In this study, we intend to fill this research gap by exploring which type of shareholders have an impact on the decision to issue green bonds. We find that state ownership increases the likelihood of issuing green bonds the following year. We also find that this link is stronger in weaker institutional contexts.

In the literature on corporate social responsibility (CSR), ownership is one key component of a firm's commitment to pursue sustainable goals. Graves and Waddock (1994) find that the number of institutional shareholders in a firm has a positive and significant impact on the corporate social performance (CSP) of such firms. Johnson and Greening (1999) find that not only the number but also the type of owners play a key role in CSP. Based on a sample of newly privatized firms, Boubakri et al. (2019) explore the link between CSR and state ownership. They find a stronger relationship between residual state ownership and CSR performance, attributable to the trade-off between political objectives and profit maximization. Hsu et al.

(2018) find that state-owned enterprises have a higher propensity for dealing with environmental issues. We complement this literature as we measure how the state has an impact on past CSR strategies as well as on future CSR commitments of the firm. Green bonds indicate the direction in which firms wish to develop their CSR strategy given that proceeds can be invested over several years after the green bond issuance³.

We base our analysis on the signaling theory of Spence (1978), which is becoming increasingly important in the CSR literature (Zerbini, 2017). As per this theory, there is a trade-off between the costs and benefits of using green bonds as a signal of a firm's CSR policy. The issuance of green bonds comes with both a cost (about 0.4 to 1.8 basis points for \$200m issuances according to the Asian Development Bank (2018)) and a benefit (2 basis points on average, based on Zerbib (2018)). The difference between benefits and costs being narrow, the question remains as to why firms, and more specifically state-owned firms, would issue green bonds. While the cost-benefit analysis gives a narrow result for privately owned firms, state-owned firms have additional benefits in issuing green bonds. They can use this instrument both to delegate their own CSR commitments (Bénabou & Tirole, 2010) and for reputation-building purposes (Boubakri et al., 2019; Porter & Kramer, 2002).

To test this theoretical framework, we built a sample of 1,851 green and conventional bond issuers and 10,649 firm-year observations. Our database includes all corporate green and conventional bond issuers over the 2013–2017 period from 18 countries. Descriptive statistics indicate that green bond issuers have significantly higher levels of state ownership (by 7.8%). Sample statistics⁴ also show that green bond issuance has sharply increased in the year of the

³ One example is given in the Engie Investor presentation dated 15th March 2017 (<https://www.engie.com/espace-experts-rse/green-bond-2017/>).

⁴ See Appendix I.

Paris Agreement. These two first elements indicate that state ownership and institutional context may be material in the decision to issue a green bond.

To further test the link between state ownership and green bond issuance, we use a regression analysis. The dependent variable of the regression analysis is a dummy equal to one when the firm issues a green bond the following year, and the independent variable of interest is state ownership. Using this regression analysis, our measurements show that the coefficient for state ownership is positive and significant after controlling for alternative types of ownership. To test how the state delegates its own commitments, we also measure how the link between state ownership and green bond issuance holds before and after the Paris Agreement. Our results show that the Paris Agreement has increased the link between the likelihood of green bond issuance and state ownership. This additional element confirms expectations from our theoretical framework that governments intend to delegate their own CSR commitments to firms using their shareholdings (Bénabou & Tirole, 2010).

The decision to hold shares in a firm is endogenous, as is shown in the state ownership literature (Andrianova, Demetriades, & Shortland, 2012; Boubakri et al., 2019). To account for any endogeneity due to selection bias (James J Heckman, 1979), we use propensity score matching following the method of previous studies (Cahan, Chen, Chen, & Nguyen, 2015; Flammer, 2018; Ioannou & Serafeim, 2017). To further test for endogeneity, we use an instrumental variable (IV) regression methodology (Roberts & Whited, 2013) with instruments from the state ownership literature (Boubakri, Cosset, Guedhami, & Saffar, 2011; Boubakri et al., 2019). These two analyses confirm that after accounting for endogeneity the link between state ownership and green bond issuance still holds.

The delegation channel between the state, its shareholdings, and green bond issuance goes through the ability of the state to implement its agenda. If the country has stronger institutions, we would expect it to have more difficulties in implementing its own CSR agenda. Our

signaling framework would therefore only work on the condition that institutions do not limit the state's ability to influence firms' decisions. The literature has already established that weaker institutional frameworks allow states to more easily implement their CSR agenda (Boubakri et al., 2019). We complement this literature by testing how a weaker institutional framework can influence the firm's 'green' investment policy. Indeed, green bonds not only give an indication of a firm's existing CSR policies but also show how the state can influence its medium-term investment policy. We find that the link between state ownership and green bond issuance is stronger in weak institutional contexts, thus confirming the predictions from our theoretical framework.

Our study contributes to the literature on green bonds by investigating the underlying reasons for a firm to issue green bonds. This is the first study, to our knowledge, that measures how state ownership and institutional framework impact green bond issuance. Our theoretical framework posits that green bonds are used as signals of commitment to future environmentally linked CSR investments. The signal implies a cost–benefit analysis by prospective issuers. This cost–benefit analysis is favorable to state-owned firms as they have additional benefits that come from reputation-building and CSR commitment delegation (Bénabou & Tirole, 2010; Boubakri et al., 2019). Our results comply with this theoretical framework given that state ownership has a positive and significant link with green bond issuance.

This study also contributes to the literature on state ownership and CSR (Chen, El Ghouli, Guedhami, & Wang, 2017; Ghouli, Guedhami, & Kim, 2017; Zhao, 2012). Our findings are more specifically consistent with those of Hsu et al. (2018), who find that state-owned enterprises have a higher propensity for dealing with environmental issues. Our findings are complementary to those of Boubakri et al. (2019), who find that state-owned firms who prepare for privatization use CSR as a reputation-building tool to increase the acceptability of the privatization process. Finally, there are two views of the link between state ownership and

governance. The first view is that state ownership negatively impacts the governance of the firm (Ben-Nasr, Boubakri, & Cosset, 2012; Chen et al., 2017; Shleifer & Vishny, 1994). The second view is that government ownership may bring benefits to the firm especially in the context of CSR (Boubakri, Chen, El Ghouli, & Guedhami, 2017; Boubakri et al., 2019; Hsu et al., 2018). Our results are in line with this second view of state ownership and governance.

The remainder of this study is organized as follows: Chapter 2 presents a literature review. In Chapter 3 we discuss our theoretical framework and hypotheses. Chapter 4 is dedicated to our data, and Chapter 5 to our methodology. In Chapter 6, we describe and analyze our results, and in Chapter 7 we test the robustness of these results. We present our conclusion in Chapter 8.

2. Literature Review

The literature on green bonds is still emerging. The current literature is mostly interested in green bond market premiums (i.e., the yield or spread advantage to the issuer of issuing a green bond instead of a conventional bond). Zerbib (2018) concludes there is a slight premium (2 basis points) for green bonds. Ehlers and Packer (2017) report similar results on labeled green bond credit spreads, which are on average lower by 18 basis points for 21 green bonds issued between 2014 and 2017. Febi et al., (2018) analyze how liquidity risk impacts the yield spreads of green bonds. They show that even though liquidity plays a key role in determining the yield spreads of green bonds, its impact diminishes over time. Flammer (2018) shows that corporate green bond issuance contributes to the issuing firm's financial performance and documents improvements in the firm's environmental performance.

While the evidence seems clear on the market premiums of green bond issuance and on the potential signaling benefits of green bond issuance, the motives of firms for issuing green bonds are still unclear. To our knowledge, the role of ownership in green bond issuance has not yet been sufficiently explored.

The CSR literature identifies state (Boubakri et al., 2019), family (El Ghouli, Guedhami, Wang, & Kwok, 2016), institutional (Hsu et al., 2018) and foreign ownership (Oh, Chang, & Martynov, 2011) as the main contributors to firms' CSR. Our study focuses on state ownership, given the evidence from the literature and governments' commitment to curbing climate change.⁵ Boubakri et al. (2019) find that even residual state ownership can impact the CSR performance of firms. This strengthens the case for the link between green bond issuance and state ownership in countries where state ownership still exists in residual form.

Recent evidence from the literature shows that state ownership plays a key role not only in the CSR strategy of a firm but more specifically in its environmental policy (Hsu et al., 2018). Firstly, green bonds are by construction an instrument to signal the involvement of firms in reducing greenhouse gas (GHG) emissions (Flammer, 2018) and therefore belong to the environmental component of corporate strategy. Calza et al. (2016), using a sample of European firms, conclude that higher state ownership positively impacts the environmental policy of firms. Zheng and Zhang (2016) show that state-owned enterprises outperform privately held firms in China in terms of CSR. Zhang et al. (2010) show that there is a negative relationship between state ownership and firms' contributions after a catastrophic event, using a sample of Chinese state-owned firms. Li and Zhang (2010) show that state ownership negatively influences firms' involvement in CSR due to political interference in less-developed areas within China. Maung et al. (2016) find that state-owned firms benefit from lower environmental

⁵ Governments' incentives to curb climate change comes from their legally binding commitment to the Paris Agreement, but also from the pressure of public opinion. A recent poll from the Yale Program on Climate Change Communication (Leiserowitz et al. 2018) found that 72% of polled Americans say that global warming is personally important to them. (This figure has risen by 10% since March 2015.) A survey by the European Commission finds that 92% of European citizens see climate change as a serious problem, with 89% believing that national governments should set targets to increase renewable energy use (European Commission 2016).

levies due to political connections. We, therefore, expect state ownership to influence the environmental policy of firms.

Two main conflicting views emerge as regards governance and state ownership (Hsu et al., 2018; La Porta et al., 2002). The first view posits that political interference in the governance of firms creates agency issues that result in poorer financial performance of the firms (Megginson, Nash, & Van Randenborgh, 1994), additional costs due to political intervention (Shleifer & Vishny, 1994), a higher cost of equity (Ben-Nasr et al., 2012), less accounting transparency (Guedhami, Pittman, & Saffar, 2009), and lower investment efficiency (Chen et al., 2017). The alternative view is that government ownership can have a positive impact on some specific firm characteristics such as stock liquidity (Boubakri et al., 2017) and CSR performance (Boubakri et al., 2019; Hsu et al., 2018). In line with this second view, we believe that in the CSR policy of firms, state ownership should have a positive impact on the decision to issue green bonds.

A second factor seems to favor the positive impact of state ownership on green bond issuance. According to Bénabou and Tirole (2010), stakeholders such as governments may use CSR to delegate their own commitments to firms. Article 2 (c) of the Paris Agreement states that governments' response to climate change must involve "making finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development" (Agreement, 2015). Firms use green bonds to signal their proactive environmental policy to their investors (Flammer, 2018), the state being among these investors. We can expect firms to issue green bonds to signal to the state their commitment to reducing GHG emissions, thereby helping the state to fulfill its own commitments to the Paris Agreement.

3. Theoretical Framework and Hypotheses

a. Signaling theory

Our study explains the link between green bond issuance and state ownership using the signaling theory as a theoretical framework (Spence, 1978). Signaling is used in the context of information asymmetry where the firm can transfer private information to the investor, thus revealing its true quality and limiting the risk of adverse selection (Akerlof, 1970). Signaling theory has progressively developed in the field of CSR (Zerbini, 2017), yet previous studies have struggled to establish a link between signaling through engagement in environmental performance (Menz, 2010). Zerbini (2017) attributes this difficulty in the signaling and business ethics literature mainly to the fact that social and environmental performance is difficult to observe. Following the definition from Spence (1978), the author explains that signals need to be observable and under the control of the firm, which is not the case for environmental social and governance (ESG) ratings for example.

Green bonds materialize the commitment of a firm to reduce its environmental impact through the issuance of a financial instrument. They are the result of a financing decision under the control of the firm's management. Our study thus augments the previous research in signaling and CSR by studying how green bonds are used as a CSR signaling tool.

b. Green bond issuance working as a signal

Green bonds have signaling characteristics in common with existing CSR signaling tools that are codes of ethics (Verschoor, 1998), voluntary corporate disclosures (Hahn & Lülfs, 2014), third-party certification (Perego & Kolk, 2012), and ESG scores (van Duuren, Plantinga, & Scholtens, 2016). When a firm opens a green bond issuance program, they first define a framework, setting out amongst other elements what types of assets can be financed, how the proceeds of the issuance will be used, and how the use of these proceeds will be reported, measured, and audited. This framework can be considered as a code of ethics, as it signals the

firm's ability to comply with rules in excess of legal obligations. Green bonds are close to voluntary disclosures, as the issuance of green bonds comes necessarily with additional pre-issuance and post-issuance reporting (ICMA, 2014). They can, therefore, signal the ability to provide objective data to give credibility to the firm's commitment to environmental issues. The GBP guidelines state that green bond issuers should have recourse to an external review of their green bond framework and reporting. Green bond issuance thus shares common signaling qualities with third-party certification. Finally, green bonds have a close to ESG ratings signaling function as they provide information on the environmental performance of the issuer while relying on precise quantitative and qualitative metrics. As evidenced by these similarities to other signaling tools, the issuance of green bonds allows firms to signal their environmental performance to stakeholders through a wide range of transmission channels. This multi-dimensional nature of green bonds entails specific costs and benefits for which each issuer has a trade-off.

A recent study by the Asian Development Bank has detailed the costs associated with the issuance of a green bond as compared to a conventional bond (Asian Development Bank, 2018). The study distinguishes between internal and external costs. Internal costs include the establishment of the green bond framework, the asset selection process, the management of proceeds, and reporting. External costs include legal costs and external review costs. The same study explains that these costs range from 0.4 basis points to 1.8 basis points for a \$200m issuance depending on the maturity of the issuance. Based on this study, and confirmed by interviews we made with issuers⁶, the organizational cost is the main cost to green bond issuers.

⁶ In 2019, we have conducted several interviews of CFOs to understand the motivations of issuing firms. All CFOs confirmed that organizational costs (reporting, preparation of the issuance, necessity to organize a discussion between several departments of the firm) are significant.

The issuance of green bonds implies that firms reorganize their treasury and finance teams to set up the green bond framework and proper reporting procedures, as is the case with sustainability reporting (Eccles, Ioannou, & Serafeim, 2014).

These costs provide the guarantee that firms less committed to environmental issues will not be able to issue green bonds and follow GBP guidelines. This makes these costs compliant with the definition of signaling costs by Spence (1978) (i.e., signaling costs are too high to be imitated by firms performing badly in terms of environmental practices).

Using green bonds as a signal can lead to direct or indirect benefits to issuers. Amongst the measured and direct benefits, we can cite the reduction of funding costs (Hachenberg & Schiereck, 2018; Kapraun & Scheins, 2019; Zerbib, 2018). The evidence seems to point to a limited green bond premium. Zerbib (2018) measures an average premium of 2 basis points to green bonds as compared to equivalent conventional bonds. Other studies explore indirect benefits such as financial performance (Flammer 2018) and stock price reaction (Tang & Zhang 2018), but they still show these benefits to be limited.

Based on previous studies, benefits and signaling costs seem to have an equivalent value. In view of this, we think that for any green bond issuer, it is the opportunistic behavior specific to its cost–benefit trade-off that will have an effect on the decision to issue green bonds.

c. Why state-owned firms have a stronger incentive to use green bonds as a signal

State-owned firms have the same kind of trade-off as other types of issuers, but with an additional incentive. Previous literature has shown the fundamental importance of reputation-building for state-owned firms (Boubakri et al. 2019) and delegated philanthropy (Bénabou and Tirole 2010). Boubakri et al. (2019) show that state-owned firms use CSR to build their reputations in the context of privatization. We believe that the same mechanism occurs with state-owned firms' reputation-building in the context of environmental commitments.

Based on these elements, we believe that states delegate a part of their environmental commitments to firms. This delegation involves the use of their ownership in firms and is materialized by the issuance of green bonds⁷. This leads us to our first hypothesis:

H1: A higher share of state ownership in a firm leads to a higher likelihood of green bond issuance by that firm.

To test this hypothesis, we use regression analysis to measure the impact of state ownership on the likelihood of green bond issuance. We also control for endogeneity that may bias our regression analysis results through matching and instrumental variable methods.

d. The role of the institutional context

The business ethics literature has established that country-level institutional factors impact firm-level CSR (Kim et al., 2013; Yin & Zhang, 2012). There is a specific difference between weak and strong institutional contexts. For example, Boubakri et al. (2019) find that the strength of country-level institutions influences CSR in firms. In our cost–benefit trade-off framework, we posit that the state’s ability to enforce its own agenda and the firm’s need for political legitimacy play key roles in the link between state ownership and green bond issuance.

Firstly, in weak institutional contexts, private shareholders have less power to limit the state’s will to enforce its own agenda (La Porta et al., 1999). The importance of putting environmental issues in the political agenda comes with strong support from public opinion (European Commission, 2016; Leiserowitz et al., 2018). We, therefore, posit that in weak institutional

⁷ This delegation channel has been confirmed to us through interviews with CFOs from state-owned green bond issuing firms. In some cases, the government does not directly give directives to issue green bonds. CFOs are usually willing to build on their relationship with the government as a shareholder and would take the initiative to issue green bonds. This phenomenon is probably even stronger following international agreements such as the Paris Agreement, when the visibility of environmental subjects is higher.

contexts, states can more easily implement their own environmental agenda through their shareholdings. This translates into stronger delegated philanthropy, and hence a stronger link between state ownership and green bond issuance.

Secondly, in weak institutional contexts, firms need political legitimacy to limit state meddling and to increase access to resources (Zimmerman & Zeitz, 2002). Previous literature has shown that political legitimacy can be obtained through the environmental component of CSR (Wei, Shen, Zhou, & Li, 2017). The difference in the case of state-owned firms is that signaling through green bond issuance becomes even more visible to the state as the latter is part of the firm's governance. Benefits of green bond issuance, therefore, become even stronger than costs for state-owned firms in weak institutional contexts. While pro-active environmental engagement is difficult to measure with ESG scores, it is easier to do so with green bonds. With this in mind, we test how environmental engagement signaling through green bonds is used by firms to seek political legitimacy. As detailed in the study, the rationale behind this increase in green bond issuance after the Paris Agreement was expectations from investors of green financial regulation or incentives to green investments.

In line with these theoretical developments, we test how the strength of country-level institutions influences the link between state ownership and green bonds.

This leads us to our second hypothesis:

H2: Weaker country-level institutions lead to a stronger link between state ownership and green bond issuance.

We test this hypothesis by splitting our sample into sub-samples reflecting different institutional contexts. We then test the link between state ownership and green bond issuance using regression analysis in each sub-sample following the method of Boubakri et al. (2019).

4. Data Description

a. Sampling

We extracted all 999 corporate green bonds⁸ issued between 2013 and 2017 from Bloomberg. We kept issuers with International Securities Identification Numbers (ISIN). From Thomson ONE, we selected all bond issuers over the 2013–2017 period with available data⁹ and a final maturity date¹⁰. The control group includes firms that have access to debt security markets but do not issue green bonds. This choice of the control group thus rules out access to the debt securities markets as an explanation for the choice of whether or not to issue a green bond.

From COMPUSTAT, we extracted all characteristics of firms and their accounting data between 2012 and 2017 for all green and non-green bond issuers. From Datastream, we extracted all equity market-related data between 2012 and 2017 for all issuers. We used fiscal year-end data as a reference to base our study on accounting data that has been through an auditing process, which is not usually the case for quarterly data.

We then excluded financial firms from the sample (excluding two-digit Standard Industrial Classification (SIC) codes between 60 and 69). For these firms, high leverage is normal, which would alter the conclusions we could draw from our sample (see a detailed explanation in Fama and French (1992)).

⁸ Bloomberg defines green bonds as all bonds following the Green Bond Principles based on the prospectus provided and other bond documentation.

⁹ We take all debt securities issuers and then include Thomson ONE Master_deal_types corresponding to straight debt (“AND”, “ASPD”, “CED”, “CND”, “D”, “ED”, “ID”, “JPD”, “KD” and “LAD”).

¹⁰ We therefore exclude perpetual bonds from the selection.

b. Measures and variables

In this section, we present the dependent, independent, and control variables used in our study. Table I presents the variables we used and their definitions. These variables are commonly used in the literature.

[Insert Table I about here]

i. Dependent variable

We measure how the firm's ownership structure influences the decision to issue green bonds. As detailed in the previous section, we obtained from Bloomberg the list of green bond issuers that follow the GBP. We measure the decision to issue a bond in a given year with the dummy variable $Issue_{i,t}$, equal to 1 if firm i issued a green bond during year t , and 0 otherwise. We measure this dependent variable one year ahead of the independent and control variables (included in the regressions as of year $t-1$), for two reasons. The first is that we are interested in measuring the independent variables that influence the decision to issue green bonds before green bond issuance. The second reason is that we would like to limit the risk of simultaneity, which is the risk of dependent variables causing independent variables at the same time as independent variables causing dependent variables (Roberts and Whited 2013).

ii. Independent variables

Our key independent variables are ownership-related, as we intend to explain part of the decision to issue green bonds by the issuing firm's ownership structure.

To test our first hypothesis, we use the percentage of shares owned by the state (GOVHELD) as a first measure.¹¹ We measure the impact of GOVHELD on Issuein1Y on the whole sample to determine whether it is a determinant of the decision to issue green bonds for the full sample.

Following the method of Boubakri et al. (2019), we test how country-level institutions influence the link between green bond issuance and state ownership. We built three subsamples to account for different institutional contexts. The first subsample is split according to the country-level legal system (common law or civil law) based on the classification by La Porta et al. (1998). The second subsample is split between a high and a low level of minority shareholder protection, as per the classification by Djankov et al. (2008). Finally, we test the impact of the rule of law through judicial independence, based on the classification by La Porta et al. (2004).

Following Boubakri et al. (2019), we consider the importance of the legal system in the ability of states to implement their political agenda. In common law countries, states have less power to distort rules of law to reach political objectives given the stronger power of judicial entities to produce such rules of law. Moreover, in civil law countries, literature finds that the state as a shareholder has more influence on firm's governance (Bortolotti & Faccio, 2009; La Porta et al., 1999). Liang and Reneboog (2017) find that CSR is stronger within state-owned firms in civil law countries as compared to common law countries, which is explained by the ability of the state to implement its political agenda. We, therefore, use the civil law and common law classifications of La Porta et al. (1998) to test whether the delegated philanthropy hypothesis is verified depending on legal origin.

¹¹ Appendix II shows the evolution of state ownership of green and conventional bond issuers. We observe a drop in state ownership of green bond and conventional bond issuers between 2016 and 2017. This drop is due to key divestments by the French government in this period.

If judicial entities are independent they will be able to limit the government's power over the economy and its ability to implement political objectives using state-owned firms. This judicial independence is key for minority shareholders of state-owned firms. Minority shareholders whose objective will be profit maximization may suffer from the government's use of its stake in the firm to reach political objectives rather than economic objectives (Megginson et al., 1994; Shleifer & Vishny, 1994). In case of litigation, minority shareholders would not be able to defend their position in front of a state-dependent court. We, therefore, use a variable for judicial independence to test whether governments have more (weak judicial independence) or less power (strong judicial independence) to implement their own objectives. The same issue concerns self-dealing rules tested in our model. Anti-self-dealing rules weakness measured by Djankov et al. (2008) are meant to protect minority shareholders of a firm. In the case of firms controlled by the state with private minority shareholders, the rules protecting minority shareholders would help them implement economic rather than political objectives within the firm. To test the delegated philanthropy hypothesis of the government through state-ownership, we test whether rules protecting minority shareholders have an influence on the likelihood to issue green bonds.

We then use our main specification for each subsample, which allows us to measure the strength of the link between green bond issuance and state ownership, given different institutional contexts.

iii. Control variables

We referred to the previous literature on firm ownership and determinants of CSR to build a wide set of control variables (Jo & Harjoto, 2012; W. Li & Zhang, 2010). We accordingly control for firm characteristics, including size computed as the natural logarithm of assets (SIZE), leverage (LEVERAGE), firm performance measured by return on assets (ROA), and Tobin's Q (TOBINQ). We also control whether ESG ratings influence the future issuance of

green bonds rather than ownership using the Asset4 ESG score (ESGscore). Finally, given the international and cross-sectoral nature of our sample, we control for country and industry fixed effects. To control for the effect of macro-economic factors, we use time fixed effects (YEAR). To show that other types of ownership do not affect the likelihood of green bond issuance, we use institutional investor ownership (INSTIT) and share of foreign ownership (FOREIGN) as alternative explanatory variables. Following Rees and Rodionova (2015), we use the variable EMPLOYFAMHELD, extracted from Datastream, to capture family ownership.

c. Descriptive statistics

Table II shows the descriptive statistics of the whole sample for the 2012–2017 period.

[Insert Table II about here]

Table III shows the country and industry split of green bond issuers.

[Insert Table III about here]

Table IV shows the correlation matrix of the variables used in our study.

[Insert Table IV about here]

The descriptive statistics in Table II show that green bond issuers have larger sizes, higher ESG scores, a substantially higher share of government ownership, and a lower share of employee and institutional ownership. Finally, green bond issuers have a slightly higher share of foreign ownership. From Table III, we see that green bond issuers mainly come from the United States, China, and European countries. Transportation, public utilities, and manufacturing are the main industries of green bond issuers, given that these issuers are mainly from the renewable energy industry.

The correlation matrix in Table IV shows that size, government holdings, system, and ESG scores correlate at a significant level with green bond issuance the following year. This table

also reveals that correlation levels are below 0.7, which suggests a low risk of collinearity issues in our regression models.

5. Methodology

In this section, we describe the methodology used to test our hypotheses. In the first section, we detail how we applied the propensity score matching method. We then describe the regression model used.

a. Matching

The decision to issue a green bond originates from the firm. We assume that firms will self-select into becoming green bond issuers based on their observable financial and CSR characteristics. This selection bias may lead to erroneous regression coefficients and limit our ability to make causal inferences between ownership and green bond issuance (Roberts & Whited, 2013). One way to overcome these selection issues is propensity score matching (Dehejia & Wahba, 2002), used in both the green bond (Flammer 2018) and the CSR literature (Biswas, 2017; Shen & Chang, 2009). The idea of matching is to pair treated and untreated firms¹² on observables to get a sample of firms that are similar based on a set of covariates. In our analysis, we matched on commonly used covariates from the CSR and green bond literature (Cahan et al., 2015; Flammer, 2018; Ioannou & Serafeim, 2017), as of 2012 before the first green bond issuance. We carried out matching before the first green bond issuance so that the issuance could not impact the covariates, we were matching the firms on.¹³ Covariates we match the firms on are the two-digit SIC code, the country, the ESG score, the size, the leverage, the ROA, and Tobin's Q. In our study, we used the nearest neighbor propensity score matching

¹² The 'treatment' is being a green bond issuer in our study.

¹³ For example, green bond issuance may increase leverage, so using this variable as covariate after issuance may bias the propensity score matching.

without replacement and with a 0.2 caliper, as recommended in the literature (Austin, 2011). We implemented the propensity score and propensity score tests using the algorithm of Leuven and Sianesi (2018).

[Insert Table V about here]

As shown in Table V, the propensity score matching reduced the selection bias on the selected set of covariates. Matching reduced the standardized percentage bias¹⁴ to 7% for the matched sample, against 11% before matching. Given that we did not fully eliminate the selection bias, we still controlled for the covariates used in the matching section when we proceeded to regressions after matching.

b. Regression analysis

Our sample is a panel data sample with *Issuein1Y* as the dependent variable and one-year lagged independent and control variables. We then estimate a linear probability model (LPM). To consider the international and cross-industry nature of our sample and given that we focus on estimating the impact of ownership on green bond issuance, we use country and industry fixed effects in our model. To limit the impact of unmeasured macro-economic variables, we use year fixed effects. Fixed effects thus allow us to limit endogeneity issues due to omitted variable bias (Roberts and Whited 2013). Finally, we estimate the model with robust standard errors to control for heteroskedasticity. We estimate our models on the full 2013–2017 sample before and after matching, as follows:

¹⁴ The percentage bias is the percentage difference of the sample means in the treated and non-treated subsamples as a percentage of the square root of the average of the sample variances in the treated and non-treated groups (Leuven and Sianesi 2017; Rosenbaum and Rubin 1985).

$$\text{Issuein1}Y_{i,t+1} = \beta_0 + \beta_1 \text{GOVHELD}_{i,t} + \beta_2 \text{Control}_{i,t} + \text{Country}_i + \text{Industry}_i + \text{Year}_{i,t} + \varepsilon_{i,t} \quad (1)$$

Where $\text{Issuein1}Y_{i,t+1}$ is 1 if firm i issued a green bond during year t , and 0 otherwise. $\text{GOVHELD}_{i,t}$ is the independent variable representing government ownership in the firm. $\text{Control}_{i,t}$ is the vector of the previously described control variables. Country_i represents country fixed effects and Industry_i industry fixed effects. $\text{Year}_{i,t}$ represents year fixed effects and $\varepsilon_{i,t}$ the error term.

6. Results

In Table VI, we first show the LPM model results on the full sample before matching, and then the model on the matched sample. In this table, we measure whether state ownership in year t increases the likelihood of issuing green bonds in year $t+1$.

[Insert Table VI about here]

The Model (1) results are in line with hypothesis H1, in that the coefficient for GOVHELD is positive and significant at the 1% level. Our results for control variables show a significant and negative coefficient for ROA and leverage. We also find a significant and positive relationship between Tobin's Q , size, and the likelihood of issuing green bonds the following year. Control ownership variables (foreign, family, and institutional ownership) do not seem to impact the likelihood of issuing green bonds.

In model (2), we test the first hypothesis, but after matching, to check whether the results from our first model are not due to sample selection bias. Results are still in line with our first hypothesis on the impact of state ownership on green bond issuance.

To check whether the political agenda has an influence on the way governments use their ownership in firms to implement their climate-related objectives, we use a second regression analysis (Table VII). In this analysis, we estimate our main specification during the year of the

Paris Agreement, a dummy variable (PARIS) equal to zero before and one after the Paris Agreement and the interaction between GOVHELD and PARIS.

[Insert Table VII about here]

We find that the link between green bond issuance and state ownership is stronger after the year of the Paris Agreement. We find that this interaction is positive and significant. This confirms that the Paris Agreement has increased the link between state ownership and green bond issuance. These additional elements provide further evidence that governments use their stakes in firms to push their climate-related political agenda. This also confirms hypothesis H1.

In conclusion, we apply two different models. In the first, we use a direct regression of dependent and independent variables on the full sample, controlling for sample selection bias. In the second model, we test the influence of the Paris Agreement on the link between state ownership and green bond issuance. Both models confirm our hypothesis H1.

Table VIII presents our results concerning the second hypothesis H2. We split our sample into subsamples based on legal origin, the strength of market institutions, and the rule of law. We then test in which institutional contexts the link between state ownership and green bond issuance works best.

[Insert Table VIII about here]

We find that state ownership impacts green bond issuance in civil law countries and in countries with weaker market protection mechanisms and a weaker rule of law. These results are in line with the findings of Boubakri et al. (2019) and with our hypothesis H2 that weaker country-level institutions seem to favor the ability of the government to implement its own agenda in firms it has stakes in.

7. Robustness Tests

a. Endogeneity

In our models presented in table VI, state ownership may be an endogenous variable. Endogeneity may, in this case, bias the regression coefficient and therefore limit our conclusions (James J Heckman, 1979). Two frequently cited sources of endogeneity are omitted variable bias and simultaneity (Roberts and Whited 2013). Once it issues a green bond, the issuer cannot change past state ownership data or past accounting data. In view of this, we do not expect simultaneity to be an issue in our estimated regressions. Considering that some variables not included in our models may impact both the dependent and the independent variables, omitted variable bias may occur. Previous studies on state ownership address this endogeneity issue by using an IV approach (Andrianova et al., 2012; Boubakri, Cosset, & Saffar, 2013). This procedure allows us to account for biases to the coefficient of GOVHELD (including omitted industry effects, for example).

Following the method of Boubakri et al. (2013), we use the political system as an instrument for state ownership, based on the Database for Political Institutions (DPI) 2017, as described by Scartascini et al., (2018), to build the variable SYSTEM, equal to 0 when the political system is presidential, 1 when the president is assembly-elected, and 2 when the political system is parliamentary. The rationale behind this instrument is the strong link between the political system and the government's willingness to engage in the governance of firms (Boubakri et al., 2011). To further confirm our results, we add a second instrument, the political orientation of the state (Boubakri et al. 2019). We expect countries governed by a right-wing party to have more incentives to have an impact on government holdings (through sales and privatization). We also expect that in these countries there would be a weaker link between government and CSR (Di Giuli & Kostovetsky, 2014). We use the binary variable RIGHT, equal to 1 if the

largest government party of the country is right-wing (conservative, Christian democratic, or right-wing), based on the DPI 2017.

According to Hall et al. (1996), instruments need to be relevant, that is, they must have a high correlation with the endogenous variable. The second required property of an instrument is exogeneity. The instrument must show a correlation with the dependent variable only through the endogenous variable. Based on the correlations presented in Table IV, we see that the SYSTEM and RIGHT variables seem to have a low correlation with the dependent variable Issuein1Y, while they show a higher level of correlation with GOVHELD. These elements make SYSTEM and RIGHT good potential instruments for government ownership.

In Table IX, we show the results of our instrumental variable approach. Given that the second stage of our IV regression has a binary dependent variable, we use the IV probit approach (Harkness, 2005; Newey, 1987).

In Model (1), we perform a first-stage regression with GOVHELD as the dependent variable and our instruments as independent variables. In Model (2), we use a probit regression with Issuein1Y as the dependent variable and instrumented GOVHELD as the independent variable. Models (3) and (4) are the same as (1) and (2) but with RIGHT as an additional instrument for GOVHELD. All models include control variables.

[Insert Table IX about here]

In Models (1) and (3), which represent the first stage of the IV regression, we see that the SYSTEM and RIGHT instruments are highly significant (at the 1% level), suggesting that these variables are valid instruments for GOVHELD. Finally, the second-stage regression in Models (2) and (4) shows that instrumented GOVHELD is positive and highly significant. The table also displays the F-test for the joint significance of the first stage regression. Based on Staiger

and Stock (1994)'s rule of thumb (i.e. instruments are valid if the first stage F-test is above 10), SYSTEM and RIGHT are valid instruments as both first-stage F-tests are above 10.

These results seem to confirm the first hypothesis that government ownership drives the likelihood of issuing green bonds.

b. Industry and country effects

As seen in the descriptive statistics (Table III), state ownership is concentrated in industries where there is an important share of green bond issuance. There is a risk that our main specification reflects an industry effect rather than an ownership effect. As our models rely on industry classification based on two-digit SIC codes, there also may be a micro-industry effect at the four-digit SIC level that explains our results. To test these alternative explanations of our results we have estimated three models, one model with four-digit SIC code fixed effect, and two new matching procedures based on a four-digit SIC code matching. We use our main model specification from Table VI, and we replace two-digit SIC code fixed effects with four-digit SIC code fixed effects. To target industry effects between green and conventional bond issuers, we use two different exact matching procedures based on (1) country and industry and (2) industry only. Under the first matching procedure, we keep only green and conventional bond issuers with the same four-digit SIC code and International Standards Organization (ISO) country code. Provided that we exactly match firms within the same industry and country, any difference in the results cannot be due to differences in the industry (or country). The second matching procedure matches green and conventional bond issuers who have the same four-digit SIC code. We thus test in Table X whether government holdings still explain green bond issuance given that green bond and conventional bond issuers in the sample are from exactly the same industry. As we could still have cross-sectional heterogeneity, we add industry fixed effects based on the four-digit SIC codes in our model after matching. This procedure ensures that we fully control for industry effects.

We show in Model (1) in Table X the main specification before matching with a four-digit SIC code fixed effect instead of a two-digit SIC code fixed effect. In Model (2), we exactly match green and conventional bond issuers based on the country and four-digit SIC code. In Model (3), we match exactly four-digit SIC code only.

[Insert Table X about here]

Model (1) is positive and significant with a coefficient that has similar levels to Model (1) in Table VI. This indicates that micro-industry effects do not seem to impact the link between state ownership and green bond issuance. In Models (2) and (3) we further see, after applying an exact matching based on a four-digit SIC code, that we still have a significant and positive sign for GOVHELD. Our previous conclusions still hold, and industry effects do not seem to impact the link between state ownership and green bond issuance.

Descriptive statistics in Table III reveal that aside from industry concentration, firms' countries of residence are strongly concentrated in China and Hong Kong (34% of the sample). Given that state-owned firms account for a large part of firms in China (about 40% of total assets and 20% of total employment¹⁵) the sample could be biased. We have, therefore, excluded these firms from our main and matched samples, we have then applied models in Table V to this sample in Table XI.

[Insert Table XI about here]

¹⁵ (*Explained, the Role of China's State-Owned Companies*, 2019)

Table XI shows that coefficients for GOVHELD are still significant when firms located in China and Hong Kong are excluded. Therefore, geographic concentration does not seem to bias our results¹⁶.

8. Conclusion

We studied why a firm would engage in green bond issuance when expected value generation from this financial product seems thin. The previous literature on green bonds has mainly focused on the bond market characteristics of this new financial product. We measure how ownership, and more specifically state ownership, as well as country-level institutional context, impact the decision to issue a green bond. We find that one potential channel drives our results, namely the use by governments of their stakes in firms to serve their own climate-related political agenda. A second channel is that of institutional weakness, which leads to an even stronger link between green bond issuance and state ownership. This confirms results from previous studies (Boubakri et al. 2019) that weaker institutions provide the state with a greater ability to push its political agenda within their firms.

Our results have theoretical implications for the state ownership literature, on which there are two conflicting views. A first view is that political interference is detrimental to the firm (Megginson et al., 1994; Shleifer & Vishny, 1994). According to the second view, state

¹⁶ We also test for state ownership threshold effects. We test whether a 50% majority ownership or a relative majority of the state in the firm's capital impacts the likelihood to issue green bonds. We use the same models as in Table VI replacing the GOVHELD variable by the QGOV and QGOV2 variables. QGOV is equal to 1 when the government has a 50% majority stake in the firm and 0 otherwise. QGOV2 is equal to 1 when the government has a relative majority in the firm and 0 otherwise. We find that QGOV and QGOV2 are positive and significant indicating that a government's majority stake increases likelihood to issue green bonds. Still, these results do not hold when we apply matching as per Table VI. These results are therefore limited by the selection bias.

ownership brings benefits to firms, and these benefits are more specifically observable in terms of CSR performance (Boubakri et al., 2019; Hsu et al., 2018). Our results seem to confirm that state ownership favors environment-linked CSR. Our results also confirm the philanthropy delegation channel of CSR (Bénabou and Tirole 2010), which suggests that stakeholders, in our case governments, push firms to fulfill their own CSR commitments. The fact that the Paris Agreement seems to have had a positive impact on the link between green bonds and state ownership confirms these results.

One key policy implication is that state ownership should be considered as a channel to promote green innovation generated by firms. As a result, the increase (or decrease) in state ownership should have an impact on a state's ability to meet its environmental commitments. Another key policy implication from our results is that a political signal, such as the Paris Agreement, has an impact on a firm's propensity to engage in environment-linked CSR.

One limitation of this study is that we do not consider the share of green bonds in the total funding mix of green projects financed, as we do not have granular data on the use of funds for conventional debt and equity. Another limitation is that we do not consider the impact of any state-initiated rules on the green bond market. We did not find any laws targeting corporate green bonds for the sample period. Future research could explore these aspects more deeply and consider other state policy mechanisms such as taxes or regulation.

In chapter 2, we further explore the impact of national policies and regulations on the issuance of green bonds. In this chapter, we describe how the 2016 U.S. presidential election has influenced the value perception of a green bond issuance announcement. Given that this value perception increases when stronger environmental regulations are expected and decreases when weaker environmental regulations are expected, green bond issuers have a lower incentive to issue such securities. This mechanism should be even stronger for state-owned firms that implement the government's political agenda.

Tables

Table I: Variables definition

Below are presented the definitions of all of the data used in our study. Accounting data and firm characteristics are extracted from COMPUSTAT. Equity market and ownership data are extracted from Datastream. Other sources of data are disclosed in the definition column.

Variable	Definition
Anti-self-dealing	Country anti-self-dealing index established by Djankov et al. (2008).
COUNTRY	International Standards Organization (ISO) Country code in numerical form.
COUNTRY_GHG	Carbon dioxide emissions per capita based on the World Bank database.
EBITDA	Earnings before interest, taxes and depreciation and amortization divided by total assets.
EMPLOYFAMHELD	The percentage of strategic holdings (of 5% or more) held by employees or those with a substantial position in the company's shares that leads to relevant voting power at an annual general meeting (family members).
ESGscore	Asset4 ESG score is an overall company score based on the self-reported information in the environmental, social, and corporate governance pillars.
FOREIGN	The percentage of strategic holdings (of 5% or more) held by foreign investors.
GOVHELD	The percentage of strategic holdings (of 5% or more) held by the government or by government-related institutions.
INDUSTRY	The first two digits of the Standard Industrial Classification code
INSTIT	The percentage of strategic holdings (of 5% or more) held by endowment funds or pension funds plus the percentage of strategic holdings (of 5% or more) held by investment banks or institutions seeking a long-term return.
Issuein1Y	Dummy equal to 1 if a green bond issued the following year; 0 otherwise.
Judicial independence	Country judicial independence classification as established by La Porta et al. (2004).
Legal Origin	Country legal origin classification as established by La Porta et al. (1998).
LEVERAGE	Total debt divided by total assets.
PARIS	Dummy equal to 1 after the Paris Agreement year; 0 otherwise
QGOV	Dummy variable equal to 1 if the government has a 50% stake in the firm and 0 otherwise.
QGOV2	Dummy variable equal to 1 if the government has a relative majority in the firm and 0 otherwise.
RIGHT	A dummy variable that identifies when the largest government party is right-wing (conservative, Christian democratic, or right-wing). The classification is based on the Database of Political Institutions 2017 as compiled by Scartascini et al. (2018).
ROA	Net income divided by total assets.
ROE	Net income divided by shareholder equity.
SIZE	Natural logarithm of total assets.
SYSTEM	Count variable equal to 0 when the political system is presidential, 1 when the president is assembly elected, and 2 when the political system is parliamentary. The classification is based on the Database of Political Institutions 2017 as compiled by Scartascini et al. (2018).
TOBINQ	$(\text{Assets} + \text{Market Capitalization}) / (\text{Assets} + \text{Common equity})$

Table II: Descriptive statistics 2012-2017 sample of all firms before matching

Descriptive statistics are for the sample of green bond issuers and control firms (conventional bond issuers) before matching between 2012 and 2017. All data are winsorized at the 1st and 99th percentiles to minimize the effect of outliers on the results. Ownership data are expressed in percentage points. We use 2012 as the first year given that we are interested in firm characteristics the year before the first green bond issuance. We add the difference in means between each variable and associated p-values.

Variables	Conventional issuers					Green bond issuers					Difference in means
	N	mean	SD	min	max	N	mean	SD	min	max	
SIZE	10,283	8.0	1.7	3.9	12.1	324	8.9	1.8	4.1	12.1	-0.94***
ROA	10,156	0.0	0.1	-0.6	0.2	305	0.0	0.1	-0.3	0.2	0.01***
LEVERAGE	10,282	0.3	0.2	0.0	1.1	324	0.4	0.2	0.0	0.8	-0.05***
TOBINQ	7,223	1.4	1.1	0.3	8.8	244	1.2	0.8	0.3	7.7	0.29***
ESGscore	2,208	55.3	17.8	13.0	88.1	130	62.2	15.0	24.7	83.5	-6.92***
EBITDA	10,271	0.1	0.1	-0.5	0.3	320.0	0.1	0.0	-0.1	0.3	0.02***
ROE	10,147	0.1	0.4	-2.2	2.7	305.0	0.0	0.3	-1.9	1.7	0.05**
GOVHELD	7,206	1.1	6.5	0.0	59.0	249.0	8.9	17.0	0.0	59.0	-7.82***
INSTIT	7,191	3.8	6.9	0.0	36.0	249.0	3.3	6.9	0.0	30.0	0.50
EMPLOYFAMHELD	7,246	9.0	16.6	0.0	73.0	250	4.2	9.9	0.0	55.0	4.81***
FOREIGN	7,201	4.6	12.6	0.0	68.0	250.0	5.6	12.6	0.0	65.0	-1.01

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

Table III: Country and industry split of green bond issuers

We present below the split of bond issuers per country. The country split is based on the International Standards Organization (ISO) country code extracted from COMPUSTAT. The industry split is based on the two-digit Standard Industrial Classification (SIC) code extracted from COMPUSTAT.

Variable	Frequency
<i>Industry</i>	
Agriculture, Forestry, & Fishing	2%
Construction	4%
Manufacturing	30%
Transportation & Public Utilities	61%
Services	2%
Other	2%
Total	100%
<i>Country</i>	
Austria	2%
Brazil	5%
China	25%
Denmark	4%
France	5%
Germany	4%
Greece	2%
Hong Kong	9%
India	4%
Italy	7%
Japan	4%
South Korea	2%
New Zealand	2%
Norway	2%
Spain	5%
Sweden	4%
United Kingdom	5%
USA	12%
Total	100%

Table IV: Correlation matrix on the full 2012-2017 sample before matching

The correlation matrix shows the correlations of key variables of our model based on the full 2013–2017 sample before matching. All data (except for dummy variables) are winsorized at the 1st and 99th percentiles to minimize the effect of outliers on the results.

	Issuein1Y	SIZE	ROA	LEVERAGE	TOBINQ	ESGscore	GOVHELD	INSTIT	FOREIGN	EMPLOY FAMHELD	SYSTEM	RIGHT
Issuein1Y	1											
SIZE	0.131***	1										
ROA	-0.0402	-0.0488*	1									
LEVERAGE	-0.00669	0.0234	-0.283***	1								
TOBINQ	-0.0118	-0.307***	0.401***	0.0556**	1							
ESGscore	0.0629**	0.420***	0.0231	-0.106***	-0.0966***	1						
GOVHELD	0.190***	0.252***	-0.0278	0.0321	-0.120***	0.135***	1					
INSTIT	-0.0275	-0.203***	0.0605**	0.0658**	0.144***	-0.0824***	-0.123***	1				
FOREIGN	0.0139	-0.0643**	-0.0201	-0.00422	0.0678**	-0.0561**	-0.0650**	-0.00332	1			
EMPLOYFAMHELD	-0.0243	0.0258	-0.0369	-0.0414*	-0.00804	-0.0758***	-0.0424*	-0.0665**	0.0241	1		
SYSTEM	0.0657**	0.104***	-0.0114	-0.190***	-0.161***	0.249***	0.221***	-0.258***	0.0728***	-0.0198	1	
RIGHT	-0.00334	-0.0428*	-0.0151	-0.119***	-0.102***	0.142***	-0.0772***	0.0337	-0.0942***	-0.00816	0.230***	1

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

Table V: Testing of matching bias reduction

Using the nearest neighbor matching methodology, we match green bond issuers and conventional bond issuers on Country, Standard Industrial Classification (SIC) code, Size, Return on Assets (ROA), Tobin Q, Leverage and Environment Social and Governance (ESG) score. We present below a means comparison before and after matching between treated and untreated groups. The percentage bias is the percentage difference of the means in the treated and non-treated sub-samples as a percentage of the square root of the average of the sample variances in the treated and non-treated groups, following the method of Rosenbaum and Rubin (1985), and as described in Leuven and Sianesi (2018).

Variable	Unmatched (U) / Matched (M)	Mean Treated	Mean Control	% bias
SIZE	U	8.7	7.8	43.3
	M	10.0	9.9	6.1
ROA	U	0.0	0.1	-7.8
	M	0.0	0.0	0.2
TOBINQ	U	1.1	1.4	-16.9
	M	0.8	1.0	-9.2
LEVERAGE	U	1.3	1.1	2.7
	M	1.3	0.7	7.7
ESGscore	U	60.2	54.7	33.1
	M	62.4	57.4	30.1
Average	U			10.9
	M			7.0

Table VI: Linear Probability Model results before and after matching

The models below have the binary Issuein1Y as the dependent variable. In Model (1), we use a linear probability model (LPM) on the full sample of green and conventional bond issuers. In Model (2), we use the LPM on the sample of matched firms following (Cahan et al. 2015; Flammer 2018; Ioannou and Serafeim 2017). We use year, country, and industry fixed effects in all models.

Variables	(1) Before Matching Issuein1Y	(2) After Matching Issuein1Y
GOVHELD	0.174*** (0.059)	1.363** (0.661)
INSTIT	0.021 (0.052)	-0.051 (0.671)
EMPLOYFAMHELD	-0.012 (0.026)	-0.600 (0.777)
FOREIGN	0.054 (0.033)	1.281 (0.924)
ROA	-0.018** (0.008)	0.315 (0.298)
LEVERAGE	-0.055*** (0.016)	-0.007 (0.012)
ESGscore	-0.000 (0.000)	-0.000 (0.005)
SIZE	0.014*** (0.004)	0.032 (0.055)
TOBINQ	0.014** (0.006)	-0.018 (0.121)
Constant	-0.091 (0.072)	-0.922 (0.623)
Observations	2,282	210
R-Squared	0.16	0.33
Year FE	YES	YES
Industry FE	YES	YES
Country FE	YES	YES

Robust standard errors in parentheses

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

Table VII: Linear Probability Model results before and after the Paris Agreement

The four models have the binary Issuein1Y as the dependent variable. In the model (1), we use the linear probability model (LPM) on the sample of green bond issuers who decided to issue in the year of the Paris Agreement. In Model (2), we estimate a model including an interaction between GOVHELD and PARIS, which is a dummy equal to one after the date of the Paris Agreement. In Model (3), we estimate Model (2) including year fixed effects. We use country and industry fixed effects in all models. We use robust standard errors in all models.

Variables	(1) Year of the Paris Agreement Issuein1Y	(2) Interaction GOVHELD and Paris Agreement Issuein1Y	(3) Interaction GOVHELD and Paris Agreement Issuein1Y
GOVHELD*PARIS		0.237** (0.108)	0.237** (0.109)
GOVHELD	0.366** (0.168)	0.061 (0.066)	0.061 (0.066)
PARIS		0.005 (0.005)	0.003 (0.007)
INSTIT	0.195 (0.159)	0.028 (0.054)	0.028 (0.054)
EMPLOYFAMHELD	0.037 (0.070)	-0.015 (0.026)	-0.015 (0.026)
FOREIGN	0.028 (0.105)	0.047 (0.034)	0.048 (0.034)
ROA	-0.022 (0.018)	-0.215** (0.085)	-0.216** (0.085)
LEVERAGE	-0.044 (0.040)	-0.070*** (0.020)	-0.071*** (0.020)
ESGscore	0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)
SIZE	0.011 (0.008)	0.014*** (0.004)	0.014*** (0.004)
TOBINQ	0.015 (0.013)	0.020** (0.008)	0.020** (0.008)
Constant	-0.257** (0.116)	-0.077 (0.071)	-0.081 (0.071)
Observations	443	2,282	2,282
R-squared	0.25	0.17	0.17
Year FE	NO	NO	YES
Industry FE	YES	YES	YES
Country FE	YES	YES	YES

Robust standard errors in parentheses

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

Table VIII: Green bond issuance, state ownership, and institutional environment

The four models have the binary Issuein1Y as the dependent variable. We use the linear probability model (LPM) in all models. In Models (1) and (2), we estimate our model on the sample of firms in civil law countries and common law countries using the classification of La Porta et al. (1998). In Models (3) and (4), we estimate our model with firms in countries with low or high anti-self-dealing. The split of the sample between high and low anti-self-dealing is based on the variable for each country being higher or lower than the average. We use the classification established by Djankov et al. (2008). In Models (5) and (6), we estimate our model with firms in countries with low or high judicial independence using the classification by La Porta et al. (2004).

	(1)	(2)	(3)	(4)	(5)	(6)
	Legal Origin Civil Issuein1Y	Legal Origin Common Issuein1Y	Anti-self- dealing Low Issuein1Y	Anti-self- dealing High Issuein1Y	Judicial Independence Low Issuein1Y	Judicial Independence High Issuein1Y
GOVHELD	0.258** (0.101)	0.111 (0.071)	0.267** (0.116)	0.120* (0.069)	0.339** (0.134)	0.039 (0.048)
INSTIT	0.013 (0.084)	0.067 (0.074)	0.028 (0.123)	0.050 (0.061)	0.030 (0.090)	0.015 (0.066)
EMPLOYHEL D	-0.059** (0.027)	0.111 (0.068)	-0.067 (0.049)	0.055 (0.037)	-0.057** (0.026)	0.158** (0.077)
FOREIGN	0.093* (0.054)	0.004 (0.042)	0.216** (0.108)	-0.021 (0.025)	0.066 (0.044)	0.044 (0.039)
ROA	-0.044*** (0.015)	-0.200* (0.102)	-0.062** (0.026)	-0.163** (0.081)	-0.044*** (0.015)	-0.174* (0.094)
LEVERAGE	-0.107*** (0.036)	-0.062** (0.025)	-0.194*** (0.070)	-0.038** (0.017)	-0.107*** (0.035)	-0.066*** (0.024)
ESGscore	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000** (0.000)
SIZE	0.018*** (0.005)	0.008 (0.006)	0.036*** (0.012)	0.003 (0.003)	0.021*** (0.006)	0.003 (0.006)
TOBINQ	0.005* (0.003)	0.024** (0.012)	0.028*** (0.009)	0.017* (0.009)	0.005* (0.003)	0.025* (0.013)
Constant	-0.107 (0.086)	-0.070 (0.060)	-0.350** (0.159)	-0.054 (0.043)	-0.148** (0.072)	-0.044 (0.053)
Observations	1,415	867	643	1,639	1,341	941
R-Squared	0.20	0.17	0.26	0.12	0.21	0.19
Year FE	YES	YES	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES	YES	YES
Country FE	YES	YES	YES	YES	YES	YES

Robust standard errors in parentheses

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

Table IX: Instrumental variable regressions

In Model (1) we show the first-stage regression of GOVHELD against the SYSTEM instrument. In Model (2) we show results of the probit regression with Issuein1Y as the dependent variable and instrumented GOVHELD as the independent variable. In Model (3) we show the first-stage regression of GOVHELD against both SYSTEM and RIGHT instruments. In Model (4) we show results of the probit regression with Issuein1Y as the dependent variable and instrumented GOVHELD as the independent variable. At the bottom of our table, we add the first stage F-test and the Wald chi-square. All models are shown with robust standard errors. The difference in the number of observations with Table VI is due to fixed effects.

Variables	(1) GOVHELD	(2) Issuein1Y	(3) GOVHELD	(4) Issuein1Y
GOVHELD		6.120*** (1.233)		4.240*** (1.577)
<i>Instruments</i>				
SYSTEM	0.027*** (0.003)		0.031*** (0.003)	
RIGHT			-0.030*** (0.006)	
<i>Control variables</i>				
INSTIT	-0.035 (0.024)	0.829 (0.914)	-0.016 (0.024)	0.703 (1.067)
EMPLOYHELD	-0.057*** (0.018)	-0.124 (0.428)	-0.056*** (0.018)	-0.332 (0.515)
FOREIGN	-0.066*** (0.011)	0.833** (0.388)	-0.079*** (0.011)	0.833* (0.433)
ROA	-0.003 (0.007)	-0.057 (0.152)	-0.006 (0.007)	-0.087 (0.172)
LEVERAGE	0.033** (0.014)	-0.311 (0.352)	0.028** (0.014)	-0.286 (0.403)
ESGscore	-0.000 (0.000)	0.002 (0.004)	-0.000 (0.000)	0.003 (0.004)
SIZE	0.027*** (0.004)	0.076 (0.089)	0.026*** (0.004)	0.161* (0.086)
TOBINQ	-0.002 (0.001)	0.125* (0.065)	-0.003** (0.001)	0.129* (0.073)
Constant	-0.233*** (0.028)	-3.034*** (1.160)	-0.209*** (0.028)	-4.072*** (1.006)
Observations	2,282	2,282	2,282	2,282
Fixed effects	NO	NO	NO	NO
First stage F-test	32.72		33.34	
Wald Chi-square		108.71		51.32

Robust standard errors in parentheses

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

Table X: Linear Probability Model results before and after matching on industry

The models below have the binary Issuein1Y as the dependent variable. In Model (1), we use a linear probability model (LPM) on the full sample controlling for four-digit Standard Industrial Classification (SIC) code. In Model (2), we use the LPM on firms matched exactly based on the country and the four-digit SIC code. In Model (3), we use the LPM on the sample of firms matched exactly and only on the four-digit SIC code.

Variables	(1) Sample before matching Issuein1Y	(2) After Country and SIC matching Issuein1Y	(3) After SIC matching Issuein1Y
GOVHELD	0.177*** (0.063)	0.284*** (0.086)	0.145** (0.057)
INSTIT	0.038 (0.066)	-0.009 (0.020)	-0.014 (0.013)
EMPLOYFAMHELD	-0.008 (0.031)	-0.029** (0.014)	-0.040*** (0.012)
FOREIGN	0.069* (0.040)	-0.010 (0.010)	0.007 (0.006)
ROA	-0.017 (0.011)	-0.176*** (0.056)	-0.138*** (0.036)
LEVERAGE	-0.065*** (0.023)	-0.068*** (0.025)	-0.066*** (0.016)
ESGscore	-0.000 (0.000)	-0.000*** (0.000)	-0.001*** (0.000)
SIZE	0.015*** (0.004)	0.013*** (0.004)	0.012*** (0.003)
TOBINQ	0.020** (0.008)	0.009** (0.004)	0.006*** (0.002)
Constant	-0.098 (0.094)	-0.081** (0.033)	-0.072*** (0.026)
Observations	2,282	1,242	2,097
R-squared	0.21	0.36	0.45
Year FE	YES	YES	YES
Industry four-digit FE	YES	YES	YES
Country FE	YES	YES	YES

Robust standard errors in parentheses

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

Table XI: Linear Probability Model results before and after matching (Excluding China and HK)

The models below have the binary Issuein1Y as the dependent variable. In Model (1), we use a linear probability model (LPM) on the full sample of green and conventional bond issuers. In Model (2), we use the LPM on the sample of matched firms following (Cahan et al. 2015; Flammer 2018; Ioannou and Serafeim 2017). We use year, country, and industry fixed effects in all models.

Variables	(1)	(2)
	Before Matching Issuein1Y	After Matching Issuein1Y
GOVHELD	0.132** (0.058)	1.593** (0.746)
INSTIT	0.025 (0.058)	0.185 (0.667)
EMPLOYFAMHELD	-0.015 (0.029)	-0.508 (0.785)
FOREIGN	0.092* (0.050)	1.512 (0.960)
ROA	-0.230** (0.092)	0.391 (0.318)
LEVERAGE	-0.075*** (0.022)	-0.004 (0.011)
ESGscore	-0.000** (0.000)	-0.002 (0.006)
SIZE	0.016*** (0.004)	0.033 (0.060)
TOBINQ	0.023** (0.009)	-0.034 (0.133)
Constant	-0.119 (0.076)	-0.904 (0.617)
Observations	1,080	184
R-squared	0.16	0.33
Year FE	YES	YES
Firm FE	NO	NO
Industry FE	YES	YES
Country FE	YES	YES

Robust standard errors in parentheses

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

Table XII: Linear Probability Model results with threshold effects before and after matching

The models below have the binary Issuein1Y as the dependent variable. Our key dependent variable is QGOV equal to 1 if the government has a 50% majority stake in the firm 0 otherwise. Our second key dependent variable is QGOV2 equal to 1 if the government has a relative majority in the firm 0 otherwise. In Models (1) and (2), we use a linear probability model (LPM) on the full sample of green and conventional bond issuers. In Models (3) and (4), we use the LPM on the sample of matched firms following (Cahan et al. 2015; Flammer 2018; Ioannou and Serafeim 2017). We use year, country, and industry fixed effects in all models.

Variables	(1) Before Matching Majority 50% Issuein1Y	(2) Before Matching Relative majority Issuein1Y	(3) After Matching Majority 50% Issuein1Y	(4) After Matching Relative majority Issuein1Y
QGOV	0.091** (0.043)		-0.022 (0.361)	
QGOV2		0.055** (0.023)		0.243* (0.128)
INSTIT	0.024 (0.054)	0.035 (0.054)	0.140 (0.681)	0.042 (0.676)
EMPLOYFAMHELD	-0.022 (0.026)	-0.014 (0.027)	-1.092 (0.872)	-0.922 (0.800)
FOREIGN	0.048 (0.034)	0.050 (0.034)	0.667 (0.918)	1.129 (0.927)
ROA	-0.222*** (0.085)	-0.218*** (0.085)	0.191 (0.310)	0.257 (0.304)
LEVERAGE	-0.073*** (0.020)	-0.078*** (0.021)	-0.013 (0.014)	-0.006 (0.012)
ESGscore	-0.000 (0.000)	-0.000* (0.000)	0.002 (0.005)	0.000 (0.005)
SIZE	0.015*** (0.004)	0.015*** (0.004)	0.036 (0.057)	0.033 (0.056)
TOBINQ	0.019** (0.008)	0.020** (0.008)	0.029 (0.118)	0.010 (0.119)
Constant	-0.089 (0.070)	-0.080 (0.072)	-0.471 (0.527)	-0.598 (0.615)
Observations	2,282	2,282	210	210
R-squared	0.15	0.15	0.31	0.32
Year FE	YES	YES	YES	YES
Firm FE	NO	NO	NO	NO
Industry FE	YES	YES	YES	YES
Country FE	YES	YES	YES	YES

Robust standard errors in parentheses

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

Chapter 2: Green Regulation and Stock Price Reaction to Green Bond Issuance

Abstract

This paper shows how changes in regulatory pressure impact the way equity investors react to green bond issuance announcements. We find a positive stock price reaction to a green bond issuance announcement compared to that of a conventional bond issuance announcement. Based on our analysis, this positive reaction increased in size and statistical significance after the Paris Agreement. Our results suggest that one determinant of this reaction is that investors expect climate-related regulations following such an agreement and, therefore, place greater value on the “green” flag of the bond issuance.

JEL: Q56, G14, G15, G30

Keywords: ecological regulation; green bonds; sustainable finance; event-study

Status: Published in “*Finance*”

1. Introduction

Between 2007 and 2017, the annual issuance of green bonds¹⁷ grew sharply from \$0.8bn to \$155.5bn (“Bonds and Climate Change,” 2018). Initially, the market was dominated by sovereign supranational and agency (SSA) issuers. By 2013, investors’ growing interest in this class of assets pushed corporates and banks to enter the market (Climate Bond Initiative, 2014). Considering that green bond issuance implies additional reporting and auditing costs compared to conventional bonds, the reason behind this growing interest remains unclear. Literature indicates that the green bond market premium¹⁸ (Ehlers & Packer, 2017; Zerbib, 2019), signaling (Flammer, 2018), and an increase in the bondholder base (Zerbib, 2019) are three drivers of green bond issuance. However, to our knowledge, there has been no specific study of the impact of climate-related regulation on the value perception of these financial instruments.

Our study, therefore, addresses the question of regulatory pressure and its impact on the value perception of a green financial instrument. This question is key to understanding how equity investors use regulatory pressure as a factor impacting value. Since green bonds signal the issuing firm’s environmental proactiveness (Flammer, 2018), they constitute a specific part of its corporate social responsibility (CSR) policy. Bénabou and Tirole (2010) formulated three hypotheses to explain why firms engage in CSR. According to the first hypothesis, called the

¹⁷ The International Capital Markets Association (ICMA) provides a set of guidelines for issuing green bonds known as the Green Bond Principles (GBP). According to these guidelines, green bonds are “any type of bond instrument where the proceeds will be exclusively applied to finance or refinance, in part or in full, new and/or existing eligible Green Projects” (ICMA, 2014). Our study uses this definition of green bonds.

¹⁸ The bond market premium refers to the lower yield of a green bond in comparison to a similar conventional bond.

“long-term perspective,” firms aim to increase their long-term benefits through CSR. According to the second hypothesis, the “delegated philanthropy” hypothesis, a firm’s stakeholders use CSR to delegate their own objectives. Their third hypothesis, the “insider-initiated corporate philanthropy” hypothesis, adopts an agency view, stating that CSR reflects the managers’ rather than the firm’s interests. In our study, we tested the “long-term perspective” and “delegated philanthropy” hypotheses to explain the expansion of the green bond market.¹⁹

Our sample is based on all of the available bonds flagged as “green” in the Bloomberg database (“Bloomberg”) from January 2013 to August 2018. We started with the full sample of 275 green bond issuers. First, we excluded private firms, given that we were interested in the stock price reaction to a green bond issuance. Second, we excluded financial firms following Fama and French (1992). We also excluded financials, since the issuance of a bond may convey a regulatory message and we would, therefore, have had difficulties disentangling whether the stock price reaction occurred in response to the regulatory message conveyed by the bond issuance announcement rather than to the “green” flag of the bond issued. Finally, we excluded firms that do not issue conventional bonds, because we are interested in seeing how the stock price of a given firm reacts when the same firm issues green or conventional bonds. Our final sample therefore comprised green bond issuers who could decide to issue either green or conventional bonds. After these data-cleaning procedures, we obtained a sample of 74 green bond issuers. For each green bond issuer, we took all announcements of green or conventional

¹⁹ Two limitations led us to focus on the “long-term perspective” and the “delegated philanthropy” hypotheses. The first is that agency issues are difficult to directly or indirectly measure.

bond issuance. The announcement of bond issuance corresponds to the first time the bond issuance is known to the market. We, therefore, extracted all 302 green and 478 conventional bond issuance announcements.²⁰

Using this data, we tested the “long-term perspective” hypothesis (Bénabou & Tirole, 2010). To test this hypothesis, we first used an event study methodology. In the event study, the event date was the green or conventional bond announcement date. We then applied the multi-country event study methodology of Campbell, Cowan, & Salotti (2010) to set the other parameters of the event study (i.e., estimation window, market model, and return computation). From this first phase, we obtained the cumulative average abnormal return (CAR) at each green or conventional bond issuance announcement. By comparing the CAR of green and conventional bonds, we found that there is a premium (0.3%²¹) at the announcement of a green bond issuance as compared to a conventional bond. Since this higher CAR at the green bond issuance announcement can be due to other factors, we applied a regression analysis method to further test the “long-term perspective” hypothesis. In the regression analysis, the dependent variable is the CAR, and the independent variable is the dummy variable *Green*, which equals one when the bond issuance is green and zero otherwise. We also added control variables following Godlewski, Turk-Ariss, & Weill's (2013) model. We found that the regression coefficient for *Green* is positive and significant in all specifications. This indicates that when

²⁰ We excluded all green and conventional bond issuance announcements released on the same trading day.

²¹ Equivalent to \$68m increase in value at the announcement for a green bond issuer with an average market capitalization.

the bond issuance announcement is green, there is a positive and significant increase in CAR of 1.4% on average. Finally, since endogeneity issues may have biased our results, we added a difference-in-differences (DiD) methodology following the recommendations of Roberts and Whited (2013), Atanasov & Black (2016), and Bertrand, Duflo, & Mullainathan (2004). In the DiD methodology, we used the CAR as a dependent variable, *Green* as an independent variable, and the Paris Agreement as an exogenous shock (i.e., the event date of the DiD model). After applying the DiD, we still found that the “green” flag of the bond issuance had a positive and significant impact on the stock price reaction. The results of these three methods suggest that the “long-term perspective” hypothesis holds for green bonds.

We tested the “delegated philanthropy” hypothesis (Bénabou & Tirole, 2010) using regression and DiD methodologies. We first applied a regression before and after the Paris Agreement with the CAR as the dependent variable, *Green* as the independent variable, and control variables from the Godlewski et al. (2013) model. The results of this analysis show that the announcement of a green bond issuance had no or little impact on the CAR before the Paris Agreement but a positive and significant impact (1.8%²² on average) after the Paris Agreement. This first result confirmed that a signal of forthcoming green regulations due to philanthropy delegation from the state had an impact on the link between value creation and green bond issuance announcement. We then used a DiD methodology on the sample of issuers from the

²² Equivalent to \$406m increase in value at the announcement for a green bond issuer with an average market capitalization.

United States (U.S.).²³ Under the “delegated philanthropy” hypothesis, the state’s commitment to the Paris Agreement meant more delegation of state-level climate objectives to firms. A signal of withdrawal from the agreement (the U.S. 2016 presidential election results) indicated less delegation of such objectives. Therefore, we used the Paris Agreement date, and the U.S. 2016 presidential election results as exogenous shocks in this DiD model. We found a significant and positive coefficient for *Green* after the Paris Agreement and a negative and significant coefficient after the U.S. presidential election. These results suggest that the “delegated philanthropy” hypothesis holds for green bonds.

The political signals (Paris Agreement and U.S. Presidential Election) we use are mostly focused on climate-related questions rather than biodiversity-related questions. The reason for this focus is due to the green bond market structure, the Convention on Biological Diversity estimated that only about 4% (Convention on Biological Diversity, 2017) green bond proceeds go to biodiversity conservation. We, therefore, expect that climate-related political signals rather than biodiversity-related political signals would have a stronger effect on the green bond market.

The remainder of this study is organized as follows: in section 1, we conduct a review of the existing literature on green bonds and explain the hypotheses tested. In section 2, we describe the data used, and in section 3, we describe the methodology. Section 4 presents the results of our event study, regression analysis, and difference-in-differences analysis. In section 5, we discuss the results of the study.

²³ We used the sample of U.S. issuers because it is the only one that contains data and presents a clear case of commitment to and withdrawal from the Paris Agreement.

2. Literature Review and Hypotheses

In this section, we present key literature on green bonds and our hypotheses.

a. Literature review

The existing literature on green bonds primarily focuses on their benefits in terms of bond market premiums.²⁴ Ehlers and Packer (2017), Zerbib (2019), and Hachenberg and Schiereck (2018) found that there was a small bond market premium for green bonds as compared to conventional bonds. Baker, Bergstresser, Serafeim, and Wurgler (2018) found that U.S. municipal green bonds were issued at a bond market premium as compared to conventional U.S. municipal bonds. Conversely, Karpf & Mandel (2017) compared the yield term structure of green and conventional U.S. municipal bonds and concluded that green bonds have a higher average yield. Febi, Schäfer, Stephan, and Sun (2018) found that one of the drivers of the green bond yield spread was the liquidity of these bonds. These studies explain one aspect of the motive behind issuing green bonds, which is the influence of bond market characteristics on value creation. We complement this work by explaining that indirect effects, such as equity value creation and preparing for future regulations, may also provide incentives to green bond issuers.

Bauer and Hann (2010) found that firms with environmental concerns paid a higher cost of debt while firms with more active environmental management entailed a lower cost of debt. Chava (2014) finds that firms with more environmental concerns have a higher cost of debt and cost of equity. Krüger (2015) finds that investors respond negatively to negative CSR

²⁴ The bond market premium refers to the lower yield of a green bond in comparison to a conventional bond.

events and weakly negatively to positive CSR events. We intend to complement the advances in this stream of literature with our study by showing that environmental signaling yields positive investor reaction. Our study also complements this literature by testing how political events impact this link between investor reaction and environmental signaling.

Flammer (2018) showed that green bonds enhance firms' financial and environmental performance while being used as an environmental performance-signaling tool. This study also used an event study methodology on the announcement date. Our study complements Flammer's (2018) since we used a different methodology based on Campbell et al. (2010). We also add to the prior literature by comparing stock price reactions to green bond as compared to conventional bond issuance announcements. We also add to the studies of Flammer (2018) and Tang & Zhang's (2018) by testing the effects of regulation on the stock price reaction to green bond issuance announcements. Finally, while previous researchers (Flammer, 2018; Tang & Zhang, 2018) used an event study to test the market response to green bond issuance only, we contribute to the literature by addressing endogeneity issues that may arise in such methodology.

b. Hypotheses

Bénabou and Tirole (2010) explored the fundamental motives for firms to go beyond their legal obligations to invest in CSR. The authors identified three main motives to invest in CSR. The first motive, also called "doing well by doing good" (which we refer to as the "long-term perspective" hypothesis in our study), was that firms intended to invest in CSR in order to increase the value of the firm. Under this first motive, CSR was used as a tool by shareholders to monitor management so that it puts more weight into long-term benefits. An example given

by the authors was the investment in pollution control by firms in order to limit future environmentally linked lawsuits. By investing in CSR, the firm increased its long-term profits. Empirical work seems to suggest that long-term profit-maximizing may play a role in investors' behavior (Dimson, Karakaş, & Li, 2015; Gibson & Krueger, 2017). Drawing from this motive we built the first hypothesis that investors expect long-term value creation following the issuance of green bonds and investment in green projects.

Bénabou and Tirole (2010) provided a second motive, which they called “delegated philanthropy”. Under this view, stakeholders expect firms to engage in CSR. A key element is that stakeholders delegate CSR commitments to firms since firms may suffer fewer transaction costs, have better know-how, and have direct access to such investments. An example given by the authors is subsidizing employee engagement with the community to obtain better relations with the local government. The empirical literature has tested this hypothesis in the context of CSR and different stakeholders, such as the state (Di Giuli & Kostovetsky, 2014) or community environment (Wu, Lin, & Liu, 2016). To our knowledge, this view has not been tested in the context of green bonds. Based on this second view, we built a second hypothesis that an increase (decrease) in governments' environment-related regulatory pressure increases (decreases) delegated philanthropy. The delegation, in this case, goes through investor expectations of increased (decreased) costs due to regulation and therefore, increased (decreased) stock reaction to firms' signaling through green bonds.

Finally, Bénabou and Tirole (2010) referred to “insider-initiated corporate philanthropy” as the last motive for firms to invest in CSR. Under this view, the authors considered an agency context whereby management invests in CSR to pursue the individual objectives of managers (e.g., increased entrenchment, improved personal branding) rather than firm profit-

maximizing. This view relies on the fact that managers would be willing to use the firm's, and, as a consequence, shareholders' money rather than their own to invest in CSR. Empirical evidence links corporate donations to the chief executive officer's (CEO's) own career objectives (Cheng, Hong, & Shue, 2013; Masulis & Reza, 2014).

In the existing literature, researchers have already established a link between debt-originated information and the reaction of equity investors. Stock returns react to debt offerings (Eckbo, 1986; Fungáčová, Godlewski, & Weill, 2015; Spiess & Affleck-Graves, 1999) and a firm's credit rating downgrades when it conveys information other than an increase in leverage (Goh & Ederington, 1993). Stock returns also react negatively to a Sukuk²⁵ issuance (Godlewski et al., 2013). In addition, a more recent study also revealed that bond variables, such as yield curve slope, affected value stock returns (Kojien, Lustig, & Van Nieuwerburgh, 2017). We can, therefore, expect that information generated by the debt market, such as green bond issuance, can affect the perception of future value creation by investors.

Given their focus on signaling the environmental pro-activeness of the issuing firm (Flammer, 2018), green bonds are part of a firm's CSR policy. We can, therefore, test Bénabou and Tirole's (2010) first hypothesis of value creation using green bonds as a case of engagement in CSR. On the investor side, empirical evidence has shown that institutional investors chose sustainability-oriented portfolio allocation with the objective of long-term value creation

²⁵ Sukuk refers to "securities of equal denomination representing individual ownership interests in a portfolio of eligible existing or future assets" as per the definition set by the Accounting and Auditing Organization for Islamic Financial Institutions (AAOIFI).

(Gibson & Krueger, 2017). From a green bond issuer's perspective, we would, therefore, expect that green bond issuance announcements would trigger positive stock price reactions.

Consistent with this approach, our first hypothesis is as follows:

H1. Stock returns react positively to the announcement of green bond issuance.

Here, we tested Bénabou and Tirole's (2010) hypothesis of "delegated philanthropy". After the Paris Agreement (United Nations, 2015), we expected the governments to be committed to reducing greenhouse gas emissions. Empirical work in this area appears to suggest that green bonds contribute to enhancing a firm's environmental performance (Flammer, 2018). States have therefore been incentivized since the Paris Agreement to push further for regulation that favors green bonds.²⁶ The fact that firms act when they expect regulations to tighten has been documented (Fremeth & Shaver, 2014). This led us to our second hypothesis that investors anticipate future regulation and would, therefore, have a more pronounced positive reaction to the announcement of the green bond issuance after the Paris Agreement.

H2. There is a positive (negative) stock return reaction to green bond issuance announcement when regulatory pressure strengthens (weakens).

3. Data

We used Bloomberg as the data source for all green bonds issued by corporates, including matured and privately placed bonds during the period from January 2013 to August 2018. All

²⁶ One example of state-originated push to the green bond market comes from China. The People's Bank of China and China Securities Regulatory Commission released guidelines on green bond certification in order to promote the development of the green bond market in May 2017 (Anon., 2017).

of the green bonds included in the sample comply with the Green Bond Principles (ICMA, 2014). We excluded financials from our sample (Standard Industrial Classification (SIC) codes between 60 and 69) due to the specificities of these issuers with regard to regulation.²⁷ Bloomberg also provided green and conventional bond issuance announcement dates,²⁸ which were used as the event dates in our event study. Subsequently, we extracted all conventional bonds issued by the same firms between January 2013 and August 2018. Our final sample comprised green bond issuers who could decide to issue either green or conventional bonds. For these firms, we had access to all green and conventional bond issuance announcement dates. Using this methodology, we obtained a sample of 302 green bond issuances and 478 conventional bond issuances. The relatively low number of conventional bond issuances may be explained by the fact that once a firm launches a green bond issuance program, it prioritizes the issuance of green bonds as compared to conventional bonds.²⁹

We then used Datastream to extract stock prices and total return prices for all 74 green bond issuers with an available firm-level International Securities Identification Number (ISIN). With the ISIN, we found the corresponding local market index for each stock using the Datastream

²⁷ Bonds issued by banks also serve as regulatory capital such as Tier 1 or Tier 2 capital with increased loss absorption. This dual function (funding instrument and regulatory capital) of bonds issued by banks does not allow to mix this type of bonds with other corporate bonds in the same sample.

²⁸ Bloomberg defined the announcement date as the earliest known date for which the security is publicized to the market.

²⁹ This point has been confirmed to us by several interviews between 2017 and 2019 of CFOs in firms issuing green bonds.

Index function. Datastream market indices cover a minimum of 75%–80% of the total market capitalization of each local market (Indices, 2008). Following the methodology established by Campbell et al. (2010), we used these indices as a reference for the market index in the event study.

Table I provides the summary statistics of bond issuance characteristics.

[Insert Table I about here]

Table II contains industry and country splits of bond issuances.

[Insert Table II about here]

The descriptive statistics presented above show that green bond issuances are smaller in amount than conventional bond issuances. This is because green bonds are being used to finance specific projects for which the funding need is lower than conventional bonds used for general corporate purposes. Green bonds possess a similar average maturity at issuance, a higher average coupon, and slightly fewer callability provisions as compared to conventional bonds. The issuers belong primarily to the manufacturing, transportation, and public utilities industries. This is consistent with the expected classification, given that the primary issuers are utilities that fund renewable projects. The manufacturing sector has a large share of issuances given that renewable project suppliers and retailers have been classified under this category as well. The main countries of issuance are the United States, China, and Japan.

4. Methodology

Given the nature of our sample with issuers from 22 countries, we built on Campbell et al.'s (2010) work on multi-country event study methodology. We used the same market index, abnormal returns computation, and estimation windows. We executed the event study and computed test statistics using the algorithm developed by Kaspereit (2016). For all of the

regression and DiD models we used in this study, we controlled for heteroskedasticity by using robust standard errors (Huber, 1967; White, 1980).

To test H1, we used the event study, regression, and DiD methodologies on the full sample of green and conventional bond issuance announcements. These methodologies allowed us to test how equity investors react to green bond issuance announcement as compared to conventional bond issuance announcement. The difference in reaction is due to the “green” flag of the green bond issuance. This premium illustrates the value creation equity investors expect from firms’ commitment to environment-linked CSR.

To test H2, we used the regression analysis before and after the Paris Agreement on the full sample of green and conventional bond issuance announcements. We also used a DiD approach on the sample comprising U.S. firms. We applied the DiD model with the Paris Agreement and the U.S. elections as a signal of increased and then decreased philanthropy delegation from the government. These methods allowed us to measure the extent to which equity investors reacted to different levels of delegated philanthropy from governments.

Previous empirical literature relied on the CAR to test Bénabou and Tirole’s (2010) theoretical framework (Becchetti, Ciciretti, & Hasan, 2015; Dimson et al., 2015). Using abnormal returns on a sample of U.S. public companies from 1999 to 2009, Dimson et al. (2015) found that active ownership led to diminished intertemporal loss of profits (which is equivalent to H1). Previous literature also used the Paris Agreement and the 2016 U.S. presidential election as exogenous shocks in their empirical setting (J. Brown & Huang, 2017; Cifci & Oliver, 2018; Wagner, Zeckhauser, & Ziegler, 2018a, 2018b). Wagner et al. (2018a) used the 2016 U.S. presidential election to test how investor expectations shifted in regard to corporate taxes and the impact of trade policies on firms. Similar to Wagner et al. (2018a), we tested how equity

investor expectations shifted in regard to the environmental regulation impact on firm valuation using the 2016 U.S. presidential election as an exogenous shock. To our knowledge, no prior study has examined stock price reaction to green bond issuance announcement using this research setting.

a. Abnormal Returns

Total return prices were computed using the return index function of Datastream. According to Binder (1998), when event dates are not clustered in time, the market-model estimator is considered unbiased and efficient. Given that the event dates in our case were not clustered (see Appendix IX for the monthly distribution of issuance announcements across the year), we used the market model. Following Campbell et al.'s (2010) event study method for multi-country samples, we used Datastream's country-level indices as a reference for the market index. The market-model abnormal returns were computed as follows:

$$AR_{it} = Ret_{it} - (\hat{\alpha}_i + \hat{\beta}_i Ret_{mt}) \quad (1)$$

where AR_{it} is the abnormal return of firm i on day t , Ret_{it} is the total return of firm i on day t , $\hat{\alpha}_i$ and $\hat{\beta}_i$ represent coefficients of the ordinary least squares regression of market returns, and Ret_{mt} the market return based on Datastream local market index. The return estimation period was 250 trading days, excluding any day that fell in the event window. As implemented in Kaspereit (2016), in the event of a lack of data to compute the expected return or the event window stock price reaction, the observation was excluded from the sample.

We used zero- to three-trading-day windows around the bond issuance announcement date to consider information-leakage risk before or the under-reaction risk after the announcement of bond issuance.

The cumulative abnormal return between t_1 and t_2 was computed as follows:

$$CAR_i(t_1, t_2) = \sum_{t=t_1}^{t_2} AR_{it} \quad (2)$$

The cumulative average abnormal return was computed as follows:

$$CAAR_i(t_1, t_2) = \frac{1}{N} \times \sum_{t=t_1}^{t_2} CAR_{it} \quad (3)$$

b. Event-study

Some issues may arise in using the event study method. The first issue is the assumption of cross-sectional independence³⁰ that allows statistical testing of CAR's significance. Kolari and Pynnönen (2010) found that even low levels of cross-sectional correlation led to the null hypothesis of no average abnormal return over-rejection. This issue materialized more specifically in cases of event-date clustering. In Appendix IX, we show the monthly average number of issuance announcements; using this data we can observe that these announcements are spread across the year. Event-date clustering is limited in our dataset given this distribution of announcement dates. Therefore, we do not expect that cross-sectional correlation will be an issue in our event study analysis.

The second issue related to event studies raised by Boehmer, Masumeci, and Poulsen (1991) is increased variance around the event date while the variance used in the test statistic is

³⁰ In the case of the cross-sectional dependence of events, the covariance across firms will not be equal to zero. A null covariance forms the primary assumption to aggregate abnormal return results across firms (Campbell, Lo, & MacKinlay, 1997). This means that if there is cross-sectional dependence the event study will not be statistically valid.

computed based on the estimation window.³¹ This leads to increased rejection of the null hypothesis, implying that there are no abnormal returns given that the variance measured in the estimation window is, relative to the event window, excessively low. We accounted for this issue using the test statistic designed by Boehmer et al. (1991) and the sign test designed by Cowan (1992) in our study.

We tested the CARs obtained for green and conventional bonds issuance announcements separately, using four tests widely used in the literature: the simple t-test, the test designed by Patell (1976), the test designed by Boehmer et al. (1991), and the generalized sign test developed by Cowan (1992). Test statistic calculations are detailed in Appendix VII.

c. Regression analysis

We drew the variables used in the regression³² from previous literature exploring the link between bond and equity markets. First, firm size (Bradshaw, Richardson, & Sloan, 2006; Spiess & Affleck-Graves, 1999), computed as the natural logarithm of total assets (*size*), is considered a potential driver of market reaction to bond issuance. Second, risk-related factors such as equity-to-assets ratio, EBIT to total interest expenses ratio, and operating margin (Godlewski, et al., 2013; Goh & Ederington, 1993) are also expected to impact the equity investor reaction. Third, the performance measure return on assets (ROA) is expected to affect the equity market reaction (Godlewski et al., 2013). Fourth, bond-specific characteristics may affect the perception of firm value by equity investors such as issuance maturity and coupon

³¹ During the estimation window variance may therefore be under-estimated and the one of the test statistic may be over-estimated.

³² We used the same variables in the difference-in-differences analysis.

(Godlewski et al., 2013). To further strengthen our analysis, we also added the bond's call/put/sink provisions, payment rank, and the natural logarithm of the amount issued (*bond size*) as additional control variables.

We tested the following regression using the same model as Godlewski et al. (2013):

$$CAR_{ij}(t_1, t_2) = \alpha_i + \beta_{ij} \times Green + Controls_{ij} + \varepsilon_{ij} \quad (4)$$

where *Green* represents the dummy variable equal to one if the bond issued is a green bond and zero otherwise, *Controls_{ij}* is the list of control variables for firm *i* on issuance *j*, and ε_{ij} is the error term.

As explained in the sample description, all issuers in our sample are green bond issuers that can issue either green or conventional bonds. Thanks to this sample, we can control for all firm characteristics using the firm fixed effects, and we can control for a wide set of bond characteristics using additional control variables (i.e., coupon, maturity, bond size, rank, call, put, or sink options). In doing so, we control for both firm-specific and bond market-specific variables. This means we can rule out a wide set of alternative explanations to the CAR and ensure that the variable *Green* captures all investor value creation expectations linked to the “green” flag of the bond.

To test H1, we applied the regression formula (4) to the full sample of green bond issuances between 2013 and 2017. To test H2, we applied this regression to two sub-samples: the first before 2015 (excluded) and the second after 2015 (excluded). We then compared β_{ij} before and after 2015 to see how reactions to the announcement of the green bond issuance evolved before and after the Paris Agreement.

d. Difference-in-differences analysis

Two frequently cited sources of endogeneity are omitted variable bias³³ and simultaneity³⁴ (Roberts & Whited, 2013). In our study, for practical reasons, simultaneity does not appear to be a risk. Once the green bond issuance is announced, the issuer cannot control the stock price reaction which is due to equity investors' assessment of this information in terms of firm value. Therefore, we did not expect simultaneity to be the main issue in our estimated regressions. Considering that some variables may impact both the dependent and independent variables, omitted variable bias may occur. The first way in which we tackled this issue was by using the firm and year fixed effects in our regression analyses. Firm fixed effects allow for control of time-invariant omitted variables, and time fixed effects allow controlling for time-variant omitted macroeconomic variables. The use of these two controls did not impact our results (Tables IV and VI).

To further verify whether or not omitted variable bias influenced our results, we used an exogenous shock with a DiD methodology following recommendations from Roberts and Whited (2013). This method is frequently employed in finance for causal inference when omitted variable bias is present (Atanasov & Black, 2016). In our case, we compared the impact of the exogenous shocks on the CARs of a green bond and on that of a conventional bond as described in the following equation:

³³ Omitted variable bias occurs when the regression model used does not include a key explanatory variable. In this case, the estimated coefficients of the variables included in the model may be biased.

³⁴ The risk of the dependent variable causing the independent variables at the same time as the independent variable causing the dependent variable.

$$CAR_{it}(0,0) = \beta_1 \times Green_i \times post_t + \beta_2 \times Green_i + \beta_3 \times post_t + \beta_4 \times Controls_{it} + \varepsilon_{ij} \quad (5)$$

where i refers to the firm, t refers to the event day, $Green_i$ is the dummy equal to one when firm i is green, $post_t$ is the dummy variable equal to one from the day of the exogenous shock to the last sample date, and $Controls_{it}$ comprises a set of control variables (*size, equity-to-assets, operating margin, return-on-assets, coupon, maturity, callable, sinkable, putable, rank, and bond size*). The DiD estimator β_1 is the key element in this analysis. If it is positive and significant, it would suggest a positive link between green bond issuance announcements, and conventional bond announcements (H1).

As an exogenous shock, we used the date the Paris Agreement was adopted, December 12, 2015 (Agreement, 2015). Atanasov and Black (2016) discussed the credibility conditions of any exogenous shock under a DiD research design. The exogenous nature of the shock is one of the key credibility conditions mentioned in this study. The Paris Agreement was negotiated in the frame of the United Nations Framework Convention on Climate Change (UNFCCC). The 196 member-states of the UNFCCC have met annually at the Conference of the Parties (COP) since 1995. The date of the Paris Agreement does not, therefore, come in response to a macroeconomic shock or market regulation.³⁵ Second, the fact that the conference gathers representatives from a wide range of countries and corresponding industries limits the risk of the green bond issuing firms having the power to lobby in favor of the agreement. Finally, COPs between 2010 and 2014, such as the Copenhagen Conference (COP 15), have not led to any meaningful legally binding treaty between state parties (see Bodansky (2010) and Dimitrov (2010)). This means any legally binding outcome of the COP 21 could not be precisely

³⁵ Which would limit the exogenous nature of the event.

anticipated by any market participant.³⁶ These elements make the case for the Paris Agreement to be considered a suitable exogenous shock in our study.

During the 2016 U.S. presidential campaign, the Republican candidate committed to withdrawing from the Paris Agreement (Tollefson, 2017). While the Paris Agreement signaled further ecological regulations, the election of a candidate willing to withdraw from it would indicate reduced future ecological regulations. If H2 holds, using the DiD model with the election day as the event date should lead to a lower stock price reaction. Therefore, we used the DiD model presented in equation (5) including the U.S. 2016 presidential election day as an exogenous shock to test H2.

The time between the Paris Agreement and the implementation of the corresponding measures at national levels may create a lag on the effect in terms of market reaction. As an example, in the People's Republic of China ("China") the Paris Agreement was ratified on September 3, 2016 while the Paris Agreement was adopted December 12, 2015. In the article 21 of the

³⁶ One other risk faced by the use of the Paris Agreement as exogenous shock is that information about the individual contribution of each country was partly known before the agreement. This would therefore reduce the importance and value of the Paris Agreement as a political signal. This issue remains limited for two main reasons. First, any individual contribution announced by members of the COP21 was not legally binding while the Paris Agreement is a legally binding document. Disagreements between developing and developed countries on contributions and financial aid (the "Danish text" leak during the COP 15 was an example of such strong disagreements) to lower carbon emissions was an existing risk during the COP 21. Previous failures and systemic disagreements were still risks on the ability of the UNFCCC to reach a global binding agreement. The revelation of the Paris Agreement can as a result be considered as a real political signal towards future regulations and therefore could be interpreted by markets as a value-relevant signal.

Agreement, it is said that “This Agreement shall enter into force on the thirtieth day after the date on which at least 55 Parties to the Convention accounting in total for at least an estimated 55 percent of the total global greenhouse gas emissions have deposited their instruments of ratification, acceptance, approval or accession”. We see two factors explaining why stock price reactions to future regulations would occur just after the Paris Agreement rather than with a lag. First, since China, the U.S., Russia, India, Japan and EU countries agreed on the Paris Agreement the 55% of total global greenhouse gas emissions condition was fulfilled making it very likely that the agreement would enter into force. Second, following Fama, Fisher, Jensen, and Roll (1969), our models assume that stock prices react to all value-relevant information. We, therefore, assume that the information provided by the Paris Agreement and the signal it sends regards to future environmental regulations are value relevant.

5. Results

In this section, we link each hypothesis to its respective empirical results. We tested the “long-term perspective” hypothesis using event study results, regression analysis results, and the DiD model on the full sample with the Paris Agreement as an exogenous shock. We used short windows around the announcement date in the event study for two main reasons. First, following Fama, Fisher, Jensen, and Roll (1969), we assumed that stock prices react to value-relevant information even though they are relative to longer-term future cash flows.³⁷ Second, we wanted to isolate the specific effect of the green bond issuance announcement.

³⁷ In this case, we assumed that the issuance of green bonds will result in avoiding future environment-related costs to the firm and thus, to shareholders. With the positive (negative) stock price reaction we then tested whether the equity investor uses green bond issuance announcement to expect higher (lower) future cash flows.

To test the “delegated philanthropy” hypothesis, we applied a regression model before and after the Paris Agreement and a DiD model with two different types of events. In the DiD model, we first used the Paris Agreement as a signal of forthcoming green regulations, and we then used the 2016 U.S. election as a signal of low forthcoming green regulations. Our aim was to understand the impact of a specific type of future cost to the investor which is the regulatory cost. As green regulatory pressure increases, firms that signal their commitment to follow future green regulations will avoid future regulatory costs and suffer less as a result of the government’s delegated philanthropy. Therefore, we would expect investors to positively value the announcement of green bond issuance in this case. When regulatory pressure decreases, we would expect that the green project’s value relative to avoided regulatory costs decreases. Equity investors would then expect less value generation from a green bond as opposed to a conventional bond, since green bonds imply higher issuance and reporting costs (Asian Development Bank, 2018).

a. Testing the “long-term perspective” hypothesis

i. Event-study analysis results

As discussed, we first show the results of the event study with all test statistics in Table III.

[Insert Table III about here]

Both green and conventional bond announcements yielded positive CARs. The CAR for green bonds varied between 0.36% and 0.57%³⁸, while the CAR for conventional bond announcements varied between 0.14% and 0.37%. The CAR was significant for green bond

³⁸ Equivalent to a \$81m to \$129m increase in value at the announcement for a green bond issuer with an average market capitalization.

announcements with respect to the [0,0] window in all test statistics.³⁹ Using the [0,1] window, it was found to be significant using the t-test, Patell Z test, and Boehmer test. The Boehmer test, which specifically considers the issue of the event having a volatility increase impact, is significant for both windows. Therefore, we expect that volatility increase due to the announcement of green bond issuance has a limited impact on our results.

The first analysis of these results was that green bond issuance announcements yielded positive investor reaction. We observe a slight premium regarding stock return reaction when green bonds were issued rather than conventional bonds. Therefore, these results suggest that the H1 hypothesis that green bonds increase firm value holds.

ii. Regression analysis results

In this section, we present the regression analysis results to measure the extent to which the “green” flag of the green bond issuance impacts the stock price reaction.

Table IV presents the results of the regression for the whole 2013–2018 period on the full sample of green and conventional bond issuances.

[Insert Table IV about here]

In model (1), we applied the Godlewski et al. (2013) specification. In this first model, we observed that the dummy variable for the “green” flag of the bond (*Green*) is positive and significant. Under this first specification, the “green” flag of the bond issuance yielded a CAR

³⁹ Aside from the results shown in Table III, results were also significant for the [0,0] event window when we considered the S. J. Brown and Warner (1985) crude dependence adjustment test.

1.4%⁴⁰ higher when compared to a conventional bond. Therefore, we could first observe that after accounting for alternative factors, the green equity premium was measured to be higher than the one comparing static CAR results in Table III. We observed that firm size and the share of equity-to-assets were two other key drivers of the CAR. In model (2), we tested the same specification but using industry and country fixed effects instead of firm fixed effects. While the significance of other coefficients dropped, the coefficient for *Green* was not affected by these alternative fixed effects. The coefficient remained positive and significant with a similar economic significance (the “green” flag implies a 1.3% higher CAR when green bonds are announced rather than conventional bonds). In model (3), we added bond characteristics to the specification of Godlewski et al. (2013), and we applied firm fixed effects. Again, the coefficient for *Green* was positive and significant with the same economic significance as in previous models (the “green” flag implies a 1.4% higher CAR).

These results further suggest that the H1 is valid.

iii. Difference-in-differences analysis results

In Table V, we present the results of the DiD analysis.

[Insert Table V about here]

In model (1), we applied the DiD model from equation (5), the full specification with all control variables from Godlewski et al. (2013), and all additional bond-level control variables. In this first model, the DiD estimator was positive and significant. The “green” flag of the bond

⁴⁰ Equivalent to a \$316m increase in value at the announcement for a green bond issuer with an average market capitalization.

increased the CAR by 1.5%⁴¹ which is similar to the CAR increase we measure in Table IV. When we additionally controlled for industry and country, the DiD estimator remained positive and significant with a higher economic effect (the “green” flag increased the CAR by 1.7%). The difference between the control and treated firms before the Paris Agreement was found to be negative and not significant in both models. The same difference was positive after the Paris Agreement. These results, therefore, also suggest that H1 is valid.

b. Testing the “delegated philanthropy” hypothesis

i. Regression analysis results

First, we tested how the coefficient for *Green* changes before and after the Paris Agreement. A higher and significant coefficient indicates the stock price reaction was higher after the Paris Agreement.

[Insert Table VI about here]

In Table VI, we present the same models as in Table IV but show the coefficients before and after the Paris Agreement. In models (1) and (3), we show the regression coefficients using firm fixed effects. In these two models, we observed that coefficients for the variable *Green* were positive but have a low value (the “green” flag of the bond implied a 0.7% to 0.9% increase in CAR), and they were not significant. In model (2), where we used industry and country fixed effects instead of firm fixed effects, we found that the coefficient for *Green* became slightly negative. Since the coefficients for *Green* were not significant in these three models, we could not conclude that there was any impact of the “green” flag on stock price

⁴¹ Equivalent to a \$339m increase in value at the announcement for a green bond issuer with an average market capitalization.

reaction before the Paris Agreement. Before the Paris Agreement based on model (3), we could observe that the operating margin and equity-to-assets were key drivers of the CAR. In models (4) to (6), we presented the same models as (1) to (3) but after the Paris Agreement. The coefficient for *Green* was positive and significant in all specifications. The positive economic impact of the “green” flag went from 1.7% to 1.9% on the CAR. This result showed similar levels of the “green” flag impact on the CAR when compared to Tables IV and V. Finally, we observed that firm size seemed to be a key driver of the CAR after the Paris Agreement. Given the consistently positive results of the coefficients for *Green* after the Paris Agreement, we expected that increased green regulatory pressure had indeed had a valuation impact on the green bond issuance announcements as described in H2. These results, therefore, suggest that H2 holds.

ii. Difference-in-differences analysis results

To further test H2, we present the results of the same DiD analysis as in Table V but using a sample of U.S. green bond issuers and the U.S. presidential election as an exogenous shock.

[Insert Table VII about here]

In Table VII, we used only the U.S. sample as this sample contained enough data and presented a case where a country committed to and had withdrawn from the Paris Agreement. Both models had the same specification as the model (1) in Table V. In model (1), we used this specification with the Paris Agreement as an exogenous shock. We found a positive and significant coefficient for the DiD estimator. The coefficient was at the same level as one of the full sample in Table V (the “green” flag yielded a 1.5% increase in CAR). In model (2), we used the same specification but with the U.S. presidential election day as an exogenous shock. We found a negative and significant DiD estimator. The level of the estimator is in a similar

range (1.7%) as the positive estimator after the Paris Agreement (1.5%). These results illustrated how equity investors reacted differently to green bond issuance announcements after a positive and a negative regulatory signal. Equity investors seemed to positively value firms' green signaling after increased green regulatory pressure, and conversely, they negatively valued green signaling after decreased green regulatory pressure. These findings were also in line with previous literature on green bonds (Karpf & Mandel, 2017; Zerbib, 2019) that found that the bond market green premium decreased in 2016. Finally, these results suggest that the hypothesis of “delegated philanthropy” holds.

6. Robustness checks

a. Placebo tests and sample balancing

Atanasov and Black (2016) provide good practices in terms of DiD methodology with exogenous shock implementation, and we based our robustness checks on their findings. One issue was the case in which green bond issuances and conventional bond issuances had different pretreatment trends for the outcome variable. In this case, our DiD analysis would not be able to properly measure the causal effect of green bond announcements on the CAR. To test pretreatment trends, we applied arbitrary placebo exogenous shock tests as recommended by the authors. To implement placebo tests, we considered that the exogenous shock applied to the sample occurred exactly one calendar year before the Paris Agreement (12/12/2014). We then excluded all observations after December 12, 2015 in order to exclude the real exogenous shock from our sample. We also applied a placebo exogenous shock exactly one calendar year after the Paris Agreement (12/12/2016) and excluded all observations before 12/12/2015. These tests are displayed in models (1) and (2) in Table VIII.

Atanasov and Black (2016) raised the issue of covariates balancing. Severe observable covariate imbalances can cast doubt on unobservable covariate imbalances, which would result in biased DiD results. The main solution proposed for balancing issues comes from matching methods (J. J. Heckman, Ichimura, & Todd, 1997). Matching methods allow for reducing the imbalance between treated and control firms based on a set of observable covariates (see implementation in Doidge, Karolyi, & Stulz (2010), Litvak (2007) and Low (2009)). Following this method, we matched green bond and conventional bond issuance announcements in our study using control variables from the literature (Bradshaw et al., 2006; Goh & Ederington, 1993; Spiess & Affleck-Graves, 1999) and additional controls from our study. Therefore, we used firm identification number (ID),⁴² coupon, maturity, callable/putable/sinkable, payment rank, bond size, country code, SIC code, and issuance announcement year. Firm ID matching allowed us to match green bond issuances on all issuing firm characteristics, including those used in the regression analysis. We used all available bond characteristics (coupon, maturity, callable/putable/sinkable feature, payment rank, and bond size) from the literature and our study to further limit imbalances on bond characteristics between green and conventional bonds. Finally, we also matched issuances on country, industry, and announcement year characteristics. Using the Villa (2016) DIFF Stata command, we executed both a kernel propensity score matching based on Heckman et al. (1997) and a DiD analysis. The results using observables balancing are implemented in the model (3) of Table VIII. All robustness checks results are reported in Table VIII.

[Insert Table VIII about here]

⁴² We generated a unique identifier for each firm and then matched the firms based on this identifier.

The DiD estimators for placebo shocks in models (1) and (2) of Table VIII were not significant. Provided that we use the same model as the model (1) in Table V, we found that we do not expect pretreatment trends to impact our results. Model (3) showed the DiD estimator after matching of treated and control firms. The coefficient was highly significant and positive with an even higher value than the DiD estimator in Table V. Therefore, we did not expect covariates imbalance to bias our results.

b. Serial correlation

A key study on DiD from Bertrand et al. (2004) found that DiD coefficients may be biased by auto-correlation issues. Generating placebo events on state-level data they found significant effects (at the 5% significance level) for 45% of placebo tests. For random assignments of treated states and years, we would expect significance 5% of the time rather than 45%. After testing for alternate explanations, Bertrand et al. (2004) found that these standard errors underestimations were due to serial correlation. Bertrand et al. (2004) considered bootstrapping and used an arbitrary variance-covariance matrix (i.e., standard error clustering) as key methods to account for serial correlation. In order to check whether our empirical design suffered from this issue, we applied both methods on both the full sample and the U.S. sample. In Table IX, we showed the results of equation (5) on the full and the U.S. samples using bootstrapping with 50 repetitions as in Bertrand et al. (2004). We also show the results of equation (5) on the full and the U.S. samples using a firm ID level clustering.

[Table IX about here]

We observed that our results in Table IX were in line with the results in Table V and Table VII, with the interaction term being significant in all cases.

c. Alternative proxies

Our study relies on proxies such as the CAR to measure firm value creation. Measurement error in the dependent variable may bias the coefficients the same way an omitted variable would (Roberts & Whited, 2013). In order to account for this issue, it was necessary to confirm our results with additional proxies for firm value creation. As discussed in Grunfeld (1960), firms' asset market valuation reflects the value creation expectations of investors. Tobin (1969) built a proxy to measure this value creation expectation (Tobin's Q). A higher Tobin's Q means a greater difference between the book and market value of assets and thus, higher future value creation expectation from investors. We could, therefore, use this additional proxy to test H1 following the same specification as in equation (4) but replacing CAR with Tobin's Q. In Table X, Tobin's Q is the dependent variable, and *Green* the independent variable with the same control variables as used in previous specifications. A positive and significant value for *Green* would mean that the green bond issuance announcement yields positive investor value creation expectations.

[Table X about here]

The coefficient for green was positive and significant in all models of Table X. In model (1), we presented our base specification without fixed effects. In this model, the coefficient for *Green* indicated that the "green" flag of the bonds led to a 0.63 significant increase in Tobin's Q. In model (2), where we added year, country, and industry fixed effects we measured a 0.20 increase in Tobin's Q due to the "green" flag of the bond. Finally, in model (3), we used firm and time fixed effects, and we obtained a 0.23 coefficient for *Green*. Therefore, after accounting for potential time-invariant omitted variables, we still measured a positive impact

of a green bond issuance announcement on firm value creation. This additional proxy for value creation suggests that H1 holds.

We tested H2 using the Paris Agreement and the 2016 U.S. elections as proxies for increased (decreased) green regulatory pressure. In this section, we added an additional proxy for regulatory pressure, which is a component of the Global Index Score (GIS; Lafortune, Fuller, Moreno, Schmidt-Traub, & Kroll, 2018). The United Nations (UN) has established an agenda for 2030 comprising 17 Sustainable Development Goals (SDG). The SDG were approved by resolution 70/1 of the UN General Assembly and apply to all developed and developing countries. The GIS aimed to measure the degree of achievement of the SDG at the state-level. In our study, we expected SDGs to reflect a state's commitment to sustainability and therefore imply a stronger probability of delegated philanthropy from the state's sustainability goals to firms. We used one of the components of the GIS, which is the energy-related CO2 emissions per capita. We chose this criterion since it reflects proactiveness in terms of the country's green policy. The country can be on-track or not on-track with the SDG on this criterion as measured by Lafortune et al. (2018). In Table XI, we split the sample between the countries that are on-track and those that are not on-track with the energy-related CO2 emissions per capita SDG target. We then estimated our main specification from equation (4) in each sub-sample. If H2 holds, we would expect the link between green bond issuance announcement and CAR to be stronger (weaker) in countries where the delegated philanthropy from the state on this green SDG target is stronger (weaker). This translates in Table IX with a positive and significant (not significant and/or not positive) coefficient for *Green* in countries that are on-track (not on track) with the energy-related CO2 emissions per capita SDG target.

[Table XI about here]

In model (1), we showed the coefficients for firms in countries that are on-track with the SDG target. The coefficient for *Green* was significant, and the “green” flag of the bond implied an 11.2% increase in CAR. In model (2), we used the same model but with additional bond characteristics as control variables, as well as firm and year fixed effects. The coefficient for *Green* was significant, and the “green” flag of the bond leads to a 12.2% increase in CAR when a green rather than a conventional bond was announced. Conversely, in models (3) and (4), we applied our main specification to the sub-sample of firms not on-track on the energy-related CO2 emissions per capita SDG target. In both cases, the coefficient for *Green* was very close to zero and was not significant at the 5% level. We, therefore, observed that a higher (lower) probability of philanthropy delegation positively (negatively) impacts the link between the “green” flag of the bond announcement and the CAR. This result suggests that H2 holds.

d. The role of market supply and demand

The stock price reaction to green bond issuance announcements may be driven by exterior supply and demand factors. Shleifer (1986) found a positive and significant abnormal return when a stock is added to the S&P 500. This addition to the S&P 500 sparked additional demand for the stock. Hopman (2007) found that the difference between buy and sell orders explains most of the stock price changes. Therefore, we expected that the supply and demand equilibrium to play a key role in the stock price reaction to the green bond issuance announcement. Green bonds, as defined by the GBP, are investments that promote sustainability. Due to their specific nature, green bonds are a well-identified sustainable and responsible investment (SRI) (Inderst, Kaminker, & Stewart, 2012). Therefore, we would expect funds with SRI guidelines to have a larger appetite for green bonds when compared to

funds without such guidelines. SRI assets under management (AUM) are, in this context, a good proxy for green bonds and green bond issuer stock demand. To test the importance of the demand side of the stock price reaction to a green bond issuance announcement, we used the SRI AUM data from the Global Sustainable Investment Alliance (GSIA). To measure the supply side of green bonds, we used a direct measure, which was the total amount of green bonds issued each year. We used these variables as control variables in our main regression described in equation (4). The dependent variable of this model was the *CAR* and *Green* remained the independent variable. If market forces measured by SRI AUM and green bond total issuance per year impact the *CAR*, we would expect these variables to be significant. If these market forces played a more material role on the *CAR* as compared to the “green” flag of the green bond, we would expect the coefficient for *Green* not to be significant when we add these variables as control variables in our models. We test these effects in Table XII.

[Table XII about here]

In model (1), we show the main specification with *SRI AUM* as a control variable. The coefficient for *Green* was significant at 1.4% which is in line with our results in Table IV. The coefficient for *SRI AUM* was not significant. In model (2), we tested the impact of total green bonds issued as a control variable in our main specification. The coefficient for *Green* was positive (1.4%) and significant, and the coefficient for total green bonds issued was not significant. We obtained the same result if we added both variables to the model (3). Finally, when we added market forces⁴³ to the model (4), we obtained results similar to models (1)-(3).

⁴³ Computed as the difference between SRI AUM and total green bond issuance.

Therefore, we did not expect supply and demand factors to be the main drivers of the stock price reaction to green bond issuance announcement.

7. Conclusion

Our study contributes to the literature on green bonds. While the existing literature primarily focuses on bond market premiums, we have presented evidence that the announcement of the issuance of such securities constitutes positive value creation information to equity investors. We measure how the “green” flag of a bond issuance is perceived by equity investors. Our results also suggest that climate-related regulatory pressure is material to the interest of investors in green bonds. These results are key to measuring the motives that drive firms to engage in CSR.

These results are valuable to firms that issue green bonds. Our findings suggest that equity investors expected positive outcomes in relation to value creation from the issuance of these types of securities. We also find that as the regulatory pressure grows, this positive outcome grows as well. This can have implications for other new green financial products such as green loans. Finally, further investigation is needed to measure the extent to which other policies, such as taxes and subsidies, impact equity investor perception of green financial instruments.

Tables

Table I: Descriptive statistics of green and conventional bond issuances

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

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

Table II: Industry and international split of bond issuances

The table is the split of bond issuances per industry and per country. The industry split is based on the one-digit Standard Industrial Classification (SIC) code. The country split is based on the International Standards Organization (ISO) country code. Both are extracted using the issuing firm data from Datastream.

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

Table III: Cumulative Average Abnormal Returns around the announcement date

The table shows the Cumulative Average Abnormal Returns (CAR) around the green and conventional bond issuance announcement date. The event windows are of 0 to 3 days with the event date being the bond issuance announcement date. We show the number of observations and the CAR as a percentage. We then show the event study test statistics described in detail in Appendix VII, as well as their significance level. The two parametric test statistics are the t-test and the Patell Z test (Patell, 1976). The two non-parametric test statistics are the Boehmer t-test (Boehmer et al., 1991) and the Cowan sign test (Cowan, 1992).

Event window	Type of announcement	N	CAR (%)	t-stat	t-test p-value	t-stat Patell	Patell Z test p-value	Boehmer t-stat	Boehmer test p-value	Cowan Sign test	Cowan Sign test p-value
[-1,1]	Conventional bond	327	0.37%	1.96	0.051	2.14	0.032	1.35	0.179	0.89	0.374
	Green Bond	157	0.46%	1.58	0.116	1.04	0.298	0.89	0.373	1.81	0.071
[0,1]	Conventional bond	327	0.20%	1.28	0.203	1.07	0.286	0.77	0.442	0.56	0.574
	Green Bond	157	0.57%	2.38	0.018	2.63	0.009	2.27	0.024	0.53	0.594
[-1,0]	Conventional bond	327	0.31%	2.00	0.046	1.75	0.081	1.19	0.234	-0.22	0.827
	Green Bond	157	0.36%	1.50	0.136	0.85	0.395	0.77	0.443	0.85	0.396
[0,0]	Conventional bond	327	0.14%	1.24	0.217	0.59	0.555	0.50	0.620	0.89	0.372
	Green Bond	157	0.46%	2.74	0.007	2.40	0.016	2.44	0.015	1.97	0.049

Table IV
Regression results sample for the full 2013-2018 period

Robust standard errors are in parentheses. The symbols ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Results show regressions with robust standard errors. The dependent variable is the Cumulative Average Abnormal Return (CAR) in all models. In model (1), we followed Godlewski et al. (2013); the independent variable (Green) is the dummy equal to 1 when the announcement of the CAR is a green bond announcement and 0 for a conventional bond announcement. We then add the control variables, as defined in Appendix VIII as well as firm and year fixed effects. Model (2) is the same model with industry and country fixed effects instead of firm fixed effects. Model (3) is the same model with firm and year fixed effects to which we add bond characteristics, as defined in Appendix VIII, as control variables.

Variables	(1) CAR	(2) CAR	(3) CAR
Green	0.014*** (0.005)	0.013*** (0.004)	0.014*** (0.005)
Size	0.014** (0.005)	-0.002 (0.002)	0.014*** (0.005)
Equity-to-assets	0.087** (0.037)	0.003 (0.016)	0.085** (0.037)
EBIT to interest expense	-0.000** (0.000)	-0.000** (0.000)	-0.000** (0.000)
Operating margin	-0.000* (0.000)	-0.000 (0.000)	-0.000* (0.000)
ROA	-0.001 (0.001)	0.000 (0.000)	-0.001 (0.001)
Coupon	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)
Maturity	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Callable			-0.000 (0.002)
Putable			0.007 (0.006)
Sinkable			0.014 (0.021)
Rank			0.004 (0.004)
Bond Size			0.000 (0.000)
Constant	-0.272*** (0.090)	0.013 (0.033)	-0.285*** (0.087)
Observations	741	741	741
R-squared	0.29	0.24	0.29
Firm FE	Yes	No	Yes
Industry FE	No	Yes	No
Country FE	No	Yes	No
Year FE	Yes	Yes	Yes

Robust standard errors in parentheses

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

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

Robust standard errors are in parentheses. The symbols ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. We display the difference-in-difference (DiD) estimators before and after the day of the Paris Agreement (12/12/2015), which we take to represent the day of the exogenous shock. The dependent variable is the Cumulative Average Abnormal Return (CAR) in all models. In model (1), the DiD analysis is computed with the same control variables as model (3) in Table IV. In model (2), we add the Standard Industrial Classification (SIC) two-digit code and the country as controls to model (1).

	(1)	(2)
	CAR	CAR
Difference-in-difference estimator	0.015*** (0.005)	0.017*** (0.005)
Observations	741	741
R-squared	0.11	0.13
Mean control before	0.036	0.051
Mean treated before	0.035	0.046
Difference before	-0.001	-0.005
Mean control after	0.036	0.053
Mean treated after	0.050	0.065
Difference after	0.014***	0.012**

Robust standard errors in parentheses

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

Table VI: Regression results before and after the Paris Agreement

Robust standard errors are in parentheses. The symbols ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. The sample is based on issuances before and after 2015, the year of the Paris Agreement. Results below show regressions with robust standard errors. The dependent variable is the Cumulative Average Abnormal Return (CAR) in all models. Models (1)-(3) are computed before the Paris Agreement. In model (1), we use the same model as Godlewksi et al. 2013 with firm and year fixed effects. Model (2) is the same model with industry, country, and year fixed effects. Model (3) is the same model with firm and year fixed effects, to which we add bond characteristics as control variables. Models (4)-(6) replicate models (1)-(3) but after the Paris Agreement.

Variables	Before the Paris Agreement			After the Paris Agreement		
	(1) CAR	(2) CAR	(3) CAR	(4) CAR	(5) CAR	(6) CAR
Green	0.009 (0.006)	-0.001 (0.005)	0.007 (0.006)	0.018** (0.008)	0.017*** (0.006)	0.019** (0.008)
Size	0.089 (0.079)	0.000 (0.003)	0.125* (0.073)	0.043** (0.022)	-0.006*** (0.002)	0.050** (0.024)
Equity-to-assets	0.425 (0.367)	-0.002 (0.051)	1.309** (0.652)	0.016 (0.101)	0.001 (0.022)	0.012 (0.091)
EBIT to interest expense	0.002 (0.002)	-0.000 (0.000)	0.006* (0.003)	0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)
Operating margin	0.007 (0.007)	-0.000 (0.001)	0.027** (0.014)	-0.000 (0.000)	0.000 (0.000)	-0.000 (0.000)
ROA	0.000 (0.005)	0.002 (0.002)	-0.013* (0.007)	0.000 (0.002)	0.001 (0.001)	0.001 (0.002)
Coupon	0.003* (0.001)	0.003* (0.002)	0.003* (0.002)	-0.005 (0.003)	-0.004 (0.003)	-0.005 (0.003)
Maturity	-0.000** (0.000)	-0.000** (0.000)	-0.000** (0.000)	0.000 (0.000)	0.000 (0.000)	-0.000 (0.000)
Callable			-0.003 (0.004)			-0.002 (0.005)
Putable			0.010* (0.006)			0.010 (0.008)
Sinkable			0.085* (0.044)			0.021 (0.030)
Rank			-0.016** (0.007)			0.012* (0.006)
Bond Size			-0.000 (0.001)			-0.002 (0.002)
Constant	-1.841 (1.413)	-0.009 (0.054)	-3.173** (1.404)	-0.734** (0.371)	0.045 (0.040)	-0.838** (0.392)
Observations	173	173	173	350	350	350
R-squared	0.52	0.43	0.58	0.45	0.39	0.46
Firm FE	Yes	No	Yes	Yes	No	Yes
Industry FE	No	Yes	No	No	Yes	No
Country FE	No	Yes	No	No	Yes	No
Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors in parentheses

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

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

Robust standard errors are in parentheses. The symbols ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. The dependent variable is the Cumulative Average Abnormal Return (CAR) in all models. Model (1) is the same difference-in-differences model as the one used in table V but with a sample of U.S. firms. Model (2) is the same model with the election day in the U.S. (November 8, 2016) as the event day.

	(1) USA CAR	(2) USA CAR
Difference-in-difference estimator	0.015*** (0.005)	-0.017** (0.008)
Observations	314	65
R-squared	0.14	0.64
Mean control before	-0.005	-0.027
Mean treated before	0.005	-0.005
Difference before	0.010	0.022***
Mean control after	-0.003	-0.045
Mean treated after	0.022	-0.040
Difference after	0.025***	0.005

Robust standard errors in parentheses

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

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

Robust standard errors are in parentheses. The symbols ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. The dependent variable is the Cumulative Average Abnormal Return (CAR) in all models. In models (1) and (2), we computed the same difference-in-differences (DiD) analysis as model (1) in Table V. The difference is that in model (1) we simulated a placebo exogenous shock exactly one calendar year prior to the Paris Agreement day (i.e., December 12, 2014 instead of December 12, 2015). We then excluded all data after December 12, 2015. In model (2), we simulated a placebo exogenous shock exactly one calendar year following the Paris Agreement day (i.e., December 12, 2016 instead of December 12, 2015). We then excluded all data before December 12, 2015. In model (3), we show the DiD analysis after kernel propensity score matching on control variables.

	(1)	(2)	(3)
	CAR	CAR	CAR
Difference-in-difference estimator	0.007 (0.006)	0.008 (0.006)	0.036*** (0.009)
Observations	377	364	629
R-squared	0.06	0.21	0.11
Mean control before	-0.033	0.114	0.026
Mean treated before	-0.033	0.122	0.002
Difference before	0.000	0.007	-0.023***
Mean control after	-0.038	0.105	0.001
Mean treated after	-0.030	0.120	0.014
Difference after	0.008	0.015**	0.012***

Robust standard errors in parentheses

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table IX: Difference-in-differences serial correlation tests

Robust standard errors are in parentheses. The symbols ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. The dependent variable is the Cumulative Average Abnormal Return (CAR) in all models. Models (1) and (3) are the same as the model (2) in Table V except that we applied bootstrapping with 50 repetitions in the model (1) and standard errors clustering in model (3). Models (2) and (4) are the same as model (1) in Table VII except that we applied bootstrapping with 50 repetitions in model (2) and standard errors clustering in model (4).

	(1)	(2)	(3)	(4)
	Full Sample Bootstrapping CAR	U.S. Sample Bootstrapping CAR	Full Sample Cluster ID CAR	U.S. Sample Cluster ID CAR
Difference-in-difference estimator	0.017*** (0.006)	0.015** (0.006)	0.017** (0.007)	0.015** (0.006)
Observations	741	314	741	314
R-squared	0.126	0.14	0.126	0.14
Mean control before	0.051	-0.005	0.051	-0.005
Mean treated before	0.046	0.005	0.046	0.005
Difference before	-0.005	0.010	-0.005	0.010
Mean control after	0.053	-0.003	0.053	-0.003
Mean treated after	0.065	0.022	0.065	0.022
Difference after	0.012**	0.025	0.012	0.025**

Robust standard errors in parentheses

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table X**Regression results with the Tobin's Q**

Robust standard errors are in parentheses. The symbols ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Results below show regressions with robust standard errors. The dependent variable is Tobin's Q (TobinQ) the following year in all models. In model (1), the independent variable (Green) is the dummy equal to 1 when the issuance is green and 0 otherwise. We then added the control variables as defined in Appendix VIII. Model (2) is the same model with firm and year fixed effects. Model (3) is the same model with industry, country, and year fixed effects.

Variables	(1) TobinQ	(2) TobinQ	(3) TobinQ
Green	0.627*** (0.081)	0.196** (0.076)	0.226*** (0.077)
Size	0.034* (0.018)	-0.044 (0.334)	0.002 (0.326)
Equity-to-assets	-0.067 (0.231)	-2.032* (1.096)	-2.038* (1.091)
EBIT to interest expense	0.009*** (0.001)	0.002 (0.001)	0.001 (0.001)
Operating margin	-0.000 (0.003)	0.014** (0.006)	0.012** (0.005)
ROE	-0.028*** (0.003)	-0.005 (0.004)	-0.006 (0.004)
Constant	0.595* (0.335)	1.827 (5.673)	1.135 (5.624)
Observations	764	764	764
R-squared	0.50	0.89	0.89
Firm FE	No	Yes	No
Industry FE	No	No	Yes
Country FE	No	No	Yes
Year FE	No	Yes	Yes

Robust standard errors in parentheses

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

Table XI
Sustainable Development Goals regression results

Robust standard errors are in parentheses. The symbols ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Results below show regressions with robust standard errors. The dependent variable is the Cumulative Average Abnormal Return (CAR), and the independent variable (Green) is the dummy equal to 1 when the issuance is green and 0 otherwise in all models. In model (1), we took the firms in countries on-track with the energy-related CO2 emissions SDG target. We then estimated our main specification following the model of Godlewski et al. (2013). Model (2) is the same model as (1) but with additional bond characteristics as control variables, firm and year fixed effects. In model (3), we took the firms in countries not on-track with the energy-related CO2 emissions SDG target. We then estimated our main specification following the model of Godlewski et al. (2013). Model (4) is the same model as (3) but with additional bond characteristics as control variables as well as firm and year fixed effects.

Variables	(1)	(2)	(3)	(4)
	Energy-related CO2 emissions per capita SDG on-track CAR	Energy-related CO2 emissions per capita SDG on-track CAR	Energy-related CO2 emissions per capita SDG not on-track CAR	Energy-related CO2 emissions per capita SDG not on-track CAR
Green	0.112*** (0.041)	0.122** (0.060)	-0.000 (0.002)	0.005* (0.003)
Size	0.010 (0.013)	0.024 (0.025)	-0.001* (0.001)	0.007* (0.004)
Equity-to-assets	0.091 (0.180)	-	0.007 (0.007)	0.057** (0.026)
EBIT to interest expense	0.011 (0.008)	0.016* (0.008)	-0.000** (0.000)	-0.000 (0.000)
Operating margin	0.003 (0.003)	-0.006 (0.016)	-0.000** (0.000)	-0.001*** (0.000)
ROA	-0.015 (0.010)	-0.010 (0.021)	0.000 (0.000)	-0.000 (0.000)
Coupon	-0.005 (0.005)	-0.007 (0.006)	0.001 (0.000)	0.001 (0.001)
Maturity	0.000 (0.002)	0.001 (0.001)	0.000 (0.000)	-0.000 (0.000)
Callable		-0.031 (0.031)		-0.000 (0.002)
Puttable		-		0.004 (0.005)
Sinkable		-0.049 (0.065)		0.007 (0.007)
Rank		-0.004 (0.010)		0.002 (0.002)
Bond Size		-0.000 (0.007)		0.000 (0.000)
Constant	-0.152 (0.210)	-0.234 (0.392)	0.018* (0.010)	-0.147** (0.061)
Observations	54	54	676	676
R-squared	0.71	0.74	0.04	0.24
Firm FE	No	No	No	No
Industry FE	No	Yes	No	Yes
Country FE	No	Yes	No	Yes
Year FE	No	Yes	No	Yes

Robust standard errors in parentheses

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

Table XII
Market forces regression results

Robust standard errors are in parentheses. The symbols ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Results below show regressions with robust standard errors. The dependent variable is the Cumulative Average Abnormal Return (CAR), the independent variable (Green) is the dummy equal to 1 when the issuance is green and 0 otherwise in all models, firm fixed effects and year fixed effects. In model (1), we added the assets under management (AUM) under sustainable and responsible investment (SRI) strategies as provided by the Global Sustainable Investment Alliance (GSIA) as a control variable. In model (2), we added the yearly total volume of green bonds issued as a control variable. In model (3), we included both SRI AUM and the yearly total amount of green bonds issued variables separately in the model. In model (4), we compute and add the difference between SRI AUM and the yearly total volume of green bonds issued (called market forces) in the model.

	(1)	(2)	(3)	(4)
	AUM SRI	Total Green Bond Issuance	AUM SRI + Total Green Bond Issuance	Market Forces
Variables	CAR	CAR	CAR	CAR
Green	0.014*** (0.005)	0.014*** (0.005)	0.014*** (0.005)	0.014*** (0.005)
Size	0.014*** (0.005)	0.014*** (0.005)	0.014*** (0.005)	0.014*** (0.005)
Equity-to-assets	0.085** (0.037)	0.085** (0.037)	0.085** (0.037)	0.085** (0.037)
EBIT to interest expense	-0.000** (0.000)	-0.000** (0.000)	-0.000** (0.000)	-0.000** (0.000)
Operating margin	-0.000* (0.000)	-0.000* (0.000)	-0.000* (0.000)	-0.000* (0.000)
ROA	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)
Coupon	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)
Maturity	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Callable	-0.000 (0.002)	-0.000 (0.002)	-0.000 (0.002)	-0.000 (0.002)
Putable	0.007 (0.006)	0.007 (0.006)	0.007 (0.006)	0.007 (0.006)
Sinkable	0.014 (0.021)	0.014 (0.021)	0.014 (0.021)	0.014 (0.021)
Rank	0.004 (0.004)	0.004 (0.004)	0.004 (0.004)	0.004 (0.004)
Bond Size	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
AUM	-0.000 (0.000)		-0.000* (0.000)	
Total GB Issued		-0.000 (0.000)	0.000 (0.000)	
Market Forces				-0.000 (0.000)
Constant	-0.280*** (0.087)	-0.285*** (0.087)	-0.271*** (0.085)	-0.280*** (0.087)
Observations	741	741	741	741
R-squared	0.29	0.29	0.29	0.29
Firm FE	Yes	Yes	Yes	Yes
Industry FE	No	No	No	No
Country FE	No	No	No	No
Year FE	Yes	Yes	Yes	Yes

Robust standard errors in parentheses

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

Chapter 3: Green bonds and financial constraints

Abstract

Green bond issuance is often attributed to issuers' will to diversify their investor base and therefore increase market access. Using a large sample of green and conventional bond issuers, we find that green bond issuers are more financially constrained. We use three measures of financial constraint, which are the FCP index, the SA index, and the Altman's Z score. Using regression analysis, we document that these constraints increase after the issuance of the first green bond, which represents the opening of the green bond issuance program. Finally, we find that green bond issuers suffer more from information asymmetry than conventional bond issuers. This last finding may explain the interest of these firms for green bonds.

JEL: Q56, G14, G15, G30

Keywords: green bonds; sustainable finance; financial constraints

Status: Revise and Resubmit in "Economics Bulletin"

1. Introduction

Financial constraints, as defined by Tirole (2006), are frictions in capital markets, resulting in a capital supply lack, and are explained mainly by information asymmetries. In this chapter, we consider financial constraints as the consequence of information asymmetry between green bond issuers and investors. This information asymmetry arises from a lack of financial reporting or financial reporting that does not sufficiently show the real value of the issuer. These firms may, therefore, suffer from a lack of access to funding from financial markets using traditional tools such as equity issuance and conventional bonds.

Financial constraints lead to inefficient decisions by firms, including suboptimal investment (Campello et al., 2010), underinvestment in R&D (B. H. Hall, 2002), and ousting the most productive workers (Caggese et al., 2018). Studies usually measure the consequences of financial constraints, but few are interested in the way firms cope with this financial situation. Since previous research has found that green bonds are used to diversify the investor base (Zerbib, 2018), we would, therefore, expect that this would positively impact financial constraint measures. Thus, our study's first question addresses the links between green bond issuance and financial constraints.

As the concept of financial constraint cannot be directly measured, we use several proxies from the literature. Our first measure is the SA index, based on the work of Hadlock and Pierce (2010), which is based on a large sample of financially constrained firms. This measure is an update of the Kaplan-Zingales (KZ) index (Kaplan & Zingales, 1997) and is based on the size and age of firms. The second measure we use is the FCP index, as designed by Schauer et al. (2019). This index is built around firm poll data, while previous indices were based on qualitative assessments of the firms' constraint based on their reporting (Hadlock & Pierce, 2010; Kaplan & Zingales, 1997). The discriminatory power of the FCP index is based on more elaborate quantitative tools and has proven to perform better in predicting financial constraints than the existing indices usually used in the literature. Finally, we use the Altman Z score (Z score) (Altman, 2000), which measures the bankruptcy risk of firms based

on accounting data. We use these three different financial constraint proxies to limit measurement error in our study.

Green bonds are instruments used to finance assets with positive environmental externalities. These instruments have one specific feature: they give additional information on the projects being financed to investors as compared to conventional bonds (ICMA, 2014). We explore how green bonds—which have proven their ability to reduce funding costs for firms (Zerbib, 2018) and to generate financial value (Flammer, 2018)—may bring an additional solution to constrained firms. While the question of financial constraints has been studied in the context of Corporate Social Responsibility (CSR) literature (Hong, Kubik, & Scheinkman, 2012), no research has yet been conducted, to our knowledge, on the use of green bonds to limit the negative effects of financial constraints.

This subject has not been explored yet partly due to the recent development of the green bond market for corporates. Green bonds were initially mainly limited to AAA-rated issuers and supranational entities. However, the strong growth and investor interest in the green bond market led to the diversification of issuer type and risk. The first corporate green bond issuance was made in 2013, but the market remained limited in size. A major push to the market was allowed by the implementation of the Green Bond Principles (GBP) by the International Capital Markets Association (ICMA) in 2013 and then by the Paris Agreement in 2015. Thanks to these market developments, we can now build a sample across the whole risk spectrum, which allows us to see whether issuers behave linearly across this spectrum as compared to other bond issuers (called conventional bond issuers in this study). The sample we built includes an important share of riskier bonds with 43% of unrated⁴⁴ issuances and 2.4% of issuances that are not investment grade. Thanks to the available market and accounting data, we were able to build proxies to measure financial constraints.

⁴⁴ These issuances were not rated by Standard & Poor's, Moody's, or Fitch Ratings, which are the rating agencies accounting for roughly 90% of the market share (Riddiough and Zhu, 2009).

We first estimate whether green bond issuers suffer more from financial constraints based on these proxies. We estimate a regression with financial constraint proxies as a dependent variable and a dummy variable equal to one after the firm issues its first green bond. This estimation confirms that green bond issuers are more constrained after the issuance of a first green bond.

We further test whether high or low levels of constraints influence this link between green bond issuance and financial constraint. We observe that for the 10% of firms with the lowest Z score, and therefore the highest bankruptcy risks, this link is positive and significant. We also observe that green bond issuers show initially (i.e. before the creation of the green bond market) higher levels of information asymmetry proxied by the bid-ask spread and cash flow volatility. These results suggest that green bond issuers are more financially constrained and suffer more from information asymmetry before they start building their green bond issuance program. We can therefore expect that these issuers use green bonds as a solution to financial constraint and information asymmetry.

The theoretical foundation to explain these results relies on financial constraints and financial asymmetry (Akerlof, 1970; Myers & Majluf, 1984). Green bonds structurally imply less information asymmetry between the bond issuer and investors. As explained previously, by following GBP guidelines, firms commit to describe the projects in which they will invest, to provide an audit of their green bond program framework, and to provide ongoing reporting on the use of funds lent by investors. We believe that these commitments imply the GBP framework serves as an agreement that limits management operational flexibility and aligns it with investors' expectations. This effect limits asset substitution (Green & Talmor, 1986) and underinvestment (Myers, 1977) issues.

We contribute to the literature on the motives for firms to engage in a green bond issuance program. Green bonds are important to the financing of climate change mitigation and adaptation (OECD, 2017). While it is not the only tool to bring private capital into climate change, green bonds have been one of the most successful ones, with a 62.6% compound annual growth rate of issuances between 2007 and 2018 (CBI, 2018). Previous research has proven a positive signaling effect of green bond issuance (Flammer, 2018) but did not document whether these positive effects are linear across firm

risk types. Previous literature has also documented the positive impact of green bond issuance in terms of direct effects (Zerbib, 2018), but little has been done around documenting specific indirect effects of green bond issuance. These indirect effects are important to understanding the motives of green bond issuers and understanding how the market has developed since 2013.

In section 2, we present our theoretical framework. In section 3, we explain our data and methodology. In section 4, we analyze our results, and section 5 is our conclusion.

2. Theoretical framework

Covenants allow investors to limit the operational flexibility of managers to align them better with their interests. We argue that green bond issuance guidelines, such as the GBP framework, work the same way as covenants. Although the documentation of a conventional bond issuance concerning the use of proceeds does not emphasize how the funds must be used,⁴⁵ green bond issuers have to give specific indications on how proceeds will be used for their bonds to qualify as green (ICMA, 2014). Additionally, managers must report to investors to demonstrate that funds are used in line with what is stated in the issuance documentation. According to the GBP guidelines, this reporting is audited by third parties, which limits the risk of misreporting. All of these elements limit managerial operational flexibility and contribute to aligning the interests of investors and management in the same way covenants would do. We, therefore, believe that managers issuing green bonds have identified existing asymmetry issues with investors and want to show a willingness to tackle them using green bonds.

There is structural information asymmetry between management and investors. Management has more specific information on the expected cash flows of firms' projects than investors, who do not have access to the same granularity in terms of access to project information (Jensen and Meckling, 1976). Again, costly monitoring has been implemented to limit this information asymmetry, such as

⁴⁵ The bond documentation in the “use of proceeds” section usually refers to “general corporate purposes.”

the auditing process or specific board committees. For green bonds following the GBP framework, additional reporting on the projects must be provided to investors before and after the green bond issuance. Such processes do not exist for conventional bonds, even though some specific reporting can exist for more structured debt, as in the case of securitization or covered bonds (EBA, 2019). We, therefore, believe that green bonds reduce these information asymmetries between investors and management.

Previous literature has also shown that information asymmetry negatively impacts the cost of capital (Lambert et al., 2012). As detailed in Botosan (1997), information asymmetry first affects firms through transaction costs which are higher for firms suffering from information asymmetry, therefore, creating lower demand for securities issued by these firms. This lower demand finally affects securities' liquidity and as a consequence increases liquidity premia (Amihud & Mendelson, 1988). The second issue with information asymmetry comes from estimation risk, investors will expect a higher risk of firm equity misevaluation. This misevaluation will lead to additional estimation risk premia for the firm (Lambert et al., 2012).

The asset substitution issue (Jensen and Meckling, 1976; Green and Talmor, 1986) occurs in situations where, after the issuance of a bond, the firm invests in projects that tend to substantially increase the risk profile of the firm. Debt investors have priced the bond based on an expected risk profile, whereas firms increase their risk profile above this expected level. Such asset substitution happens as low-risk projects are replaced by high-risk projects without the investors having the ability to reprice the bond at no cost. In the case of green bonds, the management of the firm has committed to using the proceeds from these bonds for a specific project or group of projects; not following this commitment would lead to costly reputational risks for the firm (Morel and Bordier, 2012). Green bonds, therefore, limit the asset substitution issue by pushing the management to invest in projects specified in the bond documentation.

The underinvestment issue (Myers, 1977; Pour, 2017; Stulz & Johnson, 1985) arises when firms have the opportunity to invest in positive NPV projects but do not do so, since future payoffs will accrue

to debtholders. This accrual to debtholders does not incentivize managers to invest in positive NPV projects, thus creating missed opportunities for the firm. Green bonds allow investors to have a better understanding of projects in which the funds are invested. This enables them to measure the extent to which the management is limiting its investment opportunities.

Due to lower information asymmetry and lower risk of asset substitution or underinvestment, green bonds allow constrained firms to continue funding their investments. In the following sections, we will present the empirical elements to support this hypothesis.

3. Data and methodology

In this section, we will present the data and methodology used in our study.

a. Data

From Bloomberg, we extract all registered corporate green bonds⁴⁶ from 2007 to 2019. We then extract the issuer's International Securities Identification Number (ISIN) from this list of green bonds. For green bond issuers, we directly obtain the issuer equity ISIN. From the Securities Data Company (SDC), we extract the list of all bonds issued in countries where green bonds are issued. Using the bond ISIN, we find the equity ISIN using Bloomberg for this list of bonds. Based on the equity ISIN, we exclude the bond issuers already registered as green bonds.

We extract from Datastream all firm characteristics and all financial data of green and conventional bonds based on the equity ISIN. We use Datastream because it allows for a wide cross-country extraction of data. Using green bond and conventional bond issuers' ISIN, we extract the Standard Industrial Classification (SIC) code. To account for specific characteristics of financials, we exclude all financial firms (SIC code between 6000 and 6999) from our sample.

⁴⁶ We, therefore, exclude municipal as well as sovereign, supranational, and agency issuances, which are beyond the scope of this study.

b. Descriptive statistics

In Table I, we present the key statistics of green and conventional bond issuers. Green bond issuers are, on average, about double the size of conventional bond issuers, with \$20m in average total assets. Both green and conventional bond issuances are skewed, with the median being \$8.8m for green bond issuers and \$3.0m for conventional bond issuers. Green bond issuers have a significantly lower return on assets (ROA), return on equity (ROE), and higher leverage, which may explain part of the measured financial constraint for these firms. The Environment Social and Governance (ESG) score of green bond issuers is high and significantly higher than that for conventional bond issuers. This difference is justified by the fact that investors in green bonds expect firms issuing these bonds to have high ESG scores. Green bond issuers have significantly higher FCP and SA indices and a significantly lower Z score, reflecting a higher level of financial constraint.⁴⁷ What Table I seems to reveal is that green bond issuers have weaker financial metrics regarding leverage, ROA, and ROE but stronger metrics regarding investment, ESG score, and sales growth. This would mean that their low financial performance metrics penalize firms that need funding to maintain their higher level of investments. These firms would, therefore, seem to have advantages in signaling their high ESG score and, therefore, using the green bond market to ease their access to funds while suffering from negative financial metrics.

[Table I about here]

We then test how these firm financial metrics correlate in Table II. These results confirm our intuitions from Table I: being a green bond issuer positively and significantly correlates with firm size, leverage, ESG score, and financial constraint indices. The indicator for the issuer being green correlates negatively and significantly with the Z score. These elements seem to confirm that green bond issuers suffer from stronger financial constraints.

⁴⁷ Firms with higher FCP and SA indices are more constrained. Firms with lower Z score are considered to have a higher bankruptcy risk.

[Table II about here]

Static analysis by means of the comparison in Table I and the correlation matrix in Table II suggest that green bond issuers are more constrained than conventional bond issuers.

c. Methodology

We first test whether green bond issuers are more constrained after the first green bond issuance. We then measure how financial constraints evolve after the first issuance of green bonds.

i. Measures of financial constraints

In our study, we use the FCP and SA indices to measure financial constraints. We complement these measures by the Z score, which more precisely measures the bankruptcy risk of a firm. The detailed computation of these indices is shown in Appendix XI. To assess financial constraints, Kaplan and Zingales (1997) read the Securities Exchange Commission (SEC) filings of 49 low-dividend U.S. firms between 1970 and 1984. The index was then built by Lamont et al. (2001) based on a set of accounting variables (cash flow, cash holdings leverage, dividends, and market-to-book), for which coefficients were estimated under a logit model with the degree of financial constraint as the dependent variable.

An important study conducted by Hadlock and Pierce (2010), however, casts doubt on the power of the KZ index as a proxy for financial constraint. The authors collected qualitative data on firm financial constraints based on the 10Ks of 356 randomly selected U.S. firms between 1995 and 2004. They find that the KZ index does not perform well in predicting financial constraints and find a higher predictive power of the SA index, which is based on firm age and size. We, therefore, include the SA index in our study to provide the first measure of financial constraints.

Financial constraint indices have recently been heavily criticized for their inability to properly measure firms' access to capital markets (Farre-Mensa & Ljungqvist, 2016). The authors find that these indices are mainly linked to young and small firms that are in a growth phase rather than to firms that have issues accessing capital markets or raising funds at a reasonable cost. More recent

work from Schauer et al. (2019), acknowledging these critics, tests the predictive power of the KZ, the Whited-Wu, age-size-cash flow-leverage (ASCL), and SA indices (Hadlock & Pierce, 2010; Kaplan & Zingales, 1997; Lamont et al., 2001; Mulier, Schoors, & Merlevede, 2016; Whited & Wu, 2006). The authors used comprehensive survey data and more advanced quantitative methods⁴⁸ to estimate a stronger proxy for financial constraints called the FCP index. We, therefore, use this index in our study.

The Altman Z score, based on the work of Altman (2000), is our third measure of financial constraints. This measure was built to predict the probability of a firm going into bankruptcy, using accounting data scaled to assets (working capital, retained earnings, earnings before interest and taxes (EBIT), the market value of equity, and sales). A lower score indicates a higher risk of distress and a higher probability of bankruptcy in the following years (the Z score has 80% to 90% accuracy one year before bankruptcy).

ii. Proxies for information asymmetry

In our study we use the bid-ask spread to measure information asymmetry following extensive empirical literature (Brennan & Subrahmanyam, 1996; Lu et al., 2010; Stoll, 1978; Tourani-Rad et al., 2016). The bid-ask spread is measured as the ask price minus the bid price divided by the average between bid and ask prices (Tourani-Rad et al., 2016). The rationale behind the use of bid-ask spread as a measure of information asymmetry relies on the fact that when dealers expect informed traders to have information advantage they widen the spread to account for potential loss due to lack of information.

Cash flows volatility is the second proxy for information asymmetry following previous literature (Minton & Schrand, 1999). Cash flows are being used to value the equity and to pay future debt. The

⁴⁸ The authors use German manufacturing firms' financial status survey from 1989 to 2012 as the basis for their study. The predictive power of the updated index was measured using receiver operating characteristic (ROC) curves.

best predictor of future volatility is the historical volatility of cash flows. Under higher cash flow volatility expectations information asymmetry is, therefore, higher between investors and the firm. We intend to measure whether green bond issuers have higher bid-ask spreads and higher cash flow volatility as compared to conventional bond issuers. We measure these proxies before the corporate green bond market was created (2010-2012 period) in order to prevent green bond issuances from disturbing the results. We, therefore, test the means comparison of firms that will become green bond issuers after 2013 and firms that will continue issuing only conventional bonds after 2013. This method measures initial information asymmetries through bid-ask spread and cash flow volatility differences between future green and conventional bond issuers.

iii. Model

In the first model specification, we test whether green bond issuers have a higher or lower level of financial constraint using the following model:

$$Constraint\ proxy_{it} = \beta_0 + \beta_1 After_{it} + \beta_2 Controls_{it} + Year_t + Industry_i + \varepsilon_{it} \quad (1)$$

where i is the firm and t is the year-end of the data. $Constraint\ proxy_{it}$ is the financial constraint proxy of firm i at the year-end t . $After_{it}$ is a dummy variable equal to one after the firm has issued its first green bond. We use standard firm-specific control variables (TobinQ, leverage, cash flow, ESG score, board size, sales growth, firm size, and the natural logarithm of the number of employees) and macro-economic variables linked to access to capital markets, extracted from Erel et al. (2015). All variables are defined in Appendix X. $Year_t$ is the time fixed effect and $Industry_i$ is the industry fixed effect. ε_{it} is the error term.

4. Results analysis

As discussed in the previous section, we start by measuring whether financial constraints increase after the first green bond issuance. Using equation (1), we are interested in the coefficient for the dummy variable $After$. Positive (negative) and significant coefficients for $After$ in models (1)-(3) of

Table III indicate an increase (decrease) of financial constraints after the first issuance of a green bond.

[Table III about here]

The coefficient for the dummy variable *After* is significant for all three measures of financial constraint. This first analysis suggests that after the first green bond issuance, the financial constraints increase.

In Table IV, we add the average value of several key components of financial constraint measures before and after the first green bond issuance. The analysis of these components will help us explain the factors leading to increased financial constraints.

[Table IV about here]

Based on these descriptive statistics, we observe that the interest coverage ratio decreases sharply after the first green bond issuance while leverage increases by a significant number in the same period. One explanation to the increase in financial constraints comes from the fact that green bond issuers seem to have increased leverage and as a consequence lower interest coverage ratios. Lower interest coverage ratios lead to a firms' lower ability to obtain additional external funds and increase financial constraints.

We then measure the bid-ask spread and cash flow volatility in Table V in order to understand whether future green bond issuers suffered from information asymmetry as compared to conventional bond issuers before the green bond market existed.

[Table V about here]

We measure an 11% higher significant average bid-ask spread for green bond as compared to conventional bond issuers before 2013. We also measure significantly higher cash flow variances for green bond as compared to conventional bond issuers. We, therefore, expect soon-to-become green bond issuers to be firms that suffer from information asymmetry.

5. Conclusion

Our study explores the link between green bond issuance and financial constraints. We first find that green bond issuers suffer more from financial constraints than conventional bond issuers. Our findings show that after the first green bond issuance, financial constraints do not ease.

These findings contribute to the financial constraints literature that mainly focuses on the consequences of these constraints. We find that green bonds may be a tool for firms to continue obtaining funds to invest. These findings also contribute to the green bond literature. While most studies focus on green bond pricing properties, a few studies explore the nature and motives of green bond issuers. Our study contributes to the literature by showing that green bond issuers suffer from financial constraints. These firms seem to be in a growth phase that leads to high levels of leverage and lower financial return, limiting their funding capacity. We find that green bonds allow these firms to limit the negative effects of financial constraints by allowing them to signal the quality of the projects they invest in.

One limitation of our study is that we exclude financials from our sample for leverage and regulatory purposes. Further work still needs to be done to understand if financials use green bonds the same way as corporates do.

Table I: Summary statistics on the key variables for green and conventional bond issuers

The table presents the summary statistics of variables for green and conventional bond issuers. All firm-level data are from Datastream. All data are winsorized within each yearly cross-section at the 1% and 99% percentiles. *Total Assets* are presented in USD million. The last column shows the results of the mean difference test for each variable. Variable definitions are provided in Appendix X. The symbols ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Variables	Green bond issuers				Conventional issuers				Difference in means
	N	mean	median	SD	N	mean	median	SD	
Total Assets	1,107	20.02	8.80	33.36	28,578	10.36	3.01	21.39	9.66***
CAPEX/ Assets	1,076	0.06	0.04	0.06	27,753	0.05	0.04	0.05	0.00**
ROA	1,070	3.92	3.83	5.90	27,864	5.01	4.92	7.26	-1.09***
ROE	1,061	7.93	8.81	19.05	26,847	9.56	10.08	26.37	-1.63**
Sales growth	1,007	0.17	0.07	0.45	26,077	0.12	0.06	0.35	0.06
Leverage	1,106	0.39	0.37	0.20	28,540	0.33	0.31	0.19	0.06***
ESG	561	62.56	65.52	16.94	12,658	55.42	56.66	17.75	7.14***
Z score	1,050	1.95	1.50	1.79	29,717	2.93	2.78	3.47	-0.98***
FCP	1,052	-19.13	-19.10	25.30	27,266	-24.60	-24.02	32.46	5.47***
SA Index	579	-2.20	-2.14	1.24	18,084	-2.73	-2.59	1.33	0.53***

Table II: Correlation matrix

The correlation matrix shows the correlations of key variables of our model based on the full sample of green and conventional bond issuers. Green is a dummy variable that equals one (zero) when the issuer is a green bond issuer. Variable definitions are provided in Appendix X. All of the data are winsorized within each yearly cross-section at the 1% and 99% percentiles. The symbols ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	Green	Size	CAPEX	ROA	ROE	Sales Growth	Leverage	ESG	Z Score	FCP	SA Index
Green	1										
Size	0.134***	1									
CAPEX	-0.00387	0.0119	1								
ROA	-0.0251*	-0.0174	-0.160***	1							
ROE	-0.0107	0.00879	-0.126***	0.760***	1						
Sales Growth	0.0165	0.00132	-0.0678***	0.182***	0.106***	1					
Leverage	0.0627***	-0.0121	0.0715***	-0.167***	-0.0236*	0.0104	1				
ESG	0.0990***	0.513***	-0.0732***	0.0720***	0.0888***	-0.114***	-0.115***	1			
Z Score	-0.0858***	-0.131***	-0.279***	0.536***	0.332***	0.0366**	-0.379***	0.0429***	1		
FCP	0.0250*	-0.00104	0.0530***	-0.525***	-0.393***	-0.0503***	0.151***	-0.0673***	-0.431***	1	
SA Index	0.0738***	0.417***	0.0773***	-0.0109	-0.00212	0.0917***	0.114***	0.0736***	-0.188***	0.00197	1

Table III: Evolution of financial constraints after the first green bond issuance

This table presents regressions with financial constraint proxies as dependent variables, a dummy variable equal to one after the first green bond issuance, and a set of control variables. *After* is a dummy variable that equals one (zero) after the first green bond issuance. Definitions and sources of the other variables are provided in Appendix X. Country, industry, and year fixed effects are included in all equations. Robust standard errors are shown in parentheses. All of the data are winsorized within each yearly cross-section at the 1% and 99% percentiles. The symbols ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Variables	(1) FCP Index	(2) SA Index	(3) Z score
After	11.672** (5.618)	0.375*** (0.125)	-0.542** (0.223)
TobinQ	-13.895*** (0.680)	0.128*** (0.021)	0.902*** (0.062)
Leverage	23.547*** (2.742)	0.369*** (0.087)	-7.538*** (0.239)
CF	-144.567*** (9.779)	0.463 (0.299)	9.638*** (0.777)
ESG	0.032 (0.020)	-0.010*** (0.001)	-0.002 (0.002)
Board Size	-0.029 (0.090)	-0.052*** (0.006)	0.023*** (0.008)
Sales growth	1.954 (2.006)	0.245*** (0.064)	0.181 (0.136)
Size	-3.410*** (0.448)	0.703*** (0.021)	0.139*** (0.042)
ln(Employees)	0.291 (0.367)	-0.077*** (0.015)	-0.107*** (0.036)
Private Credit	-0.021 (0.021)	-0.002 (0.002)	-0.001 (0.002)
GDP Growth	-0.200 (0.220)	-0.009 (0.013)	-0.048** (0.019)
Market capitalization	-0.007 (0.011)	0.000 (0.001)	-0.001 (0.001)
Constant	37.178*** (5.745)	-12.246*** (0.445)	3.224*** (0.552)
Observations	8,768	6,708	8,727
R-squared	0.399	0.422	0.503
Year FE	YES	YES	YES
Industry FE	YES	YES	YES
Country FE	YES	YES	YES

Table IV: Summary statistics on the key components of financial constraints before and after the first green bond issuance

The table presents summary statistics for the key variables of the green and conventional bond issuers. All data are from Datastream. *ROA* is in percentage points. Variable definitions are provided in Appendix X. All t-tests are adjusted for change in variance differences between both samples. The symbols ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Variables	Before the first green bond issuance			After the first green bond issuance			Difference in means
	N	mean	SD	N	mean	SD	
ROA	28,816	4.98	0.04	118	3.52	0.52	-1.46***
Cash / Assets	29,505	0.12	0.10	121	0.11	0.09	-0.01
Interest Coverage	29,169	14.76	53.17	122	5.61	1.00	-9.15***
Leverage	29,525	0.33	0.19	121	0.38	0.19	0.05***

Table V: Difference in means information asymmetry proxies of green compared to conventional bond issuers

The table presents summary statistics for the key variables of the green and conventional bond issuers. All data are from Datastream. Variable definitions are provided in Appendix X. The symbols ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Variables	Standard Bond Issuers			Green Bond Issuers			Difference in means
	N	mean	SD	N	mean	SD	
BidAsk	24,537	0.03	0.50	17,135	0.15	0.62	0.11***
VarFCF	15,084	2.05	92.96	576	317.40	3,096.22	315.35***

General Conclusion

The green bond market is still in its premises, it took six years between the first green bond issuance and the emergence of the corporate green bond market. The literature on this market first aimed at studying the direct effects of green bond issuances for issuing firms and for investors. The research has therefore looked at yield differences between green and conventional bonds (Kapraun & Scheins, 2019; Zerbib, 2018), at diversification benefits of green bonds as investments (Reboredo, 2018) or at financial benefits coming after the green bond issuance (Flammer, 2018). The theoretical basis of this research relies on the existence of investors' green utility (Baker et al., 2018). There is a consensus in the empirical literature that there is a green bond premium in the bond market, therefore, proving the existence of an investor green utility. Still, the measured economic impact of such issuances is too thin to explain the underlying motives of issuers. The current dissertation, therefore, focused on studying green bond issuers' motives by studying ex-ante financial factors and indirect effects of green bond issuance.

A key question arising from the literature on CSR is to know how the role of the state and the institutional context (Boubakri et al., 2019) in incentivizing or disincentivizing CSR and more specifically environment-linked CSR (Hsu et al., 2018). One of the main issues faced by the literature was to measure a firm's commitment to environment-linked CSR (Zerbini, 2017). CSR is usually measured through CSR scores that are difficult to measure and that are not fully under the firm's control. Green bonds can both be measured and are issued on the initiative of the firm. In our study, we consider green bonds as commitments from the firm to environmentally linked CSR. We find that political signals play a key role as a motive to issue green bonds and on the value perception of these financial instruments.

Most studies in the green bond literature focus on the effects of these instruments on the bond market. Few studies are specifically interested in the way the equity investors look at corporate actions on the bond market. While the literature has documented how major financial events such as

rating downgrades affect the stock price (Ederington & Goh, 1998; Goh & Ederington, 1993; Koijen, Lustig, & Van Nieuwerburgh, 2017), little work has been done on how equity investors receive environment-linked information. Endogeneity is a key issue in identifying how equity investors react to such information. Indeed, this issue identified in the CSR literature (Al-Tuwajri, Christensen, & Hughes II, 2004; Taneja, Taneja, & Gupta, 2011) remains when we study green bonds. To account for this issue, we take the Paris Agreement and the U.S. presidential election as exogenous shocks to better understand the impact of a green bond issuance announcement on firm value. After accounting for endogeneity, we find that green bonds give a positive signal to equity investors on the firm's value. We find as well that this value depends to a large extent on the regulatory and political signals. This impact of regulatory signals seems to depend on the expectations of future regulations that increase the cost-benefit analysis of green bond issuing firms.

The literature on bonds has explored how financial covenants and secured debt allow debt issuing firms to reduce information asymmetry with investors (Jensen & Meckling, 1976; Jiang & Zhou, 2017; Stulz & Johnson, 1985). Specific features of green bonds that follow the GBP include additional reporting and increased involvement of investors in the investment policy of the firm. To this extent, green bonds can have the same function as covenants on non-financial factors of the firm. While the literature has studied this phenomenon for conventional bonds no study to our knowledge has looked at green bonds as non-financial covenants. To study the effect of such covenants on information asymmetries, we look at firm financial constraints and explore how green bonds impact the development of these financial constraints. The main results in this dissertation first find that, looking at static data, green bonds are more constrained as compared to other firms. The results suggest that financial constraints do not ease after the first issuance of a green bond and the opening of the green bond program. We, therefore, argue that the issuance of green bonds is also used as a way to continue investing while suffering from financial constraints.

The findings of this dissertation emphasize the fact that indirect benefits stemming from the issuance of green bonds give further motives for firms to engage in such environmentally linked CSR.

This dissertation gives also new evidence of the importance of the state as a stakeholder in pushing firm environment-linked CSR materialized by green bonds. Aside from the state's direct intervention, it seems that political signals are widely followed by both fixed income and equity investors respect to green regulation of the financial sector.

The three chapters show us that new financial markets and green finance initiatives have first to be incentivized by the state before the market can take off. Green bonds have first been issued by the European Investment Bank owned by EU member states. It then developed after the Paris Agreement which was a political signal sent by world governments towards an increased push on greenhouse gas reduction and green finance. Main corporate issuers include SNCF and Engie which are state-owned firms. We, therefore, believe that the state, through its shareholdings, has a key role to play to help such green finance markets to start and develop.

Some issues have arisen in the green bond market, these include lack or low quality of post-issuance reporting (CBI, 2019) and the lack of market regulation that could lead to major market scandals. During its first phase of expansion, the green bond market was based on voluntary guidelines and was largely unregulated. This helped the market expand at a very high pace for the last 10 years. Now that the market has expanded, there is a need for regulation to limit the risk of investors losing trust in the green bond market. There is also a need for investors to prevent greenwashing cases by considering the inappropriate use of green bonds proceeds and the lack of reporting as cases of default in green bonds' legal documentation. Finally, one further push for the market can come from lower capital requirements for banks that hold such financing instruments (see appendix XV). If we consider climate change as a systemic risk, actions taken by governments and firms to limit this risk should benefit from bank capital relief to account for this risk reduction.

The green finance market is still at its premises, and several research subjects have yet to be explored. First, research on governance and green finance still needs further research in order to determine mechanisms that lead to the decision to use green finance. The role of activist shareholders

and the role of firm's management needs to be better understood. The role of long-term investors, who should have a stronger focus on long-term value creation has not been explored yet.

Second, green finance is mostly discussed as a tool to tackle climate-related issues, work has still to be done on the impact of green finance on biodiversity. One should answer the question of the slower development of green bonds in the biodiversity preservation space as compared to the renewable energy space.

Third, further research in the field of green regulation will be necessary. The quantitative impact of existing green regulations on firm behavior would help policymakers better understand what mechanisms work best to implement green policymaking. Analysis of the impact of capital relief as compared to taxes on bank asset allocation would also be useful to policymakers in order to better shape green regulations. This subject is for example key in the context of the "Green Deal" currently pushed by the European Commission.

Fourth, a key area of development will be to understand how regulations to lower the risk of greenwashing could be implemented without affecting the strong development of the green bond market. It is indeed key to show an equilibrium between heavy requirements on issuers and investors that would deter small issuers and investors to enter the market as opposed to the absence of regulation that may lead to major greenwashing scandals undermining the confidence of investors regarding the market.

Finally, the broader question of the additionality of such new financial instruments has to be discussed. Questions such as the carbon impact of the projects financed by green finance instruments and the ability of these instruments to push firms into investing in carbon emissions reduction and biodiversity preservation projects have yet to be answered. These are fundamental issues as green finance would have little use to the common good if these issues were left unanswered.

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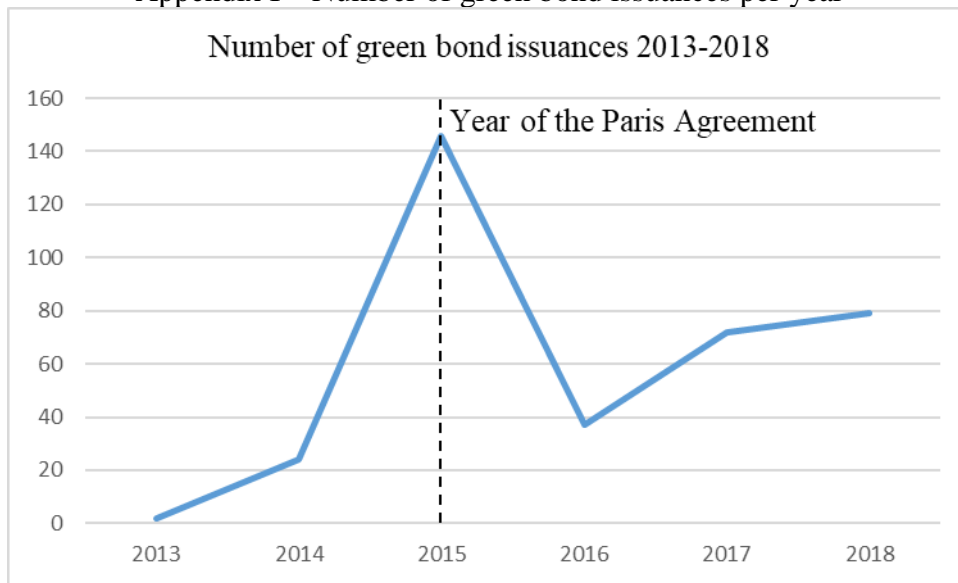
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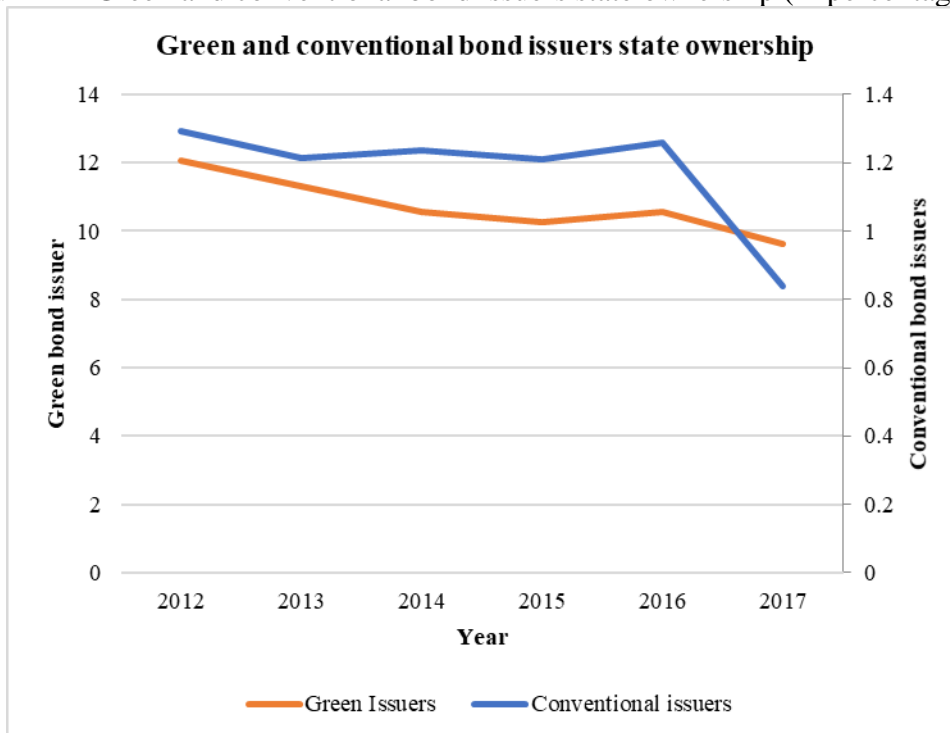
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Appendix

Appendix I – Number of green bond issuances per year



Appendix II – Green and conventional bond issuers state ownership (in percentage points)



Appendix III – Hausman specification test

Hausman specification test

We present below the results of the Hausman test based on J. A. Hausman (1978) and J. Hausman and McFadden (1984). We use the results of equation (1) with and without fixed effects. We obtain the estimators using fixed effects in (1) below, estimators using random effects in (2) below, and the difference in (3). Using these results, we compute the Hausman test.

	Fixed effects	Random effects	Difference
	(1)	(2)	(3)
GOVHELD	0.174	0.201	-0.027
INSTIT	0.021	0.020	0.001
EMPLOYFAMHELD	-0.012	-0.023	0.011
FOREIGN	0.054	0.029	0.024
ROA	-0.018	-0.010	-0.008
LEVERAGE	-0.055	-0.020	-0.036
ESGscore	0.000	0.000	0.000
SIZE	0.014	0.013	0.001
TOBINQ	0.014	0.006	0.008
Chi-square	35.3		
p-value	0.000		

Appendix IV – Investors in green bonds by investor type as of January 2019

Investor types	Percentage of total green bonds held
Investment Advisor	81%
Insurance Company	14%
Bank	2%
Unclassified	0%
Hedge Fund Manager	0%
Other	1%
Corporation	0%
Private Equity	0%
Pension Fund	0%
Brokerage	0%
Holding Company	0%
Government	1%
Sovereign Wealth Fund	0%
Business Development Corporation	0%
Venture Capital	0%
Foundation	0%
Trust	0%

Appendix V – Regression results with country-level greenhouse gas emissions as a control variable

Regression results with country-level greenhouse gas emissions as a control variable

Below models have the binary Issuein1Y as the dependent variable. In the Model (1), we use the same Model as in Table VI in Model (1) to which we add country-level GHG emissions as a control variable. In the Model (2), we use the same model as in (1) but using four-digit Standard Industrial Classification (SIC) code fixed effects instead of two-digit SIC code fixed effects.

Variables	(1) GHG Issuein1Y	(2) GHG + SIC 4 Issuein1Y
GOVHELD	0.132** (0.066)	0.140** (0.070)
INSTIT	0.007 (0.058)	0.024 (0.066)
EMPLOYFAMHELD	-0.009 (0.025)	-0.000 (0.035)
FOREIGN	0.005 (0.021)	-0.001 (0.020)
ROA	-0.355** (0.178)	-0.333* (0.187)
LEVERAGE	-0.086*** (0.027)	-0.106** (0.041)
ESGscore	-0.000** (0.000)	-0.000 (0.000)
SIZE	0.009* (0.005)	0.009* (0.005)
TOBINQ	0.027* (0.015)	0.037** (0.018)
COUNTRY_GHG	-0.014 (0.019)	-0.013 (0.020)
Constant	0.106 (0.177)	0.117 (0.176)
Observations	1,166	1,166
R-squared	0.18	0.35
Year FE	YES	YES
Four-digit SIC FE	NO	YES
Two-digit SIC FE	YES	NO
Country FE	YES	YES

Robust standard errors in parentheses

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

Appendix VI – Green bond issuance, state ownership and institutional context after four-digit standard industrial classification code and country matching

Green bond issuance, state ownership and institutional environment

The three models have the binary Issuein1Y as the dependent variable. We use the sample of firms matched on four-digit standard industrial classification (SIC) code and country and simple four-digit SIC code matching. We use the linear probability model (LPM) in all models. In the Model (1) and (2), we estimate our model on the sample of firms in civil law countries using the classification from La Porta et al. (1998). In Model (3) and (4), we estimate our model with firms in countries with low anti-self-dealing. We use the classification established by Djankov et al. (2008). In Model (5) and (6), we estimate our model with firms in countries with low judicial independence. The split of the sample between high and low is based on the variable for each country being higher or lower than the average. We use four-digit SIC codes for the industry fixed effects.

	(1) Four-digit SIC + Country	(2) Four-digit SIC	(3) Four-digit SIC + Country	(4) Four-digit SIC	(5) Four-digit SIC + Country	(6) Four-digit SIC
	Legal Origin Civil	Legal Origin Civil	Anti-self-dealing Low	Anti-self- dealing Low	Judicial Independence Low	Judicial Independence Low
Variables	Issuein1Y	Issuein1Y	Issuein1Y	Issuein1Y	Issuein1Y	Issuein1Y
GOVHELD	0.948*** (0.123)	0.483*** (0.119)	1.317*** (0.117)	0.633*** (0.130)	0.938*** (0.123)	0.667*** (0.136)
INSTIT	-0.000 (0.000)	0.000 (0.000)	0.003** (0.001)	-0.000 (0.001)	-0.000 (0.000)	-0.001*** (0.000)
EMPLOYHELD	0.000 (0.000)	-0.000** (0.000)	-0.001 (0.001)	-0.001*** (0.000)	0.000 (0.000)	-0.000 (0.000)
FOREIGN	-0.001*** (0.000)	-0.000*** (0.000)	-0.000 (0.000)	-0.002*** (0.000)	-0.001*** (0.000)	-0.000*** (0.000)
ROA	-0.230** (0.097)	-0.350*** (0.091)	-0.530** (0.229)	-0.712*** (0.161)	-0.206** (0.097)	-0.046 (0.059)
LEVERAGE	-0.028 (0.044)	-0.110*** (0.031)	-0.108 (0.115)	-0.308*** (0.086)	-0.029 (0.044)	-0.056** (0.023)
ESGscore	-0.000*** (0.000)	-0.000*** (0.000)	0.006*** (0.002)	-0.001*** (0.000)	-0.000*** (0.000)	-0.000*** (0.000)
SIZE	0.005 (0.004)	0.007** (0.003)	0.003 (0.012)	0.004 (0.006)	0.004 (0.004)	0.008** (0.003)
TOBINQ	0.002 (0.006)	0.012*** (0.004)	0.152** (0.072)	0.015 (0.014)	0.001 (0.006)	0.001 (0.003)
Constant	0.068* (0.038)	-0.054 (0.042)	0.018 (0.158)	-0.120 (0.088)	0.116*** (0.041)	-0.109** (0.055)
Observations	765	1,378	210	612	764	1,317
R-squared	0.72	0.44	0.83	0.55	0.71	0.54
Year FE	YES	YES	YES	YES	YES	YES
Industry four- digit FE	YES	YES	YES	YES	YES	YES
Country FE	YES	YES	YES	YES	YES	YES

Robust standard errors in parentheses

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

Appendix VII – Test Statistics Computation

We used annotations from Boehmer, Masumeci, and Poulsen (1991) and Cowan (1992) to develop this section; the main test statistics were used to test the significance of the CAR in our study.

Definition of main variables

N: number of firms

T: Estimation window

AR_{it} : Abnormal returns of firm i on day t

CAR_i : Cumulative abnormal return for firm i

$CAAR_i$: Cumulative average abnormal return of firm i

R_{mt} : Market expected return on day t

\bar{R}_m : Average market return during the estimation window

S_i : Standard deviation of abnormal returns during the estimation window for firm i

$StCAAR_i$: Standard deviation of cumulative abnormal returns during the estimation window for firm i

$StCSAR_i$: Standard deviation of cumulative standardized abnormal returns during the estimation window for firm i

\overline{StCSAR}_i : Standard deviation of average cumulative standardized residual on the event day for firm i

SAR_i : Standardized residual on the event day for firm i

$CSAR_i$: Cumulative standardized residual on the event day for firm i

\overline{CSAR}_i : Average cumulative standardized residual on the event day for firm i

T-test

Parametric test where the null hypothesis is: $H_0: CAAR_i = 0$

$$t_{CAAR(t_1, t_2)} = \frac{CAAR(t_1, t_2)}{StCAAR_i}$$

Patell Z test (Patell, 1976)

Parametric test where the null hypothesis is: $H_0: CAAR_i = 0$

Abnormal returns are first standardized as follows:

$$SAR_i(t_1, t_2) = \frac{AR_i(t_1, t_2)}{S_i}$$

Subsequently, these standardized abnormal returns are cumulated over time as follows:

$$CSAR_i(t_1, t_2) = \sum_{t_1}^{t_2} SAR_{it}(t_1, t_2)$$

The test statistic then becomes:

$$t_{CAAR(t_1, t_2)} = \frac{1}{\sqrt{N}} \times \sum_{i=1}^N \frac{CSAR(t_1, t_2)}{StCSAR_i}$$

Boehmer test statistic (Boehmer, Masumeci, & Poulsen, 1991)

Parametric test where the null hypothesis is: $H_0: CAAR_i = 0$

This test uses the cross-sectional average \overline{CSAR}_l and the standard deviation of \overline{CSAR}_l and is computed as follows:

$$t_{CAAR(t_1, t_2)} = \frac{\overline{CSAR}_l(t_1, t_2)}{StCSAR_i}$$

Generalized sign test (Cowan, 1992)

The generalized sign test is a non-parametric test that measures whether the number of stocks with positive CAR in the estimation window is lower than that in the event window. We therefore first measure the share of positive CAR in the event window as follows:

$$P_+ = \frac{1}{N} \times \sum_{i=1}^N \sum_{t=t_1}^{t_2} \frac{1}{100} \times H_{it}$$

where

$$H_{it} = \begin{cases} 1 & \text{if } CAR_{it}(t_1, t_2) \\ 0 & \text{otherwise} \end{cases}$$

The test statistic is based on the normal approximation of the binomial distribution as follows:

$$t_{CAAR(t_1, t_2)} = \frac{w - NP_+}{\sqrt{NP_+(1 - P_+)}}$$

where w denotes the number of stocks in the event window for which the CAR is positive.

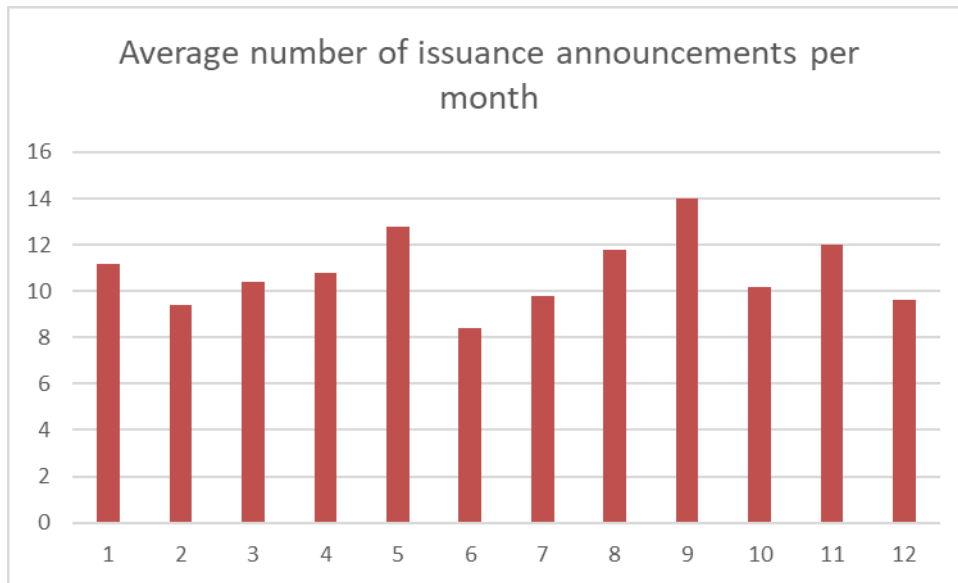
Appendix VIII – Variables Definition

Variables definition

Below are presented the definitions of all data used in our study. Accounting, stock price data, and firm characteristics are extracted from Datastream. Bond characteristics are extracted from Bloomberg. Other data sources are detailed in the table.

Variable	Definition	Source
Amount Issued	The bond amount at issuance in millions of US dollars.	Bloomberg
Audit Committee	Number of members of the audit committee	Datastream
AUM SRI	Assets under management managed following sustainable and responsible investment guidelines.	Global Sustainable Investment Alliance
Board Independence	Dummy variable equal to 1 if the board is independent and 0 otherwise;	
Board Size	Number of board members.	Datastream
Bond Size	Size of the bond at issuance computed as the natural logarithm of the amount issued.	Bloomberg
Callable	Dummy variable equal to 1 if the bond is callable and 0 otherwise.	Bloomberg
CEOreturn	Dummy variable equal to 1 when the CEO's salary depends on shareholder total return and 0 otherwise.	Datastream
Coupon	Coupon in percentage at issuance.	Bloomberg
EBIT to interest expense	earnings before interest and taxes divided by interest expense	Datastream
Energy-related CO2 emissions per capita SDG	Achievement of the CO2 emissions per capita sustainable development target achievement as measured by Lafortune et al. (2018).	Sustainable development report
Equity-to-Assets	Shareholder's equity divided by total assets.	Datastream
Market forces	AUM SRI - Total green bonds issued	Global Sustainable Investment Alliance Sustainable development report
Maturity	Bond maturity at issuance in years.	Bloomberg
Operating Margin	Operating income divided by sales.	Datastream
Putable	Dummy variable equal to 1 if the bond is putable and 0 otherwise.	Bloomberg
Rank	The payment rank has been transformed into a count variable where 1 is senior unsecured or first lien, 2 is senior secured and 3 is subordinated.	Bloomberg
ROA	Return on assets computed as earnings divided by total assets.	Datastream
Sinkable	Dummy variable equal to 1 if the bond is sinkable and 0 otherwise.	Bloomberg
Size	Firm size measured as the natural logarithm of total assets.	Datastream
TobinQ	Total assets plus market capitalization divided by total assets plus common equity.	Datastream
Total green bonds issued	Total amount of green bonds issued each year.	Bloomberg

Appendix IX – Average number of issuance announcements per month



Appendix X – Variables definition

Variables definition

Below are presented the definitions of all data used in our study. Green bond data is extracted from Bloomberg. Conventional bond data is extracted from Securities Data Company. Accounting data and firm characteristics are extracted from Datastream. Macroeconomic variables are extracted from the World Bank Database. All data is extracted in USD.

Variable	Definition
After	Dummy equal to zero before a firm issues its first green bond and one after.
Age	Age is the age of foundation and if not available the age of incorporation of the firm as registered in Datastream.
Board Size	The total number of board members at the end of the fiscal year.
BidAsk	Bid-ask spread computed as the difference between the ask and bid prices divided by the average between the bid and ask prices.
CAPEX	Capital expenditures (CAPEX) are the funds used to acquire fixed assets other than those associated with acquisitions.
Cash	Cash and cash equivalents
Cash Flow	Cash flow to the firm as registered in Datastream
CEO return	Dummy variable equal to one when the CEO compensation is linked to the firm's return and zero otherwise.
Country	International Standards Organization (ISO) Country code in numerical form.
Dividend	Total dividends paid to shareholders.
EBIT	Earnings before interest and taxes.
Employees	Number of both full and part-time employees of the company.
ESG	Asset4 ESG Score is an overall company score based on the self-reported information in the environmental, social, and corporate governance pillars.
Europe	Any company with an ISO 3166-1 alpha-2 head office location within Europe
Europe	Any company with an ISO 3166-1 alpha-2 head office location within Mainland China or Hong Kong
FCP index	The FCP index is a financial constraint proxy based on the work of Schauer, Elsas, and Breitkopf (2019). It is defined in Appendix II.
GDP Growth	Annual percentage growth rate of GDP at market prices based on constant local currency.
Green	Dummy equal to zero when the firm is a conventional bond issuer and one if it is a green bond issuer.
Industry	First two digits of the Standard Industrial Classification code.
InterestCov	$\text{Earnings before Interest and Taxes} / (\text{Interest Expense on Debt} + (\text{Preferred Dividends (Cash)} / (1 - \text{Tax Rate} / 100)))$
KZ index	The SA index is a financial constraint proxy based on the work of Kaplan and Zingales (1997). It is defined in Appendix II.
Leverage	Total debt divided by total assets.
Market Capitalization	Market capitalization (also known as market value) is the share price times the number of shares outstanding (including their several classes) for listed domestic companies.
Private Credit	Domestic credit provided by the financial sector includes all credit to various sectors on a gross basis, with the exception of credit to the central government, which is net.
Retained Earnings	Retained Earnings represent the accumulated after-tax earnings of the company which have not been distributed as dividends to shareholders or allocated to a reserve account.
ROA	Net income divided by total assets.
ROE	Net income divided by shareholder equity.
SA index	The SA index is a financial constraint proxy based on the work of Hadlock and Pierce (2010). It is defined in Appendix II.
Sales	Sales represent gross sales and other operating revenue less discounts, returns, and allowances.
Sales growth	Growth in sales between t and t-1.
Size	Natural logarithm of total assets.
TobinQ	$(\text{Assets} + \text{Market Capitalization}) / (\text{Assets} + \text{Common equity})$
Total Assets	Book value of total assets of the firm.
USA	Any company with an ISO 3166-1 alpha-2 head office location within the United States of America
VarFCF	Variance of Free Cash Flows as a percentage of assets.
Working capital	Current Assets - Current Liabilities
Z Score	Altman Z score based on the work of Altman (2000) and as defined in Appendix II.

Appendix XI – Financial constraint measures

We present in this section the formulas of the three proxies for financial constraint we use throughout our study. These three proxies are the FCP index based on the work of (Schauer et al., 2019); the Kaplan Zingales (KZ) index based on the work of (Kaplan & Zingales, 1997; Lamont et al., 2001); and the SA index based on the work of (Hadlock & Pierce, 2010). Finally, we use a measure for bankruptcy probability called the Z score following the work of (Altman, 2000).

Formula of the FCP index:

$$FCP_{it} = -0.123 \times Size_{it-1} - 0.024 \times InterestCov_{it-1} - 4.404 \times ROA_{it-1} - 1.716 \times Cash_{it-1}$$

Where i is the firm and t the year-end of the data. Variables Size, InterestCov, ROA, and Cash are defined in Appendix X.

Formula of the SA index:

$$SA_{it} = -0.737 \times Size_{it} + 0.043 \times (Size_{it})^2 - 0.04 \times Age_i$$

Where i is the firm and t the year-end of the data. Variables Size and Age are defined in Appendix X.

Formula of the Z score:

$$Z_{it} = 1.2 \times \frac{Working\ capital_{it}}{Total\ Assets_{it}} + 1.4 \times \frac{Retained\ Earnings_{it}}{Total\ Assets_{it}} + 3.3 \times \frac{EBIT_{it}}{Total\ Assets_{it}} + 0.6 \times \frac{Market\ Cap_{it}}{Liabilities_{it}} + \frac{Sales_{it}}{Total\ Assets_{it}}$$

Where i is the firm and t the year-end of the data. Variables Total Assets, Working Capital, Retained Earnings, EBIT, Market Capitalization, and Sales are defined in Appendix X.

Appendix XII – Split of bond issuances

Industry and international split of bond issuances

Below is the split of bond issuances per industry and per country. The industry split is based on the one-digit Standard Industrial Classification (SIC) code. The country split is based on the International Standards Organization (ISO) country code. Both are extracted using the issuing firm data from Datastream.

Variable	N	Frequency
<i>Industry</i>		
Agriculture	39	3%
Mining	13	1%
Construction	156	12%
Manufacturing	364	27%
Transportation & Public Utilities	624	47%
Wholesale trade	13	1%
Retail Trade	26	2%
Services	91	7%
Total	1,326	100%
<i>Country</i>		
Austria	13	1%
Australia	26	2%
Brazil	52	4%
Canada	26	2%
Switzerland	13	1%
China	195	15%
Germany	39	3%
Denmark	26	2%
Spain	52	4%
Finland	13	1%
France	65	5%
United Kingdom	52	4%
Hong Kong	143	11%
Indonesia	13	1%
India	26	2%
Italy	52	4%
Japan	182	14%
Korea	39	3%
Malaysia	26	2%
Norway	13	1%
New Zealand	13	1%
Portugal	13	1%
Sweden	65	5%
Singapore	13	1%
Taiwan	39	3%
USA	117	9%
Total	1,326	100%

Appendix XIII – Evolution of financial constraints across geographic regions

Evolution of financial constraints after the first green bond issuance per region

The table presents regressions with financial constraint proxies as dependent variables, a dummy variable equal to one after the first green bond issuance, and a set of control variables. We split the sample into three geographic areas: the U.S., Europe, and China. *After* is a dummy variable that equals one (zero) after the first green bond issuance. Definitions and sources of the other variables are provided in Appendix X. Country, industry, and year fixed effects are included in all equations. Robust standard errors are shown in parentheses. All of the data are winsorized within each yearly cross-section at the 1% and 99% percentiles. The symbols ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	USA	USA	USA	Europe	Europe	Europe	China	China	China
Variables	FCP Index	SA Index	Z score	FCP Index	SA Index	Z score	FCP Index	SA Index	Z score
After	46.095*** (14.706)	0.152 (0.408)	-1.836*** (0.457)	3.777 (6.751)	1.170*** (0.258)	0.178 (0.259)	3.547 (6.776)	0.293*** (0.073)	-1.392*** (0.374)
TobinQ	-10.641*** (1.014)	0.111*** (0.027)	0.815*** (0.092)	-17.676*** (1.526)	-0.195** (0.089)	0.962*** (0.141)	-21.200*** (2.336)	-0.024 (0.057)	0.598*** (0.140)
Leverage	22.807*** (4.385)	0.370*** (0.110)	-7.336*** (0.350)	14.210*** (5.370)	0.838** (0.331)	-8.002*** (0.693)	43.489*** (8.734)	0.134 (0.106)	-7.543*** (0.859)
CF	-194.726*** (15.101)	0.316 (0.403)	13.610*** (1.180)	-101.081*** (21.379)	2.738*** (0.939)	7.459*** (1.532)	-48.045 (38.659)	0.142 (0.318)	9.116*** (2.219)
ESG	0.096*** (0.033)	-0.013*** (0.001)	-0.010*** (0.003)	0.048 (0.051)	-0.004 (0.004)	0.010** (0.004)	0.130** (0.061)	-0.002* (0.001)	-0.019*** (0.005)
Board Size	-0.097 (0.251)	-0.069*** (0.011)	0.067*** (0.022)	0.027 (0.164)	-0.045*** (0.015)	-0.018 (0.018)	-0.549** (0.245)	-0.003 (0.006)	0.065*** (0.018)
Sales growth	2.842 (3.196)	0.318*** (0.086)	0.345 (0.237)	-10.091* (5.588)	0.225 (0.259)	0.507 (0.309)	9.171*** (2.929)	-0.017 (0.063)	-0.299 (0.268)
Size	-3.891*** (0.735)	0.843*** (0.028)	0.125* (0.067)	-3.218*** (0.994)	0.451*** (0.071)	0.303*** (0.092)	-6.240*** (1.365)	0.802*** (0.025)	0.078 (0.141)
ln(Employees)	-0.461 (0.587)	-0.139*** (0.020)	0.041 (0.056)	-0.596 (0.867)	0.035 (0.067)	-0.280*** (0.089)	2.229*** (0.827)	-0.043*** (0.015)	-0.316*** (0.085)
Private Credit	0.036 (0.144)	-0.011 (0.008)	0.012 (0.017)	0.039 (0.046)	-0.003 (0.003)	-0.004 (0.004)	-0.020 (0.063)	-0.000 (0.001)	-0.001 (0.006)
GDP Growth	-0.596 (0.577)	-0.021 (0.020)	-0.051 (0.046)	0.268 (0.421)	-0.016 (0.026)	-0.009 (0.030)	0.591 (1.017)	0.013 (0.012)	-0.095 (0.083)
Market capitalization	0.052 (0.065)	0.005 (0.003)	-0.001 (0.008)	0.034 (0.058)	-0.003 (0.005)	0.002 (0.004)	0.012 (0.014)	0.000 (0.000)	-0.000 (0.001)
Constant	34.213 (28.101)	-10.895*** (1.543)	-0.444 (3.400)	36.266*** (11.870)	-10.757*** (0.897)	3.992*** (1.131)	49.698** (21.760)	-13.812*** (0.381)	5.084*** (1.795)
Observations	4,101	4,121	4,129	1,693	1,138	1,699	662	395	659
R-squared	0.383	0.381	0.488	0.462	0.501	0.630	0.615	0.940	0.674
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Country FE	YES	YES	YES	YES	YES	YES	YES	YES	YES

Appendix XIV – Tobin’s Q evolution in each geographic region

Tobin's Q after the first green bond issuance per region

The table presents regressions with financial constraint proxies as dependent variables, a dummy variable equal to one after the first green bond issuance, and a set of control variables. We split the sample into three geographic areas: the U.S., Europe, and China. *After* is a dummy variable that equals one (zero) after the first green bond was issued. Definitions and sources of the other variables are provided in Appendix X. Country, industry, and year fixed effects are included in all equations. All data is winsorized within each yearly cross-section at the 1% and 99% percentiles. Robust standard errors are shown in parentheses. The symbols ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Variables	(1)	(2)	(3)
	USA TobinQ	Europe TobinQ	China TobinQ
After	0.685*** (0.264)	-0.051 (0.054)	0.272*** (0.085)
Cash Flow	7.833*** (0.233)	4.948*** (0.394)	3.062*** (0.517)
CEO return	0.077*** (0.019)	0.039 (0.024)	0.099 (0.152)
Capex	-1.058*** (0.207)	-0.796** (0.359)	-0.038 (0.321)
Leverage	0.441*** (0.055)	0.644*** (0.112)	-0.221** (0.107)
Age	0.000** (0.000)	-0.000** (0.000)	0.003*** (0.001)
Sales growth	0.137*** (0.037)	0.053 (0.080)	-0.102*** (0.033)
Size	-0.024*** (0.007)	-0.050*** (0.008)	-0.222*** (0.013)
Constant	2.038*** (0.355)	0.866*** (0.162)	4.818*** (0.271)
Observations	7,335	3,206	2,937
R-squared	0.484	0.513	0.490
Year FE	YES	YES	YES
Industry FE	YES	YES	YES
Country FE	YES	YES	YES

Les obligations vertes : un outil au service du financement de la transition écologique

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Résumé

La transition écologique nécessitera des financements importants pour décarboner les modes de production⁴⁹. Depuis un peu plus d'une décennie, le marché des obligations vertes s'est développé pour répondre aux besoins des investisseurs et des émetteurs qui souhaitent contribuer à la lutte contre le réchauffement climatique. Cet article répond aux questions suivantes. Les obligations vertes diffèrent-elles des obligations classiques ? Pourquoi les entreprises émettent-elles des obligations vertes ? Si ces instruments sont efficaces pour lutter contre le changement climatique, comment les développer ?

Mots-clés : obligations vertes, transition écologique, régulation verte, finance carbone, green bonds, green finance, green régulation

1. Qu'est-ce qu'une obligation verte ?

La définition de ce qu'est une obligation verte a évolué au cours du temps. Depuis 2014, l'International Capital Markets Association (ICMA) élabore les Green Bond Principles (GBP). Ces principes proposent un ensemble de règles non contraignantes qui permettent de qualifier le caractère

⁴⁹ Les investissements globaux nécessaires pour atteindre les objectifs des accords de Paris sont estimés à 452 milliards de dollars par an pour la période 2021-2025 pour les seules énergies renouvelables (Zindler and Locklin 2016).

« vert » d'une obligation. Selon la définition de l'ICMA, les obligations vertes sont des obligations pour lesquelles les fonds collectés doivent exclusivement être utilisés pour financer ou refinancer, en partie ou en totalité, des projets verts. Un consensus s'est progressivement bâti autour de cette définition qui est désormais utilisée comme référence par la plupart des organismes nationaux et internationaux (ASEAN⁵⁰, Union Européenne, etc.).

L'ICMA dresse une liste des projets verts qui peuvent être financés, comme les projets de développement des énergies renouvelables, les projets liés à l'efficacité énergétique et les projets destinés à réduire les émissions de gaz à effet de serre (GES). L'ICMA a défini les critères fondamentaux pour respecter les GBP. Il s'agit notamment de réserver l'usage des fonds à des projets verts, de mettre en place des procédés d'évaluation et de sélection des projets et de suivre les investissements par un reporting post-émission.

La définition de l'ICMA ne permet cependant pas de répondre à toutes les questions. Tout d'abord, les obligations vertes peuvent-elles servir à financer (ou à refinancer) des projets qui auraient été dans tous les cas financés par des obligations classiques ? Par ailleurs, il n'existe pas de consensus sur la définition de ce qu'est véritablement un projet vert. Enfin, l'activité de l'entreprise émettrice peut poser. Par exemple, une entreprise opérant dans un secteur fortement émetteur de CO2 peut-elle émettre des obligations vertes et bénéficier de ce type de label pour une partie de son activité ?

Les scientifiques (voir Ehlers and Packer (2017)), les acteurs de marché et les pouvoirs publics tentent d'apporter des réponses à ces questions. La commission européenne met actuellement en place une taxonomie des projets verts⁵¹ (sachant par ailleurs que le Climate Bond Initiative (CBI) qui est un organisme de certification des obligations vertes dispose déjà de sa propre taxonomie). Pour de

⁵⁰ Association des nations de l'Asie du Sud-Est

⁵¹ Proposal for an EU Green Bond Standard, source : https://ec.europa.eu/info/sites/info/files/business_economy_euro/banking_and_finance/documents/190306-sustainable-finance-teg-interim-report-green-bond-standard_en_0.pdf

nombreux professionnels que nous avons interviewés, une approche pragmatique est nécessaire. Le marché des obligations vertes doit continuer à se développer et c'est par la pratique et l'émergence d'un consensus de place que les réponses seront apportées.

2. Le marché des obligations vertes

La première obligation verte⁵² a été émise par la Banque Européenne d'Investissement (BEI) en 2007. La BEI sera suivie par la banque mondiale qui a émis sa première obligation verte en 2008. Pendant la période allant de 2007 à 2013, les principaux émetteurs étaient les banques et les agences de développement. Le développement du marché reposait principalement sur l'engagement de ces institutions à financer la transition écologique en proposant aux investisseurs des titres présentant un faible risque de crédit (noté AAA par les agences de notation). On peut noter dans le tableau 1 que le marché des obligations vertes en 2018 est encore largement composé de titres peu risqués.

Un nouvel élan a été donné par la mise en place des GBP en 2014 pour les obligations vertes émises par les entreprises du secteur privé, ce qui a permis d'élargir la base d'émetteurs et d'investisseurs. Depuis 2015 et les accords de Paris, les émissions annuelles d'obligations vertes se situent entre 100 et 150 milliards de dollars selon le CBI. Ce montant est cependant très faible comparativement au montant des émissions annuelles d'obligations classiques (environ 7 424 milliards de dollars d'émissions en 2018 pour sur le seul marché américain⁵³). Selon la Banque des Règlements Internationaux et le Climate Bond Initiative, les encours des obligations vertes représentent aujourd'hui moins d'un pourcent de l'encours obligataire mondial.

⁵² Appelé au départ « Climate Awareness Bond »

⁵³ Données Securities Industry and Financial Markets Association (SIFMA), émissions d'obligations par tous types d'émetteurs en 2018.

Tableau 1 : répartition des notations financières des obligations vertes en 2018

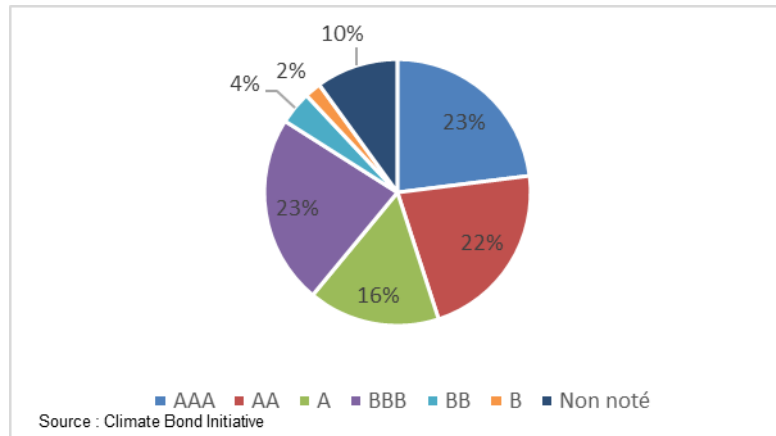
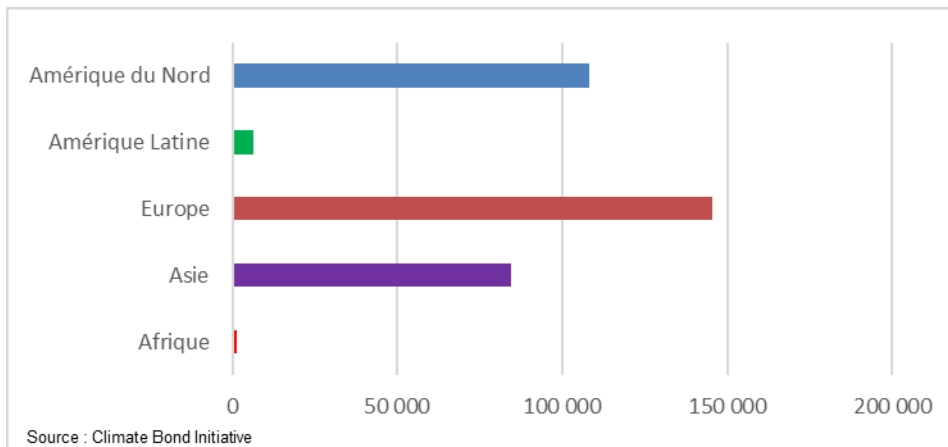


Tableau 2 : encours des obligations vertes par zone géographique en 2018 (en millions d’US dollars)



L'Europe est actuellement leader mondial des émissions d'obligations vertes (tableau 2). Ce leadership est notamment dû au fait que les états français, belge et polonais ont émis des obligations vertes pour des montants importants (respectivement 7,5 ; 4,5 et 0,75 milliards d'euros). Ces émissions augmentent à la fois le total des encours d'obligations vertes et envoient également un signal positif aux émetteurs du secteur privé.

3. En quoi les obligations vertes sont-elles différentes des obligations classiques ?

La différence entre les obligations vertes et les obligations classiques découle de la définition précédemment citée. La principale différence se situe au niveau de l'usage des fonds. Les fonds issus de l'émission d'une obligation classique sont généralement destinés à financer différents actifs de l'entreprise alors que dans le cas des obligations vertes, les fonds ne sont destinés qu'à un certain type de projets (ICMA (2014)). Dans le cas d'une obligation classique, il n'est donc pas indispensable de prédéfinir dans quel cadre les fonds seront utilisés et de suivre l'utilisation jusqu'à maturité de celle-ci.

Dans ce contexte, les obligations vertes engendrent des coûts supplémentaires par rapport aux obligations classiques (Asian Development Bank (2018)). Ces coûts supplémentaires correspondent à des coûts administratifs liés au processus d'émission, aux coûts légaux, au coût d'audit de l'émission et au coût du reporting. Par ailleurs, émettre une obligation verte nécessite davantage de temps de préparation et suppose de mobiliser plus de ressources, ce qui génère des coûts organisationnels conséquents. Au total, ces coûts sont estimés entre 0,1 et 7,1 points de base pour une émission d'une obligation verte (Asian Development Bank 2018). Enfin, émettre des obligations vertes engendre un risque de réputation (Morel and Bordier (2012)) qui n'existe pas pour les obligations classiques. L'émetteur doit en effet tenir ses engagements sous peine de perdre sa crédibilité et sa réputation.

En contrepartie, les obligations vertes génèrent des bénéfices économiques et écologiques (Flammer (2018) et Zerbib (2018)). Selon la littérature en finance, les émissions d'obligations vertes permettent aux émetteurs de bénéficier d'une prime d'environ 2 points de base en moyenne. Cette prime peut cependant s'accroître jusqu'à environ 20 points de base pour les émetteurs les plus risqués (Zerbib (2018)). Des travaux récents ont également démontré que les obligations vertes apportaient des bénéfices en termes de diversification pour les investisseurs (Reboredo (2018)). Sur la base de ces éléments, les bénéfices économiques des émissions d'obligations vertes demeurent cependant faibles comparés aux coûts additionnels.

Nos interviews avec les émetteurs et les investisseurs ont également révélé d'autres avantages associés à l'émission d'obligations vertes. Le premier est que ces obligations permettent d'élargir la base d'investisseurs de l'émetteur. La San Francisco Public Utilities Commission (SPUC) a par exemple réussi à placer son émission d'obligations vertes auprès d'investisseurs européens, suisses et asiatiques, alors que sa base d'investisseurs est habituellement locale⁵⁴. Une grande entreprise française a réussi à émettre des obligations vertes en octobre 2016, dans un contexte de marché relativement tendu. A cette époque, l'imminence des élections françaises et allemandes avaient diminué l'appétit des investisseurs pour les emprunts européens. Les autres bénéfices plus difficiles à quantifier incluent une plus forte coopération entre les équipes chargées du financement des projets et les opérationnels qui les mettent en œuvre. Enfin, un dernier avantage qui a fréquemment été mentionné concerne la montée en compétence des équipes de financement sur les sujets liés à l'impact écologique.

Pour résumer, pour la plupart des entreprises que nous avons rencontrées, l'émission d'une obligation verte est un véritable projet d'entreprise qui donne du sens aux engagements sociétaux de l'entreprise.

4. Comment continuer à développer le marché des obligations vertes ?

Des travaux académiques récents ont démontré que les obligations vertes permettaient d'améliorer le bilan des entreprises en termes d'émission de CO2 ainsi que leur performance économique (Flammer 2018). Au regard des engagements des Etats à maintenir la hausse de la température moyenne à 2°C par rapport aux niveaux préindustriels (Accords de Paris sur le Climat), les obligations vertes apparaissent comme l'un des outils qui permettront d'atteindre ces objectifs (OECD (2017)).

Certains mécanismes existent déjà pour aider au développement de ce marché. En juin 2017, l'autorité monétaire de Singapour (*Monetary Authority of Singapore*) a reconnu que les émetteurs d'obligations

⁵⁴ Source: <https://www.climatebonds.net/2018/07/sfpuc-seeks-widen-investor-base-latest-wastewater-infrastructure-green-bonds>

vertes assument des coûts supplémentaires et a proposé de rembourser ces frais additionnels jusqu'à hauteur de 100 000 SGD. Les autorités monétaires chinoises (notamment Mr. Ma Jun, le chef économiste de la banque centrale chinoise⁵⁵) évoquent fréquemment la possibilité de réduire la pondération en fonds propres des obligations vertes. Cette initiative permettrait de réduire le coût en fonds propres pour une banque qui détiendrait des obligations vertes. Dans un premier temps, la commission européenne a choisi la voie de la taxonomie pour construire une définition claire de ce que sont un actif vert et une obligation verte⁵⁶.

Pour le moment, il n'y a pas d'accord sur l'utilisation d'un outil législatif contraignant ou incitatif qui permettrait de développer ce marché. Il existe toutefois certaines pistes : lors de la mise en place des accords de Bâle III (Capital Requirements Directive IV (CRD IV) et la Capital Requirements Regulation (CRR)), de nombreux analystes prédisaient une hausse substantielle des coûts du financement pour les PME. Dans ce contexte, pour inciter les banques à soutenir les PME, le choix a été fait d'apporter un allègement du coût en fonds propres associé au financement des PME (« facteur de soutien » dans l'article 501 du CRR). Pour les obligations vertes, la mise en place d'un dispositif de même nature que celui prévu pour les PME pourrait réduire le coût du financement pour les émetteurs d'obligations vertes et permettre une plus grande implication du secteur bancaire.

D'autres mécanismes innovants pourraient aider le développement de ce marché, notamment l'apport de financements dédiés par la banque centrale européenne (BCE). Lorsque les banques se refinancent auprès de la BCE, elles doivent apporter des actifs en garantie. La BCE dresse une liste d'actifs

⁵⁵ Source : <http://www.chinadaily.com.cn/a/201810/11/WS5bbeedb5a310eff303281d13.html>

⁵⁶ Proposal for an EU Green Bond Standard, source : https://ec.europa.eu/info/sites/info/files/business_economy_euro/banking_and_finance/documents/190306-sustainable-finance-teg-interim-report-green-bond-standard_en_0.pdf

éligibles⁵⁷ et une liste de décotes correspondantes⁵⁸ (car plus les actifs sont risqués, plus la décote appliquée à la garantie est importante). Il serait donc envisageable de rendre les obligations vertes éligibles à ce mécanisme en leur accordant une décote plus faible, ce qui renforcerait leur attractivité auprès des banques.

5. Conclusion

Les obligations vertes sont un des mécanismes qui permettent de contribuer à la lutte contre le dérèglement climatique et au financement de la transition écologique des économies. Les obligations vertes ne sont pas seulement des instruments financiers. Elles incitent les entreprises à se poser la question de leur empreinte carbone et à la coopération entre les équipes de financement et les équipes opérationnelles. Malgré des avancées majeures, ce marché est cependant encore embryonnaire. Nous ne pouvons que militer pour une plus grande prise en compte des obligations vertes par les régulateurs et la mise en place de mécanismes incitatifs qui assurerait un cadre légal clair et permettrait le développement de ce marché dans la durée.

⁵⁷ Source : <https://www.ecb.europa.eu/paym/coll/assets/html/list-MID.en.html>

⁵⁸ Source : <https://www.ecb.europa.eu/paym/coll/risk/liquidity/html/index.en.html>

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