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[programme Financial Economics]

The effect of green bonds on companies: a study of firms' capital structure, performance, and firm value

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Abstract

This paper investigates the impact that green bonds have on firms' capital structure and performance. The data collected and results obtained indicates that this fixed income instrument became more popular throughout the years and has an impact on firms' capital structure. As a result of green bond issuance, companies increase their overall leverage and long-term leverage. In addition, the firm performance analysis suggests that green bond also improve performance indicators such as EBITDA and EBIT. The results of green bond impact on firm performance are positive in the fixed effects analysis, confirming the assumptions that green bonds enhance long-term performance. While the outcomes from the firm value analysis returns more mixed results. In this thesis three assumptions were made on why companies issue green bonds these are: cheaper financing, better performance, and the positive signal argument. Overall, the results are consistent with these assumptions.

Table of Contents

1. Introduction

In the last decade, investors and institutions have become more aware of the increasing necessity to preserve our planet and started taking actions to try to limit global warming and decrease Co2 emissions. A cornerstone in this battle was the Paris Agreement, an international agreement on climate change, signed on the 4th of November 2016. This is a crucial moment because, for the first time, a legally binding agreement brought all nations together and set out ambitious efforts to combat climate change and adapt to its effects. With the increase of visibility and importance of this issues, investors themselves also became more conscious about the environment and started to increasingly invest in companies that follow the so-called environmental, social, and governance (ESG) criteria (UNFCC, n.d.).

This environmentally aware international setting helped the rapid development of the green bond market. Even though the first bond was issued already in 2007 by the European Investment Bank (EIB), it is possible to identify that the first big expansion of this market started only in 2013 when large multinationals begun to issue green bonds. One of the first global company to do so was Unilever. In 2013 the company issued a £250M green bond, it was then closely followed by other multinationals such as Apple that in 2016 issued a green bond worth 1.25 billion dollars. In the last few years, the green bond market increased at an exponential rate. Based on data from the Climate Bonds Initiatives (Climate Bonds Initiative, n.d.) the amount of green bond issued between 2014 and 2020 is more than 1 trillion USD, reaching a record of 290-billion US dollar green bonds placed in 2020. Most green bonds are issued in developed regions such as Europe and North America, but the green bond market in emerging economies is also growing rapidly.

When we speak about green bonds, we refer to a fixed income security that is issued by companies to finance their environmentally friendly projects, such as sustainable agriculture, pollution prevention, clean water, to name a few. In simple words, green bonds' proceeds are reserved solely for green projects, and the bonds are backed by the issuers' balance sheet.

This is a relatively new and interesting tool that can affect companies' capital structure. Previous literature has already extensively researched what the factors that could influence the capital structure of firms are. Across several different studies a few significant factors, such as profitability, size, and tangibility, have been identified to influence capital structure. Previous literature has tested many hypotheses, for example the Modigliani Milner theory, the Pecking Order theory, and the Agency theory. However, past literature has not researched whether this new instrument – green bonds – can play a role in the balance between equity and debt.

This paper investigates whether green bonds can incentivize companies to increase their debt level and check what is the green bond issuance impact on firm performance. To do so, a wide dataset of large companies retrieved from Bloomberg and Compustat was used. The dataset contains two groups, a treated and control group. In this thesis, the impact of green bonds on capital structure is studied by running three different models, pooled OLS, fixed effects and difference-in-difference. In a second moment, a similar methodology is used to research the effect that green bonds have on firm performance and value.

The remainder of the paper is structured as follows. Section 2 touches upon relevant previous literature. Section 3 introduces the theoretical framework and assumptions made for this study. Section 4 describes the data and methodology. Section 5 presents results and discussion related to them. Section 7 mentions the main limitations encountered. Finally, section 8 sums up and concludes.

2. Literature review

Capital structure literature aims at giving clarity on what the factors that lead companies to choose to finance themselves with either debt or equity are, and what the best ratio between the two of them is. Even though there is a significant body of literature on this topic there is no overall agreement on a single theory. The debate around this concept started with the theory proposed by Modigliani and Miller in 1958, called *Capital-Structure Irrelevance*. In their work the authors stated that the value of a firm and its investment decision, in perfect capital markets, are independent of the way of financing, as summarized by Myers and Majluf (1984). However, in practice, the assumptions made by Modigliani and Miller have not hold. The authors did not consider several factors that can affect the choice of capital structure in real life, such as the advantage deriving from debt that is nontaxable.

A large part of literature that followed tried to develop new theories to overcome the lack of real-world applicability of the *capital-structure irrelevance* theory. The main theories that resulted are *the Trade-off theory, the Pecking Order theory and the Agency theory*. The first theory developed by Kraus and Litzenberger (1973) states that taxes and bankruptcy penalties need to be taken into account when assessing the value of a firm and – most importantly for the research herein – when determining the capital structure. The authors suggest that firms choose a target debt ratio that is in equilibrium between tax shield benefits, financial distress, and agency costs.

The second theory, *the Pecking Order theory*, is based on the concept of asymmetric information. Investors cannot exactly know if the shares being sold represent a good opportunity, with a positive NPV, or if managers are simply trying to sell overvalued shares. Myers and Majluf (1984) derived an equilibrium model based on this asymmetry issue. Firstly, the Pecking Order theory predicts that firms prefer internal funding over external funding. In a scenario where the company is forced to issue securities, it will prefer debt over equity. This is because issuing debt minimizes the manager's information advantage since optimistic managers, that believe that their company shares are undervalued, will issue debt (Myers, 2003). The last theory, the Agency theory, developed from a different assumption than the first two theories: managers do not act solely in the interest of the firm's stakeholders (Constantinides et al., 2003). Jensen (1986) understood that the problem was not directly related to the poor investment decisions of managers but rather about the abundance of cash flow. The author points out to the importance of making sure that managers do not have free cash flow to invest in negative NPV projects. Two years later Stulz (1990) created a model in which managers will always invest free cash flow in negative NPV projects, unless the cash is required to pay back debts. The idea behind is that debt is used to constrain managers, and therefore a higher level of debt improves company performance by decreasing company agency costs.

Several authors have furthered the studying of these theories by applying them to case studies in developed countries (see for example Rajan and Zingales (1995) and Dang (2013)). On one hand, some authors such as Shyam-Sunder and Myers (1999) found some arguments in favour of the Pecking-order theory. On the other hand, Frank and Goyal (2008, 2009) found more evidence that seems to be consistent with the Trade-off theory. These findings strengthen the belief that there is no such a theory that is applicable to all companies. In fact, there are a lot of factors that can influence the capital structure of companies ranging from institutional differences to the tax and bankruptcy code of the country where the company operates.

This is reflected in the numerous empirical studies that have tried to explain the determinants of capital structure. Frank and Goyal (2008) suggest that, even when considering the Trade-off and Pecking Order theory, there is not a single model that can explain the choice between debt and equity. One year later the authors published a new research on the factors that influence the choice of capital structure (Frank & Goyal, 2009). They used several variables and determined which of these had the greatest explanatory power on capital structure choices. The author's finding show that size, profitability, and asset tangibility are among the

most influential ones. In later years, other studies followed the approach used by Frank and Goyal (see for example Chen (2004), Moradi and Paulet (2019), and Öztekin and Flannery (2012)).

Chen (2004) researched whether the same factors that were used to explain capital structure in developed countries also applied to companies in China. The author found that profitability, size, growth, tangibility and nondebt tax shield were all statistically significant. Additionally, neither the Trade-off theory nor the Pecking Order theory can explain the capital choice preferences of Chinese firms. Although the choice between debt and equity depends heavily on firm-specific factors, de Jong et al. (2008) analyzed the importance of country-specific and firm-specific factors in the capital structure choice in 42 countries. In their study they found that country-specific factors impact firms' choices as well.

This thesis adds to this body of literature that analyses factors that impact capital structure. It does so by studying whether green bond issuance is one of these influencing factors, while controlling for some of the variables that have been identified above as possible capital structure determinants. To the best of this author's knowledge, no previous literature has focused on researching whether issuing green bonds significantly changes the debt-equity ratio. As such, the main research question of this paper is:

> *Do firms that issue green bonds change their appetite for debt over equity and change their capital structure?*

To answer this question, a group of companies that issued green bonds has been selected and matched with a group of firms that issue bonds, but not green bonds. The theoretical arguments as well as the derived assumptions will be explored in the next section. In sum, three different regressions including a dummy variable for green bond issuance will be used to check whether this new instrument has an impact on capital structure, while controlling for profitability, tangibility, and size. This will be further explained in section 4. Based on previous literature it is expected that all the control variables will have a statistically significant impact on financing decisions.

In parallel, this thesis will research whether there are any differences in performance between these two groups. Thus answering:

> *Do firms that issue green bonds have better performance than firms that issue just straight bonds?*

3. Theoretical background

While the section above provided a short overview of the state of capital structure research and identified the gap that the planned research will explore, the following section lays out the theoretical approach that will be used in this thesis. This study examines how the issuance of green bonds impacts the capital structure preferences of a company. Several theories on green bonds can inform the understanding of their impact on the appetite for a different debt to equity ratio. Three sets of theories and their assumed impact on capital structure are herein presented. First, cheaper financing argument, followed by market reaction and corporate performance, and lastly the signalling argument. For each argument a short literature review is offered, followed by the link back to the capital structure theories explored in the previous section.

To begin, however, the concept of green bonds must be defined. As previously mentioned, when we refer to green bonds, we are talking about fixed income securities issued by firms to finance environmentally friendly projects. Contrarily, conventional bonds are bonds that must not finance environmentally friendly projects. Conventional bonds may also be called straight, or brown bonds, these terms will be used interchangeably herein. Based on the three arguments discussed in this chapter, it is expected that an increased interest in green bonds and more frequent issuance of this instrument occurs. This would increase the level of debt of the company, consequently influencing their capital structure.

3.1. Greenium (Cheap Financing Argument)

One of the rationales for issuing green bonds is the cost of capital argument. More concretely, if investors are willing to trade part of their returns in the name of the fight against climate change, then green bonds could represent a cheaper way for a firm to finance sustainable investments. This was shown in the study by Martin and Moser (2016) where the authors conclude that investors value more the societal benefits rather than the pecuniary benefits of green investments. The authors found that, in experimental markets, investors and managers are willing to trade off wealth for societal benefits. The main question at hand is whether this Greenium - a green bond premium – exists in actual markets or not.

The most common research strategy applied in the existing literature is a comparison between green and brown bonds of similar firms, with the aim of identifying whether green bonds were traded at a premium. A green bond traded at premium would imply that the yield

for an investor is lower and therefore the companies can benefit from a lower cost of capital. However, there have been conflicting results in previous studies depending on methodology, type of sector used or even currency. This short literature review on the greenium will first address the previous studies that found unconclusive results, followed by discoveries of a negative premium, and concluding with authors who discovered the existence of a greenium.

One strand of literature has found unconclusive results on the existence of a green bond premium. For example, in their comparison study Tang and Zhang (2020) regressed the yield spread at the issuance date on the green bond dummy as well as control variables associated with bond and firm characteristics. When country fixed effects were included, the authors found a 6.9 bps premium, meaning there was a significant pricing benefit for the firm issuing green bonds in comparison to the matching firm issuing regular bonds. However, these promising results became statistically insignificant when firm fixed effects and year by month fixed effects were added. Meaning that, when only examining the bond yield spread differences issued by the same issuer within the same year and month, the pricing benefit of green bonds was no longer found. They conclude that market reacts positively to the announcement of green bond issuance, but this positive reaction is not driven by the lower cost of debt.

Recently, Flammer (2021) used an exact matching method between green bonds and straight bonds, the author matched each green bond with a similar straight bond issued by the same issuer. By using this methodology, Flammer was able to isolate the difference caused only by the greenness of the bond. Flammer found that the average difference is small and statistically insignificant, and the median is exactly zero. Other authors such as Reed et al. (2019) also found that green bonds premium is essentially zero compared to brown bonds.

Another strand of literature argues that green bonds have a negative premium because they are a relatively new instruments and are riskier or less approachable by investors. In their analysis, Karpf and Mandel (2017) found that green bonds are on average traded in the secondary market at 7 basis points higher yield than straight bonds.

Larcker and Watts (2019) used a methodology like the one used by Flammer (2021) and found that there is no greenium in US Municipal Bond market which, in their opinion, proves that investors are not willing to trade off payoff for social benefit. However, Larcker and Watts (2019, p. 5) also advance that "*investor non-pecuniary preferences are unlikely to drive the asset pricing differentials previously found in some of the prior literature. Instead, it is much more likely that asset prices are a function of the impact of ESG and CSR on future firm profitability and risk*".

Using a different research strategy, Chiang (2017) came to a similar conclusion. Chiang conducted a survey onto the US green bond market in which respondents confirmed they would not invest in green bonds if the returns were not competitive. Therefore, he concluded that the cheaper financing argument does not stand.

Nonetheless, a considerable number of authors have proven the existence of a green premium. Zerbib (2019) used a matching analysis, just as Larcker and Watts (2019) and Flammer (2019). The author paired a group of firms that issued green bonds with a group of companies, with similar characteristics, that issued straight bonds between 2013 and 2017. He found that on average green bonds were traded with a premium of -2 basis points, and a maximum of 8bps when taking into consideration the difference in liquidity. Thus proving the existence of a greenium in his data.

In their research, Della Croce et al. (2011), discovered that the liquidity in the green bonds market is higher compared to the liquidity in the straight bonds one. For this reason, the issuers can benefit from a larger demand and the green bonds can be traded at a lower premium. This means that the company that issues the green bond can raise funds at a cheaper price compared to brown bonds. These results are also supported by Agliardi and Agliardi (2019) who also found that green bonds are traded at a negative premium for companies compared to straight bonds.

With promising results, Baker et al. (2018) ran a regression model on a US green bonds sample from 2010 to 2016, and observed a statistically and economically significant premium of 8bps. Interestingly they also report that this premium is statistically stronger for bonds with the CBI Climate certification[1]. The same greenium was found by Gianfrate and Peri (2019) when the authors used a matching technique to investigate whether green bonds carry with them a premium compared to non-green ones in the euro market. These findings link back to the theory that societal considerations are possibly more valued than monetary benefits by Martin and Moser (2016).

Kapraun and Scheins (2019) have also researched whether green bonds are traded at a premium compared to straight bonds. They have found that green bonds issued by high entities such as supernational organizations and governments are traded at a premium in the primary market. Similarly, Fatica et al. (2021) found that green bonds issued by these two groups are

[1] The certification given by the Climate Bond Initiative (CBI) provides assurance that the bond meets the Climate Bonds Standard's requirements. This makes sure that the proceeds deriving from this instrument are used as describes in the prospectus.

sold at a premium compared to brown bonds, but they also found that there is no significant difference for green bonds issued by financial institutions. This thesis will include both financial institutions and multinational organisations. However, due to time feasibility concerns it will not conduct this separation. Further investigation on this difference is recommended for future research.

Given the fact that this last strand of literature, which finds that green bonds are a cheap financing option for corporations, has a large weight in the body of literature, this thesis will take it as a given assumption.

When linked back to the capital structure literature, one criticism to this greenium assumption that may arise is offered by the Irrelevance of Capital Structure theory by Modigliani and Milner. The authors wrote that "there is no magic in financial leverage. Any attempt to substitute *cheap* debt for *expensive* equity fails to reduce the overall cost of capital, because it makes the remaining equity still more expensive – just enough more expensive to keep the overall cost of capital constant" (as cited in Myers, 2003, p. 219). However, this statement assumes that capital markets are perfect and therefore the composition of the capital structure between debt and equity is not relevant, which does not hold. This leads to the first assumption on the link between green bonds and capital structure:

A1: Green bonds offer a cheap financing opportunity to companies. This instrument is an attractive opportunity of financing, leading to higher debt over equity ratios.

In the previous literature, the cheap financing argument did not seem to be one of the main reasons for companies to base their capital structure decisions upon. Indeed, the three main theories that we are focusing on hardly mention it, with the exception for Modigliani and Milner. Nevertheless, a reference to the Pecking Order theory can be made. The pecking Order states that, in certain conditions, companies prefer to issue debt because it is the safest option, and therefore, we can see it also as the cheapest way of financing, after internal financing.

However, some previous studies investigated how debt helps to decrease the overall cost of capital (WACC). Brusov et al. (2014) researched the companies optimal capital structure, focusing on decreasing the cost of debt. They found that WACC decreases when the leverage level increases. Therefore, the paper by Brusov et al. also supports the first theoretical argument presented in this paper.

3.2. Market reaction and corporate performance

The second important set of theories feeding into this study is on the effect that green bonds have on corporate performance. There are two main opposing strands of literature on this topic. The first finds that investors and researchers believe that green bonds are the same as brown bonds with the only difference that the proceeds must be used for green projects or investments. This constrain can limit firms' operation decisions and optimal investment choices. Adding to that, literature from this camp argues that issuing green bonds instead of straight bonds is much more costly. This is due to the certification cost involved in making sure the market perceives the green bond as trustworthy. The second strand contends that green bond issuance can increase the firm value enhancing long-term performance and decreasing the negative response from the market around the announcement date of (green) bond issuance.

In the first branch of literature we see Lebelle et al. (2020) arguing that the financial markets react to the announcement of green bonds in the same manner as they react to straight and convertible bonds. The authors demonstrate that on the announcement date and the day after the total cumulative abnormal return (CAR) is between -0.5% and 0.2%. Ultimately, Labelle et al. (2020) conclude that "green debt offerings convey unfavourable information about the issuing firms".

Contradictorily, Flammer (2021) finds that the stock market responds positively to green bond issuance. Her results show that the cumulative abnormal return around the announcement date is 0.49%, and these results can be larger for third party certified green bonds and first-time issuers of green bonds. These findings are supported by Tang and Zhang (2020) that observed that the market reacts positively to green bond issuance. More specifically, the cumulative abnormal return for the time window of 10 days before and after the announcement is 1.4% and this result is larger for first time issuers. This reaction is not due to a significant price difference compared to straight bonds, they argue, but rather due to more extensive institutional firm ownership after the issuance. Also Wang et al. (2020), Glavas (2018) and Kuchin et al. (2019) found similar results. Wang et al. (2020) in their research on how the market responds to Chinese green bonds found particularly interesting results that slightly differ from the others. They not only found that the market reacts in a positive way to green bond issuance, but part of this positive reaction could be explained by the premium carried by Chinese green bonds. This links back to the previous argument of the greenium, which the authors find to be much higher for Chinese green bonds than the one carried by international bonds.

The previous literature related to market reaction after equity offering, found that the markets react negatively. Wang et al. (2020) researched how the market respond to the equity offering and how the stock prices adjust around the announcement date. They found that on average the market reacts negatively to equity issue, the average announcement period return is -3.25%. Asquith and Mullins (1986) found that more than 80% of the companies that issued equity had a negative response from the market. The average announcement date return is -2.75%, however the impact that equity offering has on equity value is much larger and average to -31%. Whilst the literature about straight bonds and convertible bonds report an average negative return around the announcement date, this is a less severe negative return than the one found around equity offering. Eckbo et al. (2007) show that the average announcement return for convertible bonds issuance is on average -1.82%, for straight bonds -0.22% and finally for equity -2.22%.

Moving from the performance of the companies around the issuing date to the overall performance of firms, there is a branch of literature that supports the thesis that green investments, including green bonds, enhance the corporate performance and help companies to create value in the long term. For example, Agliardi and Chechulin (2020) compared the effect that green bond issuance versus straight bond issuance have on corporate performance. Using a ratio of EBITDA over assets as a dependent variable, the authors found out that the performance improves by 7.3 basis points in the three years after the issuance. In addition, the authors noticed that a higher percentage of green bonds in the total level of debt of a company has a positive effect on corporate performance. When the share of green bonds increases by 10% in the total level of debt, the performance indicators growth is between 1 and 3 bps. The results found are more significant in the first years after the green bond issuance because green investments impact corporate performance in a shorter term compared to brown bonds.

Most of the previous literature has shown that debt level has a positive impact on corporate performance. It can therefore be assumed that the company are more willing to invest in green bonds since the company performance tend to improve after their issuance. However, not many studies researched the impact of green bonds on corporate performance by comparing it with straight bonds. This thesis aims to contribute to this existing gap.

Capital structure literature has researched extensively how leverage influences firms' performance. There is a big strand of literature that supports the argument that higher level of leverage improves a firms' performance. Looking back at the three capital structure theories presented in the literature review, there are arguments in favor of this thesis also in the Agency theory. Berger and Bonaccorsi di Patti (2006) tested whether the Agency theory has a practical

application in real life and their findings were in line with the theory hypothesis. This means that lower equity to assets ratio increases profitability by constraining managers behavior and enhancing firm investments. They found that an increase in leverage of 1% predicts an increase in standard profit efficiency of around 16%. Margaritis and Psillaki (2010) used a sample of French firms to research the relationship between capital structure, ownership structure and firm. They found similar results of Berger and Bonaccorsi di Patti, confirming that companies, especially the ones with less growth opportunities, benefit from a higher debt-equity ratio. Therefore, the use of green bonds, i.e., a type of debt instrument, can have a positive impact on firm performance.

Considering the positive impact observed by previous authors of green bonds on company performance, and the capital structure literature that predicts that a higher leverage improves companies' performance. My second assumption, which will be empirically tested, is as follow:

A2: Companies that invest in green bonds increase firm value and long-term performance.

3.3. Signaling Argument

The last main reason why companies may issue green bonds is the signaling argument. Green bonds may be an indicator, to the external stakeholders and investors, of the commitment that a company has towards sustainable and environmentally friendly projects or standards. This argument may attract investors that value societal benefits and believe in the transition towards a greener economy, but also investors that believe that greener investments enhance company performance in the long run.

Agliardi and Chechulin (2020) argue that green bonds issuance may be a kind of "green advertising of bonds" (greenwashing). Greenwashing represents often unfounded and misleading declarations made by corporate management concerning obligations around environmental preservation. In such cases, companies offer green bonds, describing themselves as ecologically responsible corporations, but they take no actual measures. However, Flammer (2021) found that the greenwashing argument does not hold. In fact, in her study she observed that companies tend to improve their environmental performance after the issuance of corporate green bonds. As advanced by the author, one of the possible reasons why the greenwashing argument was not observed in her research, is that this fixed income instrument is costly, and therefore not a sustainable greenwashing strategy.

Flammer continues by saying that companies issue green bonds to communicate to the market their positive attitude towards the environment. This is a credible way of signaling because firms are investing a considerable amount of money, as issuing green bonds is expensive due to the third-party certification. Meaning that to meet the standards required by the entity that certifies the bonds, companies need to invest effort and resources, which are costly for a company.

With respect to investors attraction, Flammer shows that green bond issuers experience a bigger increase in ownership by long-term investors, and green investors after issuance of green bonds compared to straight bond issuers. These results also support the signalling argument, as green bonds appear to provide a credible signal of the commitment towards the environment strong enough to attract conscious investors. Tang and Zhang (2020) investigated the institutional ownership after green bond issuance compared with firms that issue straight bonds, they found a 7.9% increase in the institutional ownership of the green bond issuers.

Linking back to the capital structure, the signalling argument is used also in the Pecking Order theory and in the convertible bonds' rationales. In the Pecking Order theory, the signal arguments derive from the adverse selection issue. Managers know that if they issue straight equity, they convey to the market a negative signal such as the shares are overvalued and therefore not a good buy. Stein (1992) claims that managers can try to avoid this adverse selection by using convertible bonds. Companies issue convertibles to offer equity through the backdoor. In this case, we can think about green bonds as an instrument that has a similar function to that of convertible bonds. Meaning that the investors will rather focus on the positive commitment of the companies towards a greener economy rather than the bond as a pure instrument to raise financing that offers a negative signal. As such, the last assumption of this paper is:

> A3: Companies that issue green bonds give a positive signal to the market and attract investors. Therefore, these companies are able to issue debt without incurring in negative market response, leading to a higher debt-equity ratio.

4. Data and Methodology

4.1. Sample and data collection

The data used in this research were retrieved from Compustat and Bloomberg. The latter was used to identify the companies that have issued green bonds, while the former was used to get all the fundamentals data for the companies included in the dataset.

First the list of all green bonds issued from 2013 until 2022 was retrieved from Bloomberg. Data was included from 2013 onwards as this was when the green bond market started to expand. The total amount of green bonds issued in this period is 3807, issued by 1307 unique entities. On average each entity issued three green bonds.

The issuing companies' identifier were manually matched to the Compustat-Capital IQ to retrieve the fundamental information from the database for the period between 2010 and 2022. The reason why data was retrieved from 2010 onwards is to capture the performance for the companies before the issuance started in 2013. After this matching process, the number of companies remaining in the sample were 634. Out of these, 545 were Global companies and 89 North America ones. Approximately half of these firms did not have all the required data for the defined period range and thus had to be dropped from the sample, resulting in a final number of 344 green bond issuers.

Subsequently, I created a control group of conventional bond issuers in order to conduct a matching analysis. To find the conventional bond issuers group, the net debt issuance of each company in the entire Compustat-Capital IQ database was calculated. Only the companies that had a positive net debt issuance were included.

Once the control group was found, I performed a matching between the two different groups, using the nearest neighbor matching. The initial combined sample was made of roughly 260.000 observations, after the matching the observations left were 114.783 coming from firms operating in 85 countries and 8 different sectors. The matching was based on year, industry and country.[2] Here below table 1 presents summary statistics for the two group separately.

[2] Additional matching criteria were carried out using size, leverage, EBIT and EBITDA, but the use of this additional criteria was reducing the size of the sample to less than 1000 observation and making the sample losing all the explanatory power.

Table 1. Summary statistics

This table provides summary statistics for the treated group (left side) and the control group (right side). *Green bond issuance* is the dummy variable used to identify the company that issued green bonds (treated group) and the companies that did not (control group); *Leverage* calculated as the ratio of book value of total debt to total assets; *Long-term leverage* is the ratio of book value of long-term total debt to total assets; *Size* represents the logarithm of total assets; *Profitability* calculated as ratio of earnings before interest, tax, and depreciation (EBITDA) to total assets; *Tangibility* proportion of tangible assets (the sum of fixed assets and inventories) to total assets; *EBIT/Assets* and *EBITDA/Assets* are two financial performance indicators calculated as EBIT and EBITDA over assets respectively. *Tobin's Q* represents the last financial indicator as MV of assets divided by the book value of assts; Country and industry are two dummy variables that represent the country and industry of each company.

	Treated Group					**Control Group**				
	N	Mean	Std. Dev.	Min	Max	N	Mean	Std. Dev.	Min	Max
Green bond issuance	2510	1	0	1	1	112273	0	0	0	0
Year	2510	2015.18	3.15	2010	2021	112273	2015.30	3.19	2010	2021
Leverage	2510	.35	.18	.00	1.56	112273	.27	.24	.00	2.15
Long term leverage	2510	.25	.16	0	1.10	112273	.16	.19	0	1.33
Size	2510	10.16	1.73	1.13	12.26	112273	6.09	2.17	-.57	12.26
Profitability	2510	.08	.08	-1.19	.36	112273	.03	.21	-1.70	.40
Tangibility	2510	.91	.13	.22	1	112273	.91	.15	.22	1
EBIT/Assets	2510	.05	.08	-1.24	.3	112273	.00	.21	-1.77	.34
EBITDA/Assets	2510	.08	.08	-1.19	.36	112273	.03	.21	-1.70	.40
Tobin's Q	714	1.26	1.10	.36	19.45	34944	2.32	4.40	.25	47.97
Industry	2510	6.85	3.17	2	10	112273	4.93	2.31	2	10
Country	2510	54.43	30.19	8	92	112273	59.80	30.75	8	92
Unmatched	2510	0	0	0	0	112273	0	0	0	0

The data in Table 1 show some difference between the two groups. Firstly, the number of observations between the groups differs significantly. In fact, after performing the nearest neighbor matching, roughly 44 control observations were matched with each treated one. On average, the treated entities are bigger and have a higher leverage than the straight bond issuer companies. Size, Leverage and long-term leverage are respectively around 40%, 8% and 9% higher in green bond issuers compared to non-green bond issuers. In addition, treated

companies are on average better performers than control companies by about 5%. Overall, the green bond issuers seem to be in a better condition, and this could be also one of the reasons why these companies can afford the cost and the effort associated with issuing a green bond.

4.2. Variables

In this paper there are two main sets of regressions, one to test the impact of green bond issuance on capital structure and the other to analyze how green bond issuance influences firm performance.

4.2.1. Dependent variables

In the first group of regressions, I used two different variables, the overall leverage, and the long-term leverage. These variables were used also in previous literature, see for example Chen (2004) who used these while researching the determinants of capital structure of Chinese-listed companies. Overall leverage and long-term leverage are the ratio of total debt over total assets and long-term debt over total assets, respectively.

For the performance analyses, two other dependent variables were used, EBIT over assets and EBITDA over assets. A significant part of corporate performance studies used EBITDA as a performance indicator. The ratio of EBITDA over assets has also been used in several papers (see for example Agliardi & Chechulin (2020)), dividing the EBITDA by assets harmonizes for the size of the company, thus offering a more comparable performance indicator. This is particularly important given the above-discussed difference in company size between treated and control group. Finally, I added a firm value analysis using Tobin's Q as a dependent variable in order to make my analysis more robust.

4.2.2. Independent variables

The independent variable in this paper is a dummy that expresses whether a company issued green bonds. In the performance regressions two more independent variables were added: leverage and long-term leverage, in order to understand if a higher level of debt can influence firm performance. The definition for long-term leverage from Compustat is applied, i.e., debt obligations due in more than one year from the company's balance sheet date.

4.2.3. Control variables

As mentioned previously, the past literature on corporate capital structure is broad and therefore there are a few factors have repeatedly been found to significantly impact capital structure. For example, size calculated as logarithm of total assets, tangibility, profitability as well as country, and sector in which companies are active, were used by Chen (2004), Kayo and Kimura (2011), as well as Deesomsak et al. (2004). I decided to include these variables in my regressions and control for them to try to isolate the impact of green bonds in capital structure.

4.3. Methodology

I first analyze what are the determinants of companies' capital structure. To do so, I run different models, starting with a more general one and then refine the research with the additional models. I start by running a pooled OLS regression including a dummy variable for green bond issuance to analyze whether the green bond issuance has an impact on the capital structure decision. As mentioned above the independent variables (y_{it}) are total leverage and long-term leverage, while the control variables are size, country, industry, tangibility, and profitability. The specification of the model is as follows:

$$y_{it} = \alpha_{GreenBond} + \beta_{LogAssets} + \gamma_{Country} + \delta_{Industry} + \vartheta_{Tangibility} + \xi_{Profitavility} + \varepsilon_{it}$$

Afterwards I run two fixed effects model regressions. In the first model I control for company ID, country, year, and industry fixed effects, while in the second I exclude year fixed effects. Fixed effects are used because this method allows to explore the relationship between predictor and outcome variables within the companies. There are characteristics, such as country and industry that are company specific and that could impact or bias the predictor or outcome variables, therefore we need to control for them. Fixed effects remove the effects of the time-invariant variables and allow to assess the net effects of the interested variables on the outcome. After performing the fixed effects regression, a joint test to see whether time-fixed effects were needed was carried out. In all the FE models we reject the null hypothesis that the coefficients for all years are jointly equal to zero, and therefore time-fixed effects are needed in these analyses.

For the analysis of the performance, I run again three different models, one pooled OLS and two different fixed effects model. Also, in this case it was used company ID, country, year,

and industry fixed effects, and in the second fixed effects model the year FE are excluded. For this analysis the variables EBITDA over assets and EBIT over assets were used as dependent variables. The independent variables are green bonds issuance and leverage, making the regression is as follows:

$$y_{it} = \alpha_{GreenBond} + \beta_{Leverage} + \gamma_{LogAssets} + \delta_{Country} + \vartheta_{Industry} + \xi_{Tangibility} + \varepsilon_{it},$$

In order to check the impact that long-term leverage together with green bonds have on performance, an additional set of similar regressions was run, with the difference that the independent variable *long-term leverage* was used instead of *Leverage.* The specification is as follows:

$$y_{it} = \alpha_{GreenBond} + \beta_{LongTermLeverage} + \gamma_{LogAssets} + \delta_{Country} + \vartheta_{Industry} + \xi_{Tangibility} + \varepsilon_{it},$$

Finally, a firm value analysis was performed. The models run were the same as the performance and capital structure. The only difference in this analysis is the dependent variable used, which is the firm value indicator Tobin's Q.

5. Results

The results from the capital structure analysis suggest that the issuance of green bond increases the overall debt and the long-term leverage. Table 2 below shows the estimation of average treatment effect (issuing a green bond) calculated with the nearest neighbor matching algorithm. The issuance of green bonds has an impact on leverage by around 3%.

Table 2. Capital Structure Analysis: Nearest neighbor matching

This table reports estimates of the average treatment effect (ATE). *Green bond* is a dummy variable equal to one if the firm has issued a green bond. Here *, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively.

	(1)
	Leverage
Green bond issuance	0.0325***
	(0.0103)
Observations	114,783

In Table 3, the results from the pooled OLS regressions suggest that green bond issuance increases leverage by more than 5% and long-term debt by roughly 4%, all things remaining equal. These results are statistically significant at 1% critical level. Additionally, size, calculated as logarithm of total assets, has a slightly positive impact on leverage and on long-term leverage, of 0.1%, and 0.5% respectively. Looking at the other control variables, tangibility, and profitability both have a negative coefficient in the regressions for both leverage variables.

Table 3. Capital Structure Analysis: Pooled OLS

This table shows the capital structure pooled OLS regressions outcomes. The independent variables are leverage (1) and long-term leverage (2). *Green bond issuance* is a dummy variable equal to zero if the firm has not issued a green bond while it is equal to 1 if the firm has issued a green bond. *Size* is a variable calculated as logarithm of total assets. *Tangibility* represents the % of tangible assets owned by the companies and *profitability* is calculated as ratio of earnings before interest, tax, and depreciation (EBITDA) to total assets. The regressions include country and industry dummy for each country and industry respectively. *, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)
	Leverage	Long-term leverage
Green bond issuance	0.0539***	0.0389***
	(0.00383)	(0.00321)
Size	0.00145***	0.00556***
	(0.000358)	(0.000513)
Tangibility	-0.153***	-0.162***
	(0.0131)	(0.00716)
Profitability	-0.375***	-0.170***
	(0.0258)	(0.0160)
Constant	0.399***	0.305***
	(0.0162)	(0.0130)
Observations	114,783	114,783
R-squared	0.162	0.229
Country dummy	Yes	Yes
Industry dummy	Yes	Yes

The results from the fixed effects regressions, demonstrated in Table 4 below, seem to strengthen the results found so far. Looking at the main variable of interest of this study, it is

possible to observe that green bond issuance increases leverage by more than 6.5% in the fixed effects model with time-fixed effects and 5% in the model without time-fixed effects. Both these outcomes are statistically significant. The difference between the two models can possibly be explained by the elimination of bias from unobservable factors that change over time but are constant over countries, industries, and entities. Additionally, the fixed effects control for factors that differ across entities, industries and countries but are constant over time.

The fixed effects model also strengthen the control variables results obtained in the pooled OLS models. The magnitude of the negative impact of tangibility on the dependent variables is a bit smaller in fixed effects regression while the negative impact of profitability remains similar.

Table 4. Capital Structure Analysis: Fixed effects

This table provides capital structure fixed effects regressions outcomes. The independent variables are leverage (1) (2) and long-term leverage (3) (4). *Green bond issuance* is a dummy variable equal to zero if the firm has not issued a green bond while it is equal to 1 if the firm has issued a green bond. *Size* is a variable calculated as logarithm of total assets. *Tangibility* represents the % of tangible assets owned by the companies and *profitability* is calculated as ratio of earnings before interest, tax, and depreciation (EBITDA) to total assets. The regressions include country and industry dummy for each country and industry respectively. *, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)	(4)
	Leverage		Long-term leverage	
Green bond issuance	0.0671***	0.0502***	0.0563***	0.0407***
	(0.0111)	(0.00784)	(0.00898)	(0.00684)
Size	-0.0190***	-0.0143***	-0.00705***	-0.00273*
	(0.00226)	(0.00193)	(0.00167)	(0.00145)
Tangibility	-0.109***	-0.105***	-0.110***	-0.106***
	(0.0133)	(0.0132)	(0.0104)	(0.0103)
Profitability	-0.362***	-0.369***	-0.184***	-0.189***
	(0.0126)	(0.0126)	(0.00879)	(0.00875)
Observations	113,205	113,205	113,205	113,205
R-squared	0.773	0.773	0.770	0.769
Company ID FE	Yes	Yes	Yes	Yes
Year FE	Yes		Yes	
Country FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes

Finally, the difference-in-difference regression results presented in Table 5 below indicate that green bond issuance tend to increase the level of leverage in firms' capital structure by almost 7%. The result is significant at 1% critical level.

This model also highlights a negative influence of size on leverage. Even tough size was having a small positive impact on leverage in the first capital structure regression – the pooled OLS model – in all the remaining models this factor has a negative impact on leverage. The previous literature also found mixed results between size and leverage correlation. In the Agency theory Jansen (1986) states that larger companies have little control over managers due to the more diluted ownership structure and they may use debt to retain more control, and these would imply a positive relationship between size and leverage. While the Pecking Order theory predicts that the relationship between size and debt is negative since larger firms can access capital markets more easily. Finally, the Trade-off theory says that larger firms tend to have higher leverage since they have a higher debt capacity. In addition, it is argued that generally larger firms are more diversified and therefore less exposed to bankruptcy costs and have lower transaction costs connected to long-term debt. The analysis conducted herein mostly points towards a negative relationship between size and leverage, thus supporting the Pecking Order theory.

The difference-in-difference analysis also shows that profitability is negatively correlated with leverage. The negative relationship between profitability and leverage seems to support the Pecking Order theory. In the Pecking Order theory companies that are more profitable have generally a lower level of debt since they can use the internal financing option. These results on profitability go against the Trade Off theory which predicts that high profitable firms tend to have a higher leverage due to bankruptcy costs, taxes, and agency costs. The results found herein are supported by results shown in Fama and French (2002) and Chen (2004).

Regarding the effects of tangibility on leverage, the coefficient for the impact of this factor on leverage is approximately -10% in the diff-in-diff model. This is perhaps surprising because past literature has found a positive relationship between tangibility and leverage, since tangible assets can be used as collateral for loans (see for example Rampini and Viswanathan (2013), and Rajan and Zingales (1995)). Jensen and Meckling (1976) argue that companies issue debt to mitigate the underinvestment problem created by the Agency cost of equity. Thus, the Agency theory also predicts a positive relationship between tangibility and leverage. As stated, surprisingly the results obtained in this paper are opposite to what previous literature discovered and what the Agency theory predicts. Since the companies in the treated group are

larger and overall performing better than the control group this result is particularly unexpected. A negative relationship between tangibility and leverage has been found for micro and small enterprises, as they have less assets to offer as collateral. This is not the case with this dataset. Therefore, this result should be further investigated.

Considered the outcomes of the analyses, it can be said that green bond issuance incentivizes firms to use more leverage and that green bonds have an impact in capital structure decisions. All the models that were carried out show that green bond issuance tends to increase the debt level and the outcomes are all statistically significant. This positive relationship between green bonds and leverage seems to support the Pecking Order theory and the Agency theory. In fact, it is argued that in the Pecking Order theory debt is seen as the safest choice among the external financing possibilities and therefore also the cheapest. In addition, the increase in leverage caused by green bonds issuance supports the strand of literature that argues that an increase in leverage tends to decrease the overall cost of capital (Brusov et al., 2014).

Table 5. Capital Structure Analysis: Difference-in-difference

This table shows estimates of the difference-in-differences specification in equation (1). *Green bond issuance* is a dummy variable equal to zero if the firm has not issued a green bond while it is equal to 1 if the firm has issued a green bond. *Size* is a variable calculated as logarithm of total assets. *Tangibility* represents the % of tangible assets owned by the companies and *profitability* is calculated as ratio of earnings before interest, tax, and depreciation (EBITDA) to total assets. *, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)
	Leverage	
Green bond issuance	0.0671***	
	(0.00870)	
Size		-0.0190***
		(0.00381)
Profitability		-0.362***
		(0.0171)
Tangibility		-0.109***
		(0.0208)
Constant		0.493***
		(0.0329)
Observations	114,783	114,783
Year dummy	Yes	Yes

Having discussed the results from the capital structure analysis, we now move to the results of the performance analysis. In Table 6 the outcomes from the pooled OLS regressions are presented. It is possible to notice that green bond issuance has a negative influence on company performance, reducing by almost 10% the EBITDA and EBIT ratio over assets. In all four regressions, the green bond issuance coefficient is negative, and all these results are statistically significant at 1%. Another interesting finding in this empirical analysis is the large negative impact that leverage and long-term leverage have on firm performance. The results suggest that increasing leverage by 1%, the performance indicators will drop by roughly 20%.

Table 6. Performance Analysis: Pooled OLS

This table reports firm performance pooled OLS regressions outcomes. The independent variables are EBITDA/Assets (1) (2) EBIT/Assets (3) (4). *Green bond issuance* is a dummy variable equal to zero if the firm has not issued a green bond while it is equal to 1 if the firm has issued a green bond. *Leverage* is calculated as the ratio of book value of total debt to total assets. *Long-term leverage* is the ratio of book value of long-term total debt to total assets. *Size* represents the logarithm of total assets. *Size* is a variable calculated as logarithm of total assets. *Tangibility* represents the % of tangible assets owned by the companies. The regressions include country and industry dummy for each country and industry respectively. *, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)	(4)
	EBITDA/Assets		EBIT/Assets	
Green bond issuance	-0.102***	-0.113***	-0.0984***	-0.110***
	(0.00583)	(0.00673)	(0.00625)	(0.00718)
Leverage	-0.227***		-0.247***	
	(0.0180)		(0.0175)	
Long term leverage		-0.195***		-0.217***
		(0.0182)		(0.0175)
Size	0.0383***	0.0412***	0.0386***	0.0418***
	(0.00162)	(0.00186)	(0.00167)	(0.00193)
Tangibility	-0.156***	-0.160***	-0.144***	-0.148***
	(0.0102)	(0.00900)	(0.00898)	(0.00784)
Constant	-0.0420***	-0.0811***	-0.0580***	-0.0991***
	(0.00777)	(0.00975)	(0.0109)	(0.0122)
Observations	114,783	114,783	114,783	114,783
R-squared	0.320	0.281	0.332	0.288
Country dummy	Yes	Yes	Yes	Yes
Industry dummy	Yes	Yes	Yes	Yes

The results of the performance analysis using two fixed effects regression are reported in Table 7, four regressions use year FE, while in the remaining four regressions the year FE are excluded. It can be noticed that results are very similar across the two fixed effects models but differ to some extent with the pooled OLS model. Green bond issuance has a positive relationship on performance. The results suggest that when a company issues green bonds they tend to increase performance by 6%. The findings support assumption 2 mentioned in the theoretical framework which states that green bond enhances long-term firm performance. My findings are very similar to the one of Agliardi and Chechulin (2020), who found that green bonds increase long-term performance by more than 7%.

The positive impact that green bonds tend to have on leverage seem to also support the Agency theory which states that a higher level of leverage helps the company to mitigate the risks derived by the abundance of free cashflow that may be misused by the mangers. However, it is important to note that my empirical findings do not always support the Agency theory. More specifically, all models have found that leverage has a negative impact on firm performance. This is quite surprising as it contradicts a large part of literature. Further research into this aspect is suggested to understand why and how leverage is having a negative impact on performance.

When looking at size, on the other hand, the results follow most of the previous literature (see for example Ibhagui & Olokoyo (2018) and Lee (2009)). Size is positively correlated and statistically significant with EBITDA and EBIT in each model used in this paper.

Lastly, a final analysis using Tobin's Q as the dependent variable was conducted. As before, in this case also one pooled OLS and two fixed effects, one with and one without year fixed effects, were run. In this final analysis, the observations dropped significantly because Compustat-Capital IQ Global does not have market information for companies, thus this sample represents just North American companies.

It is interesting to notice in table 8 below - that shows Tobin's Q results - that the impact of variables differs when we add/remove fixed effect variables. Indeed, when other parameters are included, the study may be more or less significant. Nevertheless, by comparing the two R-squared, we see that the goodness of the tests is comparable. In addition, all included variables are significant and have a subtle variation in impact. The only variable to change in positivity, quantity, and significance is the variable of interest green bond issuance. This could result from a high dependence on the variable Year.

Table 7. Performance Analysis: Fixed effects

This table provides firm performance fixed effects regressions outcomes. The independent variables are EBITDA/Assets (1) (2) EBIT/Assets (3) (4). *Green bond issuance* is a dummy variable equal to zero if the firm has not issued a green bond while it is equal to 1 if the firm has issued a green bond. *Leverage* is calculated as the ratio of book value of total debt to total assets. *Long-term leverage* is the ratio of book value of long-term total debt to total assets. *Size* represents the logarithm of total assets. *Size* is a variable calculated as logarithm of total assets. *Tangibility* represents the % of tangible assets owned by the companies. All the regressions contain country, industry, and company ID fixed effects. Regressions (1) (2) (3) and (4) also incorporate year-fixed effects. The regressions include country and industry dummy for each country and industry respectively. *, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	EBITDA/Assets				EBIT/Assets			
Green bond issuance	0.061***	0.059***	0.062***	0.061***	0.062***	0.059***	0.062***	0.061***
	(0.0090)	(0.0089)	(0.0081)	(0.0076)	(0.0096)	(0.0093)	(0.0095)	(0.0090)
Leverage	-0.181***		-0.188***		-0.197***		-0.204***	
	(0.0063)		(0.0063)		(0.0064)		(0.0065)	
Long-term leverage		-0.153***		-0.161***		-0.166***		-0.174***
		(0.0074)		(0.0075)		(0.0076)		(0.0077)
Size	0.054***	0.059***	0.043***	0.047***	0.060***	0.065***	0.047***	0.052***
	(0.0017)	(0.0018)	(0.0015)	(0.0016)	(0.0018)	(0.0019)	(0.0016)	(0.0017)
Tangibility	0.047***	0.053***	0.045***	0.051***	0.066***	0.072***	0.063***	0.069***
	(0.0104)	(0.0106)	(0.0104)	(0.0106)	(0.0106)	(0.0109)	(0.0106)	(0.0109)
Observations	113,205	113,205	113,205	113,205	113,205	113,205	113,205	113,205
R-squared	0.843	0.837	0.840	0.833	0.835	0.828	0.832	0.824
Country dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Company ID FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes			Yes	Yes		
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

It can be noticed that some results differ from the results found in the previous performance analysis. For example, there are mixed results regarding the effect of green bond

issuance. On one hand, the pooled OLS regressions suggest that green bonds issuance increase the value of the company, which is in line with previous results and with A3. On the other hand, the fixed effects results using the time-fixed effects are positive but not statistically significant, while the model without time-fixed effects the green bond issuance results are significant and negatively correlated with firm value. These latter results do not support assumption 2 on firm performance and assumption 3 on signalling as both these assumptions state that green bond issuance enhance firm's value.

Leverage and long-term leverage have a positive and significant impact on firm value. This could be explained by the Agency theory as previously mentioned. The results found for tangibility in the performance analysis are confirmed by this last firm value regression. Finally, in contrast with previous outcomes, size has a negative relationship with firm value. This is surprising because generally investors tend to have high expectations for big companies' dividends, this makes the company more attractive and therefore also the market value should grow.

Table 8. Firm value: Tobin's Q

This table shows firm value pooled OLS and fixed effects regressions outcomes. The independent variable is Tobin's Q. *Green bond issuance* is a dummy variable equal to zero if the firm has not issued a green bond while it is equal to 1 if the firm has issued a green bond. *Leverage* is calculated as the ratio of book value of total debt to total assets. *Long-term leverage* is the ratio of book value of long-term total debt to total assets. *Size* represents the logarithm of total assets. *Size* is a variable calculated as logarithm of total assets. *Tangibility* represents the % of tangible assets owned by the companies. Regressions (3), (4), (5) and (6) contain country, industry, and company ID fixed effects. Regressions (3) and (4) also incorporate year-fixed effects. The regressions include country and industry dummy for each country and industry respectively. *, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively

	(1)	(2)	(3)	(4)	(5)	(6)
	Tobin's Q					
Green bond issuance	0.484***	0.726***	0.194	0.208	-0.488***	-0.516***
	(0.0459)	(0.0587)	(0.152)	(0.164)	(0.0472)	(0.0509)
Leverage	5.033***		2.544***		2.722***	
	(0.414)		(0.215)		(0.214)	
Long term leverage		4.466***		2.405***		2.620***
		(0.464)		(0.232)		(0.233)
Size	-0.495***	-0.624***	-0.777***	-0.929***	-0.596***	-0.715***
	(0.0349)	(0.0472)	(0.0617)	(0.0663)	(0.0548)	(0.0587)
	(0.0677)	(0.0797)				
Tangibility	1.340***	1.256***	1.900***	1.793***	2.045***	1.933***
	(0.136)	(0.122)	(0.336)	(0.343)	(0.336)	(0.343)
Constant	1.729***	3.132***				
	(0.167)	(0.185)				
Observations	35,658	35,658	34,905	34,905	34,905	34,905
R-squared	0.313	0.245	0.790	0.786	0.788	0.784
Country dummy	Yes	Yes	Yes	Yes	Yes	Yes
Industry dummy	Yes	Yes	Yes	Yes	Yes	Yes
Company ID FE			Yes	Yes	Yes	Yes
Country FE			Yes	Yes	Yes	Yes
Industry FE			Yes	Yes	Yes	Yes
Year FE			Yes	Yes		

6. Limitations

There are a few limitations that are worth mentioning. The first is related to the nearest neighbor matching analysis. For this paper I used the program Stata to run the statistical analysis, but unfortunately this software does not have the same capacity as R to combine the propensity score matching with the nearest neighbor algorithm, and consequently use this matching to run a difference-in-difference analysis. Therefore, using R could have resulted in a more precise matching technique.

The second limitation is that the number of companies that issued green bonds is still relatively small compared to the straight bond issuers. It is important to remember that the green bond market only started to grow significantly less than 10 years ago. While the novelty of the market gives an opportunity to explore a topic that has not yet been widely researched, it also results in limited data. Surely, future studies will have a larger set of data to work on which will provide the chance to obtain more reliable results. Another data limitation encountered in this thesis process was the lack of the market data for global companies in Compustat to calculate the Tobin's Q. It would have been possible to retrieve these data from different databases, but this was not possible due to the time constraints.

Finally, the last limitation, which is in its essence a call for future research, concerns the omission of an ownership structure analysis in this research that would study the third Assumption. It would have been interesting to perform an ownership structure analysis similar to the one carried out by Flammer (2021), to study whether the issuance of green bonds attracts a different type of investors that are more environmentally conscious and long-term focused. As this would have involved searching in additional databases to retrieve ownership information, due to time constraints this was not possible to conduct this additional analysis.

7. Conclusion

The main goal of this study was to determine the impact of green bond on capital structure and on firm performance. The empirical evidence that this study offers regarding the influence of green bond issuance on capital structure support the assumptions made. The results indicate an increased appetite for debt after green bond issuance, and all the results are statistically significant. It is, therefore, possible to conclude that this new instrument plays a role and will likely play an even bigger role in the future when it comes to the decision-making process of managers. Particularly, when deciding whether to finance the company with debt or equity.

The three arguments presented in the theoretical framework – cheap financing, better performance and signaling argument – can help explain the increase in leverage caused by green bond issuance. These reasons found by previous authors can justify why companies are interested in this fixed income instrument that by consequence increase the leverage of companies. Having said this, this paper does not study the causation relationship between green bonds issuance and the arguments provided. This could be an interesting subject for future research that would help to shed light on this topic.

In addition, the results of green bond impact on firm performance are strongly positive in the fixed effects, confirming the assumptions that green bonds enhance long-term performance. On the other hand, the pooled OLS regression shows a negative relationship between green bonds and firm performance, which are possibly explained by the short period of time between the green bond issuance and the time of this analysis. Indeed, Flammer (2021) mentions that at least three years need to pass before it is possible to see the green bond issuance impact on performance. This means that a substantial amount of bonds included in the dataset used for this thesis still need to mature before having a strong impact on performance. A further analysis of the data after dropping the issuance of the last three years would have been an interesting next step to this research. However, as time is a finite resource, this was not possible within the timeframe for this thesis. Further research is encouraged.

The firm value analysis returned mixed results. However, the sample was much smaller compared to the previous analysis due to the lack of data available for global companies in Compustat to calculate the Tobin's Q. Therefore, the results do not have the same explanatory power because the analysis represents just North American companies.

This research will serve as a base for future studies on the relationship between green bond and firm's capital structure. More research is needed to better understand whether there is a causality relationship between the three arguments offered by Flammer (2021) and the impact that green bonds have on capital structure and firm performance.

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