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Why being green? Investigation on the pricing advantage between green and traditional bonds.

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Abstract

Nowadays, corporations are becoming more sensitive towards environmental issues and more thoughtful on what the impact of their products and services might be on the environment and society. This is also due to the growing tendency of investors to fully dedicate investment funds to socially responsible investing (SRI). This Mater Thesis analyzes whether "it pays to be green", hence if issuing green bonds (and hence, owning eligible "green assets" according to the Green Bond Principles), pays from a pricing perspective. I compare the performance of green and non-green plain vanilla bonds issued by the same companies during the time frame 2010-2017. My results show that there is a pricing advantage for green bonds, but it is not significant when considering several factors that affect the relation between independent and dependent variables such as bond and issuer control variables.

1. Research Question and Motivation

The last decade has been a characterized by a strong interest towards the implementation of environmental, social and governance (ESG) policies in companies' corporate strategies. In fact, corporations are becoming more sensitive towards environmental issues and more thoughtful on what the impact of their products and services might be on environment and society. Moreover, academia has recently turned its attention to the economic effects of improvements in the environmental performance at various levels of analysis, where economic performance has been conceived through short-term measures, such as profitability or even long-term measure that capture firms' competitiveness.

In this Master Thesis, I focus my attention on Green Bonds, financial instruments that allow using debt capital markets to fund climate solutions. I provide some general information about Green Bonds, I list the main similarities and differences with standard bonds and I examine whether green bonds trade at a tighter spread compared to senior bonds, hence whether there is a concrete pricing advantage in "becoming green".

According to the Climate Bond Initiative, Green Bonds are regular bonds whose proceeds are used to finance projects with a positive environmental impact. Despite the important role covered by green bonds in the actual economic panorama, no clear answer has been provided yet to the question whether it pays or not to be green from the firm's point of view from a spread perspective. In fact, the very first aim of this study is to fill this gap in literature. First, I provide some theoretical background related to the relevance of corporate environmental strategies.

2. Theoretical Framework

2.1 The importance of implementing ESG factors in the investment decision

In last decade, the corporate culture towards sustainability has evolved and companies tend to implement sustainability measures to improve their impact on the environment and the society. To evaluate the sustainable growth of companies, institutional and retail investors use several environmental, social and corporate governance (ESG) indicators which reflect the general attitude of a company towards sustainability (Kocmanová et al., 2012).
Moreover, institutional investors tend to include ESG factors in the investment decision since they can help maximize long-term value for shareholders. In support of this new framework, many large institutional investors are followers of the United Nations' "Principles for Responsible Investment" (UNPRI). UNPRI is the world's most significant framework for responsible investment: almost 1600 investors globally have signed up to the UNPRI principles and report on their sustainable investments. One of the main factors that mainstream SRI investors use as a basis for the investment decision is the issuers' sustainability rating (Kocmanová et al., 2012).

Institutional investors use several approaches to responsible investing. The first step towards SRI investing is a negative exclusionary screening based on excluding poor ESG performers and/or companies that are involved in controversial business activities such as weapons, tobacco, alcohol, or nuclear power. Investors also decide to implement ESG quantitative strategies by identifying positive signals and adjusting price targets. Another common SRI approach is norms-based screening based on excluding companies that are in violation of basic societal norms such as human rights by employing child or forced labor. Sustainability funds usually apply a positive screening by investing in best-in-class companies in each sector in terms of ESG performance. Lastly, SRI investors are recently implementing positive thematic and impact investing that focus on companies that implement actions to solve sustainable developments challenges (e.g. clean drinking water in deprived areas, clean energy, etc.) and positively impact on the society. One common element to different SRI investing approaches is based on the integration of companies' sustainability ratings (Escrig-Olmedo et al., 2010). In fact, SRI investors nowadays use ESG ratings to assess the general sustainability of the companies in which they are investing. ESG ratings are provided by third-party ESG reviewers such as MSCI, Sustainalytics, ISS-Oekom and Vigeo-Eiris. The sustainability rating report provided by these agencies identify key sustainability areas and give an overall ESG score that is based on several environmental, social and governance indicators. Since ESG ratings are embedded in mainstream SRI investment decision, active rating management and disclosure on sustainability elements has become increasingly more relevant for companies.

2.2 Green bonds overview

Green bonds are ‘plain vanilla’ fixed income products that offer investors the opportunity to participate in the financing of ‘green’ projects that help mitigate climate change and to invest in sustainable projects, such as loans for sustainable real estate or making public transport more environmentally friendly (Reichelt, 2010). Other examples of projects financed through green bonds are related to promoting energy efficiency, avoiding pollution and encouraging waste management, enhancing biodiversity, protecting aquatic and terrestrial ecosystems, clean transportation and developing sustainable and/or circular economy adapted products or solutions.

Green bonds’ structure, credit risk and size are identical to those of traditional bonds, but they are issued to finance specifically environmentally-friendly projects. The International Capital Market Association’s Green Bond Principles and the Climate Bonds Initiative's (CBI) Climate Bond Standards help to determine whether a bond qualifies as green or not. Usually, green bonds require third-party verification and certification for the establishment that environmental benefits arise by the use of proceeds. Third party verification is usually a ESG score provider such as MSCI, Sustainalytics, Vigeo-Eris and CICERO. The green bond market was launched by World Bank and EIB and it was initially seen as niche market, but nowadays green bonds are proliferating. In the first half of 2017, the issuance of approximately $55 billion labelled green notes was reported, which led to an increase of 38% year-on-year comparing the $40 billion issued in the first six months of 2016 (Climate Bond Initiative). Indeed in 2017, Green bond issuances achieved $150 billion, while in 2016, when green bond issuances reached $82 billion.

Not only large corporations such as Apple, Iberdrola, Intesa SanPaolo, QBE Insurance Group and TenneT have already issued green bonds, but also sovereign issuers such as Republic of France, Republic of Poland and Kingdom of Belgium. Moreover, green bond issuances are also growing in emerging countries such as China and India, where large companies already issued billions of green bonds to finance energy efficiency and renewable energy projects in their communities. Hence, green bonds might represent an opportunity to improve the sustainability of the whole society in emerging countries. Lastly, the growth of the green bond market and the strong interest demonstrated by large institutional investors, is also stimulating the development of new capital markets solutions such as Sustainable Bonds and Social Bonds.

2.3 Advantages of Issuing Green Bonds

Issuing Green Bonds might have several advantages, disadvantages as well as risks derived. In this section, I describe the main advantages of issuing Green bonds. Green bonds offer climate-related investment opportunities that appeal investors because of the rising environmental sensitivity. Additionally, large amounts of funds can easily be raised through the green bonds channel for sustainable projects, for which funding might not have been available otherwise. Also, local governments and companies can benefit from the demand from socially responsible investors, which have demonstrated to have a strong craving for green papers. Moreover, public private partnerships can be positively affected by issuance of green bonds which might lead to the acceleration of green investment and the adoption of new technologies. Companies and governments can improve their notoriety by marking themselves as innovative and sustainable. Moreover, green bonds are tax-exempt bonds. The tax-exempt status makes acquiring a green bond a more appealing venture contrasted with a comparable taxable bond, giving a monetary incentive to tackle conspicuous social issues such as climate change and a movement to renewable sources of energy. (Reichelt, 2010).

2.4 Disadvantages of Issuing Green Bonds

Firstly, despite green bonds and regular bonds share many common aspects (such as credit risk, size, maturity), issuing green bonds is more costly than regular bonds because of the due diligence process that the issuer must conduct, to recognize and monitor ‘green’ projects. Simultaneously, a rigorous governance and due diligence process for project finance will help index providers put green bonds into a fixed income ‘Green Index’, so that investors who manage their assets based on an index add the bonds to their portfolios. Thus, this could increase retail investment because of the easier access to the market. In fact, retail investment is still limited since green bonds are not yet well integrated into ordinary funds, indices and other products. Furthermore, the first type of green bonds such those issued by the World Bank, were intended for both individual and institutional investors (Reichelt, 2010). Green bonds drew attention of large investors on climate-related financing activity and broadened the investor base for climate-related products. Furthermore, it is important to consider that green bonds are innovative products and there is still lack of consensus regarding what constitutes a green bond among investors, leading to uncertainty when making the

investment decision. Moreover, to avoid lack of transparency in the market, investors require allocation and impact reporting of the green portfolio financed through a green bond. All these characteristics negatively affect green bonds liquidity.

2.5 Risks of Issuing in Green Bonds

As for regular bonds, the main risk of green bonds is the issuer's default. The bond's structure implies more risks to be accounted for both issuer and investor, for instance bonds with variable or fixed rates. Secondary instruments, such as currency forwards and futures exist to help hedge these risks, but at a cost. Issuing green bonds by companies located in developed countries, might make other financial mechanisms more affordable due to the variability in transaction costs and issuance fees. Additionally, whether the green bond is issued abroad, more risks, like changes in foreign market regulations on capital flows, and exchange rates, should be accounted for. Therefore, in the long term, liquidity might be drawn away from domestic markets and will be directed to offshore markets. However, these additional risks are usually lower than the ones experienced in issuing bonds in less developed markets. Finally, assessing the environmental advantages claimed by issuers of green bonds has been a key issue since the market began to develop. The reputational risk for green bonds issuers, when bonds are marked as green, but eventually are not "green", remain high and can have an impact on investors' trust. Hence, despite the advantages, companies issuing green bonds face several risks and downsides.

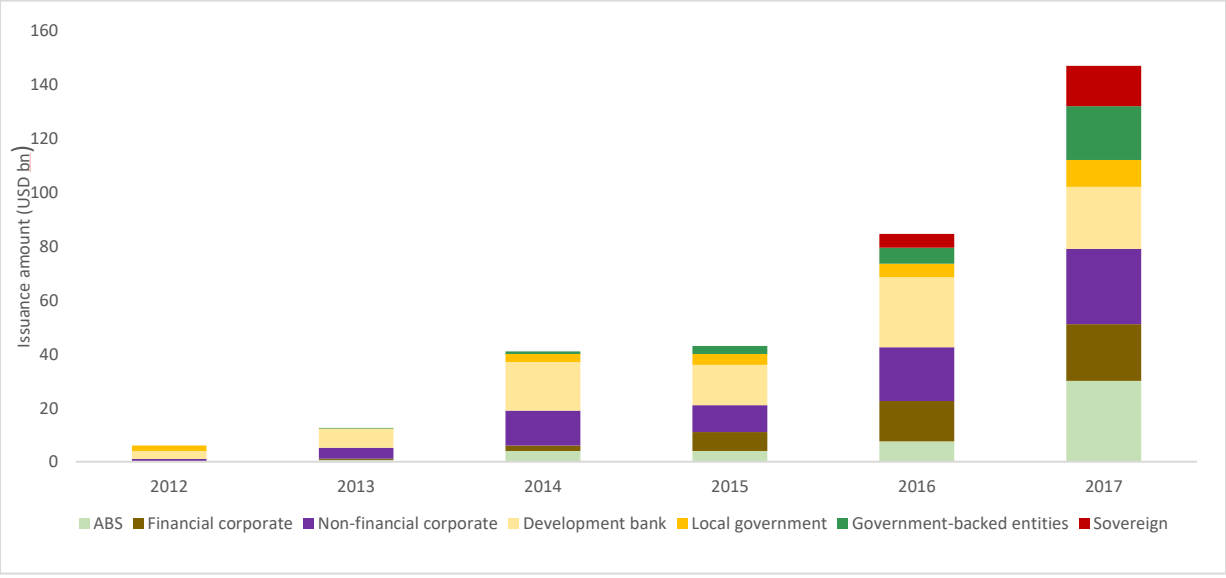
2.6 Recent Green bond market developments

In the recent years the green bond market has shown an incredible growth, reaching a stage where issuers and investors are developing a liquid market. In fact, the green bond market between 2013 and the end of 2017 has reached almost USD400bn issuance level. Moreover, recently several countries are issuing green sovereign bonds. For example, the Industrial and commercial Bank of China has issued its inaugural green bond. Also, the China Development bank issued a Climate Bond's Initiative certified green bond. This indicates that China's largest banks are prepared for best green practice and signal to the other large global banks to be ready for their green commitments. Fiji has become the first Pacific Island nation and emerging economy to issue a

sovereign green bond Moreover, Republic of France, Republic of Poland and kingdom of Belgium have issued green bonds and their orderbooks have shown oversubscription, suggesting that investors are developing a strong appetite for green bonds.

Green papers are bought by institutional investors with a dedicated green bond fund, strong appetite for sustainable financial instruments and ESG investment commitments. Indeed, institutional investors with large asset allocation to fixed income represent the most suitable investors for green bonds. Investors such as real money, banks and retail intermediaries who implement Social responsible investments filters in their investment decision, have dedicated SRI funds that invest in companies with a high ESG performance. Institutional investors such as Actiam, Aviva, ASR, BNP AM, Delta Lloyds have dedicated SRI funds. Moreover, there are institutional investors that have set up dedicated green bond funds such as Lombard Odier, NN Investment Partners, Allianz GI, Mirova/Natixis and BlackRock. Investors with a dedicated green bond fund provide key investor information about their funds' activity. Disclosing the funds' top holdings, objectives, investment policy, risk and rewards profile, performance and investment portfolio structure is required by law. Green bond funds' holdings show a considerable concentration in the energy and real estate sector.

Figure 1: Green bond market development (2012-2017)



Source: Bloomberg

Table 1: Recent UDS/EUR/GBP green bond issues

Issue date	Issuer Name	Sector	Currency	Size	Tenor	Use of Proceeds
23/05/2018	RENOVATE AMERICA	Energy	USD	206.1	30	Sustainable Water Management, Energy Efficiency
20/04/2018	LANDSEA GREEN GROUP CO.	Real Estate	USD	150	2	Climate Change Adaptation

20/04/2018	ACS SERVICIOS COMUNICAC	Building-Heavy Construct	EUR	750	8	Wind and hydro energy projects, transmission and distribution, sustainable water and waste management projects
17/04/2018	VERBUND AG	Electric-Integrated	EUR	100	10	Energy efficiency improvements of hydropower plants, Construction of wind power plants
02/04/2018	MOSAIC SOLAR	Communications	EUR	235.25	25	Renewable energy
30/03/2018	WDP	Real Estate	EUR	100	11	Sustainable Water Management, Renewable Energy, Energy Efficiency, Clean Transportation
29/03/2018	PAPREC HOLDING SA	Recycling	EUR	575	7	Industrial recycling assets and acquisitions of recycling companies
26/03/2018	IBERDROLA INTERNATIONAL BV	Utilities	EUR	700	Perpetual	Renewable Energy
26/03/2018	DANONE SA	Food-Dairy Products	EUR	300	7	R&D for advanced medical nutrition, social inclusiveness, entrepreneurship financing and quality healthcare and parental support
26/03/2018	BEIJING CAPITAL POLARIS	Real Estate	USD	500	3	Sustainable Waste Management, Air Pollution Control, Low Carbon Transportation, Sustainable Agriculture and Green Buildings
15/03/2018	PROLOGIS INTL FUND II	Property Trust	EUR	300	10	Green buildings renewable energy-solar and wind related. LEED/DNGB/BREEAM/HQE/CASBEE certified
05/03/2018	MODERN LAND CHINA CO LTD	Residential	USD	130/350	3	Commercial Green Properties
21/02/2018	FONCIERE INEA	REITS-Office Property	EUR	30.5	6	Low carbon green commercial buildings
21/02/2018	FONCIERE INEA	REITS-Office Property	EUR	34.5	7	Low carbon green commercial buildings
02/02/2018	NORDEX SE	Energy-Alternate Sources	EUR	275	5	Finance new and refinance existing wind power projects
01/02/2018	MIDAMERICAN ENERGY CO	Electric-Integrated	USD	700	30	Finance a portion of previous wind repowering projects
16/01/2018	ENGIE SA	Power Generation	EUR	1000	5	Renewable Energy, Energy Efficiency
16/01/2018	ENEL FINANCE INTERNATIONAL NV	Utilities	EUR	1250	8	Renewable Energy, Energy Efficiency
10/01/2018	SWIRE PROPERTIES MTN FINANCING LTD	Real Estate	USD	500	10	Sustainable Water Management, Renewable Energy, Energy Efficiency, Climate Change Adaptation
30/11/2017	FERROVIE	Transportation	EUR	600	6	Clean transportation
21/11/2017	TOYOTA	Auto Components	EUR	600	4	Clean transportation
16/11/2017	ORSTED	Utilities	EUR	750	12	Renewable energy
15/11/2017	GAS NATURAL FENOSA	Utilities	EUR	800	7	Renewable energy
17/10/2017	IREN	Utilities	EUR	500	10	Sustainable Water Management, Renewable Energy, Energy Efficiency
12/10/2017	INNOGY SE	Utilities	EUR	850	10	Renewable Energy, Clean Transportation
04/10/2017	MANN+HUMMEL	Industrials	EUR	400	10	Renewable energy generation, Energy efficiency, Pollution prevention and control
29/09/2017	HANJIN INTERNATIONAL CORP.	Industrials	USD	300	3	Energy Efficiency
28/09/2017	ENGIE	Utilities	EUR	750/500	11/5	renewable energy projects, energy efficiency projects, natural resources preservation projects
20/09/2017	MEXICO CITY AIRPORT	Industrials	USD	3000/1000	30/11	Green buildings, climate change mitigation projects
19/09/2017	KLABIN S.A.	Materials	USD	500	10	Terrestrial and aquatic biodiversity conservation, Sustainable Water Management
13/09/2017	ICADE	Real Estate	EUR	600	10	Renewable Energy, Energy Efficiency, Clean Transportation
13/09/2017	IBERDROLA	Utilities	EUR	750	10	Renewable Energy
06/09/2017	SSE	Utilities	EUR	600	8	Renewable Energy
06/09/2017	TENASKA	Power Generation	USD	400		Renewable Energy
05/09/2017	SUZANO PAPEL E CELULOSE S.A.	Forest & Paper Products	USD	700	10	Sustainable forestry, water management, energy efficiency
10/08/2017	ANGLIAN WATER SERV FIN	Utilities	GBP	250	8	Sustainable Water Management

Source: Bloomberg

3. Literature review

Since green bonds are extremely recent financial products, there is not yet abundant literature on whether there is a pricing advantage in issuing green bonds compared to traditional bonds. Despite this, the Climate Bond Initiative, published some recent study (2017) on this topic.

In the "Green Bond Pricing in the Primary Market: January 2016 - March 2017" published by the Climate Bond Initiative, the authors investigate the main differences between green bonds and traditional bonds. Specifically, they selected sixty-two (62) investment grade green bonds issued in EUR or USD over a 15-month period, with size equal or bigger of USD 200m and minimum maturity of 3 years, to comprehend the dynamics of green bond pricing in the primary market. The main similarities between green and vanilla bonds are: EUR corporate green bonds price on average 13.4bp tighter than IPT, similar to the normal range of 13-14bp for vanilla bonds over the same period; 3 times is the average oversubscription, something not unusual for the corporate bond market; 7 days after the announcement date, 70% of green bonds had tighter spreads and 28 days after 63%; a few green bonds priced within their credit curves, while other priced on their own credit curves, whereas other priced outside of their credit curves, which is generally comparable to plain vanilla bonds. Despite the similarities, this paper provides also evidence of different behavior between green and vanilla bonds. In fact, it appears that: green bonds tend to attract a larger range of investors, specifically those that incorporate ESG criteria in the investment decision; USD green bonds had a better market response compared to traditional bonds, since they priced around 17bps tighter than comparable regular plain vanilla bonds issued in the same period. (Climate Bond Initiative, 2017).

In addition, the Climate Bond Initiative produced a second study on EUR and USD green bonds issued in the second quarter of 2017 and its main finds are: USD denominated green bonds price on average 15.4bps tighter than IPT, while EUR denominated green bonds price on average -6.3bps tighter than IPT, average for vanilla equivalents is -9.4bps (Climate Bond Initiative, Q2 2017), EUR denominated green bonds achieve a larger investor base than comparable regular bonds (green bonds have bigger order books, than plain vanilla). Instead, USD denominated green bonds achieve similar order book size to comparable plain vanilla bonds, but they still are primarily bought by green investors.

Following the studies produced by the Climate Bond Initiative in 2017, S&P Global Rating published a study called "Green Bond Pricing in the Primary Market—Is the Grass Greener?" (2017), that investigated if there is a pricing advantage for green bonds by using Apple's green bond as a case study. The research shows that green bonds: (1) are oversubscribed and may price tighter than conventional bonds and (2) tend to attract more diversified investor base, which includes Socially Responsible Investors (SRI) and more investor interest might reduce cost of funding.

In addition to the Climate Bond Initiative (CBI, 2017) and S&P research on the Apple case study (S&P, 2017), other researchers investigate some aspects of the potential pricing advantage between green and non-green bonds. Woo and Lee (2014) investigate the yield spread between green and non-green bonds. They suggest that the yield spread for green bonds may be lower than that of a non-green bond similar in risk structure since the green bond enjoys lower environmental risk. In fact, the authors affirm that climate change is a real and unavoidable problem and green bonds represent the best instrument to finance projects with a positive environmental impact (Woo and Lee, 2014). Furthermore, the higher yield spread, the higher the investment risk. On this subject, the authors formulate the hypothesis that the yield spread for green instruments might be lower than that of "conventional" bonds with similar characteristics.

Wulandari et al. (2018) investigate the relation between liquidity risk and bonds' yield spread after adding control variables for credit risk and instrument characteristics. The authors use two different proxies for liquidity: LOT liquidity and the bid-ask spread. The LOT is a liquidity model developed by Lesmond et al. (1999) based on Tobin (1958) limited dependent variable (LDV) procedure. The intuition behind this measure is that arbitrageurs trade only when acquired information is higher than marginal cost of trading. If trading costs are substantial, it would be necessary to acquire new information before entering in trading. Hence, the frequency of the zero-return days can be a measure for the length of information accumulation. Wulandari et al. (2018) find that the LOT liquidity proxy positively affects green bonds' yield spreads, suggesting that, on average, green bonds are more liquid than non-green bonds with similar characteristics, during the time frame 2014-2016. The authors also find that the relation between the two variables decreases over time, suggesting that today liquidity risk becomes less relevant for green debt instruments (Wulandari et al., 2018).

A recent study from Tang and Zang (2018) examine the relation of announcement returns and real effects of green bonds issued by corporates over the period 2007-2017. The authors find that even if there is limited evidence of green bond issuances directly affecting stock prices, shareholders can benefit from issuing green debt instruments thanks to better stock liquidity. In fact, after green bond issuance, firms' stock liquidity shows a 13.32% improvement (Tang and Zang, 2018).

Baker et al., (2018) examine the relation between the pricing and ownership of U.S. green bonds and find that municipal U.S. green bonds are issued at a small premium compared to non-green U.S. bonds, with similar characteristics. The authors choose to focus on municipal bonds because there are far more U.S. green municipal bonds than U.S. green corporate bonds on the debt public market. The finding that U.S. municipal green bonds are issued at a lower yield, can be considered as a flip side to the results of the research by Hong and Kacperczyk (2009), according to which sin stocks are sin stocks are present higher returns.

Additionally, Goss and Roberts (2011) investigate the relation between the ESG scores of more than 8,000 firms and the cost of their bank loans. The authors find that companies with a low ESG score, on average, tend to pay around 20 basis points more than socially responsible companies. Despite this research does not directly investigate the presence of a green bond premium and the results are not applicable to the public debt market, there might be a connection between firms with a better ESG score and firms that issue green bonds on capital markets.

However, except for Baker et al. (2018) who investigate the cost of "being green" of bonds by using only a U.S. green municipal sample, no other academic study has investigated the potential pricing advantage of EUR green corporate bonds to the best of my knowledge.

In fact, despite findings of Baker et al. (2018) might lead towards the hypothesis that green bonds are issued at a lower yield spread compared to non-green bonds, other studies state there is no pricing advantage in "being green". The OECD (2015c) report affirms that financial aspects of green and non-green bonds issued by the same company are the same at the issue date, since investors does not justify paying a premium to finance environmentally-friendly investments. According to I4CE (2016), despite the presence of a more diversified investor base and the high demand for green papers by SRI investors might lower their yield spread, there is "no clear evidence" that issuing green bonds decreases the cost of capital for their issuers compared to normal bonds.

Since the green bond is destined to grow in the future and the few previous studies on this topic provide mixed results, I aim to research weather corporate issuers pay a premium when issuing a green bond compared to a non-green bond, and hence whether "being green" lowers the cost of capital for the issuers.

4. Data and Method

In my empirical analysis, I focus on green and non-green bonds issued by the same companies, during the time frame 2010 – 2017. I include green bond data between 2010 and 2017, because the introduction of green bonds in the market is relatively new. During 2007 the first green bond was issued by the European Investment Bank. However, I find consistency and comparison in my sample by 2010, when the green market started growing significantly. Moreover, I focus on corporates and I exclude bonds issued by sovereigns and financial institutions. I use Bloomberg to find green bonds by using the SRCH function, selecting green bond/loan in the proceeds field. Through this function, I find information such us I-Spread (interpolated spread), maturity and coupon of approximately 1000 green bonds. I use Compustat to find firms characteristics data and SIC industry codes. I use 3-digits SIC codes provided in Compustat to identify the industry group each firm belongs to. Moreover, to control credit rating I use Bloomberg composite which is a "blend" of the four major credit rating agencies, Moody's, S&P, Fitch, and DBRS ratings. Credit opinions on the bonds and bond issuers are included in Bloomberg's indexes and a composite of four rating agencies, is employed. I use cross sectional data to observe changes in different variables but also differences in variables among the data, at a specific time. Finally, to remove the effect of time-invariant characteristics and to test the net effect of the independent variable on the dependent variable, I use time fixed effects. Lastly, I use standard error to account for errors and to increase robustness of my results I conduct heteroskedasticity test.

5. Research Design

In this section, I describe the regression model used to test the hypothesis. Since the lack of previous studies on the whether there is a pricing advantage for green bonds, I follow Chalabi et al., who investigate whether "sin companies" pay a lower spread than other comparable companies.
I employ the following multivariate regression model to test the relation between green bonds (X) and spread (Y).

$$Spread_i = \alpha + \beta_1 Green_i + \beta_2 Controls_i + YearFixed\ Effects + IndustryFixed\ Effects + \epsilon_i$$

Where $Spread_i$ represents the cost of debt of bond i, $Green_i$ indicate whether the bond is green or not, $Controls_i$ identifies a vector of control variables (coupon, maturity) and ϵ_i are the residuals.

The dependent variable (Y) $Spread_i$, is proxied with the I-spread which is the difference (in basis points) between its yield to maturity and the linearly interpolated yield for the same maturity on a suitable reference yield curve. The I-spread is commonly used as a proxy for the risk premium of a financial instrument. The independent variable (X) $Green_i$, is a dummy variable which is equal to 1 when the bond is green and 0 otherwise.

I control for bond characteristics such as coupon and maturity, firm size [FSIZE], which is proxied by the natural logarithm of firms' total assets (Chalabi et al.). Since leverage has been shown to lead to higher spreads, I control for firm leverage [FLEV], which is measured as total debt to total assets (Demerjian, 2011). Moreover, profitability of companies is also expected to be an important determinant for the cost of debt and I use EBITDA divided by total assets as a proxy for profitability [FPROF]. Additionally, I also control for bonds' credit rating which is primary measure of default probability [CR] and it is likely to affect the cost of debt (Chalabi et al.). Lastly, I also control for industry, using the 3-digit SIC codes, year fixed effects and ϵ_i are the residuals.

6. Empirical Results

In this section, I describe the empirical results of this research. Table 2 reports the descriptive statistics on the full sample.

Table 2: Descriptive statistics

Panel A: Number of observations per year			
Year	Frequency	Percent	Cum
2010	38	2.34	11.77
2011	54	3.33	15.10
2012	105	6.47	21.57
2013	157	9.67	31.24
2014	233	14.36	45.59
2015	387	23.84	69.44
2016	354	21.81	91.25
2017	142	8.75	100.00
Total observations	**1,623**		

This table reports the descriptive statistics. It shows the number of observations per year, percentage and cumulative percentage.

Table 2: Descriptive statistics

Panel B: Shows number of observations, mean, median and standard deviation per variable				
Variable	Obs.	Mean	Median	Std. Dev.
I-Spread	1,623	156.91	224.789	250.544
Maturity	1,623	9.132	7	
Coupon	1,623	4.351	4.254	2.148
Firm Size	1,565	10.963	8.976	2.842
Firm Lev.	1,565	0.286	0.219	0.196
Firm Prof.	1,565	0.074	0.052	0.195
This table describes the descriptive statistics on the full sample.				

6.1 Test of the Hypotheses

In this section, I describe the results obtained by running the main regression. To assess the validity of the results, I check for homogeneity of variance (homoscedasticity), thus the error variance of the variables is constant. Moreover, I control for influence in to avoid single observations, exert undue influence on the coefficients.

To evaluate the importance of the independent and control variables, I regress the equation above: (1) using only the independent variable and including no control variables; (2) including also control variables to check for bonds' characteristics (maturity, coupon); (3) adding also control variables to check for issuers' characteristics (firm size, firm leverage, firm profitability and issuers' credit rating.

Table 3 shows the regression results for the paper's research question RQ, which explores whether bonds' I-spread is affected by their "greenness". To operationalize Green Bonds, I use a dummy variable called "Green" which is equal to 1 for green bonds and 0 for non-green bonds. When using no control variables, the coefficient on Green is negative and highly significant, suggesting that green bonds have a lower I-spread compared to regular bonds.

Table 3: Bonds I-spread regression results

Variable	(1)	(2)	(3)	(4)
Green	-187.182 (-3.5)***	-139.836 (-2.72)**	-144.066 (-0.87)	-433.323 (-2.24)**
Coupon		100.673 (13.84)***	72.744 (6.49)***	70.341 (5.61)***
Maturity		-2.562 (-1.64)	-1.205 (-0.59)	0.627 (0.28)
Firm Size			-0.191 (-0.01)	-13.370 (-0.65)
Firm Leverage			59.788 (1.75)*	10.707 (0.24)
F. Profitability			-10.874 (-0.39)	-38.240 (-0.93)
Credit Rating			71.117 (5.61)***	82.110 (5.09)***
YearDummies			-	Yes
IndustryDummies			-	Yes
N	1,623	1,623	1,565	1,565

This table reports the firms' spread regression results by using Green Bonds VS Regular Bonds. Because I do not specifically predict positive coefficients for the variables, the p-values are for two-tailed tests to allow for effects that have possibly been foregone. In Appendix, Table A contains the variables descriptions. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

In column (2), Table 3 shows the relation between I-spread and Green bonds, including also bonds' control variables such as Coupon and Maturity. The coefficient on Green (X) is still negative and significant at 5% level, suggesting that green bonds present lower I-Spread compared to non-green bonds. The coefficient on Coupon is positive and significant at 1% level, suggesting that the higher the coupon, the higher the I-Spread. The coefficient on Maturity is negative but not significant.

In column (3), I also include bond and issuer control variables. The coefficient on Green is negative but not significant. The coefficient on the control variable Coupon is positive and significant at 1% level. The coefficient of Firm Size is negative but not significant, suggesting that this variable does not affect the relation between dependent and independent variable. The coefficients on Firm Profitability which is proxied by firms' Return on Assets (ROA), is negative but insignificant. I also insert a control variable for Firm Leverage. The coefficient on this variable is positive and slightly significant, suggesting that firms with more long-term debt presents higher I-Spread levels on their outstanding bonds. When controlling for issuer's Credit rating, I notice the coefficient is positive and highly significant, indicating that the I-Spread is higher for bonds issued by companies with higher probability of default. When testing for potential multicollinearity concerns, I find low coefficients that do not impair the internal validity of this research[1].

Lastly, I check the strength of the relation between Green bonds and I-Spread, when including bonds' and issuers' control variables and Industry and Year fixed effects (column 4). In fact, I also include fixed year effects and industry fixed effects to control for the evolution of the relation between green bonds and their I-Spread over time and across different industries. The coefficient on Green is still negative and significant. The control variable Coupon is positively and significantly related to bonds' I-Spread. Also, the coefficient on credit rating of the issuer is still positive and significant, when adding fixed effects for Year and Industry. To increase robustness of my results I conduct heteroskedasticity test where I find the H_0: Constant variance , which suggests that there is no heteroskedasticity and the P value is 0.097 (more than 0.05) therefore the hypothesis cannot be rejected.

7. Conclusion

This Master Thesis investigates the characteristics of Green Bonds, innovative financial products whose "Use of Proceeds" are used to finance projects with a positive environmental impact such as renewable energy or energy efficiency projects, green buildings, sustainable waste management, sustainable land use, biodiversity protection and enhancement, clean

[1] The multicollinearity coefficients are: 1.01 on Green, 2.24 on Firm Size, 2.15 on Firm Profitability, 2.02 on Firm Leverage, 1.76 on Issuer Credit Rating, 1.65 on Coupon, 1.11 on Maturity.

transportation. Moreover, I examine whether green bonds trade at a tighter spread compared to senior bonds, hence whether there is a concrete pricing advantage in "becoming green". In fact, except for the proceeds, green bonds are similar in structure and risk to traditional bonds.

Today, investors are increasingly integrating ESG factors in the investment decision process. Nowadays, about USD23Ttn are currently managed with some types of ESG analysis. Moreover, there are many SRI investors started setting up dedicated green bond funds that invest only in green bonds or in bonds issued by highly sustainable companies with high ESG rating.

Since the green bond market is rapidly growing, despite being still a niche market compared to the traditional bond market, I decided to investigate whether there is a pricing advantage in issuing green bonds for companies.

I compare the performance of green and non-green plain vanilla bond issued by the same companies during the time frame 2010-2017. I also include some control variables to improve the internal validity of the research.

When using no control variables, the coefficient on Green is negative and highly significant, suggesting that green bonds have a lower I-spread compared to regular bonds. Even when including control variables such as Coupon and Maturity, the coefficient on Green (X) is still negative and significant at 5% level, suggesting that green bonds present lower I-Spread compared to non-green bonds. When including bond and issuer control variables, the coefficient on Green is negative but not significant.

Hence, my results show that there is a small pricing advantage for green bonds, but it is not significant when considering several factors that affect the relation between independent and dependent variables. This finding is in line with Baker et al., (2018) who find that municipal U.S. green bonds are issued at a small premium compared to non-green U.S. bonds, with similar characteristics.

This research contributes to existing literature because it is one of the first papers addressing the green bond subject and whether there is pricing advantage for companies in going green. Moreover, this paper provides a clear overview of the recent developments of the green bond market and analyses the increasing SRI green investors' appetite to invest in sustainable companies.

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