Green Bond Pricing: The Greenium and the Effect of Certification

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Abstract

We study green bonds, whose proceeds finance climate-friendly projects. After an overview of the rapid development of the global green bond market, we study pricing differences between green and nongreen bonds in the secondary corporate bond market. To calculate the relative price of green bonds, we match green bonds to similar ordinary bonds issued by the same firm. As predicted, we find that green bonds trade at a premium to nongreen bonds. We also find implications that this premium is larger for bonds that have been certified by the Climate Bonds Initiative. This paper adds to, and updates, the growing body of evidence on green bond pricing dynamics.

JEL: G11, G12, G24, Q56

Tutor: Ramin Baghai

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1 Introduction

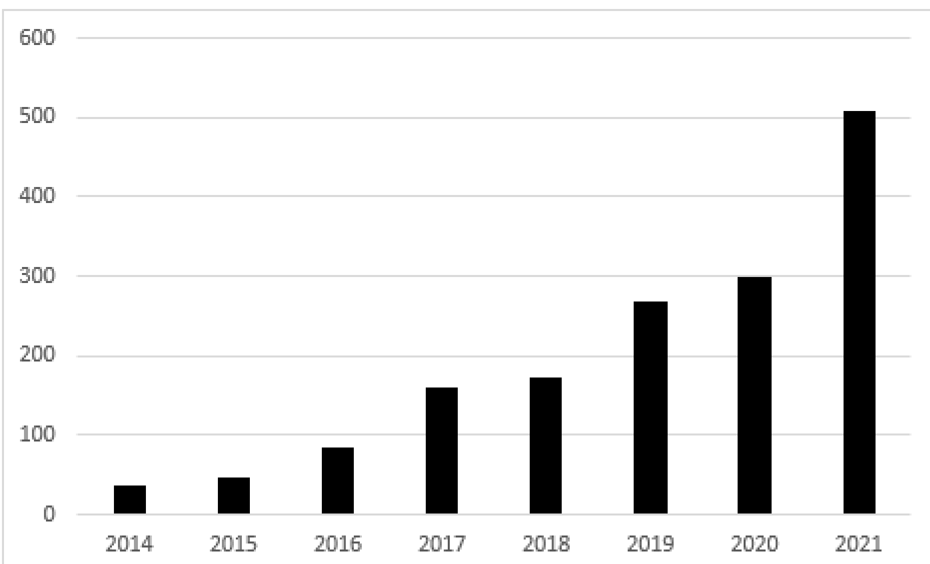
Over the last decades, it has become evident that the way humans interact with the planet is unsustainable, depletes natural resources and rapidly changes our natural environment. On the 28th of February 2022, the Intergovernmental Panel on Climate Change (IPCC) released its latest update on the developments of climate change. The report concluded that its effects are already more widespread, impacting nature and people more intensely, more frequently and over a wider geographical area than previously believed (IPCC, 2022). Some of the effects are already inevitable and will continue growing over the coming decades, while others can still be mitigated by taking relevant measures. Further consequences of climate change can still be reduced by decreasing greenhouse gas emissions, but there must be global simultaneous adaptation to deal with the already irreversible effects.

To achieve this, there is a large need for capital to be channeled towards climate change mitigation and adaptation measures. The last major joint commitment to facilitate this was made in 2015, when the developed countries that signed the Paris Agreements pledged to make USD 100 billion available annually for green investments between 2020-2025, and at least that amount in the years after. OECD estimates, however, suggested that USD 6.2 trillion per year in investments would be needed between 2016-2030 to achieve the 'low carbon' scenario (OECD, 2017). That estimate is far higher than the amount pledged under the Paris Agreements, and more than double the then-prevailing annual USD 3 trillion that was invested in infrastructure globally. So, to attain the necessary investments required for the low carbon scenario, considerable additional capital had to be mobilized.

An obvious place to look, then, were the international capital markets. The OECD (2017) and World Bank (2015) considered especially the bond market, valued around USD 128.3 trillion as of August 2020 (ICMA, 2020), a critical source of funding the energy transition. Energy transition investments, which are mostly in infrastructure, are generally characterized by high upfront investment costs and long subsequent asset lifetimes, for which bonds are an ideal-suited financing instrument.

For that reason, a new type of bond appeared in the market: a green bond. Green bonds are a special type of bonds that have the specific goal of allocating capital to projects related to climate change mitigation and adaptation (CBI, 2020). Use of proceeds of green bonds are constrained to being invested in projects that benefit the environment and therefore offer less spending flexibility than their nongreen counterparts. The first green bond was issued by the European Investment Bank (EIB) in 2007, and since then they have been issued extensively by national governments, supranationals, municipalities, financial institutions, and corporations. Since its inception, the green bond market has grown exponentially, reaching a new record high of USD 500 billion in new issues in 2021 (CBI, 2022). Figure 1.1 below presents an overview of the green bond market development between 2014-2021.

Figure 1.1: Total green bond issues, ($ billion)



Source: CBI, 2022

Shown in table 1.1 on the next page are the 2021 issues split by region, currency, issuer type, and use of proceeds. About half of the green bonds were issued in Europe, so it is not surprising that the Euro is the largest represented currency. Another thing that stands out is that a relatively big share of green bonds were issued in U.S. dollars compared to the issues the in North American region, which implies that issuers in other regions may prefer issuing dollar-denominated bonds. About 60% of the issues in 2021 were conducted by private sector financial and corporate players, whereas the rest were issued by government-related agencies. Finally, most of the use of proceeds went towards projects in energy, buildings and transport, three major pillars within the environmental transition space.

Table 1.1: Global green bond market 2021, ($ billion)

		Size ($bn)	Percentage
Total size		**495,0**	
Region	Europe	249,0	*50,3*
	Asia-Pacific	130,6	*26,4*
	North America	93,3	*18,8*
	Supranational	13,4	*2,7*
	Latin America	8,3	*1,7*
	Africa	0,4	*0,1*
Currency	EUR	212,8	*43,1*
	USD	136,8	*27,7*
	CNY	58,7	*11,9*
	GBP	35,4	*7,2*
	Other	50,4	*10,2*
Sector	Financial	159,2	*32,2*
	Corporate	140,4	*28,4*
	Sovereign	72,7	*14,7*
	Government	70,3	*14,2*
	Development Bank	37,8	*7,6*
	Local Government	14,6	*2,9*
Use of Proceeds	Energy	177,8	*35,9*
	Buildings	141,5	*28,6*
	Transport	84,4	*17,0*
	Water	30,2	*6,1*
	Land Use	23,0	*4,7*
	Other	38,1	*7,7*

Source: CBI, 2022

Shortly after the green bond market appeared, talks about potential pricing differences between green and nongreen bonds started. The underlying reasoning being that, since some investors may have utility from investing in something that makes positive impact, they may be willing to accept lower returns (Fama & French, 2007). Within environmental investing this has also transferred to the institutional investor side, where investment managers are increasingly integrating green allocation requirements in their investment strategies (Gibson et al. 2020). Due to the positive impact of green investments, demand for green securities can thus be expected to be relatively high, which may translate into pricing differences between green and nongreen securities. In the case of bonds, such a price difference would take the form of a yield difference between green and nongreen bonds. Green bonds would then be expected to yield lower compared to nongreen bonds. That potential yield difference between green and nongreen bonds has come to be known as the green bond premium, or 'greenium'.

If investors would be willing to accept lower returns based on environmental characteristics that green bonds offer, that would mean that issuers can lower their cost of capital by investing in sustainable assets. Investing in green projects would then thus be relatively cheap for issuers. Since the mobilization of capital towards environmental projects is critical in the fight against climate change, green projects being cheaper to finance can be an important motivator for issuers. Studying the potential existence of a greenium and its characteristics is therefore a highly relevant research area.

So far, research on the greenium has yielded mixed results. But, a small greenium of a few basis points appears to exist in the secondary markets (Zerbib 2018; Baghai, Becker & Feldhütter, 2020). The aim of this study is to add to this literature and investigate the general existence of a greenium. We identify a greenium of about 3.6 basis points in our sample that ranges from 2013-2021, a figure that has decreased in size over time but shows signs of renewed growth towards the end of the sample period.

Besides looking at the general existence of a greenium, the aim of this study is to look at one of its nuances: if, and how, yield differences between green and nongreen bonds are affected by certification. Since the inception of the green bond market, a one universally accepted system for determining the greenness of bonds has been lacking. Some are self-labelled as green by issuers, some receive second-party opinions on use of proceeds by verifiers, some are labelled as green by data providers such as Bloomberg, and some receive certifications (CBI, 2020). Due to the lack of generally accepted standards and procedures, it can be unclear to investors to what extent, and if at all, bonds they invest in are green. When bonds are certified, this means that the use of proceeds have been checked by the main authority in the field and the issuer has agreed to engage in (rigorous) monitoring and reporting procedures post-issuance. This reduces information asymmetries with investors and takes away risks that are related to 'greenwashing', where firms falsely pretend to engage in sustainable behavior for reputational gain. The aim of this study therefore is to see if certification affects yield differences between green and nongreen bonds, since certifying a bond reduces the information asymmetries and should therefore be valuable to investors. We find implications that certification indeed increases the size of the greenium, by about 2.0-3.3 basis points, but are unable to conclude this confidently due to a small amount of certified bonds in our dataset.

2 Literature Review

2.1 Non-pecuniary Investor Preferences & Socially Responsible Investing

To start looking at the greenium, it is important to understand the mechanisms that underly it. One rationale for the potential existence of a greenium is that there exists a subset of investors that have a 'nonpecuniary' component of utility in addition to standard mean-variance optimization (Baker et al. 2018). Under this assumption, besides the usual CAPM beta, the expected investor-specific return contains an extra term that reflects the demand for certain positive aspects that a security offers, in this case environmental benefits. This second environmental term is included in the 'total return' for some investors, making them willing to partly forgo some of the financial gains. This prediction reflects those of the general equilibrium model and taste-based framework (Heinkel et al. 2001; Fama & French 2007).

Evidence indeed supports that some investors are willing to partly forgo financial returns in exchange for social benefits. One of the first examples of this stems from a paper by Hong and Kacperzyk (2009) who show that 'sin stocks', stocks of companies that engage in generally regarded as 'bad' activities like cigarettes, weapons, or gambling, trade at discounts to fundamental financial value. Such stocks thus seem to be screened out by a subset of investors, lowering their overall demand, lowering prices and increasing financial returns. Besides some investors simply avoiding 'bad' stocks, Renneboog et al. (2008) find that there also exists a subset of investors that is willing to accept lower financial performance to invest in funds that meet certain social objectives.

Since then, Socially Responsible Investing (SRI) considerations have become centerpiece in the portfolio decisions of institutional investors. Gibson et al. (2020) report that by the end of 2017, more than half of all institutionally managed equities were owned by signatories of The Principles for Responsible Investments (PRI). Signatories of the PRI pledge to integrate Environmental, Social and Governance (ESG) considerations in their investment processes. Especially European-based investors are likely to commit to responsible investing practices compared to other regions, likely caused by regional differences in fiduciary duties. In the U.S., for instance, fiduciaries are generally expected not to put ESG goals ahead of financial ones. By the end of 2019, PRI signatories accounted for about USD 80 trillion in Assets Under Management (AUM), of which the large majority was in fixed income (41%) and equities (38%). Within both these categories, 33% of PRI signees reported to engage in 'Thematic investing', which means that they actively pursue opportunities to allocate capital to sectors that align well with certain ESG themes such as renewable energy. For fixed income, thematic investing includes green and social bonds. In practice, about 12% of listed equities and 11% of fixed income were reported to be allocated to Thematic Investments by the end of 2019. In addition, Matos (2020) finds that investment managers are now required by asset owners to be signed up to the PRI and invest some minimum percentage of AUM in green assets, or they will not receive investment mandates. Sustainability considerations have thus become a leading factor in institutional investor investment strategies.

So, it seems likely that differences in investor demand exist for investments with green characteristics. If, and to what extent, this also translates to price differences between green and nongreen securities depends on the characteristics of the underlying markets. To illustrate, we quickly touch upon the differing dynamics that debt and equity have with sustainability.

2.2 Debt, Equity & the Environment

Flammer (2020) finds that stock prices of firms rise after the announcement that the firm will be issuing a green bond. At the same time, however, she finds no price difference between green and nongreen bonds issued by the same firms. The positive environmental aspects of issuing a green bond, which investors seek out, here seem to flow to equity and not debt. To explain this, a better understanding of the different characteristics of stocks and bonds and their relation to climate change is useful.

The issuance of a green bond signals to investors that a firm is focused on, and invests in, the future (Zerbib, 2018). Firms that are not sustainability-focused, in industries where the environment is a material factor, are at risk of becoming 'stranded assets': assets that no longer comply with prevailing standards and therefore lose (all) value (Schramade, 2018). Firms that focus on, and invest in, the future are less at risk of becoming such stranded assets and are therefore less risky in general.

Equity prices reflect the present value of all expected future cashflows to equity, and future cashflow expectations are higher when a firm is future-proof. The fact that sustainability alignment influences equity pricing is therefore quite intuitive (Schramade, 2018). Sustainability-based equity pricing therefore also includes a strong 'fundamental value component' and is not just influenced by investors wanting to do good. For bonds this is different. For starters, bonds are 'senior' to equity and have a limited maturity. Common equity's value is the total expected value of all future residual cashflows, cashflows after all senior claims are paid. With debt, instrument holders have the right to, and only to, a contractually specified amount of cashflows. These cashflows vary based on specifications such as maturity date, coupon rates, payment frequency, and repayment profile. The (expected) value of such a bond is thus a function of 1) these contractually specified cashflows and 2) repayment risk. So, where the value of equity reflects all residual cashflows expectations in the life of the firm, the value of debt depends on the planned cashflows and risk of nonpayment.

The effects of climate change and risks of becoming stranded are both still (far) in the future. Debt securities, with their limited lifetimes, are therefore less affected by climate risk than equity. To illustrate, say the oil industry will be nonexistent in 20 years and an oil company currently has a bond outstanding that matures in 5. Since the value of equity reflects the future value of the firm, and that value will tend to 0 over the next 20 years if no action is taken, the equity value will go down accordingly with each day that passes. But for the bond, the value depends on the firm's ability to repay, which is much less likely to be heavily affected over the next five years.

Due to its seniority to equity and shorter lifetime, the fundamental value of debt instruments is by design less affected by climate risk. With the value component being smaller, greenness-based pricing differences should be less pronounced in debt instruments. The difference in debt yields that does exist is then a purer reflection of investor preferences and mandates, and less of priced-in climate risk. Over the last decade, a growing body of evidence has been trying to figure out if yield differences in debt instruments are, and to what extent, affected by greenness.

2.3 A Brief History of the Greenium

The first green bond was issued by the EIB, a supranational organization, in 2007. The World Bank, another supranational, raised the first USD 1 billion green bond in 2013. Green bonds have also been issued extensively by governments, with a prime example being the USD 10 billion green bond issued by the republic of the republic of France in 2017. Besides national government and supranational issuances, sub-sovereign, financial and corporate issuers have also grown rapidly since then.

After the issue of the first green bond by the EIB, discussions about the (non)-existence of a green bond premium started quickly. It began with some anecdotal statements from green bond issuers who claimed their bonds were oversubscribed, resulting in pricing benefits (Harrison et al. 2020). But, since the market was still very small with few bonds to analyze, such anecdotes were difficult to verify.

One of the first academic studies that did investigate a potential greenium was by Karpf and Mandel (2018), who looked at green bonds issued by municipalities. They, and other early authors, mostly looked at bonds issued by municipalities. The reason being that simply more data was available for that issuer type to study. Municipal bonds are often much smaller-sized than bonds issued by other entity types, such as corporates, while their respective total dollar market sizes were roughly the same. Additionally, green bonds comprised a relatively larger part of the municipal market. In 2016, 2% of new municipal bond issues were green while only 0.3% of corporates were. The smaller issue sizes and relatively high market share resulted in much more municipal green bonds to look at, making that the ideal starting point for studying the greenium. So, Karpf and Mandel construct a sample of 1,880 bonds, issued by U.S municipalities between 2010 and 2016, that were labelled as green by Bloomberg. These bonds were compared to 36,000 conventional bonds by the *same* issuers. The results of that first study actually indicate a small green bond discount, contrary to expectations.

Baker et al. (2018) subsequently performed an analysis of 2,083 municipal bonds, also issued between 2010 and 2016 and defined as green by Bloomberg. They compare these with 643,299 conventional municipal bonds, where bonds from other issuers are also included. They use a fixed effects approach where they aim to control for both issuer and bond-specific differences. Contrary to Karpf and Mandel, they find a 6-basis point greenium, a figure that grows upon certification by the CBI. The argumentation for this difference in results is that Karpf and Mandel do not account for taxability differences between green and nongreen bonds, resulting in biased estimates in their study. In the beginning of the U.S. green bond market, green bonds were awarded tax incentives that affected yields, which led Karpf and Mandel towards their green bond discount. Baker et al. account for this in their own study and therefore find different results.

Larcker and Watts' (2020) view is that Baker et al.'s study design choice leads to spurious inferences. They argue that the fixed effects approach used insufficiently controls for nonlinearities and issuer-specific time variation. For instance, green bond issuers tend to be much larger than nongreen issuers, which may be an omitted variable leading Baker towards a false greenium. To avoid these issues in their own study, Larcker and Watts compare green securities to (nearly) identical counterparts issued by the same entity, on the same day, with similar maturities. Since municipal bonds are often issued in cohorts, where a municipality for instance issues 20 bonds on one day, it is possible to find identical green and nongreen counterparts in the municipals market. Doing so, Larcker and Watts find that there is no yield difference between green and nongreen bonds. More so, they find that investment banks charge slightly more to issue green bonds, indicating that issuing green bonds may even be a bit more expensive.

Flammer (2020) uses a similar methodology as Larcker and Watts, but instead applies it to the corporate bond market. Since corporations rarely issue two identical securities on the same day, Flammer chooses a slightly different approach. She compiles a sample of 152 green bonds, corresponding to 65 unique issuers. For these issuers, 1,690 brown bonds are extracted from which each green bond is matched to its most closely related brown counterpart. Using this methodology, like Larcker and Watts (2020), Flammer finds no yield differences.

Building on these studies, Partridge and Medda (2020) perform a matched pair analysis on 453 matched pairs of green and nongreen municipal bonds, issued between 2013 and 2018. These bonds were, like those in the sample of Larcker and Watts, issued at the same time, under the same official statement, with identical bond characteristics. In line with Larcker and Watts, no price difference is found in the primary market. However, a greenium is found in the *secondary* market, a greenium that increases each year and reaches nearly 5 basis points by the end of 2018.

The nonexistence of a greenium in the primary market, at least in the first years of the green bond market, appears proven. But as the above study indicates, it may prevail in the secondary market. Zerbib (2018) also analyzed the secondary green bond market. But instead of looking at municipal bonds, the sample in that study comprised of 110 bonds issued by different issuer types: governments, national and supranational agencies, financials and energy companies. Instead of matching a green bond to a single nongreen, the greens in that study were matched to a pair so that a synthetic bond with a similar maturity to the green can be created. The sample period runs from July 2013 to December 2017, and in that period an average -2 basis point greenium is identified. The yields of green bonds are thus 2 basis points lower than that of nongreen bonds, making them 'more expensive' to investors. Additionally, Zerbib finds that the greenium is larger for bonds issued by financial institutions and bonds with lower credit ratings.

More recently, Baghai, Becker and Feldhütter (2020) also performed an analysis of the secondary market, but they instead focused on corporate bonds. Their sample comprised 229 greens issued by 133 unique issuers and runs from 2013 to 2018. On average, they find a 6bp greenium over this period. Interestingly, and contrary to Partridge and Medda (2020), they find that this greenium weakens over time and basically reaches zero in the end of the sample period in 2018. Besides a small general yield differential, they find that the price difference between green and nongreen securities is subject to the relative environmental performance of a firm's assets. The greenium is largest for those firms that are 'in the middle' of the asset sustainability range, so firms that own both green and nongreen assets.

The evidence so far seems to suggest that a small green bond premium exists in the secondary market but not (yet) in the primary. Additionally, the secondary market greenium has been shown to be context-dependent and changes based on factors such as industry type, credit rating and environmental performance. So even though the general greenium found is quite small, it may have bigger economic significance in certain contexts. If it is for instance much larger for energy companies with a lower credit rating in the middle of the sustainability range, that may still prove an important motivator for these firms to issue green bonds. Studying the greenium and what affects it therefore remains highly relevant. One important nuance that has been touched upon but not analyzed extensively, is the effect of certification on the greenium.

2.4 Signaling and Certification

An important issue within the green bond space has been the lack of regulation and global (enforceable) standards (Baker et al., 2018). Any firm can issue bonds at any time and call them green, which makes it difficult for investors to judge whether their investments serve their intended purpose. Issuers can pretend to issue green bonds to portray themselves as environmentally responsible while their use of proceeds are actually invested brown, a phenomenon known as 'greenwashing'. This is bad for both od' green bond issuers, since the ambiguity around greenness may lower the demand for its bonds, and for investors since it muddles their intended capital allocation. Of course, well-informed investors can still judge how credible the issuance of a green bond is, but this may be time and resource intensive when the reputation of the issuer is unclear. Overcoming this information asymmetry is thus an important step in the further development of the green bond market.

Issuers can reduce information asymmetries by use of 'signaling', taking actions that prove commitment towards the environment in the case of green bonds. In signaling theory, a signal is credible if it is difficult to copy by firms with nondesirable characteristics (Spence, 1978; Riley, 1979). For green bonds, the signal would be strong if it would be impossible for issuers with greenwashing intentions to send. Ideally, there would be enforceable standards and regulations that define the applicable use of proceeds and required monitoring and reporting procedures of issuing green bonds. That would hinder issuers with bad intentions to get their 'green' bonds through, making issuing a green bond already a sufficient signal. Such strong enforceable requirements, however, do not yet exist.

To deal with this, various voluntary principles and guidelines have been developed over time by different types of agencies. The first major green bond standards were the Green Bond Principles (GBP), created by a consortium of global investment banks including JP Morgan, BNP Paribas, and Bank of America Merrill Lynch (GBP, 2018). The GBP are a collection of voluntary frameworks that aim to promote the role that the global debt capital markets can play in financing progress towards environmental sustainability. The GBP defined voluntary guidelines that could be used by green bond issuers and investors to increase transparency. It specified guidelines for 4 main pillars that are central in the development and standardization of the green bond market: use of proceeds, project evaluation and selection processes, management of proceeds, and post-issuance reporting procedures. In addition, the GBP advised issuers to appoint external audit services to demonstrate compliance with the four pillars. This could take the form of Second party opinions (SPOs) regarding the use of proceeds, verification, annual auditing, or certification. Such external quality stamps decrease information asymmetries between the issuers, investors and other stakeholders and are therefore very useful. After the inception of the GBP, the Climate Bond Initiative (CBI) created its own set of guidelines and procedures. The CBI was, like the GBP, created to align the interests of green bond market participants but contributes with a much more detailed taxonomy. Where the GBP offers useful general minimum guidelines, the CBI specifies more detailed and sector-focused guidelines in its Climate Bonds Standard (CBS). The

CBS is the only standard that complies with the Paris Agreement goal of limiting global warming to 1.5 degrees Celsius. The CBI and its CBS have therefore become the 'main authority' in the field.

Green bonds can receive certification in line with the CBS, a stamp that is regarded as the strongest quality indicator available. The reason for this is twofold. First, as mentioned, the CBS is the only standard that is 100% aligned with the Paris Agreements' goal of limiting global warming to 1.5 degrees Celsius. Second, certification subjects issuers not only to heavy pre-issuance sector-specific screening, but also imposes strict post-issuance requirements. These post-issuance requirements on use of proceeds, monitoring, and reporting force issuers to comply or risk losing their bonds' certification. Due to the CBI imposing the strictest pre-and-post-issue requirements, it is the most difficult to attain for issuers. That makes it costly and resource intensive to receive, and basically impossible to get for greenwashers. Consequently, certification by the CBI is regarded as the strongest 'signal' of environmental commitment that is available to green bond issuers.

Because the information asymmetry is lowest for bonds that receive certification by the CBI, the investor that buys a certified bond has the highest certainty of rightly allocating capital to the goals s/he wants. Intuitively, the greenium should then be higher for certified bonds because the certainty of greenness and low investigation requirements are valuable. Practically, green bond yields should then be expected to be lower for certified than non-certified bonds.

Some studies have looked at this exact mechanism. Baker et al. finds, in their sample of municipal bonds, that the greenium grows by about 10bp upon certification. But as was touched upon in one of the previous paragraphs, that study has design misspecifications that make it difficult to draw meaningful conclusions. Another study that looked at the effect of certification by the CBI was Flammer's (2020), but she unfortunately only looked at its effects on equity pricing. She finds that green bond issuance announcements affect stock prices heavily and (statistically) significant for certified bonds, with a cumulative abnormal return (CAR) of 0.71%. For non-certified bonds, the response was much smaller (0.25%) and statistically insignificant. First implications that certification affects security pricing thus exist, but to what extent this is true for bonds remains open. The aim of this study is to investigate that exact phenomenon.

2.5 Hypotheses

The aim of this study is twofold. First, since evidence about the general existence of the greenium is mixed, we take another close look at its existence using data after the market has developed for a few more years. We expect:

Hypothesis 1: Green bonds trade at lower yields than nongreen bonds

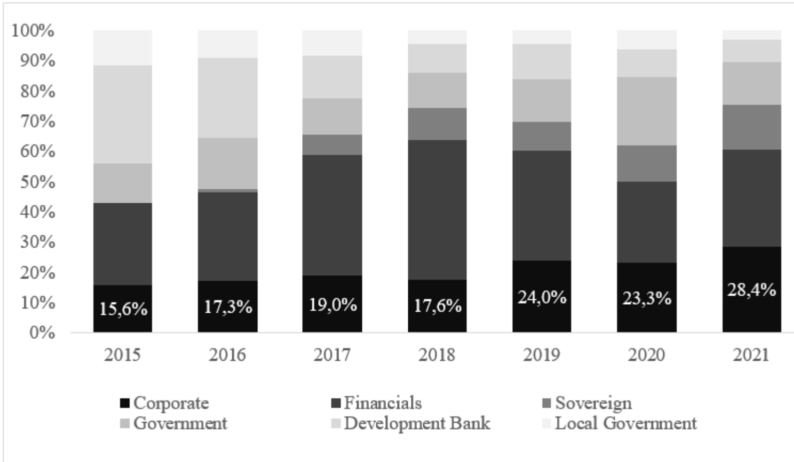
The main aim of this study then is to add an extra layer of nuance: if, and how, does the greenium change subject to certification by the CBI. We expect:

Hypothesis 2: The greenium is larger for certified bonds

2.6 Study Setting

As mentioned, early studies of the greenium mostly looked at non-corporate issuer types for lack of data. Karpf and Mandel (2018), Baker et al. (2018) and Larcker and Watts (2020) look at the municipal bonds market. Zerbib (2018) combined bonds of different issuer types. Flammer (2020) does look at corporate bonds but still had to work with a small sample. After a few more years of growth of the corporate green bond market, much more data is available now than to earlier authors. As shown earlier in figure 1.1, the green bond market has grown exponentially over the last decade. And as shown in figure 2.1 below, corporate bonds have become a more prevalent part of that market over time, accounting for almost 1/3 of the issued amount in 2021.

Figure 2.1: Total corporate green bond issues by sector 2015-2021, ($ billion)



Source: CBI, 2022

Since 2015, corporate bonds have grown from 15% to almost 1/3 of the total amount issued in 2021. Roughly the same as the combined amount issued by all different government-related issuer types. The corporate green bond market is thus strongly positioned to drive and amplify the environmental transition. The rapid growth of the corporate green bond market also entails that there is much more data available now than to earlier authors, which makes this an ideal opportunity to study corporate green bonds. This study will therefore look for the greenium, and if/how it is affected by certification, in a corporate bond market setting.

Within the corporate green bond market, this study will analyze the secondary market. In studies of the municipal bond market, analyzing the secondary market had been difficult. Municipal bonds are much smaller compared to corporates. As a result, they are less liquid and less frequently traded than their larger sized counterparts because there simply are less available to trade and more concentrated holders (Hachenberg Schiereck, 2018). Analyzing the secondary municipal market therefore meant studying theoretical prices or prices based on few trades, so 'real' market yields could still be far from estimates. Since issue sizes in the corporate bond markets are on average much higher, that makes studying the secondary market easier. Additionally, the secondary market may be the most important context in which the greenium currently exists. Primary market prices are set based on the dynamics between the issuers, investment banks, verifiers and investors involved in each issue (Ferry, 2016) . Price setting there is more affective and dependent on the dynamics between these market participants. In the secondary market, 'real demand' meets supply and market prices there are transaction-based. Yields in the secondary market therefore are a purer reflection of current demand and supply. In many cases nonpecuniary preference-based pricing differences have been shown to appear in the secondary market first, after which market pressure transfers them to the primary market (Partridge & Medda, 2020). That may explain the lack of greenium in the primary market. When a yield difference pops up after issue in the secondary market, that means benefits go to the investors. Strengthening the evidence of the greenium in the secondary markets may thus be an important step in transferring it towards issuers.

3 Matching Method & Data Description

3.1 Matching Method

The biggest challenge in studying pricing differences between green and nongreen bonds has been to compare green bonds to as similar as possible nongreen counterparts. As mentioned in the literature review, authors have tried to do so in different ways. Baker et al. (2018) used pooled fixed effects OLS, where differences in bond and firm characteristics such as credit rating, time to maturity, industry and issue size were held fixed. However, when comparing bonds of different issuers, it is very difficult to isolate one specific difference such as greenness because there may be firm-specific factors that underly it. Such constructs are thus at risk of omitting variables, where pricing differences between bonds may not be explained by greenness but some other factor that is not controlled for. Later authors therefore adopted matching approaches, also known as model-free approaches, where only bonds issued by the same issuer are compared (Zerbib 2018; Karpf and Mandel, 2018). By design, firm-specific differences such as credit rating, firm size, industry, etc. are then identical and isolating the effect of greenness becomes more straightforward. While comparing bonds of the same issuer, only bond-specific characteristics like seniority, collateral type, issue amount, time to maturity, and liquidity can then differ. Helwege et al. (2014) performed a variant of the matching approach whereby a green bond was matched with the closest related nongreen bond. But, since most corporate bonds do not have counterparts with identical maturities, single pair matchings give rise to a small maturity bias. Therefore, the approach used in this study resembles that of Zerbib (2018) and Baghai et al.(2020), where a green bond is matched to a synthetic nongreen consisting of two same-firm nongreen bonds. The two bonds in those studies are linearly interpolated or extrapolated on the green. If two bonds, one on either side of the maturity of the green are available, these are interpolated on the maturity of the green bond. If no such combination exists, but there are two bonds on one side of the green's maturity, these are extrapolated on the green. These authors create the synthetics so that the maturity of the green and synthetic bonds is matched. But, since there may be differences in coupon rates between bonds, bond maturities and durations can look quite different. Since the yield of a bond is based on its duration, and not maturity, this may give rise to a yield bias determined by the coupon characteristics of the bond triplets. Therefore, duration instead of maturity matching will be used in the creation of the synthetics. Thus, for each green for which a shorter and longer maturity brown pair is available, the daily pair weightings are determined such that:

$$D_{i,t}^{GB} = w1 * D_{i,t}^{CBs} + w2 * D_{i,t}^{CBl} \tag{1}$$

Subsequently, the yield of the synthetic becomes:

$$y_{i,t}^{CB} = w1 * y_{i,t}^{CBs} + w2 * y_{i,t}^{CBl} \tag{2}$$

When no such combination is available, the synthetic bond is created by extrapolating two bonds on either side of the maturity of the green bond. The yield construction then looks as follows:

$$y_{i,t}^{CB} = y_{i,t}^{CBc} \pm (D_{i,t}^{GB} - D_{i,t}^{CBc}) * \frac{(D_{i,t}^{CBc} - D_{i,t}^{CBf})}{(y_{i,t}^{CBc} - y_{i,t}^{CBf})} \tag{3}$$

Where:

$y_{i,t}^{CBc}$ = Yield of conventional bond with closest duration

$y_{i,t}^{CBf}$ = Yield of conventional bond with closest duration

$(D_{i,t}^{GB} - D_{i,t}^{CBc})$ = Duration difference between green bond and closest nongreen bond

$\frac{(D_{i,t}^{CBc} - D_{i,t}^{CBf})}{(y_{i,t}^{CBc} - y_{i,t}^{CBf})}$ = Slope of yield

3.2 Green Bond Sample Description

A comprehensive set of green bonds is compiled using the Green Bond database of Thomson Reuters Eikon, which includes all bonds that are self-labelled as green. This data was supplemented and cross-examined with data from the Environmental Finance Bond database. The entire database counts 5,055 securities. Since this study will look at the secondary market and sufficient datapoints must be ensured, we exclude securities issued after 2020. Since most corporate green bonds are issued in euros (Eikon, 2022; CBI, 2022), and there may be differences in investor demand for green instruments between different currency markets (Sangiorgi & Schopohl, 2021), we exclude all bonds issued in non-euro-denominated currencies. Since liquidity is a crucial part of bond pricing, we, like Hachenberg and Schiereck (2018), exclude bonds with issue amounts lower than

EUR150 million. Larger-sized bonds are typically both traded more frequently and less densely held, so taking a minimum issue size will result in higher quality pricing data.

Then, we exclude non-fixed coupon bonds such as bonds with floating rates or rate ranges. Furthermore, only senior unsecured bonds will be included in the sample. Bonds that are subordinated or collateralized (on for instance mortgages) are often imperfectly comparable to other bonds, so there is more risk of yield biases in those kinds of bonds. Finally, we exclude all bonds issued by financial institutions, since these are outside the scope of this study.

Since the goal is to compare green bonds to as similar as possible nongreen counterparts, we put several restraints on the bonds used for matching. As explained, all nongreen bonds will be from the same issuer to compensate for potential firm-specific differences. Then, all nongreen bonds must also have a fixed coupon and similar seniority and collateral characteristics since differences in those characteristics affect risk profiles and yields. The nongreens must also have similar callability characteristics. Specifically, if the green bond is non-callable, the nongreens must be also except for possibly a make-whole call provision. Since differences in size generally result in differences in liquidity, we restrain the nongreen bonds to be no smaller than $\frac{1}{4}$ of the green bonds' issue amount and no larger than 4 times that amount. The time to maturity for the matched pair cannot differ more than 5 years from the green. When bonds age, they tend to become less liquid and end up in long-term holding portfolios. We therefore also restrain the issue dates of the nongreen bonds to be within 6 years of that of the green. Each green bond for which no pair matching the criteria above is available is dropped from the sample.

Finally, we have a few bonds in our final sample for which either daily yield or duration data is missing in Eikon, so these will also be dropped. A summary of the sample selection process is added on the next page in table 3.1. Below that, descriptives about the sample sectors, credit ratings and proportion of certified bonds are added in table 3.2. All individual bonds are listed in appendix 1.

Table 3.1: Summary sample selection

	Securities
Entire sample	5,550
Less bonds issued after 2020	-2,539
Less non-euro denominated	-2,360
Less issue amount <€150 million	-293
Less non-fixed coupon	-55
Less all except senior unsecured	-93
Less financial institutions	-29
Less no pair matchings available	-75
Less missing daily data	-8
Final sample	**98**

Table 3.2: Final green bond sample by sector, credit rating and certification

		n bonds
Sector	Utilities	55
	Industrials	18
	Real Estate	15
	Basic Materials	3
	Consumer	7
Rating	AA	5
	A	35
	BBB	57
	BB	1
Certification	Certified	11
	Non-certified	87
Total		**98**

Note: Data from Thomson Reuters Eikon Nov 2013-Dec 2021

Extracted as of Mars 2022. Certification by Climate Bond Initiative

4 Empirical Approach

4.1 Greenium

Like Baghai et al.(2020), we define the ‘greenium’ as the yield difference between a green bond and a nongreen synthetic. The individual yields of the green and synthetic bonds were defined in the previous paragraph, so the green bond premium can be defined as:

$$\text{Premium}_{it}^{GB} = y_{it}^{CB} - y_i t^{GB} \tag{4}$$

The main aim of this study is to examine if certification by the Climate Bonds Initiative (CBI) affects the yield difference between green and nongreen bonds. The sample contains 11 bonds that have been certified by the CBI. These will be added with a dummy variable that takes the value of one when certified. Our main model then becomes:

$$\text{Premium}_{it}^{GB} = \alpha_{it} + \beta_1 * \text{Certification}_{it} + \epsilon_{it} \tag{5}$$

Where:

α_{it} = is the general greenium

β_1 = the extent to which it differs upon certification

To examine the existence of a certification effect, and to ensure that some other underlying factors are not driving the results, independent variables that are likely to affect the model must be included while ensuring the robustness of the approach.

A first factor that will therefore be included, because it is known to significantly affect bond yields, is liquidity. More liquid securities are traded more frequently and are therefore easier to sell for investors whenever need arises (Zerbib, 2018). Less liquid securities are thus riskier, leading investors to demand a higher yield as compensation.

To account for this, a liquidity proxy must be included in the analysis. There are a few constraints caused by the type of study and data availability that limit the range of liquidity proxies that can be used. First, because we perform a within regression, the liquidity proxy must be time varying with the bond. That excludes a range of static liquidity proxies such as issue amount, issue date or off-the-run versus on-the-run indicators (Bao et al. 2011; Houweling et al. 2005). Second, since Thomson Reuters Eikon does not offer information about daily trading volumes, volume-based proxies also cannot be used (Beber et al., 2009; Dick-Nielsen et al., 2012). Finally, this study analyzes closing yields, and no additional trading data is available, so intraday liquidity indicators such as the Range measure (Han and Zhou, 2016) and Amihud measure (Amihud, 2002) are also not usable. So, like Baghai et al.(2020) and Zerbib (2018), we use the bid-ask spread as liquidity proxy. Specifically, the closing percent quoted bid-ask. Fong et al. (2017) show that the bid-ask spread is the best low frequency liquidity proxy available, and, indeed, it has been widely used as liquidity measure in other studies (Dick-Nielsen et al. 2012; Beber et al. 2009). The construction of the daily bid-ask spreads will, for the green bond, look as follows:

$$BA_{i,t}^{GP} = \frac{Ask_{i,t} - Bid_{i,t}}{Ask_{i,t}} \tag{6}$$

For the individual nongreen bonds, the bid-ask spreads will be computed in the same way. In creating the synthetics, the bid-ask spread is constructed using the same pair weights used for the yield construction. If the synthetic bond is extrapolated, the bid-ask spread is constructed by setting both pair weightings equal. We then take the difference in spread between the green and synthetic bond to construct the liquidity proxy that will be used in the regression:

$$\text{Liquidity}_{it} = BA_{it}^{GB} - BA_i t^{CB} \tag{7}$$

Finally, in later specifications, we add variables for the issue amount and time to maturity since differences in these factors may also influence the yield differences. We take the natural logarithm of both to create the variables. The model, then, will become:

$$\text{Premium}_{it}^{GB} = \alpha_{it} + \beta_1 * \text{Certification}_{it} + \beta_2 * \text{Liquidity}_{it} + \tag{8}$$

$$\beta_3 * Ln(\text{issue size})_{it} + \beta_4 * Ln(\text{Time to Maturity})_{it} + \epsilon_{it}$$

There are several other factors that may affect yield differences which will be held fixed in later specifications. First, time fixed effects are added to account for potential time-dependent differences in yields. The time fixed effect variable will be constructed on a daily basis. Furthermore, other studies suggest that there are differences in greenium subject to credit rating. Zerbib, for instance, shows that negative premia are more pronounced for lower rated bonds. To control for that, a categorical credit rating variable will be created and held fixed in later specifications. We round bond ratings in the sample to the nearest letter value, such that they can only take full letter values. Bonds that are for instance rated A+ or A- are rounded off to A. In our sample, the lowest rated bond is rated BB. Besides time or credit-rating dependent variations, there may be industry-specific differences in yields. So, to make sure that these also do not distort the effect of certification on greenium, we add industry fixed effects. The variable is constructed categorically and based on the economic sector of the issued bond as it is defined in Thomson Reuters Eikon. The following economic sectors appear in our data set: Basic Materials, Utilities, Industrials, Real Estate, and Consumer Cyclicals.

Finally, before turning to the results, it is important to note that there are some potential limitations to the data source used in this study: Thomson Reuters Eikon. Most other studies of the greenium used data from Bloomberg or TRACE, both of which offer real-time data on transactions. In Eikon, daily price data is constructed based on transaction information Eikon receives from partner investment banks (Eikon, 2022). If data is received from multiple sources, Eikon takes their weighted average to construct its daily bids, asks, and yields. If information is received from only one source, that is copied and used. If nothing is received, Eikon uses theoretical modeling. So, even though Eikon is used extensively by institutions and is known for offering high-quality data, there still is a level of uncertainty around the data used in this study. The more data Eikon receives from its partners, the better the quality. Eikon does not disclose daily construction details, so it is impossible to know when and for which bonds theoretical modeling was used. The quality of the data thus depends on the connections Eikon has with the banks that trade the bonds, which may be especially risky for smaller-sized bonds since these tend to be traded at fewer institutions. We aimed to partly correct for this by taking a minimum issue size of EUR 150 million, but some uncertainty remains.

5 Results

For our sample of 98 bonds, corresponding to 55 unique issuers, we obtain 63,470 rows of daily data, which corresponds to an average of 648 daily data points per bond. Eleven of the 98 bonds have received certification by the CBI, and more detailed sample summary statistics of all variables are added in table 5.1 below.

Table 5.1: Summary statistics

		Mean	Median	Min	Max	No observations
Sector	Basic Materials	0,108	0,024	0,509	-0,098	1012
	Consumer Cyclicals	0,085	0,029	0,413	-0,230	3229
	Industrials	0,051	0,030	1,157	-1,665	12896
	Real Estate	0,077	0,283	0,613	-0,370	8374
	Utilities	0,020	0,030	0,878	-1,190	37959
Credit Rating	AA	0,046	0,031	0,290	-0,300	4643
	A	0,050	0,030	0,582	-1,137	25776
	BBB	0,025	0,030	1,157	-1,665	32768
	BB	0,085	0,083	0,405	-0,183	323
Certification	Non-Certified	0,036	0,030	1,157	-1,665	57168
	Certified	0,056	0,031	0,582	-0,223	6302
Liquidity		0,033%	0,005%	7,184%	4,488%	63470
Issue size (€m)		739	750	174	1.750	63470
Time to M (year)		6,57	6,23	0,26	19,65	63470

Source: Thomson Reuters Eikon, sample Nov 2013-Dec 2021

5.1 Diagnostics

First, we run a simple panel regression of certification on the yield difference. We run both random and fixed effects variants and a Hausman test shows that, in line with other similar studies, a fixed effects regression should be used. We perform Breusch-Pagan and Breusch-Godfrey tests, both of which are significant (p-value = 0%). Heteroskedasticity and serial correlation are thus present in the data, which must be accounted for to increase the models' efficiency. To deal with this, Zerbib (2018) used Newey-West standard errors that account for heteroskedasticity and serial correlation simultaneously. But Petersen (2009) finds that Newey-West standard errors are (slightly) biased whenever a time series dependence exists. So instead, we adopt the same approach as Baghai, Becker and Feldhütter (2020) who use clustered standard errors. Because we are interested in the effect of certification, and certification is bond-specific, we will cluster standard errors at the bond level (ISIN).

But before running the main regressions, we run individual effect tests for the industry and credit rating fixed effects that are planned to be included. We start with industry. We regress the categorical industry variable on the yield difference with standard errors clustered at the bond level. Both the entire model (F = 2.02, p = 0.10, R^2= 0.03) and all individual industry averages are not statistically significant. But since we are dealing with time series data, there may be time-dependent differences in industry means that underly this lack of significance. So, we interact the different industries with the individual years in our sample. We then regress the new interaction variable on the yield. This time, the model is significant (F = 174.7, p = 0.00, R^2 = 0.08) and there are several significant individual industry years. So, there are statistically significant time-varying differences in industry yields that must be considered. We will therefore include those as fixed effects in later model specifications.

We do the same for the credit rating. We find that the model is statistically significant (F = 5.05, p = 0, R^2 = 0.02) and so are individual categories A and AAA. Since there may also be time-dependent differences between credit rating yields, we create a similar interaction variable as for industries. We regress that on the yield difference and find that the explanatory power of the model greatly improves (F = 2417, p = 0, R2 = 0.05). The year-interacted credit rating variable will therefore be used to include the credit rating fixed effects in the later main regression specification.

5.2 Main Study

To analyze how and if the greenium differs subject to certification, we run four different specifications. Because certification is bond-specific, standard errors are clustered at the bond-level (ISIN) in all specifications. But before looking at the effect of certification, we look at the general greenium in more detail.

5.2.1 Greenium

The earliest datapoint in our sample stems from the 27th of November 2013, and the sample runs till the end of 2021. In total, the sample counts 63,467 daily bond yield observations. Over that period, we find a yield difference of -3.63 basis points, so a 3.63 basis point greenium, significant at the 1%-level (p = 0.005).

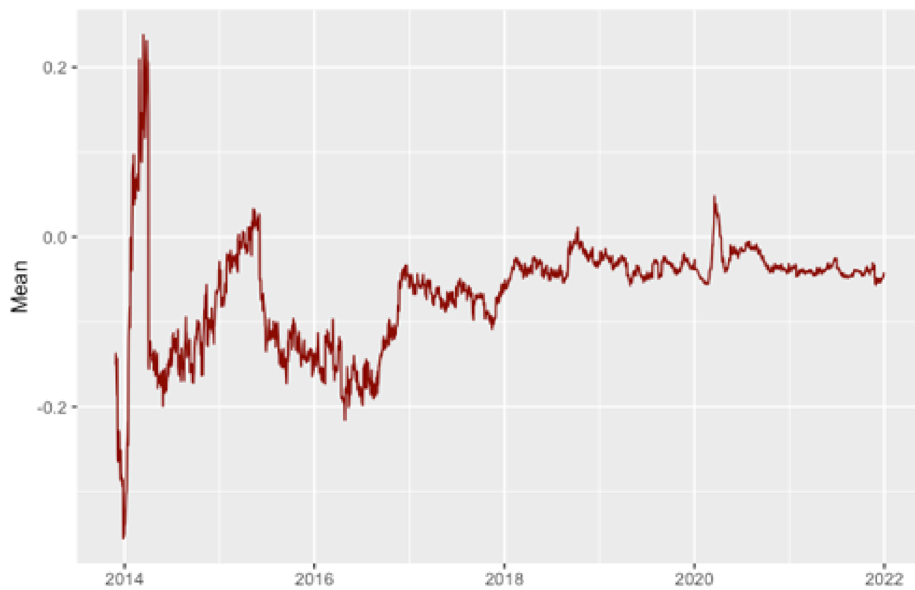
In the study of Baghai, Becker and Feldhütter (2020), who studied the secondary corporate bond market until the end of 2018, the average greenium found was about 6 basis points. They concluded that the greenium had been decreasing over time, and that it even tended towards zero at the end of their sample in 2018. To check our results and update the work of these earlier authors, we replicate that study by creating a subset of our data where all post-2018 datapoints are dropped. The subsample counts 10,565 daily bond yield observations. Performing the same test, we now find an average greenium of 5.63 basis points for the subsample, significant at the 5% level (p = 0.026). The results of both tests are added below in table 5.2.

Table 5.2: Summary greenium

	Main Sample	Subsample till 2018
Greenium	-0.036**	-0.056*
Clustered S.E.	0.013	0.025
# Observations	63,467	10,565

With a few more years of additional data on the corporate bonds market, our main results confirm that the greenium has gradually decreased in size over time. The greenium found up and until 2018 is about 5.6 basis points and decreases by two more basis points with three more years of extra data. The authors also argued that the average greenium seemed to tend towards zero over time. Looking at the results, that does not seem to be the case for our sample. The average greenium only declined by two basis points, while there were approximately 6 times as many observations in our dataset. To verify visually, figure 5.1 on the next page provides a graphical representation of the historical greenium development.

Figure 5.1: Average greenium over time (Nov 2013-Dec 2021)



This also confirms that greenium has grown smaller in size over time. However, in the last two years of the sample, the greenium shows signs of a renewed growth trend. The graph also shows that the conclusion of Baghai, Becker and Feldhütter was justified, since the greenium indeed tended towards zero at the end of their sample period. But in the years following that, that trend seems to have reversed again.

5.2.2 Certification

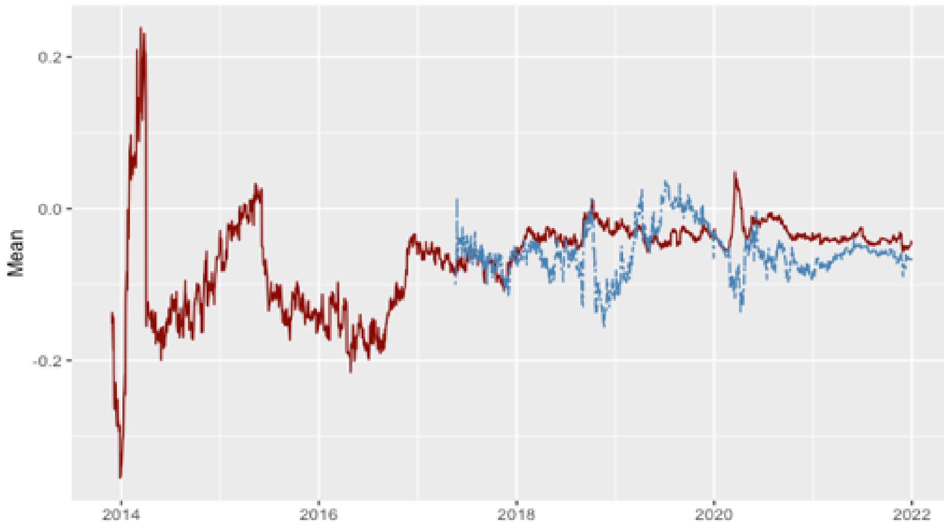
Now, we turn to the potential effect of certification on the size of the greenium. As mentioned, we run four different model specifications. In the one, we run is a simple regression of certification on the greenium. We find that, on average, the greenium increases by 2 basis points when a bond has been certified. This figure, however, is not statistically significant (p-value = 0.39). In the second specification, the same regression is performed while adding time-fixed effects. We find that the mean certification premium grows to 2.2 basis points with a slightly lower p-value (0.33). In specification 3, we add the liquidity, size, and time to maturity variables as independent variables while keeping the time fixed effects. The average effect of certification on the yield difference slightly decreases to 2.0 basis points (p-value = 0.44). The liquidity estimate is 4.475, indicating that if the bid-ask spread of the green bond would be 1% of daily ask higher than that of a nongreen bond, the yield would grow by about 4.5%. This figure, however, is not statistically significant (p = 0.14). The years to maturity variable, of which we have taken the natural logarithm, does seem to affect the greenium. The coefficient is -0.031, which can be interpreted to mean that if the maturity of a bond goes up by 1%, the greenium would grow by about 0.03 basis points. Finally, the coefficient for size is positive at 0.02, but the p-value is far too high (0.50) to draw any meaningful conclusions. In the fourth and final specification, we add the time-dependent industry and credit rating fixed effects. The average certification premium grows to 3.34 basis points but remains insignificant (p-value = 0.41). The time-to-maturity estimate decreases a little bit to -0.026 and becomes slightly insignificant at the 5% level (p-value = 0.066). The issue size factor decreases to 0.007, and seems to provide no explanatory value (p = 0.82). An overview of the results of the different model specifications is given below, in table 5.3.

Table 5.3: Certification regression table

	(1)	(2)	(3)	(4)
Certification	-0.020	-0.022	-0.020	-0.033
Δ Liquidity			4.775	5.08
Ln (years to maturity)			-0.031*	-0.026
Ln (issue size)			0.020	
Constant	-0.036**			
Date F.E.	-	Yes	Yes	Yes
Industry x year F.E.	-	-	-	Yes
Rating x year F.E.	-	-	-	Yes
Adjusted R^2	0.002	-0.006	0.014	0.107

Looking at the results of these different specifications, there are implications that certification by the CBI does increase the size of the greenium. All estimates of the certification effect are negative, indicating that the greenium is larger for certified bonds, but they do not come close to reaching statistical significance. A likely reason for this is the small amount of certified bonds in our sample. In the final sample, there were 11 certified bonds that correspond to 7 unique issuers. Much less than initially expected and an amount with which it is difficult to reach statistically meaningful conclusions. It could have been useful to decrease some of the constraints applied in the sampling procedure to increase the number of certified bonds in the sample, but we chose not to since that would have resulted in lower quality data. But, the fact that a negative premium is found in all model specifications and within a relatively close range, between 2.0-3.3 basis points, makes it unlikely that the certification effect found is based on randomness alone. In figure 5.2 below, the mean greenium of the certified subsample over time is added in blue besides the red line that represents the whole sample.

Table 5.2: Average greenium (red) and average certified greenium (blue)



Since the first daily datapoint of a certified bond was in 2017, the blue line starts in that year. The graph seems to confirm, in line with the results of the regression, that the certified subsample is generally a few basis points below that of the whole sample. During the larger part of 2019, however, the contrary was true. Since the sample comprises only 11 certified bonds, and one period in the sample is opposite, it is again not surprising that the standard errors are too high to reach meaningful conclusions. So, both the regressions and graphical representation suggest that certification increases the greenium, by about 2.0-3.3 basis points. But, due to the (too) small amount of certified bonds present in the sample, this cannot be concluded with certainty.

A last interesting implication from the results is the effect of time to maturity on the greenium. The estimates found in model specification 3 and 4 were -0.031 and -0.026 respectively, of which the first is significant at the 5% level and the latter at the 10%. That seems to indicate that the greenium, in general, is larger for bonds with a longer time to maturity. One potential explanation for that could be the mechanism of priced-in climate risk, explained in section 2.2. For bonds with longer maturities, future alignment to sustainability is more important for the risk profile. Issuing a green bond could signal that a firm is at least somewhat future-aligned, which might translate into a somewhat lower sustainability risk factor for the longer maturity bond. Another potential explanation may be related to the investment mandates of institutional bondholders. Many pension funds and other entities must, or want to, hold a certain amount of their AUM in green assets. If a green bond then has a longer maturity left, that means the bondholder can hold it longer. That way the green bond can help the investor achieve its green allocation requirements for a longer period of time, which should be valuable.

6 Conclusion

This study looked at green bonds, an asset class that has become increasingly established given the growing demand for green investment opportunities. We find that the green bond market has grown rapidly over the last decade, reaching a record high of over USD 500 billion worth of new issues in 2021. Within that market, especially corporate bonds have become increasingly prevalent, growing from 16% of new issues in 2015 to 28% in 2021. We turned to that corporate green bond market to look for pricing differences between green and nongreen bonds. We find that, on average, green bonds have lower yields than nongreen bonds of about 3.6 basis points. That yield difference has grown smaller in size over time but shows trends of renewed growth towards the end of the study sample. Furthermore, we find signs that certification by the Climate Bonds Initiative increases the size of the greenium by about 2.0-3.3 basis points. But, due to a too small size of certified bonds within our sample, this cannot be concluded with certainty. Finally, we find that the time to maturity left on a green bond positively affects the size of the greenium, implying that investors value green bonds with longer maturities. Our paper adds to, and updates, the growing body of evidence on price differences between green and nongreen bonds in the corporate bond market. In addition, we provide early evidence that a certification premium might exist, which will be an interesting area to investigate further in other academic studies.

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Appendices

Appendix I. List of issuer, bonds and observations

Issuer and bonds	No. of observations	Sector
A2A SpA	**309**	**Utilities**
XS2026150313	309	
AB Skf	**232**	**Industrials**
XS2079107830	232	
Acciona	**225**	**Industrials**
XS2036691868	225	
ACS Servicios Comunicaciones y Energia		**Industrials**
SL	**611**	
XS1799545329	611	
Aeroporti di Roma	**177**	**Industrials**
XS2265521620	177	
ALD S.A.	**644**	**Industrials**
XS1892240281	644	
Alliander NV	**405**	**Industrials**
XS1400167133	405	
Apple Inc	**556**	**Consumer Cyclicals**
XS2079716937	556	
Arkema SA	**318**	**Basic Materials**
FR00140005T0	318	
BASF SE	**411**	**Basic Materials**
DE000A289DC9	411	
CA Immobilien Anlagen AG	**309**	**Real Estate**
XS2248827771	309	
Covivio	**1499**	**Real Estate**
FR0013170834	1099	
FR0013447232	400	
CPI Property Group SA	**486**	**Real Estate**

XS2069407786	243	
XS2171875839	243	
Digital Dutch Finco Bv	**1490**	**Real Estate**
XS1891174531	583	
XS2100663579	511	
XS2100664114	396	
E ON SE	**3452**	**Utilities**
XS1702729275	938	
XS2047500769	613	
XS2047500926	512	
XS2103014291	512	
XS2152899584	454	
XS2177580508	423	
EDP Energias de Portugal SA	**1441**	**Utilities**
XS1893621026	841	
XS2053052895	600	
Electricite De France S.A	**3228**	**Utilities**
FR0011637586	1866	
FR0013213295	1362	
ENEL Finance International NV	**1924**	**Utilities**
XS1550149204	577	
XS1750986744	577	
XS1937665955	770	
Enexis Holding N.V.	**403**	**Utilities**
XS2190255211	403	
Engie SA	**6521**	**Utilities**
FR0011911247	608	
FR0013245859	608	
FR0013245867	608	
FR0013284247	1112	
FR0013284254	858	

FR0013428489	661	
FR0013428513	572	
FR0013455813	572	
FR0013504677	461	
FR0013504693	461	
ESB Finance DAC	**669**	**Utilities**
XS2009861480	669	
Eurogrid GMBH	**183**	**Utilities**
XS2171713006	183	
Ferrovie dello Stato Italiane SpA	**1319**	**Industrials**
XS1732400319	1046	
XS2026171079	273	
Fluvius System Operator Cv	**28**	**Utilities**
BE0002755362	28	
Global Switch	**323**	**Industrials**
XS2241825111	323	
Globalworth Real Estate Investments Ltd	**293**	**Real Estate**
XS2208868914	293	
Hera SpA	**1945**	**Utilities**
XS1084043451	1294	
XS2020608548	651	
Iberdrola	**8770**	**Utilities**
XS1057055060	1809	
XS1398476793	1068	
XS1490726590	1068	
XS1527758145	1323	
XS1575444622	1068	
XS1682538183	1068	
XS1847692636	917	
XS2153405118	449	
Icade SA	**1003**	**Real Estate**

FR0013281755	1003	
Iren SpA	**1179**	**Utilities**
XS1704789590	393	
XS1881533563	393	
XS2065601937	393	
Koninklijke Philips NV	**683**	**Industrials**
XS2001175657	683	
Mercedes Benz Group	**342**	**Consumer Cyclicals**
DE000A289QR9	342	
Naturgy Finance BV	**1625**	**Utilities**
XS1695276367	547	
XS1718393439	1078	
Ne Property Bv	**384**	**Real Estate**
XS2203802462	384	
Prologis Euro Finance	**497**	**Real Estate**
XS2112475509	497	
Red Electrica	**506**	**Utilities**
XS2103013210	506	
Royal Schiphol Group	**364**	**Industrials**
XS1900101046	182	
XS2227050379	182	
Schneider Electric	**1058**	**Industrials**
FR0013015559	1058	
Snam SpA	**875**	**Utilities**
XS1957442541	742	
XS2190256706	133	
SNCF Reseau	**652**	**Industrials**
XS2022425024	652	
SNCF RESEAU SA	**1975**	**Industrials**
XS1938381628	1975	
SSE PLC	**894**	**Utilities**

XS1676952481	447	
XS1875284702	447	
Stedin Holding NV	**557**	**Utilities**
XS2079678400	557	
Stora Enso Oyj	**283**	**Basic Materials**
XS2265360359	283	
Telefonica Emisiones S.A.U	**759**	**Utilities**
XS1946004451	759	
Tennet	**4347**	**Industrials**
XS1241581096	1717	
XS1432384664	1450	
XS1632897762	1180	
Terna Rete Elettrica Nazionale SpA	**1605**	**Utilities**
XS1858912915	637	
XS1980270810	637	
XS2209023402	331	
Toyota	**858**	**Consumer Cyclicals**
XS1720639779	858	
Unibail Rodamco	**1732**	**Real Estate**
XS1038708522	1334	
XS1218319702	398	
Vesteda Finance BV	**681**	**Real Estate**
XS2001183164	681	
VF Corp	**484**	**Consumer Cyclicals**
XS2123970167	484	
Vinci SA	**286**	**Industrials**
FR0014000PF1	286	
Vodafone Group Plc	**681**	**Utilities**
XS2002017361	681	
Volkswagen International Finance NV	**666**	**Consumer Cyclicals**
XS2234567233	333	

XS2234567662	333	
Volvo Car AB	**323**	**Consumer Cyclicals**
XS2240978085	323	