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Does certification of green bonds add value to investors?

The role of CBI-certification in informational efficiency

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Preface

This thesis studies the informational efficiency in the green bond market by investigating if the certification scheme from Climate Bonds Initiative contributes to new information for investors. The data on certified green bonds and green bonds conforming to the Green Bond Principles are retrieved from Climate Bonds Initiative, Thomson Reuters and Bloomberg.

We choose to look into informational efficiency in the green bond market because we are very interested in how financial markets can contribute to mitigate climate change. As this is an ongoing challenge, an increased amount of initiatives and organizations are established to direct capital to climate friendly projects. Therefore, we wanted to look into bonds certified by Climate Bonds Initiative to see whether the certification is of value to investors when assessing a bond.

This thesis concludes our time at NHH and the degree Master of Science in Economics and Business Administration with a major in Finance. Writing this thesis have been challenging, interesting and rewarding. We would like to thank our supervisor, Assistant Professor Jose A. Albuquerque De Sousa, for valuable insights and feedback during the writing process. We also thank our friends and families that have supported us and showed interest in our thesis.

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Abstract

This study looks into Climate Bonds Initiative's certification of green bonds to see whether it provides value for investors and contributes to market efficiency. We explore whether issuers of certified bonds have a higher ESG score and whether the bonds hold a green premium. This is done by contrasting certified green bonds to uncertified green bonds from Thomson Reuters' database from 2014 to 2019.

We apply OLS regressions with controls to utilize our full sample. To address endogeneity concerns, we use matched companies in a difference in differences estimation of ESG score, while pairs of matched bonds are used in a yield regression. Lastly, we analyze the ownership structure of bond issuers through an interaction term with certification, to determine whether the effect of certification varies for different values of institutional ownership.

There are no indications of differences between certified and uncertified green bonds, or between their issuers. We conclude that a green premium does not exist on certified bonds, and there is no evidence to reject the hypothesis of market efficiency. Further, institutional ownership does not seem to affect ESG score, YTM or the probability of certification. However, this study contributes with insights on informational concerns and the value of certification of green bonds.

Contents

Figures, tables and formulas

Figures

Tables

Formulas

1. Introduction

As a response to climate change, an increasing amount of capital is being directed to environmental projects. The green bond market has grown tremendously the last few years, reaching USD 258B in 2019, up 51 % from 2018 (CBI, 2020a). However, the green bond market's expansion faces some obstacles. Unclarity about the bonds' "greenness" and their impact on mitigating climate change, are among investors' concerns.

We dive into the pool of green bonds to find out whether Climate Bonds Initiative's (CBI)[1] certification of green bonds provides value for market efficiency. The certification is the only type that demands bonds to affirm to concrete sector-specific criteria to ensure greenness. In this thesis, the term "certified" is used about green bonds that have undergone CBI-certification by conforming to the Climate Bonds Standard and Certification Scheme (CBS). The process is comprehensive, since the certification consists of two phases where the issuer and the proposed project are meticulously investigated.

Lack of standards and criteria for classification of truly green bonds is a cardinal challenge as some investors are concerned about environmental impact and yield. It is interesting to explore if certification contributes to informational efficiency or whether the market absorbs information to a degree that makes certification unnecessary. The validity of the efficient market hypothesis (EMH) has been tested numerous times, where some have found predictability in stock returns, indicating that historical prices are not incorporated into present prices. However, advocates for the EMH have discarded evidence of market anomalies as problems with pricing models. In this thesis, we take a different approach by studying yield differentials within a narrow part of the green bond market.

If certification delivers new or more accurate information (financial or environmental), it means that investors are not fully informed without such intervention. That would be considered a market anomaly and indicate transparency issues. If all relevant information were available to investors, they would act on it and the market would be efficient. Investors know about green bond issuers' environmental efforts, but perhaps not to an extent that clears the

[1] Climate Bonds Initiative: https://www.climatebonds.net

market. In case of market deficiencies, there might be a difference in yield for certified and uncertified bonds.

Data from CBI and Thomson Reuters are used to investigate environmental, social and governance (ESG) scores and yield to maturity (YTM) to evaluate market efficiency in the green bond market. Based on the theory and empirics of efficient markets, our research question is:

1. *Is the green bond market informationally efficient?*

With efficient, we mean that investors are able to make informed investment decisions, and that prices reflect this. We try to answer this question through the following hypotheses:

1.1 Issuing a certified green bond does not lead to an increase in the issuer's ESG score.

We assume that capital raised from issuance is not ring-fenced and thus, that the environmental impact of the green bond is reflected in the ESG score[2]. Further, we assume that the certification scheme is effective in targeting issuers' environmental footprints and thus, that the ESG score absorbs this. If certification does not reveal any new or better information, there should be, on average, no yield differentials between certified and uncertified green bonds. Hence, we test the second hypothesis:

1.2 There is no green premium on certified green bonds.

This thesis provides analyses of bonds and issuers, contributing to the literature on market efficiency and pricing within a small segment of the green bond market. Previous research on the green bond market mostly contrasts green and conventional bonds where market premiums, ownership or risk is investigated. The results and definitions of what a green bond is, often vary. Our literature review consists of studies looking into characteristics, pricing, market efficiency and institutional ownership. Looking into certification, we hope to shed some light on informational efficiency and explore whether inefficiencies exists.

First, we conduct ordinary least squares (OLS) regressions for analyzing ESG score and YTM. For robustness, we conduct a matching method using bond couples consisting of a certified green bond and a green bond following the Green Bond Principles (GBP). Matches using

[2] We explain this reasoning further under the section on green bond pricing in the literature review on page 17.

company data are applied in a difference in differences (DiD) estimation to try to determine the effect of certification on company ESG score. Another round of matching is done using bond data to determine the average treatment effect on the treated (ATET) on YTM. Lastly, we analyze the ownership structure of bond issuers through an interaction term of certification and institutional ownership to determine whether the effect of certification varies for different values of institutional ownership.

To our knowledge, there is little research done on market efficiency in the green bond market. Due to “greenwashing” concerns, it is important to start a discussion about the functionality of this market. Furthermore, as definitions of certification and verifying standards are inconsistent, our thesis attempts to give a clear overview and understanding of the concepts.

The rest of the thesis is organized as follows: chapter 2 provides background and terminology of the green bond market; chapter 3 discusses the theories and relevant literature; chapter 4 presents the chosen methodology and the reasoning behind it; chapter 5 describes the data collection and exhibits the summary statistics; chapter 6 discusses the empirical results and implications for market efficiency as well as limitations, and chapter 7 contains concluding remarks.

2. Background

Climate change is a current topic as the world faces environmental consequences of years of tremendous economic growth with high production levels. The Sustainable Development Goals (SDGs) and the Paris Agreement are examples of action plans established to combat the rising global temperature. In financial markets, investors and corporations experience increased pressure to beware of the environmental effects of their operations. Reporting on ESG issues and publishing sustainability reports is increasingly popular and may be mandatory for several companies in the near future. Investors and corporations are requested to align their business goals with the SDGs and direct funds to projects supporting a climate-resilient economy.

The green bond market is essential to bridge the gap required to meet targets set out in the Paris Agreement and the SDGs (Doran & Tanner, 2019). Unfortunately, there are credibility challenges among issuers, no standard way of measuring sustainability, and greenwashing concerns. This accumulates into a market that may not meet its potential. In this chapter, the development of the market, definitions and standards will be presented to clarify the complexity.

The European Commission's technical expert group on sustainable finance is currently working on developing a green bond standard and creating a taxonomy to “enhance market efficiency and channel funds to sustainable projects” (UTIP, 2019). The statement implies that the green bond market is not working properly, suggesting an intervention as necessary to solve the deficiency. As the standard does not demand issuers to conform to nearly as concrete and strict industry criteria, CBI’s certification scheme might be more efficient in resolving possible informational asymmetries.

2.1 Measuring sustainability

ESG criteria are non-financial metrics of a corporation’s sustainability impact. They measure how the corporation manages social relationships, like the ones to their employees and suppliers, the environmental impact, like carbon footprint, and governance issues, like executive pay and audits. Evidence on the relationship between companies’ ESG score and financial performance differs, although several studies indicate that ESG scores affect both return and long-term risk. Therefore, a progressive number of investors emphasize ESG performance of possible investees as sustainability scores allow for more complete analyses and better-informed investment decisions (ADEC Innovations, n.d.) The latter is why we chose to study ESG scores of issuers of certified bonds.

Companies’ long and complex value chains call for more disclosure. Moreover, prevalence of scandals like human rights violations, corruption or toxic emissions, prompts investors to require openness to ensure ethical operations. In Financial Times, Sustainalytics chief Michael Jantzi proposed that ESG reporting should become mandatory and that there should be “an IFRS for ESG” (Thompson, 2020).

There are several ESG rating providers, like MSCI, Sustainalytics and Thomson Reuters. The different providers use varying methodologies and metrics, resulting in a lack of robust data and dispersed scores. We chose Thomson Reuters to provide ESG scores that are based on public and objective information. Even if calculations of ESG scores vary depending on the rater, Thomson Reuters is known as a thorough and trusted provider. They measure ESG score using percentile rank scoring to calculate a total of 11 environmental (E), social (S) and governance (G) scores. These scores are based on the number of firms being worse than the current one, having the same value as the current one, and having any value at all. It means that an issuer’s combined score is calculated on the basis of other companies’ performance. Formula 1 exhibits how the scores are calculated.

$$(1) \qquad Score = \frac{Nr.\ of\ firms\ w/\ worse\ value + \frac{Nr.of\ firms\ w/\ same\ value\ incl.current}{2}}{Nr.\ of\ firms\ that\ have\ a\ value}$$

Formula 1. ESG score (Thomson Reuters, 2017).

Benchmarks for the E and S categories are obtained following the TRBC Industry Group, while country is a benchmark for G, since practices within a country barely vary. Category weights are assigned by an automatic and factual logic. The final score is computed by multiplying the scores with the assigned weights (Thomson Reuters, 2017).

2.2 The green bond market

There is no universal definition of the term “green bond”. Various organizations operate with their own sets of criteria for naming a bond “green”. However, the most widely accepted definition is from OECD. It defines a green bond as “differentiated from a regular bond by its commitment to use the funds raised to finance or refinance “green” projects, assets or business activities” (OECD, 2017, p. 13).

The range of green bonds is vast and covers new and existing projects that cause positive climate ramifications. The issue with using the term “green” about several types of bonds, can be understood by the following example: China has used green bonds to finance coal-burning plants, arguing that the plants are less carbon-intensive than their predecessors (Pronina, 2019). This is in big contrast to financing projects like wind energy, which decrease the world’s carbon dependency. The literature on green bonds is inconclusive as there is a lack of contractual protections on what may be called a green bond.

The very first green bond was a climate awareness bond issued in 2007 by The European Investment Bank. The idea was to allocate capital to green projects, something that had never been done before. In 2008, The World Bank followed up on the issuance of green bonds after requests from some Swedish pension funds that searched for climate friendly projects. Conversations with CICERO and SEB ultimately led to the blueprint for the green bond market. The World Bank prompted collaboration between the agents in the bond market and established certain criteria the projects had to meet. This formed the basis for what is now known as the GBP. These principles are often used to ensure investors that a bond is green, but there is no formal requirement to follows these guidelines to use the label. (The World Bank, 2019).

2.3 Market standards

2.3.1 The Green Bond Principles

The GBP were introduced by the International Capital Market Association (ICMA) in 2014 but have been updated up until 2018. Their purpose is to separate the greenwashing bonds from the truly green ones through disclosure of information (ICMA, 2018). These guidelines seek to promote transparency and integrity in the green bond market, and thus make it easier for investors to identity bonds that finance environmental projects.

For a bond to be considered green by the GBP, the issuer is required to build a green bond framework aligning to four core components specified by the GBP. These components are (1) Use of Proceeds, (2) Process for Project Evaluation and Selection, (3) Management of Proceeds and (4) Reporting (ICMA, 2018). Issuers need to use funds to finance or re-finance projects falling under certain eligible categories. The projects should target environmental objectives like mitigating climate change, natural resource conservation and preventing and controlling pollution. Sustainability in the projects must be clearly communicated, issuers must attest that funds are set aside for environmental objectives, and they must report on the specific projects funded (Bhatia, n.d.).

2.3.2 External verifications

It is not mandatory to get an external review although it is believed to increase credibility among investors. Second-party opinions are offered by independent ESG providers like Sustainalytics or scientific experts like CICERO (CBI, n.d.a). An independent opinion is done by evaluating the bond’s framework, and how environmentally friendly the underlying project is. There is no follow-up on the use of proceeds after issuance. Obviously, second-party opinions have shortcomings since there are no formal and specific criteria on what qualifies as a green bond. The bond should be in line with using proceeds to finance eligible green projects mitigating climate change or exploitation of natural resources. Therefore, the reviewer forms an opinion about the project’s impact and framework. However, a common practice is evaluating compliance with the GBP.

Third-party verifications are done by audit firms like KPMG and Deloitte to enhance transparency and ensure compliance with the GBP (CBI, n.d.a). Third-party opinions are more comprehensive than second-party opinions since they demand an assurance report on the use of proceeds. This can help issuers communicate to investors that the bond is conforming to high standards and avoid greenwashing accusations. In this way, a more diverse investor base may be reached.

2.3.3 Climate Bonds Initiative

CBI is an investor-focused non-for-profit working on mobilizing the bond market for climate change solutions. It was founded in 2009 by Sean Kidney and Nick Silver with the purpose of promoting the financing of projects compatible with a climate-resilient economy. Working to reach a market with reduced costs for climate projects, the organization operates to improve market intelligence, provide policy models and advising, and develop a trusted standard (CBI, n.d.b). CBI is the only organization that works solely to direct finances to low-carbon projects. Five trustees point out the management direction and they receive advice from The Climate Bond Standards Advisory Board, The Climate Bonds Panel and other committees (CBI, n.d.c).

In 2010, CBI launched the CBS to improve environmental integrity of climate bonds. The CBS is a standard that leads to certification when certain concrete criteria are fulfilled, ensuring that the projects financed are combating climate change. The CBS is the only standard that demands green bonds to pass a number of sector-specific criteria to ensures compliance with low-carbon operations. A limitation with the certification scheme is that not all bonds are eligible for certification due to lack of sector criteria. However, the number of sectors covered is continuously increasing, allowing more issuers to obtain the certification. Also, the certification costs 0.1 basis points of the issue value (Ehlers & Packer, 2017).

CBI distinguishes between labeled green bonds not aligned with the CBI definitions, labeled green bonds aligned with the CBI definitions and certified climate bonds. The two latter are included in the CBI Green Bond Database, but according to the CBI, "the methodology for inclusion in the CBI Green Bond Database is somewhat less stringent than the certification criteria. […] The methodology uses a simplified version of the Climate Bond Taxonomy" (CBI, 2018 p. 3). In order to get certified, the bond needs to pass a certification process and be approved by the Climate Board at CBI. Certified green bonds are clearly outnumbered by uncertified green bonds. Figure 1 provides an overview of the green bond market in this context by dividing the green bond issuances into sub-categories.

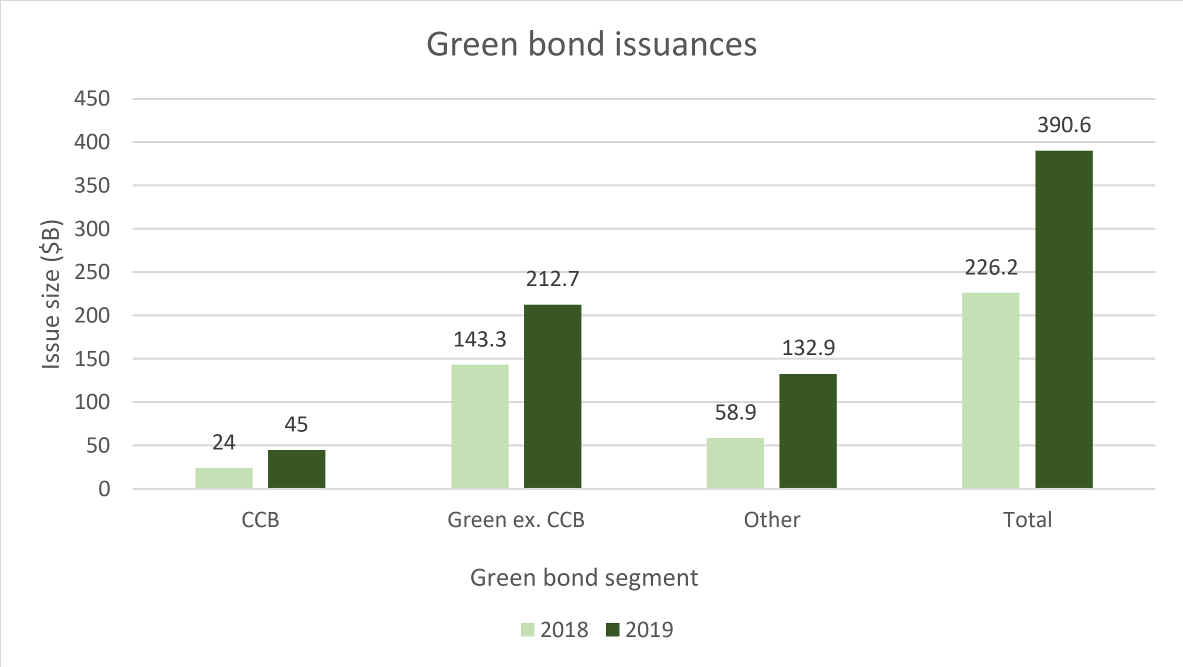

Figure 1. Green bond issuances in 2018 and 2019 (CBI, 2020a, 2019).

CBI-certified bonds (CCB) are the bonds that are approved and certified by the CBI board. Green excluded CCB are the remaining green bonds that have not been CBI-certified but are included in the CBI database that represent bonds that meet the CBI Taxonomy. This means that they are eligible to apply for certification but have not undergone the same process as those approved by the board. Other include self-labeled bonds that have not met the criteria of the CBI or are pending approval. It also includes bonds that for instance focus on solely social issues and thus do not meet the CBI's environmental requirements. In 2019, certified green bonds accounted for 17% of the bonds from the CBI green bond database, up from 14% in 2018 (CBI, 2020a).

The process of certification and inclusion in the CBI's database is illustrated in Figure 2 below. "Included" means that the bond is included in the green bond database and vice versa.

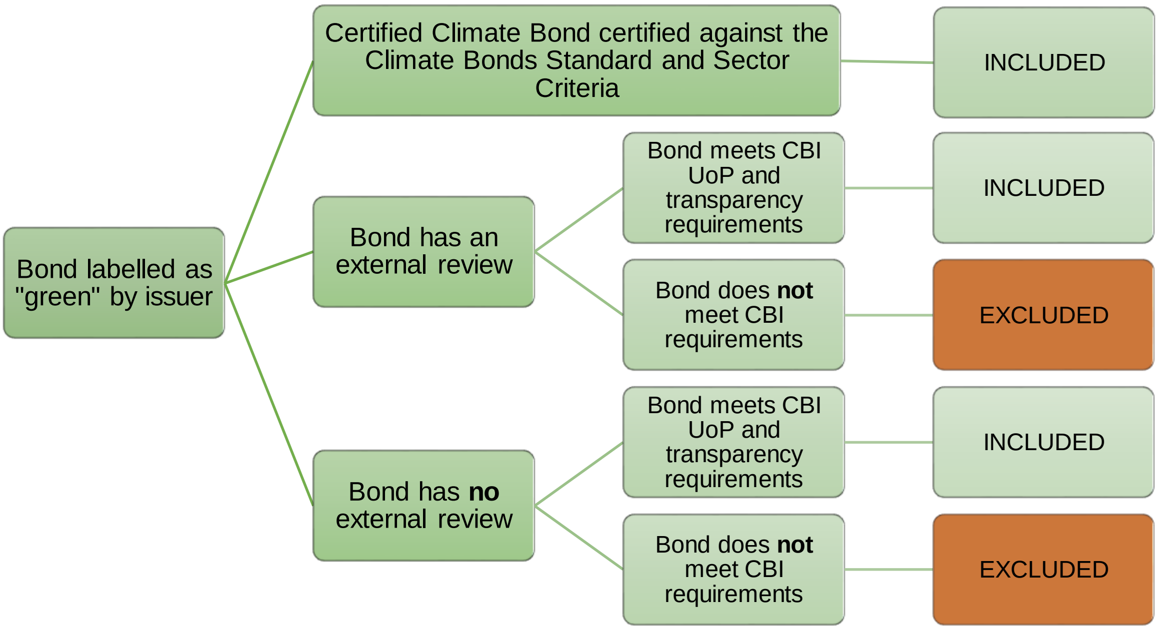

Figure 2. Summary of Climate Bonds Initiative's decision tree (CBI, 2018).[3]

As we discuss next in the literature review, bonds included in the CBI database have typically formed the treatment group in similar research, and excluded bonds have served as the control group. In this thesis, only certified green bonds are considered to be treated and the control group consists of green bonds following the GBP.

[3] UoP requirement: Use of proceeds requirement. Only bonds which are expected to allocate at least 95 % of proceeds to aligned green assets are included in the CBI Green Bond Database.

3. Literature review

As a foundation for this thesis, we present relevant theories and literature. The literature review includes studies that comprehend characteristics and pricing of green bonds, theories about efficient markets and research on institutional ownership. Few researchers have investigated efficiency in the green bond market, something that motivated us to explore this area. Since certification by CBI is a fairly new possibility, some of the studies mention this type of certification, but not in a magnitude that reveals inference about the green bond market's efficiency.

3.1 Characteristics and external verification

Several studies address how green bonds differ from conventional ones. Some look further into what is often defined as "certified bonds". However, the word "certified" is defined differently throughout papers and often means that some sort of external review is done. As mentioned, we define certified bonds as those that has undergone the process of approval by the CBI board. Therefore, being included in CBI's database that comprise bonds externally reviewed by a third-party that CBI acknowledge, does not equal being certified.

Flammer (2020) examines various characteristics of corporate green bonds and classify a certified bond as a green bond that has undergone third-party verification. She finds that their issuers have significantly better environmental rating and signal a stronger sustainability commitment than their conventional peers. Under a DiD specification, Flammer finds that issuers' environmental performance had significantly increased two years after a green bond issuance. This finding implies that there is no green bond "fad" and no case of greenwashing, supporting the argument that green bonds signal good environmental performance (Flammer, 2020). Using our dataset with CBI-certified bonds, we are curious to see whether we will observe any changes in ESG score one year after certification as Flammer (2020) did not obtain significant results only one year post-issuance.

Bachelet et al. (2019) study how returns, liquidity and volatility for green bonds differ from those of conventional bonds. The authors utilize all green bonds included in CBI's database. In contrast to similar studies, they find that green bonds obtain higher returns and liquidity in addition to being less volatile, explained by third-party verification and whether the issuer is private or institutional. Furthermore, they claim that both factors reduce information asymmetry. Another relevant finding is that green bonds may carry a negative premium, implying that they are traded at discount. Reducing information asymmetries by obtaining verification or a good reputation, issuers may ensure investors about the greenness of the bond. This ultimately reduces bond yield. The study provides a good baseline as we will see whether certification enlightens investors with more and accurate data to reduce information asymmetries.

Lack of consistency in academia of the term “certified” poses the question about investors' ability to separate between bonds that are held up to a higher standard through certification, and firms that have been externally verified by a third-party. According to Flammer (2020), the latter category represents 69% of the entire green bond market, whereas the database of CBI-certified bonds only represents 11.5% as of 2019 (see Figure 1). Distinguishing between the two, may provide insights into the role and impact of such a certification. Further, it can provide an indication of whether the market is in need of this intervention.

3.2 Green bond pricing

When assessing price differentials between green and conventional bonds, researchers often aim to determine whether a green premium exists. Schoenmaker and Schramade (2019, p. 275) define this as “the difference in yield between two matching bonds (one green and one conventional) after controlling for liquidity”. It raises the question of whether investors are willing to forego potential profit for environmental concerns. And if so, to what extent? Wensaas and Wist (2019) did not find any yield differentials between green and conventional bonds in the Nordic green bond market. Some subsamples show significance on small, negative yield differentials, but it does not hold for the entire market.

Capital raised from green bond issuances is meant to be invested in green efforts exclusively, and is not ring-fenced, unless the project constitutes all of the issuer's assets (Schoenmaker & Schramade, 2019, p. 274). As a consequence, a green bond should carry the same risk as a conventional bond (by the same issuer), given equal conditions. Since risk is an essential component in determining the price, Schoenmaker and Schramade (2019, p. 274) argue there should be no price differential between green and conventional bonds. They reference a study from Morgan Stanley (2017) where the authors found similar yield spread levels when adjusting for sector, curve and currency. Their interpretation was that, for investors, valuation is less of a driver than environmental commitment. Looking into bonds certified by CBI, we see whether our yield analysis give similar results.

In contrast, Zerbib (2019) and Baker et al. (2018), found that green bonds hold a small negative premium compared to conventional bonds. Zerbib (2019) argues that credit rating and issuer type are the main determinants for this small premium. Trading at lower yields implicates cheaper financing for the issuer, while investors must forego return if they want to invest environmentally friendly. The yield puzzle remains unsolved as studies show different results. Shedding light on certified bonds, we hope to shed light on the state informational efficiency. Since Baker et al. (2018) found that the premium doubled for bonds in CBI's database, it is interesting to look into actually certified bonds to explore if a green premium exists.

Zerbib (2019) found that demand for green bonds is sufficiently higher than the supply, and that several investors are willing to accept slightly lower yield in order to invest sustainably. This is where our thesis is especially relevant since identifying the truly green investments demands a comprehensive bond and issuer analysis. It is rather unclear if all that information is accessible and understandable for investors.

3.3 Market efficiency

The most well-known and cited theory about market efficiency comes from Fama (1970). He presented the EMH, claiming efficiency in the stock market when prices fully reflect all information at any time. The implication is that in competitive markets, information is integrated into prices immediately, making it impossible to earn risk-adjusted excess returns. In the event of a mispricing, the market will thus self-correct. In strict terms, the EMH assumes a perfect market with no transaction costs and free, accessible information. Investors are assumed be rational and have homogenous expectations, something that could be put to test in the green bond market due to costly certification and environmentally concerned investors. Our aim with this thesis is to determine whether the green bond market consists of issuers that are not giving investors enough information, creating market anomalies.

Fama (1970) pointed out three degrees, or understandings, of the EMH. He argued that the market could be efficient in a weak, semi-strong or strong way. The weak form assumes that all historical information is incorporated in today's market prices, making it impossible to earn abnormal returns by conducting fundamental analyses. The semi-strong form augments by deeming all public information to be incorporated in today's prices. Lastly, the strong form holds when all existing information, including private or insider information, is reflected in the market prices. In the literature, market efficiency in securities markets is often referred to as informational efficiency. This focuses on the role of information asymmetry, or the lack thereof, that is central for the hypothesis to hold. The semi-strong form of the EMH provides a good basis for our contribution in studying efficiency in the green bond market, even though the theory is based on movements in the stock market.

3.3.1 Limitations

Some obvious challenges with the EMH are the assumptions of no transaction costs, perfect competition and free access to information. These are strict suppositions that cannot be perfectly fulfilled in practice. The EMH also faces the challenge of not being regarded as falsifiable, meaning that it is not robust against empirical testing and criticism. This is partially explained by the joint hypothesis problem, addressing that testing market efficiency itself is nearly impossible without jointly testing with an equilibrium-pricing model (Fama, 1991).

Investigating the efficiency of fundamental analysis implies asking whether publicly available information of a security can be utilized to enhance investment performance. Per definition, these are tests of the semi-strong form of market efficiency. Facing the joint test problem, one would have to determine whether to reject the EMH or the pricing method, and one risks being left with no conclusion about market efficiency (Bodie et al., 2018, p. 351-352). In essence, the problem is maintaining the ceteris paribus, all else equal, that is needed to draw a conclusion. This cannot be achieved perfectly, and evidence against the EMH will never provide completely accurate conclusions.

3.3.2 Testing market efficiency

As mentioned, CBI's certification scheme holds the issuer to a set of criteria and follows up their ability to meet these criteria before, during and after issuance. Furthermore, CBI can revoke the certification and the issuer is required to inform then bond's investors if this were to happen. If the EMH assumptions holds true, issuers and investors know all the information about the green bond in question. There would be no need for certification as it could not provide the market with valuable intel. Information on the bond would soon be absorbed, and prices would adapt accordingly. The question is therefore weather certification contributes to more or better information that possibly enhances market efficiency.

With this rationale in mind, studying price differentials within the green bond market may contribute to a new perspective in the wide literature of market efficiency tests. The typical empirical work analyzes predictability in excess returns based on historical information (weak form-tests). Through a present value model, Ang and Bekaert (2006) explore the predictability of future stock returns. They find that excess returns in the short run can be predicted by looking at the short rate. Unfortunately, prediction of excess returns for longer horizons is impossible as the regression results are not robust across multiple sample periods nor across countries.

Looking at the bond market, the amount of research is not as extensive as for the stock market. Pesando (1978) claim that the Canadian bond market is efficient, and that market expectation is the only factor determining long-term interest rate variation. Hall and Miles (1992) measured the predictability of holding period return in Canadian, French, U.S., U.K., German and Japanese government bonds of various maturities, and found predictability in several markets. Differences in pricing models or the time span, could contribute to the authors' conflicting conclusions. Turning to our hypotheses, we find it material to keep in mind that the market of certified green bonds is in its infancy, which puts some constraints on how to assess the efficiency.

The study by Bachelet et al. (2019), that we outlined in the characteristics section, also relates to testing market efficiency, as the authors explain that issuer reputation and verification by a third-party are determinants in reducing information asymmetry. The need for verification to rule out greenwashing hunches, implies deficits in informational efficiency, making the existence of efficiency in the green bond market unclear. Though pricing differentials have been studied at length, there are, to our knowledge, no empirical studies testing the informational efficiency by looking at certified bonds. What we ultimately seek to discover, is whether the certification actually adds value to investors, and thus if the green bond market, in this sense, can be considered efficient.

3.4 Institutional ownership share

The ownership structure, in particular institutional ownership, of bond issuers may affect ESG score and YTM. Institutional ownership can be defined as the percentage of stock owned by institutions, like investment banks, mutual funds and pension funds. Arbel et al. (1983) found that smaller companies are rarely attractive for financial institutions to invest in. Hence, they offer higher returns due to little attention and lower informational efficiency. Resembling these findings, Bachelet et al. (2019) found that bonds issued by institutional issuers have lower yield than bonds of private issuers due to the signaling effect of good performance and reputation.

Even if we do not focus on institutional issuances, it is interesting to find out whether ownership by institutions may affect attractiveness and thus YTM of the bonds. The ESG score may also be affected by firm ownership. In terms of market efficiency, we want to explore if issuers' ownership structure makes some companies confirm their green commitment by certification in order to attract investors.

3.5 Contribution

Concluding the literature review, much of the research on green bonds address issues with greenwashing, existence of green premiums and implications of third-party verification, especially by Flammer (2020) and Bachelet et al. (2019). We recall that Baker et al. (2018) and Zerbib (2019) obtained results indicating that a green bond premium exists, whereas Wensaas & Wist (2019) lacked significant estimates.

There are inconclusive results on green bond yield and no studies on certified bonds where inference on yield or value of certification is obtained. We attempt to clarify the pricing and thus market efficiency by using Fama's (1970) understanding of how financial markets work. The literature review provides us with insight on relevant topics and makes it clear that there are several areas within the green bond market and especially the value of certification, that should be further studied.

The major difference with this thesis compared to existing literature, is that we go deeper into the wide concept of green bonds, in that we focus on bonds that are not only third-party verified but certified by CBI. These are contrasted with green bonds that follow the less stringent GBP. Building on the classic EMH theory by Fama (1970) and contributors like Flammer (2020) and

Zerbib (2019), we aim to measure information absorption in the market and explore whether there is a green premium on certified bonds.

4. Methodology

In order to evaluate the efficiency in the green bond market, we draw inference on ESG scores and bond yields, before exploring the effect of institutional ownership. We start out with OLS regressions, using a number of control variables. Assigning certification to green bonds is not random. A spurious relationship between certified bond issuance and company outcome may exist (Flammer, 2020). It is illustrated by the following example: Companies issuing a certified bond may experience increased ESG score after issuance due to use of proceeds, though firms with high ESG scores are more likely to issue a certified bond in the first place. Therefore, we continue with methods that address the endogeneity concerns. The chosen ones are nearest neighbor matching and DiD.

In practice, we first perform OLS regressions with control variables for both the ESG score analysis and the yield analysis. Next, we check for robustness by using matched pairs in our DiD estimation on ESG scores, and for determining the average treatment effect on YTM. The reason we only use matching as a form of robustness test is the sample size, as we will explain in the next chapter. Lastly, we do two OLS regressions with the full sample, and include institutional ownership to explore whether it affect ESG score or YTM.

4.1 Ordinary Least Squares

The first method is OLS regression to estimate the effect of certification on ESG score and YTM. Certification is the explanatory variable, while ESG score and YTM are the outcome variables. The control variables represent outcome determinants that we are not particularly interested in. Removing their effect on the outcome variable, allows us to gain inference on the effect of certification on the chosen outcomes. The main challenge with OLS is endogeneity since certification is not random. In order to view the effect of certification without this concern, and evaluate the robustness of the OLS estimates, we proceed with matching for the DiD estimation and analysis of average treatment effect, though with a smaller sample.

4.2 Matching

The matching method is commonly used to detect differences between the two groups by estimating the average treatment effect. One bond from the treatment group, certified bonds, and one bond from the control group, uncertified bonds, are matched. The two groups should have similar covariate distributions (Stuart, 2010). Any distinctions in the bond structure would appear when constructing bond couples, as these differences are often between issuers (Östlund, 2015). In the absence of a plausible setting for an experimental approach, we use a sample of matched pairs of certified and uncertified green bonds to simulate how certified bonds would perform without certification.

There are different ways of constructing good matches. We found that the best suited method is nearest neighbor matching, using Stata's functions for treatment effects with a binary treatment (certification) and continuous outcome (ESG score and YTM). The nearest neighbor is found by a weighted function of the differences between the observed and imputed potential outcomes for each subject.[4] This cannot fully make up for the lack of an experimental setting and endogeneity issues could still remain. Also, conducting an ideal matching requires a homogeneous or large sample to be able to match observations that are as close in parameters as possible. This issue will be addressed in the data chapter.

To test our hypotheses, we conduct two rounds of matching: one for issuers using company data and one for bond issuances using bond data. This is because a certified green bond can be matched with an uncertified green bond by the same issuer, whereas the analysis of issuer characteristics pre- and post-issuance needs comparison between two different companies. To examine the effects of certification on bond issuers, we perform matching on company data, followed by a DiD estimation. Then, inference about issuances is obtained by performing matching on bond data, followed by a linear regression. The two rounds of matching therefore allow us to look at firm- and bond outcomes.

[4] The nearest neighbor matching estimator imputes the missing potential outcome for each subject by using an average of the outcome of similar subjects that receive the treatment. The model uses the Mahalanobis distance, which adapts the Pythagorean theorem to handle the fact that covariates may be correlated and measured on different scales. From that, we can estimate the average treatment effect on the treated, which is different from the average treatment effect on the population. It is used if some unobserved factors change the likelihood of assignment to the treatment, which is likely in our case (StataCorp, 2019).

4.3 Differences in differences

Following our hypothesis, we are interested in the effects of certification on issuers' ESG score. The DiD method estimates causality for non-experimental data by looking into treatment effects. The technique allows for comparison of differences in ESG scores over time. We calculate the outcome difference between pre- and post-certification for the issuers of certified and uncertified bonds. Next, we find the difference between the outcome differences for the two groups to obtain the DiD estimate.

Comparing pre and post in the certified group to the pre and post in the uncertified group, we control for constant and time-varying factors. The most important requirement is the common trends assumption (Lechner, 2011). The groups must exhibit the same change in ESG score before issuance. The validity of this assumption is not testable, since we cannot know the how the specific bonds would respond without being certified (Corsman, 2015). One way to look for a parallel trend in the outcome variables, is to compare changes in outcomes for the groups before certification. Moreover, if ESG score and YTM move in the same direction before certification is introduced to the treatment group, the DiD can be conducted.

First, we create dummies for years preceding certification and the year of certification, and one for certification. The DiD estimator acts as an interaction between time and treatment group dummies. In line with Flammer (2020), matching of bonds rules out the concerns regarding control variables. The construction of matches based on a number of covariates, makes sure that the groups are similar. Hence, our model consists of the following regression:

$$(1) \qquad Y_{i,t} = \beta_0 + \beta_1 Treat + \beta_2 Post_{i,t} + \beta_3 Treat\ x\ Post_{i,t} + \varepsilon_{i,t}$$

Formula 2. Difference in differences specification

Where i indexes firms and t indexes time. The outcome variable $Y_{i,t}$ represents company ESG score; β_0 is the baseline average; Treat is a dummy variable for certification, while Post is a dummy equal to 0 in the pre-issue year and 1 in the post-issue year. $Treat\ x\ Post_{i,t}$ is the interaction term between time and treatment group dummy variables, also called the DiD estimate. $\varepsilon_{i,t}$ is the error term. The betas are there to ensure all else equal.

Some challenges may occur when DiD is conducted. The common trends assumption is by far the most important assumption since it is crucial that the ESG score for the groups of issuers follow the same path before certification is assigned to the bonds. Matching may deal with this issue, even if some differences in unobservables could remain. In addition, DiD does not account for unobservables that are not fixed over time.

5. Data

In this chapter, we describe the data used in our analyses. First, we introduce the main sources of our data: CBI, Thomson Reuters and Bloomberg. Next, we go through the selection criteria for the matching pairs of bonds and controls. Lastly, we display and go into further detail of our data by examining summary statistics.

5.1 Data sources

To test the efficiency in the green bond market, we use data on certified and uncertified green bonds to determine whether there is a premium on certified bonds. Such a premium indicates that the market benefits from interference and that, without it, investors are not fully informed. If the market cannot be considered efficient on its own, there is a market anomaly. This analogy relies on the assumption that the certification process is conducted such that material ESG issues are targeted. Further, it is presumed that these ESG matters are absorbed by Thomson Reuters' ESG score. With this in mind, the certified bonds will be used as the treated group, while the uncertified bonds will serve as the control group. As certification is not randomly assigned, there is no way to fully hedge against endogeneity. We will, however, address and attempt to mitigate this limitation in our choice of sample and methodology.

The data on certified bonds are retrieved from CBI's public database (CBI, 2020b). As mentioned, CBI has a database with bonds reviewed by one of their approved third parties and one consisting of certified bonds (see Figure 1). We use the database with merely the certified bonds from 2014 to 2019. Certified green bonds have seen a rapid growth over the last years but is still at an early stage. A limitation of this dataset is therefore the size in terms of observations and variables. The total number of unique corporate issuances as of 31.12.2019 is 124, meaning a relatively small number of treated observations. In addition, the database provides limited information on bond characteristics. It does, however, grant the information needed to identify unique certified bonds in other green bond databases. For that, we use Thomson Reuters' database.

Thomson Reuters provides a range of real-time financial information including bond characteristics. Looking into fixed income and filtering "Green Bonds", data on more than 2000 corporate green bond issuances are available. Hence, we find extended information on uncertified green bonds as well as the certified green bonds from the CBI database. Thomson Reuters' criteria for a bond to be tagged as "green" are based on the voluntary GBP. Thus, our control group consists of uncertified green bonds that follow a less extensive framework. In this database, we also collect firm data on the green bond issuers, including ESG scores. Data on institutional ownership are retrieved from Bloomberg's equity database that provides global ownership data.

5.2 Matching critera

For bond issuances, the outcome variable is YTM. We use exact matching on issuer country, issuer sector, bond type and coupon type. In addition, the issue year and tenor cannot be more than two years apart. Out of the remaining issuances, we estimate the nearest neighbor based on coupon size, issue size, company market cap and the companies' total assets. With limited availability of bond ratings, we use the issuers' Credit Smart Ratio[5] to control for credit risk. Other issuer characteristics used, are the log of market cap and log of assets. Hence, a total of 11 matching characteristics are applied.

For bond issuers, the outcome variable is the companies' ESG score. We use company-year data for those operating in the same country and sector. Furthermore, we select the nearest neighbor based on the firm characteristics described above. We apply a total of 6 matching characteristics and consider the observations in the year preceding the issues of the treated group to make sure that the treated and control firm are as similar as possible pre-issuance. The nearest neighbor is found in the control observations, selecting the one with the lowest Mahalanobis distance to the treated. This is done after cleaning the data to fit the matching criteria described above.

Allowing for slack in some of the bond criteria, introduces the risk of bias to our model. Specifically, the risk that the estimated premium stems from factors other than the bond being certified. For instance, bonds with higher tenor have a higher YTM. In addition, allowing for differences in issue size might introduce a liquidity bias. Nonetheless, exact matching on all characteristics is not possible without excluding most of the observations. The magnitude of this bias will be discussed under summary statistics. We chose to filter by sector instead of

[5] Credit Smart Ratio is Thomson Reuters' probability estimate that the company will go bankrupt or default on its debt obligations over the next 1-year period, in percent (Thomson Reuters, 2013).

industry, as this allows for more matching options. This will necessarily be less precise than filtering by industry, which contains sub-categories of sectors.

5.3 Samples

As mentioned, we conduct two rounds of matching to account for the fact that companies in this sample cannot be matched with themselves, whereas in the bond sample, bond issuances from the same issuer can be used as matching pairs. When compiling the dataset of bond issuers, we use bond data to identify companies with green bond issuances within the chosen years, though not all companies are registered in the Thomson Reuters database. We found 143 unique corporate green bond issuers, of which 27 had issued a certified green bond and had data on ESG score. Companies missing ESG observations for certain years, were assumed to have the same score throughout the years. This sample will from here on be referred to as "Company sample A. Full sample" and will be used for the OLS regression.

By applying the criteria for bond issuers described above and removing observations with missing values, we ended up with 60 unique company-year observations from 2014 to 2019 in 6 countries. 17 companies issued a certified green bond in the time frame, and these observations are therefore considered as treated. We thus end up with 17 matching pairs of unique corporations. This sample will from here on be referred to as "Company Sample B. Matching sample" and will be used in the DiD estimate for robustness.

The bond data started out with 469 unique corporate green bond issuances from 2014 to 2019 of which 124 were certified. After removing observations with missing data, we were left with 395 observations, of which 53 were certified. This data is later referred to as "Bond sample A. Full sample" and will be used for the OLS regression. For the matching, we cleaned the data to make sure that each treated observation had a match within the criteria, and that there was enough data on the issuer in the database. Then, after merging the bond data with the company data and removing observations with missing values, we ended up with 107 observations, creating 40 matches. This sample is called "Bond Sample B. Matching sample" and will be used in the matching regression for robustness.

5.4 Summary statistics

This section offers a visual overview of our data. The samples of company data are outlined first, followed by the bond data. Sample A represents the full sample and is included to allow the reader to observe the contrasts between the samples. Sample B entails the matching sample.

5.4.1 Company samples

The following tables show total assets of companies by sector and country, and a difference in means test (t-test) on all characteristics. The samples of company data are used to conduct the ESG score analysis. Table 1 below displays the average size of total assets, using a sample of companies by sector.

Table 1. Total assets of companies by sector.

Notes: This table presents total assets of companies by sector. The values are from the pre-issue year. N is the number of companies per sector and Mean ($B) is the average size of total assets in billion dollars per company. Sectors are classified according to the Global Industry Classification Standard (GICS). The sample is divided into Uncertified and Certified as the rest of our summary statistics.

Sample A. Full sample.

	(1) Uncertified		(2) Certified		(3) All	
	N	Mean ($B)	N	Mean ($B)	N	Mean ($B)
Communication Services	12	155.122	0		12	155.122
Consumer Discretionary	20	82.971	0		20	82.971
Consumer Staples	12	30.339	0		12	30.339
Financials	170	740.474	24	1444.121	194	827.523
Industrials	68	14.764	1	17.080	69	14.797
Information Technology	12	64.964	0		12	64.964
Real Estate	92	14.490	1	5.926	93	14.397
Utilities	80	40.213	1	30.686	81	40.474
Total	466	292.058	27	1285.652	489	348.489

Sample B. Matching sample.

	(1) Uncertified		(2) Certified		(3) All	
Sector	N	Mean ($B)	N	Mean ($B)	N	Mean ($B)
Financials	31	764.669	15	1922.772	46	1142.311
Industrials	5	11.138	1	17.080	2	12.129
Real Estate	7	12.915	1	5.926	8	12.042
Total	43	554.671	17	1697.917	60	878.590

As we can see, Financials is the largest sector in both samples in terms of total assets and number of issuers. It includes banks, which is generally the largest issuer of green bonds

(KPMG, 2018). They often use green bonds to invest in green loans rather than concrete projects, making the use of proceeds slightly different than for other firms (Flammer, 2020). Fatica et al. (2019) point out that financial institutions have a harder time signaling their environmental commitment as opposed to firms operating in sectors where the environment is financially material. Drawing on these observations, it is reasonable that our sample includes an overweight of observations within Financials.

Table 2. Total assets of companies by country.

Notes: The table presents total assets of companies by country. N is the number of companies per country and Mean ($B) shows the average size of total assets in billion dollars.

Sample A. Full sample.

	(1) Uncertified		(2) Certified		(3) All	
	N	Mean ($B)	N	Mean ($B)	N	Mean ($B)
Australia	8	347.8	6	611.5	14	460.8
Belgium	0		1	274.1	1	274.1
Brazil	4	14.07	0		4	14.07
Canada	16	549.6	2	496.4	18	543.7
Chile	4	6.283	0		4	6.283
China	68	375.8	7	3209	75	640.3
France	36	763.1	1	17.08	37	742.9
Germany	8	515.3	0		8	515.3
Hong Kong	4	5.086	0		4	5.086
India	10	47.28	1	30.69	11	45.77
Italy	32	202.9	0		32	202.9
Japan	140	195.7	0		140	195.7
Luxembourg	4	8.110	0		4	8.110
Netherlands	4	5.323	6	790.0	10	476.1
New Zealand	8	2.500	0		8	2.500
Norway	0		1	294.0	1	294.0
Philippines	4	23.53	0		4	23.53
Singapore	8	142.2	0		8	142.2
Thailand	4	1.662	0		4	1.662
United Arab Emirates	4	80.61	0		4	80.61
United Kingdom	16	686.6	1	2225	17	777.1
United States	80	248.5	1	5.926	81	245.5
Total	462	293.7	27	1285	489	348.5

Sample B. Matching sample.

	(1) Uncertified		(2) Certified		(3) All	
Country	N	Mean ($B)	N	Mean ($B)	N	Mean ($B)
Australia	4	682.5	6	611.5	10	639.9
Canada	4	619.2	1	483.6	5	592.1
China	26	610.5	7	3209	33	1162
France	1	7.996	1	17.08	2	12.54
United Kingdom	1	2671	1	2224	2	2448
United States	7	12.92	1	5.926	8	12.04
Total	43	554.7	17	1697	60	878.6

In Sample A, we observe that in several countries, there are only uncertified bonds issued. Consisting of only one company, United Kingdom has the largest average size of total assets at $777.1B. Thailand has the smallest average size of total assets at $1.662B.

In Sample B, there are only 6 countries represented as a result of the matching criteria. We observe an overweight of Chinese companies. Companies from United Kingdom are the largest with an average of $2.448B in total assets. American companies are the smallest with an average of $12.04B in total assets. The size varies substantially and so does the number of issuances from each country. We note that the matched sample is too small to draw any causal inference from, something that will be further discussed when we present the results. As observed by the variations in the tables, comparing companies that operate in the same country and sector is important to identify close matches.

Table 3 on the next page displays the matching characteristics of issuers in the company sample. We notice that Samples A and B show similar results. The two types of issuers cannot be said to have different probability of defaulting on their debt. On the other hand, the log of total assets and market cap is statistically different between the issuers, showing that issuers of certified bonds have a higher value of the log of assets than issuers of uncertified bonds. An explanation could be that bigger firms are often older and stronger financially. Therefore, they might have a higher probability of applying for certification. Even if the p-value is zero, it should be taken into consideration that the sample size is very small, increasing the probability of rejecting a true null hypothesis.

Table 3. Summary statistics for the company samples.

Notes: This table presents the mean values of pre-issue year for unique corporate issuers. Column (3) shows the results from a difference in means test. Log(market cap) is the natural logarithm of market capitalization, meaning market value of the outstanding shares. Log(assets) is the natural logarithm of the book value of total assets at the end of pre-issue year in USD. Credit ratio is measured the probability of defaulting on debt in the coming year. (***) (**) (*) indicate significance at the (1%) (5%) (10%) level, respectively.

Sample A. Full sample.

	(1) Uncertified		(2) Certified		(3) Diff. in means	
	N	Mean	N	Mean	Abs.	p-value
Log(market cap)	466	23.14	27	24.23	-1.080***	0.000
Log(assets)	466	24.46	27	27.17	-2.710***	0.000
Credit ratio	458	0.006	27	0.005	0.002	0.131

Sample B. Matching sample.

	(1) Uncertified		(2) Certified		(3) Diff. in means	
	N	Mean	N	Mean	Abs.	p-value
Log(market cap)	43	23.79	17	24.84	-1.055**	0.005
Log(assets)	43	25.64	17	27.40	-1.760**	0.003
Credit ratio	43	0.005	17	0.004	0.001	0.383

It should be noted that market cap is measuring firm size, but the amount and value of shares are prone to vary over time in addition to be affected by firms' capital structure. We note that Sample B is very small, making it difficult to gain inference on the analysis where this sample is used.

5.4.2 Bond samples

This section contains an overview of the bond samples, showing issue size by sector, country of issuance and other characteristics. They are included to provide insights in the data used in the yield analysis. Table 4 on the next page displays the issue size of bonds by sector.

Table 4. Issue size of corporate green bonds by sector.

Notes: This table presents the issue size of corporate green bonds by sector. N is the number of bond issuances per sector and Mean ($B) is the average issuance size in billion dollars.

Sample A. Full sample.

	(1)		(2)		(3)	
	Uncertified		Certified		All	
Sector	N	Mean ($B)	N	Mean ($B)	N	Mean ($B)
Communication Services	3	0.672	0		3	0.672
Consumer Discretionary	84	0.023	0		84	0.023
Consumer Staples	3	0.340	1	0.255	4	0.364
Financials	106	0.573	42	0.670	148	0.600
Industrials	32	0.137	4	0.299	36	0.155
Information Technology	5	0.556	0		5	0.556
Materials	5	0.066	0		5	0.066
Real Estate	48	0.278	1	0.400	49	0.281
Utilities	56	0.509	5	0.314	61	0.493
Total	342	0.337	53	0.595	395	0.372

Sample B. Matching sample.

	(1)		(2)		(3)	
	Uncertified		Certified		All	
Sector	N	Mean ($B)	N	Mean ($B)	N	Mean ($B)
Financials	43	0.822	34	0.725	77	0.779
Industrials	19	0.141	4	0.299	23	0.168
Real Estate	4	0.725	1	0.400	5	0.660
Utilities	1	0.060	1	0.060	2	0.060
Total	67	0.612	40	0.658	107	0.629

Sample A is considerably bigger than Sample B, with 342 issuances. Communication Services contains, on average, the biggest issuances, while Consumer Discretionary represents the lowest. Looking at column (3), we acknowledge that Financials, Consumer Discretionary and Utilities make up almost the entire sample.

Turning to Sample B, we observe many of the same tendencies, but first and foremost that it includes significantly fewer issuances. Some sectors only issue uncertified bonds and are therefore excluded from the matching sample. Almost all the bonds fall within Financials, meaning it remains the biggest sector by the number of observations. These issuances are also the largest in terms of issue size. Further, we observe that issuances in the other sectors are of a substantially smaller size, especially those within Industrials and Utilities. Having a sample of several firms within Financials, resembles Zerbib's (2019) sample of green bonds, using data from Bloomberg between 2013 and 2017. As stated above, financial companies often have a harder time proving their greenness, and this might be the reason for the large number of certified issuances.

Moving on, Table 5 provides the distribution of the bonds' average issue size by country.

Table 5. Issue size of corporate green bonds by country.

Notes: The table presents issuance size of corporate green bonds by country. N is the number of bond issuances per country and Mean ($B) shows the average issuance size in billion dollars.

Sample A. Full sample.

	(1)		(2)		(3)	
	Uncertified		Certified		All	
Country	N	Mean ($B)	N	Mean ($B)	N	Mean ($B)
Australia	2	0.259	9	0.372	11	0.351
Belgium	0		1	0.544	1	0.544
Brazil	2	0.544	0		2	0.544
Canada	7	0.481	1	0.352	8	0.465
Chile	2	0.451	0		2	0.450
China	62	0.533	21	0.626	83	0.556
France	36	0.629	2	0.816	38	0.639
Germany	3	0.634	4	0.421	7	0.513
Greece	0		1	0.163	1	0.163
Hong Kong	1	0.057	0		1	0.057
India	6	0.224	1	0.261	7	0.230
Italy	13	0.553	0		13	0.553
Japan	71	0.156	1	0.056	72	0.155
Luxembourg	2	0.508	0		2	0.508
Netherlands	4	0.744	5	0.870	9	0.814
New Zealand	4	0.068	1	0.060	5	0.066
Norway	6	0.188	4	1.254	10	0.615
Philippines	3	0.233	0		3	0.233
Singapore	4	0.312	0		4	0.312
Thailand	2	0.092	0		2	0.092
United Arab Emirates	1	0.587	0		1	0.587
United Kingdom	6	0.621	1	0.544	7	0.610
United States	105	0.193	1	0.400	106	0.195
Total	342	0.337	53	0.595	395	0.372

Sample B. Matching sample.

	(1) Uncertified		(2) Certified		(3) All	
Country	N	Mean ($B)	N	Mean ($B)	N	Mean ($B)
Australia	1	0.191	2	0.350	3	0.297
Canada	1	0.429	1	0.352	2	0.390
China	38	0.766	9	0.722	59	0.716
France	2	0.979	2	0.816	4	0.897
Germany	1	0.544	2	0.299	3	0.381
Japan	14	0.105	1	0.056	15	0.085
Netherlands	3	0.883	4	0.952	7	0.922
New Zealand	1	0.060	1	0.060	2	0.060
Norway	1	0.544	4	1.254	5	1.112
United Kingdom	1	1.359	2	0.544	3	0.952
United States	4	0.725	1	0.400	5	0.660
Total	67	0.612	40	0.658	107	0.629

In Sample A, we observe that the Netherlands, France and Norway issue the largest bonds. The lowest average size on issuances are bonds from New Zealand and the United States. The countries with the highest number of issuances are the United States, China and Japan.

Some of the same tendencies are also observed in Sample B. Inspecting column (3), we notice that China is the largest issuer in terms of number of bonds. Japan is the second largest issuer but inhabits a substantially smaller average issue size than the sample mean. Norwegian bonds have the highest average issue size, even though the uncertified bond is notably smaller than the certified ones. Lastly, New Zealand, which only has one issuance, has the smallest average issue size.

The samples highlight that certified bonds tend to come from western, industrialized countries. Europe is overly represented, confirming its position as the most environmentally concerned part of the world. The statement is supported by CBI (2020a) that report that 45% of all green bond issuances in 2019 were of European heritage. The last summary statistics are presented in Table 6 on the next page.

Table 6. Summary statistics for the bond samples.

Notes: This table presents summary statistics for the bond samples. The table presents the mean values of pre-issue year. Column (3) shows the results of a difference in means test. Tenor is number of years to maturity. Coupon is coupon rate in percentage. (***) (**) (*) indicate significance at the (1%) (5%) (10%) level, respectively.

Sample A. Full sample.

	(1)		(2)		(3)	
	Uncertified		Certified		Diff. in means	
	N	Mean	N	Mean	Abs.	p-value
Tenor	333	7.892	53	7.151	0.740	0.478
Coupon	342	3.003	53	2.048	0.955***	0.003
Log(issue size)	342	18.34	53	19.86	-1.522***	0.000
Log(market cap)	342	23.47	53	23.85	-0.380	0.162
Log(assets)	338	23.71	53	26.55	-2.842***	0.000
Credit ratio	334	0.007	53	0.005	0.002**	0.041
ESG score	277	48.76	44	62.78	-14.02***	0.000

Sample B. Matching sample.

	(1)		(2)		(3)	
	Uncertified		Certified		Diff. in means	
	N	Mean	N	Mean	Abs.	p-value
Tenor	67	4.940	40	4.975	-0.035	0.940
Coupon	67	2.856	40	2.059	0.798**	0.033
Log(issue size)	67	19.54	40	19.94	-0.394*	0.080
Log(market cap)	67	23.11	40	23.92	-0.818**	0.026
Log(assets)	67	25.23	40	26.80	-1.570***	0.001
Credit ratio	64	0.004	40	0.004	-0.0004	0.620
ESG score	44	53.71	34	58.58	-6.866	0.102

For both samples, we observe that information on ESG score is not given for all observations, but in fear of shrinking the sample size and missing valuable observations, we proceed. Looking at Sample A, the tenor of the bonds is approximately 7.5 years and the log of market cap is about 23.5 for uncertified and certified bonds. The rest of the characteristics have statistically different averages according to the t-test. The coupon is higher for uncertified bonds, while the log of issue size and assets, as well as ESG score are lower for these issuers. The latter is far lower among issuers of uncertified bonds, indicating that issuers of certified bonds are superior on environmental performance.

In Sample B, we note that some of the estimates have changed in significance. ESG score and Credit ratio no longer vary significantly between the groups. This suggests that issuers of certified bonds do not have higher ESG scores in the matched sample, even if the t-test is close to significance at the 10% level. The probability of defaulting on debt is fairly low for both groups. Further, the average maturity for certified and uncertified bonds is almost 5 years.

More interesting, are the significant differences between the groups on Log(market cap) and Log(assets). Larger issuers behind the certified bonds might be because certification is costly and demands comprehensive reporting of the financial and environmental state of the company. Following the analogy previously outlined, it can be argued that bigger and financially stronger companies are more likely to proceed with certification. Uncertified bonds offer the highest coupon rate, meaning they have lower interest risk than the certified bonds, so in case of increasing interest rates, investors would be better off holding an uncertified bond.

All in all, the differences seen in Sample B are not substantial, and we conclude that this matched sample ensures that the control group is fairly similar to the treated group. Therefore, we have a relatively reliable counterfactual for observing how certified bonds would behave without certification.

6. Results

In this part of the thesis, we present the results of testing the hypotheses about ESG score and YTM. Matched pairs for the issuer level and the bond level, respectively, are the basis for the regressions. Conducting matching allows us to exclude control variables, as the treatment and control groups are similar based on covariates specified in chapter 5. A discussion of the estimates and implications follows the results, before we summarize the limitations.

6.1 Company ESG score

The results of the analysis on company ESG score is outlined in the following paragraphs. First, we present the matching for the company sample before proceeding to the OLS regression and the DiD estimation.

Table 7 presents the final matching pairs used in the DiD estimation in Table 9. As expected, there are no significant differences in characteristics between the groups, due to the matching. The table exhibits 17 bond couples, which is a very small sample for drawing inference. Nonetheless, the matched controls are good counterfactuals for the certified bonds.

Table *7*. Matching for the company sample.

Notes: This table presents descriptive statistics comparing the companies that have issued a certified bond to the control group of companies that have only issued an uncertified green bond.

Matching characteristics		N	Mean	Std. Dev.	Diff. in means	p-value
Credit ratio	Certified	17	0.004	0.004		
	Matched control	17	0.004	0.002	-0.001	0.544
Log(market cap)	Certified	17	24.84	1.383		
	Matched control	17	24.79	1.047	-0.055	0.897
Log(assets)	Certified	17	27.40	1.842		
	Matched control	17	27.32	1.694	-0.077	0.899

In Table 8, we present the results of the OLS regression on certification's impact on ESG score, using the full sample of 141 observations.

Table 8. Simple OLS regression ESG score - full sample.

Notes: Simple OLS regression of ESG score. Certified is a dummy variable taking the value of one in case of certification and 0 otherwise. (***) (**) (*) indicate significance at the (1%) (5%) (10%) level, respectively. Standard errors in parentheses. Luxembourg and Communication Services omitted due to collinearity.

	(1) ESG score	
Certified	0.039	(4.415)
Log(market cap)	-2.320	(2.212)
Log(assets)	10.46***	(2.215)
Credit ratio	-369.0	(371.0)
Australia and New Zealand	-7.802	(19.09)
Belgium	-18.74	(23.61)
Brazil	-19.33	(25.62)
Canada	-19.28	(19.70)
Chile	-17.07	(23.45)
China and Hong Kong	-44.70**	(18.93)
France	-23.18	(19.22)
Germany	-16.58	(21.36)
India	-25.88	(20.17)
Italy	-2.363	(19.15)
Japan	-34.40*	(18.69)
Netherlands	-22.06	(19.30)
Norway	-5.368	(23.67)
Philippines	-8.444	(23.55)
Singapore	-13.47	(21.25)
Thailand	-9.477	(23.84)
United Arab Emirates	-18.23	(23.86)
United Kingdom	-11.58	(18.77)
United States	-19.45	(19.14)
Consumer discretionary	2.860	(13.52)
Consumer Staples	21.02	(15.72)
Financials	-20.09	(13.01)
Industrials	12.41	(12.27)
Information Technology	16.39	(14.78)
Real Estate	6.760	(12.65)
Utilities	-1.543	(12.00)
Constant	-114.9***	(34.67)
N[6]	141	
R^2	0.59	

The regression shows that for ESG score, it does not matter whether a company issues a certified or an uncertified bond. Few of the estimates show statistical significance, but we notice that Log(assets) is strongly significant, indicating that firm size affects ESG score. That is in line with former observations of our data. The standard errors are high, something that

[6] Recall that the total number of observations for Company Sample A in the summary statistics in Tables 1-3 were 395. This is because to compare the two samples, we used data from pre-issue year as in Sample B. Since treatment occurs at different times for different companies, the control group includes observations from all years that qualify as pre-treatment years for the treatment group. In the OLS regression, we simply used data from 2019 for both the treatment and control group.

happens in several of our analyses and will be discussed in the section about limitations. R_2 is 0.59, indicating that almost 60% of the data fit the model.

The main challenge with this OLS regression is endogeneity. As explained earlier, company ESG score is likely to affect certification of a bond. On the other hand, issuing a certified bond likely increases the company's ESG score. In case of such endogeneity issues, one often experiences biased and inconsistent estimates, meaning that the regression output cannot be trusted. Proceeding with the DiD estimation in Table 9, we address this issue.

Table 9. Difference in differences estimation for the matching sample.

Notes: The table summarizes the results of a DiD estimation using the matched pairs. Pre-trend is the DiD estimate conducted in the years preceding certification to test the common trends assumption. Pre-issue year is the year preceding issuance and Year after issuance is one year after issuance. DiD is the difference between the pre- and post-estimates. (***) (**) (*) indicate significance at the (1%) (5%) (10%) level, respectively. Standard errors in parentheses.

	(1) ESG score
Pre-trend	
Certified (1 – 0)	6.167
	(10.92)
Pre-issue year	
Certified (1 - 0)	7.713
	(5.947)
Post-issue year	
Certified (1 - 0)	1.954
	(5.947)
DiD	-5.759
	(8.410)
# matching pairs	17
N	68

The DiD estimate of Pre-trend is not zero, indicating that the treatment and control group may follow slightly different trends pre-issuance. However, the result is not significant, meaning that we cannot reject the hypothesis of common trends. To inspect this trend more closely, we visualize the pre- and post-trend in Figure 3.

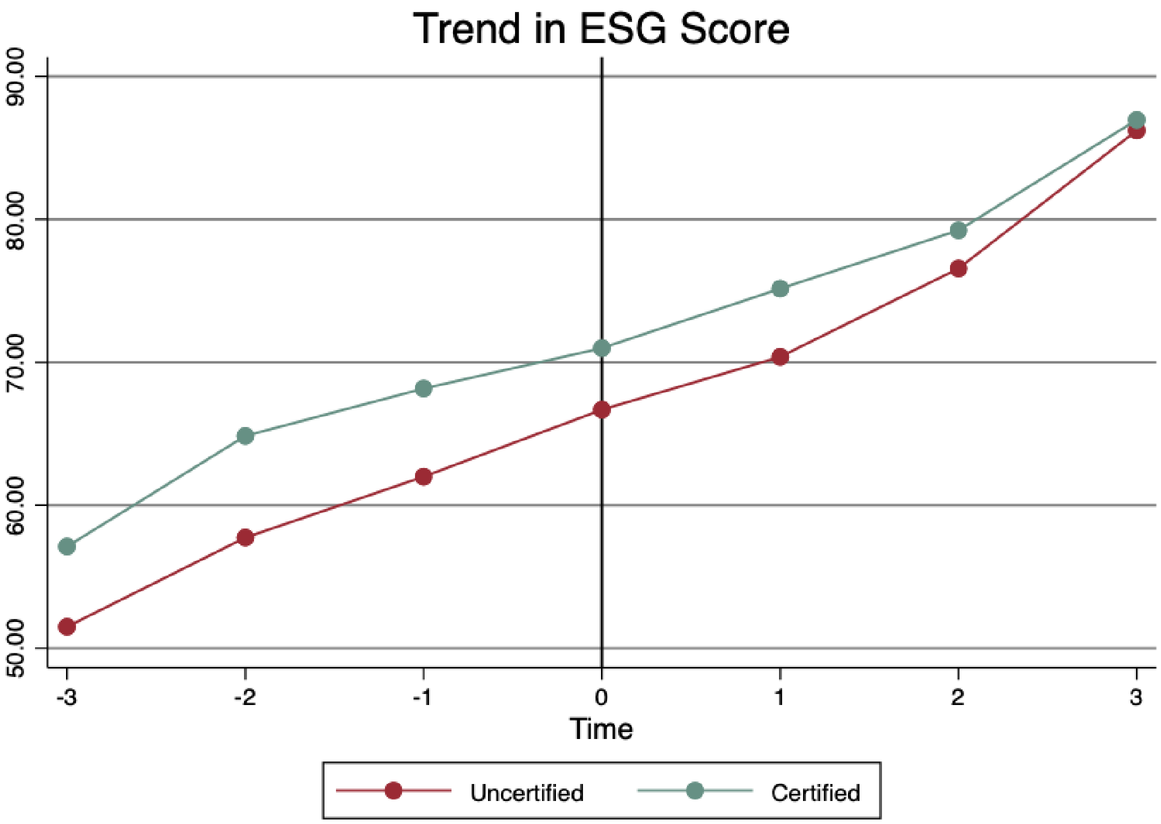

Figure 3. ESG score pre- and post-trend.

Figure 3 illustrates the trend in ESG score before and after certification for both certified and uncertified bonds, using the matching sample for bond issuers. The line at time 0 represents the year of issue. As can be seen, the trend illustrates the DiD estimate, as issuers of certified bonds start off with a higher ESG score, and this difference seems to subside over time. Since the time of treatment differs, the number of observations decreases the farther we get from time 0. This is why the DiD estimate only considers one year pre- and post-issuance: to include the entire matching sample. All in all, it looks like the ESG scores move in the same direction before certification. However, due to the small sample size, we cannot say with certainty that the common trends assumption holds.

Moving on to the estimate of DiD pre- and post-issuance, we find no statistically significant effect of certification. This inhibits us from rejecting the null hypothesis, meaning that there is no evidence to support different average ESG scores pre- and post-issuance of certified bonds. The estimate indicates that one year before issuance, the ESG score is on average 7.7 points higher for companies that are about to issue a certified bond. One year after issuance, the difference in ESG score has declined to 1.95. The result of the analysis, is a negative DiD estimate, suggesting that issuance of a certified bond results in a decline in ESG score one year after issuance. Flammer (2020) did a similar analysis with conventional and green bonds, where she does not get significant results one year after issuance, either. However, two years post-issuance, issuing a green bond had increased the issuer's environment rating.

As stated earlier, issuance of certified bonds cannot be said to affect ESG scores. Even if there were a significant effect to report, the endogeneity concern would raise questions with the results. This concern would be supported by the DiD estimate, had this been statistically significant.

Meeting CBI's criteria demands more than simply issuing a green bond. Relating to hypotheses (1.1), it is reasonable to think that the ESG score should be higher for companies issuing certified bonds, but this cannot be explained by certification. Therefore, certification may not be accurate in offering additional or better information, and maybe it is not done properly. It is also possible that the use of proceeds is not directly affecting the ESG score. Or, maybe certified bonds do not actually contribute to anything more than uncertified bonds.

If ESG scores are correctly measured, and any increases in firms' environmental performance is absorbed, unchanged scores indicate that CBI's stringent criteria appear a bit unnecessary. There is no reason to believe that certified bonds make a larger environmental impact than uncertified bonds do. Hence, certification might come off as a marketing stamp that does not ensure change of practises that increase the environmental state of the company (Kapraun & Scheins, 2019). Though, it is realistic to believe that already obtaining a high ESG score makes further improvements relatively more difficult compared to improvements among firms with lower baseline levels. From our results in the OLS and DiD estimates, we expect no yield differentials between certified and uncertified bonds, in line with hypothesis (1.2).

6.2 Bond yields

In this section, we estimate the average treatment effect of certification on YTM. Table 10 displays the bond sample after matching. Table 11 presents the results of conducting an OLS regression before matching. Then, we outline the results on treatment effect on YTM using the matched sample in Table 12.

The 40 pairs in Table 10 form the matched bond sample to be used in the yield analysis. We observe that the difference in means estimates are far from statistically significant, confirming that the matches consist of bonds that are similar to one another. This contrasts the initial summary statistics for the matching sample in Table 6 that exhibited significant differences on four covariates.

Table 10. Matching pairs for the bond sample.

Notes: This table presents descriptive statistics comparing certified green bonds to the matched control group.

Matching characteristics		N	Mean	Std. Dev.	Diff. in means	p-value
Tenor	Certified	40	4.975	2.527		
	Matched control	40	5.325	2.243	0.350	0.514
Coupon	Certified	40	2.059	1.818		
	Matched control	40	2.212	1.532	0.153	0.686
Credit ratio	Certified	40	0.004	0.004		
	Matched control	40	0.004	0.003	-0.001	0.413
Log(issue size)	Certified	40	19.94	0.882		
	Matched control	40	20.01	0.800	0.075	0.692
Log(market cap)	Certified	40	23.92	2.152		
	Matched control	40	24.09	2.222	0.164	0.738
Log(assets)	Certified	40	26.80	2.480		
	Matched control	40	26.82	2.587	0.021	0.970
ESG score	Certified	40	57.64	15.63		
	Matched control	40	60.38	14.26	2.740	0.415

Table 11 on the next page shows the effect of certification before matching, using the full sample. Lack of a significance of the coefficient Certified, inhibits us from concluding that certified and uncertified green bonds offer different yields, even before taking endogeneity concerns into account. We recall that the full bond sample in Table 6 showed that the average ESG score was 14 points higher among issuers of certified bonds. Though, there is no evidence to claim that certification has any effect on ESG scores of bond issuers.

On the other hand, our results are in line with our hypothesis (1.1). Coupon, Fixed and Log(market cap) are statistically significant at the 5% and 10% level, meaning that these variables are determinants of the YTM estimate. Certification, Log(issue size), Credit ratio, ESG score and various country, sector and year estimates, are not significant. These variables cannot be said to impact yield substantially.

Table 11. Simple OLS regression of yield to maturity – full sample.

Notes: Fixed is a dummy variable equal to one for fixed coupons and zero-coupon bonds, zero otherwise. The Y-variables are dummies taking the value of one in a specific year, zero otherwise. (***) (**) (*) indicate significance at the (1%) (5%) (10%) level, respectively. Standard errors in parentheses. Greece, Communication Services, Materials and Y_2015 omitted due to collinearity.

	(1) Yield to maturity	
Certified	0.255	(0.280)
Coupon	0.929***	(0.065)
Tenor	-0.056***	(0.017)
Log(issue size)	-0.119	(0.060)
Fixed	-0.768***	(0.279)
Log(assets)	-0.306**	(0.127)
Log(market cap)	0.404***	(0.117)
Credit ratio	48.25*	(25.88)
ESG score	0.000	(0.000)
Australia and New Zealand	-1.072	(1.582)
Belgium	-0.594	(1.988)
Brazil	2.126	(2.156)
Canada	-0.765	(1.655)
Chile	3.509*	(2.095)
China and Hong Kong	-1.498	(1.664)
France	0.814	(1.682)
India	2.562	(1.811)
Italy	0.512	(1.688)
Japan	-0.372	(1.681)
Luxembourg	1.808	(2.278)
Netherlands	-0.551	(1.673)
Norway	-1.053	(1.323)
United Arab Emirates	-1.670	(2.012)
United Kingdom	-0.222	(1.704)
United States	-0.910	(1.662)
Consumer Discretionary	2.896***	(1.041)
Consumer Staples	0.846	(1.264)
Financials	2.092**	(0.982)
Industrials	1.434	(0.969)
Information Technology	0.915	(1.101)
Real Estate	1.751*	(0.982)
Utilities	0.966	(0.939)
Y_2014	-0.872	(0.643)
Y_2016	0.065	(0.412)
Y_2017	-0.456	(0.429)
Y_2018	0.097	(0.408)
Y_2019	0.395	(0.409)
Constant	0.047	(3.254)
N	310	
R^2	0.88	

After the matching procedure, we run a linear regression to estimate the ATET. The results are displayed in Table 12. The estimator attempts to measure the causal effect of certification on YTM. The coefficient Certified is not statistically significant, meaning that there is no evidence that certification has an effect on YTM. This is not surprising, on the background that issuers' ESG score did not change one year after issuance. As discussed, the presumption is that different environmental performance is accompanied by different yield due to the green component.

Table 12. Treatment effect on yield to maturity for the matching sample.

Notes: Model: nearest neighbor matching – Average treatment effect on the treated (ATET). Outcome variable: Yield to maturity. Treatment variable: Certification. Covariates: Log(market cap), Log(issue size), issue year, tenor, issuer. Fixed variables: Coupon type, country, issuer and sector. NN indicates number of matches per treated observation. (***) (**) (*) indicate significance at the (1%) (5%) (10%) level, respectively. Independently and identically distributed Abadie-Imbens Standard errors in parentheses.

	(1) Yield to maturity
ATET	
Certified (1 vs. 0)	0.144
	(0.498)
# treated	40
# untreated	40
NN	1

All in all, we did not find evidence that a certified bond premium exists. On the basis of our results, one could say that we have consistency between the analyses. The market seems to absorb the information about ESG score through not offering any yield differentials. If environmental performance of firms matters to investors, and if issuers of certified bonds were more environmental, the rationale is that certified bonds would offer lower yield due to the value of having an issuer with high ESG score. The assumption would be that investors had a nonpecuniary preference for the certified bond and therefore be willing to accept a lower return (Baker et al, 2018). In other words, a green premium would exist, making financing cheaper for the most environmental firms. Since investors may view certification as worthless in offering any new or better information, certified bonds are not relatively more attractive. Our results of no yield differentials could therefore be explained by the demand of certified bonds being too low to bid up the prices, hence lowering the bond yield.

It is imperative to remember that the yield is also affected by the certification process itself. Certification is not random, and especially not because companies pay for it (Baker et al., 2018). The cost reduces bond yield, and so does certification itself, under the assumption that certified bonds are viewed positively in the market. If investors are fully informed about the bond and the issuer, certification would not have any value. On the other hand, if certified bonds attract a group of investors that would not have identified their characteristics otherwise, the Certified coefficient might understate the yield reduction investors accept to buy a certified bond.

In contrast to our results of no yield differences, pension asset manager Mariska Douwens says that the corporate bond market is "very inefficient with lagging price adjustments, not always reflecting real underlying trades" (Schoenmaker & Schramade, 2019 p. 271). Assuming that this also holds for the green bond market, the market could fail to absorb environmental information, implying informational deficiencies. If so, interference like certification may provide clarity for investors, affecting their investment decisions, and thus possibly bond yield.

Kapraun & Scheins (2019) observe that bonds of firms with the 30% highest ESG scores were not attractive. They find that investors are reluctant to buy green bonds from these firms, since they often carry lower yield than conventional bonds from the same issuer. In contrast to the previous chapter, and having the cost of labeling in mind, it might be that issuers of certified bonds, assuming good a high ESG score and good reputation, do not need certification to prove their greenness, meaning that the green bond market is efficient.

6.3 Institutional ownership share

Lastly, we conduct an analysis of institutional ownership to observe the effect on ESG score and YTM. Although not significant, we want to put our previous results in context by trying to understand why certification showed a small, positive effect. One reason could be that the treatment and control group are inherently different in ownership structure. It might be that companies with institutional owners are more prone to seek out certification and verify their environmental commitment. If this stands true, our previous results might stem from differences in ownership structure rather than certification. Knowing that small datasets entail challenges, we view the following results with caution.

6.3.1 ESG score

The scatterplots in Figure 4 illustrate the relationship between ESG score and the share of institutional ownership.

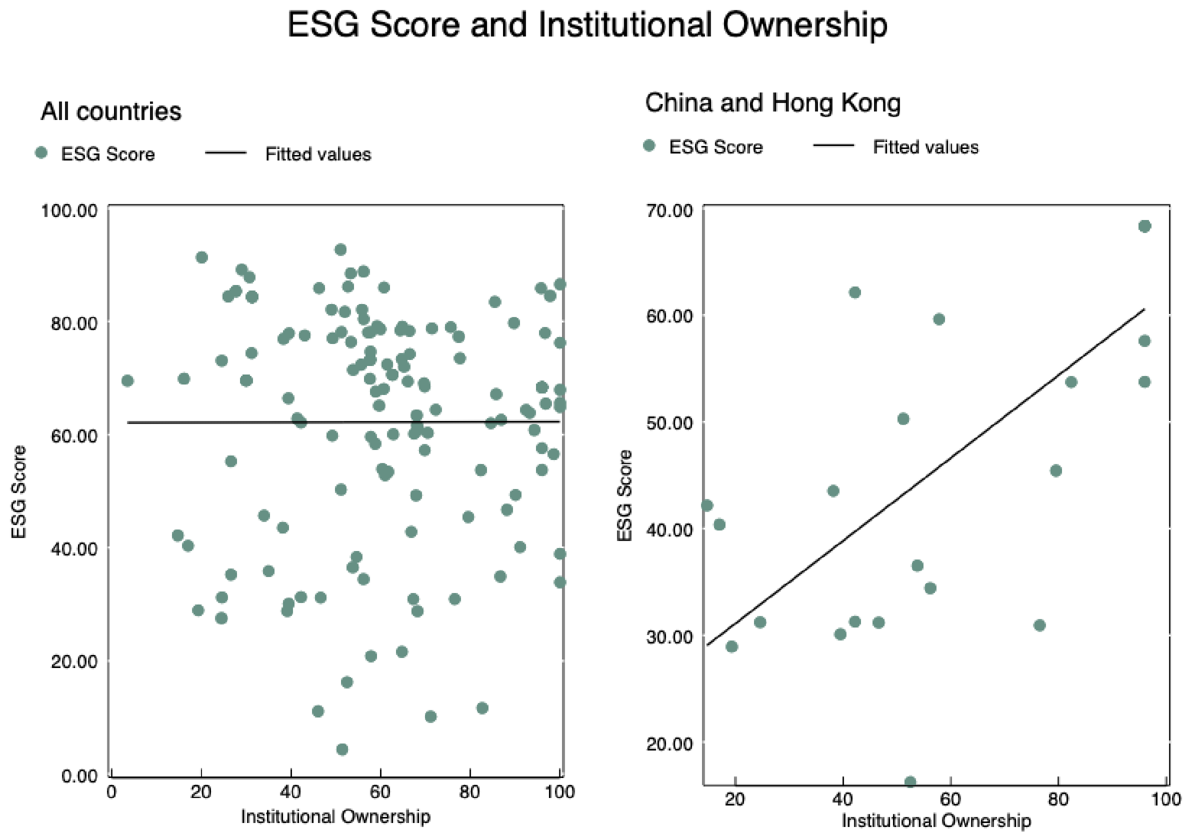

Figure 4. ESG score and institutional ownership.

We are not able to detect any trends by looking at all countries. However, when isolating the country with the highest number of observations (China and Hong Kong), we observe a positive relationship. The intuition is that there seems to be a relationship between country and institutional ownership share. The slight trend in the right-hand scatterplot resembles the findings of Dyck et al. (2019). They describe that presence of institutional ownership leads to improved E and S scores, and more so for firms with below-median scores on E and S. Although the study did not comprehend a G score, the results are similar. A reasonable explanation for the observed trend in ESG score might be pressure to report and improve sustainability, as institutions often put emphasis on issues affecting their reputation. Improving ESG scores and proceeding with certification, might be measures to improve informational efficiency and combat greenwashing suspicions. Siew et al. (2016) find that the presence of institutional ownership reduces asymmetric information in the market, and thus enhances efficiency.

The regression seen in Table 13 is included to explore whether institutional ownership has a role in determining ESG score. We create an interaction term between Certified and Institutional ownership to estimate whether the effect of certification on ESG score varies for different levels of institutional ownership. The interaction variable Cert x IO is not statistically significant, and we can therefore not say that different levels of institutional ownership impact the effect of certification on ESG score. Further, we observe that the variables Institutional ownership and Certified are not significant, either. All in all, it seems like being partially or fully owned by an institution, has no effect on neither certification nor the ESG score.

Table 13. ESG score and institutional ownership.

Notes: The table show the results of a simple OLS regression including Institutional ownership as a control. Cert x IO is an interaction term between Certified and Institutional ownership. Luxembourg and Information Technology omitted due to collinearity. (***) (**) (*) indicate significance at the (1%) (5%) (10%) level, respectively. Standard errors in parentheses.

	(1) ESG score	
Certified	3.521	(11.43)
Institutional ownership	0.009	(0.081)
Cert x IO	-0.050	(0.150)
Log(market cap)	-2.336	(2.239)
Log(assets)	10.47***	(2.235)
Credit ratio	-395.5	(382.7)
Australia and New Zealand	-9.184	(19.71)
Belgium	-19.68	(24.02)
Brazil	-19.33	(26.05)
Canada	-19.79	(20.05)
Chile	-18.11	(24.54)
China and Hong Kong	-44.88**	(19.26)
France	-23.58	(19.61)
Germany	-16.79	(21.61)
India	-25.91	(20.47)
Italy	-2.856	(19.53)
Japan	-34.94*	(19.04)
Netherlands	-23.39	(19.90)
Norway	-4.966	(24.18)
Philippines	-8.939	(24.04)
Singapore	-13.83	(21.49)
Thailand	-9.943	(24.12)
United Arab Emirates	-18.44	(24.10)
United Kingdom	-11.83	(19.46)
United States	-19.92	(19.64)
Consumer Discretionary	-13.33	(10.79)
Communication Services	-16.18	(14.94)
Consumer Staples	4.384	(13.79)
Financials	-36.50***	(11.61)
Industrials	-3.607	(9.985)
Real Estate	-9.490	(9.417)
Utilities	-17.71*	(10.10)
Constant	-98.42***	(34.85)
Observations	141	
R^2	0.59	

6.3.2 Yield to maturity

The scatterplots in Figure 5 illustrate the relationship between YTM and the share of institutional ownership.

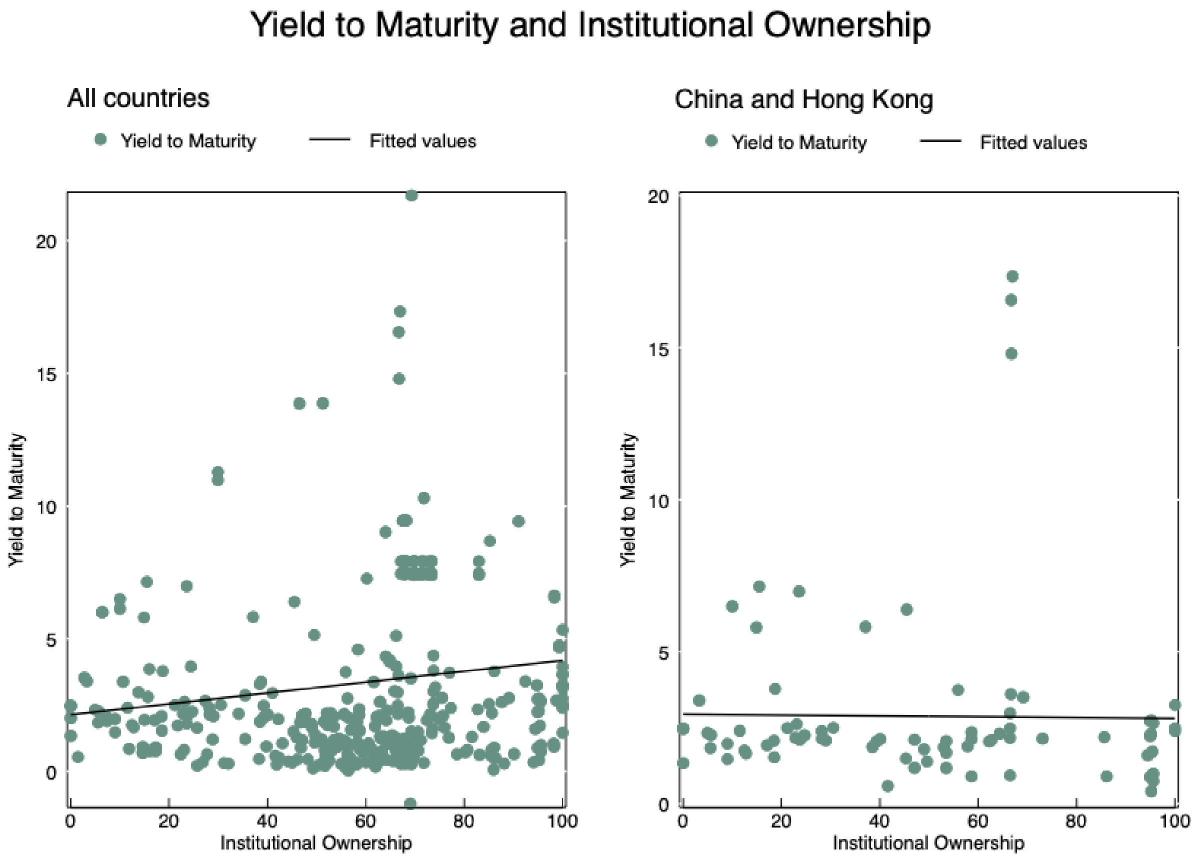

Figure 5. YTM and institutional ownership.

From the scatterplot of all the countries in the sample, we detect a slight positive association between institutional ownership and YTM. As in Figure 4, we look at the relationship for only China and Hong Kong and find a weak negative relationship.

In Table 14, we look into bond data to observe whether institutional ownership plays a role in determining YTM. Neither Certified, Institutional ownership nor the interaction term are statistically significant. The latter means that the effect of certification on YTM does not differ for different values of Institutional ownership. As expected, we observe significance among variables that are obvious determinants of YTM, like Coupon and Tenor.

Table 14. Yield to maturity and institutional ownership.

Notes: The table shows the results of a simple OLS regression including Institutional ownership as a control. Greece, Communication Services, Materials and Y_2015 omitted due to collinearity. (***) (**) (*) indicate significance at the (1%) (5%) (10%) level, respectively. Standard errors in parentheses.

	(1) Yield to maturity	
Certified	-0.453	(0.553)
Institutional ownership	0.004	(0.005)
Cert x IO	0.012	(0.008)
Coupon	0.942***	(0.065)
Tenor	-0.058***	(0.017)
Log(issue size)	-0.010	(0.061)
Fixed	-0.780***	(0.279)
Log(assets)	-0.357***	(0.128)
Log(market cap)	0.408***	(0.117)
Credit ratio	46.58*	(26.43)
ESG score	0.003	(0.007)
Australia and New Zealand	-0.644	(1.586)
Belgium	-0.493	(1.977)
Brazil	2.019	(2.144)
Canada	-0.708	(1.646)
Chile	3.402	(2.099)
China and Hong Kong	-1.403	(1.655)
France	0.913	(1.673)
India	2.320	(1.806)
Italy	0.531	(1.679)
Japan	-0.173	(1.674)
Luxembourg	1.671	(2.268)
Netherlands	-0.512	(1.664)
Norway	-1.418	(1.328)
United Arab Emirates	-1.761	(2.001)
United Kingdom	-0.308	(1.695)
United States	-0.914	(1.653)
Consumer Discretionary	2.695***	(1.040)
Consumer Staples	0.720	(1.263)
Financials	2.097**	(0.984)
Industrials	1.262	(0.968)
Information Technology	0.702	(1.113)
Real Estate	1.516	(0.993)
Utilities	0.851	(0.939)
Y_2014	-1.060	(0.644)
Y_2016	-0.008	(0.411)
Y_2017	-0.534	(0.428)
Y_2018	-0.064	(0.412)
Y_2019	0.283	(0.410)
Constant	0.537	(3.244)
Observations	310	
R^2	0.87	

Bhojraj and Sengupta (2003) observed that institutional ownership, up to a certain degree, decreased bond yields due to governance mechanisms that reduce firm risk. On the other hand, the results were opposite when ownership was concentrated. We did not experience that varying degrees of institutional ownership had something to say. According to our results, institutional ownership neither has a positive effect on YTM, nor impact the effect of certification on YTM.

To evaluate if certification has any value, we wanted to assess if some factor increased the probability of applying for certification. Looking into issuers' ownership structure was an attempt to determine whether some bonds are more likely to undergo certification and if some firms "needed" certification to communicate their greenness. The estimates in Table 13 and 14 did not provide us with any new inference. As small firms gain little attention in the market, it might be that they "need" certification more compared to bigger firms that tend to have higher institutional ownership share. We recall that having a high ownership share is often perceived as attractive and it would lower the bond's yield. Knowing that certification costs money and that issuers of certified bonds tend to be larger, supports the assumption that the most financially viable companies apply for certification, even if it does not bring any new info to the market. All in all, the lack of significance in the results of this thesis inhibits us from rejecting the efficient market hypothesis.

6.4 Limitations

In this section, we present challenges with our study. The most considerable limitation for our study is undoubtably the small sample sizes used in the analyses. Bonds certified by CBI are a very narrow part of the green bond market, which is not that big itself. Matching is challenging as we need bonds with similar covariate distributions, resulting in very few pairs. Also, the matching is merely based on observed characteristics, preventing us from excluding biases stemming from unobserved characteristics. The miniscule number of matched pairs make the DiD estimation and YTM analysis challenging, and it is not surprising that we lack significant results. The high standard errors observed are yet another important thing to beware of due to the accuracy needed to draw inference (Moore, 2010). Few observations can make it difficult to be sure that we are approaching the true mean.

Lacking significance on the DiD estimation may also be because the ESG score is observed too shortly after issuance. Due to inertia, the use of proceeds needs to make an environmental impact large enough to be absorbed by the ESG score. As recalled, Flammer (2020) only got significant results two years post-issuance. It is a challenge to merely look into ESG score as a metric of environmental performance. Researchers at MIT found that when different sustainability raters calculated scores on ethical and governance matters, they had similar results only 60% of the time (Nauman, 2020). Manipulating scores on ESG matters, is a rising concern, as companies are pressured to disclose non-financial KPI's, something that makes even professional investors unsure about information quality.

It is important to bear in mind that the certification scheme is relatively new and that sector criteria are still being defined, meaning that not all industries are not included. It may lead us to obtain a sample that is not diverse and big enough to draw inference from. Using data from a mature market over a longer time span would therefore strengthen the quality of the analysis.

7. Conclusion

This thesis attempts to gain inference on efficiency in the green bond market. More specifically, we asked if certification contributes to informational efficiency or whether the market absorbs information to a degree that makes certification unnecessary. Our data foundation reveals the fact that the green bond market, and in particular certification of green bonds, is at an early stage. Keeping in mind that we operate with a limited number of observations, we proceed with caution when concluding our findings.

We looked into green bonds certified by CBI and green bonds following the GBP to estimate the effect of certification on ESG scores and YTM through OLS. To address endogeneity issues, we conducted matching on firm and bond level, respectively, as well as a DiD estimation on firm level. Lastly, we tried to measure the impact of institutional ownership on ESG score and YTM in an attempt to explain our results

Recall our first hypothesis that issuing a certified green bond does not lead to an increase in the issuer's ESG score. The OLS estimate revealed a small, positive effect of certification, though not statistically significant. The DiD estimate showed that although issuers of certified green bonds started out with higher average ESG scores, this difference was smaller one year after the bond issuance, yielding a negative effect of certification on ESG score. Neither result proved statistically significant and we failed to reject the null hypothesis. This leads us to our next hypothesis that was contingent on the first. As there was no evidence to conclude that issuing a certified green bond leads to an increase in the issuer's ESG score, we expected there to be no green premium on certified green bonds.

If there is no green effect of certification, there can be no premium stemming from certification itself. As with the first analysis, we first performed an OLS estimation. This revealed a small positive premium that was not statistically significant. The matching estimate showed a reduced treatment effect that, however, was still slightly positive but not significant. We thus failed to reject both the null hypotheses. This means that our results are consistent and there is no evidence to reject the hypothesis of market efficiency. Hence, the comprehensive certification process seems unnecessary for increasing efficiency or the degree of information in the market. Studying the characteristics of green bonds, we observed that certified bonds tend to be of a bigger size and be issued by larger companies, perhaps because these firms are better fit to pay for certification.

In the last section, we conducted an analysis of institutional ownership to observe its effect on the outcome variables. Our hypothesis was that institutional owners are more likely to apply for certification and experience pressure to communicate their environmental efforts to the public. This could mean that our estimates actually came from differences in ownership structure rather than certification itself. Institutional ownership did not show significance in either the ESG score or the YTM analysis. The interaction between certified and institutional ownership did not come out significant either.

Our findings call for future research, especially since the market of green bonds certified by CBI is small and immature. As mentioned, access to larger samples of data would increase the quality of our analyses. If the green bond market continues to grow and more data becomes ava, the chance of robust results will increase. Moreover, data over a longer period of time could provide insights into longer-term effects.

As criteria for more industries develop, research may produce more evident results and long-term impact of certification in the green bond market, and implications for the efficiency of the market. Studying transparency or technology levels within countries may be interesting for exploring if certification is affected by a market's informational efficiency. Using a proper instrumental variable to account for certification, is another way of addressing endogeneity that might yield interesting results if a proper instrument can be found. Future studies may also explore access and cost of financing for issuers of certified bonds.

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