



**ΠΑΝΕΠΙΣΤΗΜΙΟ ΠΕΙΡΑΙΩΣ
ΤΜΗΜΑ ΟΡΓΑΝΩΣΗΣ ΚΑΙ ΔΙΟΙΚΗΣΗΣ ΕΠΙΧΕΙΡΗΣΕΩΝ
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ΣΤΗ ΔΙΟΙΚΗΣΗ ΕΠΙΧΕΙΡΗΣΕΩΝ ΓΙΑ ΣΤΕΛΕΧΗ (EXECUTIVE MBA)**

Διπλωματική Εργασία

**GREEN BONDS AS MEANS OF RAISING CAPITAL AND
CREATING VALUE WITHIN THE ESG FRAMEWORK.**

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ΒΕΒΑΙΩΣΗ ΕΚΠΟΝΗΣΗΣ ΔΙΠΛΩΜΑΤΙΚΗΣ ΕΡΓΑΣΙΑΣ

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Όνοματεπώνυμο: Μαγδαλινή Τσάτση

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GREEN BONDS AS MEANS OF RAISING CAPITAL AND CREATING VALUE WITHIN THE ESG FRAMEWORK.

Μαγδαλινή Μιχαήλ Τσάτση

Keywords: Green bonds, green bond premium, ESG framework, green label, stock market reaction

ABSTRACT

This thesis focuses on green bonds and aims to examine, via various studies conducted in this field, market's reaction to green bond issues. In particular, the studies examined aim to explore whether there is a pricing advantage for green bond issuers and the factors contributing to any such advantage as well as whether the green bond issue creates value for the issuer in the long run. The green bond market is deemed to be still at infancy stage; however, literature shows a particular interest in examining a potential benefit for firms in green bond issues, especially with respect to the cost of debt and the market reaction to such issues.

Further, this thesis analyses the ESG framework which plays a very important role in the green bond market; to that extent, the ESG regulatory framework is presented, with an emphasis on the European regulatory framework, which includes some of the most important worldwide actions taken in the field.

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1. Chapter 1: Introduction

1.1. Green bonds-Brief history and market overview

A broad definition of green bonds would describe them as fixed income securities issued by capital raising entities to fund their environmentally friendly projects. The defining feature of green bonds is the use of their proceeds, which must support projects intending to decrease climate or environmental impact.

The first green bond was issued back in 2007 from European Investment Bank (EIB) as the first Climate Awareness Bond of a value of Euro 600 million. The World Bank followed issuing its first green bond in 2008, but the market evolved rapidly the years following 2013. That being said, in 2013, Electricite de France would become the first publicly traded corporation to issue a green bond and Credit Agricole Corporate and Investment Bank would become the first commercial bank to issue a green bond.

The years that followed, the green bond market met an enormous growth. According to the Climate Bonds Green Bond Database, in early December 2020, the green bond market reached SD 1.002 trillion in cumulative issuance since market conception in 2007. The following diagram summarises market's impressive progression over the years 2007-2020:

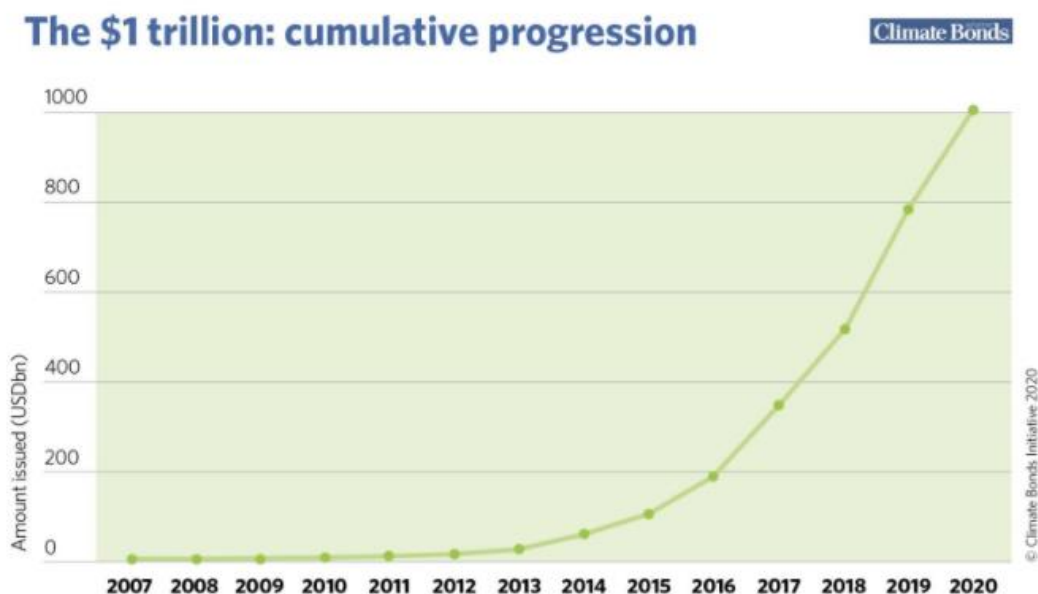


Diagram 1: The \$1 trillion: cumulative progression

Source: <https://www.climatebonds.net/2020/12/1trillion-mark-reached-global-cumulative-green-issuance-climate-bonds-data-intelligence>

Issuers vary from institutions, private and governmental, as well as financial institutions, including commercial banks. As regards the landmark of 1 trillion, financial corporates are the largest source of issuance, followed by non-financial and development banks. The issuer type breakdown is shown in the following diagram:

The \$1 trillion: green bond issuers

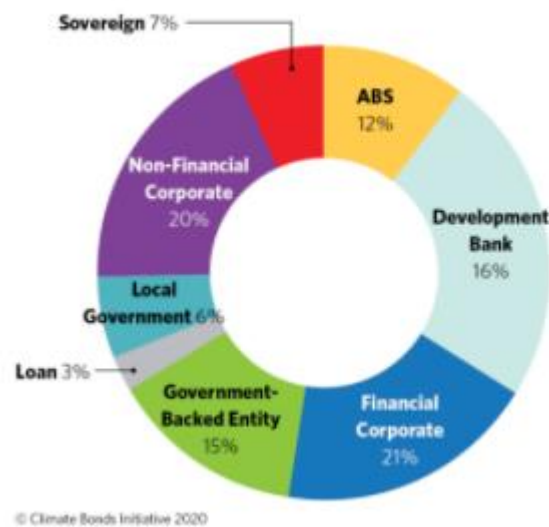


Diagram 2: The \$1 trillion: green bond issuers

Source: <https://www.climatebonds.net/2020/12/1trillion-mark-reached-global-cumulative-green-issuance-climate-bonds-data-intelligence>

1.2. The Green Bond Principles

To take a deeper look in the green bond concept, Green Bond Principles (**GBP**) need to be examined. The GBP intend to provide support to issuers in green financing by defining transparent green credentials through their voluntary process guidelines. GBP are meant to also provide investors with the necessary information in case of an investment opportunity through a transparent process. GBP were first circulated by investment

banks, namely Citi, JPMorgan, Credit Agricole, and Bank of America Merrill Lynch and are now issued by the International Capital Markets Association (**ICMA**).

As per the latest update of the GBP, for a bond to be aligned with such principles, the four core components are the following:

1. Use of Proceeds
2. Process for Project Evaluation and Selection
3. Management of Proceeds
4. Reporting

The main feature of green bonds is, as expected, the use of proceeds. According to the latest update of the GBP, the indicative list of green use of proceeds is envisaged as follows:

Renewable energy	production, transmission, appliances and products
Energy efficiency	such as in new and refurbished buildings, energy storage, district heating, smart grids, appliances and products
Pollution prevention and control	reduction of air emissions, greenhouse gas control, soil remediation, waste prevention, waste reduction, waste recycling and energy/ emission-efficient waste to energy
Environmentally sustainable management of living natural resources and land use	environmentally sustainable agriculture; environmentally sustainable animal husbandry; climate smart farm inputs such as biological crop protection or drip-irrigation; environmentally sustainable fishery and aquaculture; environmentally sustainable forestry, including afforestation or reforestation, and preservation or restoration of natural landscapes

Terrestrial and aquatic biodiversity conservation	protection of coastal, marine and watershed environments
Clean transportation	such as electric, hybrid, public, rail, non-motorised, multi-modal transportation, infrastructure for clean energy vehicles and reduction of harmful emissions
Sustainable water and wastewater management	including sustainable infrastructure for clean and/or drinking water, wastewater treatment, sustainable urban drainage systems and river training and other forms of flooding mitigation
Climate change adaptation	Including efforts to make infrastructure more resilient to impacts of climate change, as well as information support systems, such as climate observation and early warning systems
Circular economy adapted products, production technologies and processes	such as the design and introduction of reusable, recyclable and refurbished materials, components and products; circular tools and services); and/or certified eco-efficient products
Green buildings	meeting regional, national or internationally recognised standards or certifications for environmental performance

Source: Green Bond Principles, Voluntary Process Guidelines for Issuing Green Bonds, June 2021, ICMA

As regards the process for project evaluation and selection, the GBP envisage the green bond issuer to be disclosing to investors the environmental sustainability objectives of its green projects as well as information regarding procedures via which such issuer identifies and deals with any social and environmental risks connected to such projects. Such information provided should be positioned within green bond issuer's overall strategy as regards environmental policies.

The management of green bond proceeds is of high importance for the GBP. In particular, the net proceeds of the green bond (or an amount equal to these net proceeds) should be tracked by the issuer in an appropriate manner in its accounting books and for the maturity period of the green bond, such net proceeds should be periodically adjusted to match allocations to other green projects of the issuer during the same period. The green bond issuer shall disclose to investors the manner it is tracking the green bonds. For higher transparency, the GBP propose that an independent third party (eg an external auditor) should be appointed in order to verify management of proceeds.

In terms of reporting, green bond issuers should keep available on demand information regarding on the use of proceeds, in reports which should be updated on an annual basis until the full use of proceeds. Such report must describe the green projects in a brief manner, as well as the amounts utilized for such projects and their expected effect (ICMA, Green Bond Principles (2021), [Access: March 2023], <https://www.icmagroup.org/sustainable-finance/the-principles-guidelines-and-handbooks/green-bond-principles-gbp/#:~:text=The%20GBP%2C%20updated%20as%20of,issuance%20of%20a%20Gre en%20Bond>). In June 2022, Appendix 1 of the Green Bond Principle was updated to mainly with the aim to distinguish the “Standard Green Use of Proceeds Bonds” (which refers to unsecured debt obligation) and “Secured Green Bonds”.

1.3. Reasons for the study and general significance of the study

Despite its growth, the green bond market is still at infancy stage. On a rather related note, Environmental, Social and corporate Governance (**ESG**) issues, which practically measure firm’s collective conscientiousness for social and environmental impact of firm’s actions, have attracted investors and stakeholders in the sense that use of ESG information by the latter has been eagerly expanded and firms are becoming aware that it is of major importance to meet stakeholders’ expectations as regards green projects.

To that extent, and in the related context of green bond issues, numerous studies have been conducted trying to identify potential benefits for issuers of green bonds compared to those issuing conventional corporate bonds. These studies aim to find out whether there is a discounted rate for such bonds, i.e. whether investors are willing to give up on part of the bond’s coupon in order to hold a green bond and therefore green bonds

constitute lower cost of capital for firms (often referred to as the “green negative premium”) or if green bonds eventually lead to positive stock returns and therefore turn out to be beneficial for issuer’s shareholders.

Some of these studies show interesting results especially as regards green bond premium. For example, Zerbib runs a comparison for 110 senior fixed-rate green bonds to their synthetic conventional peers and finds a negative green bond premium of 2 bps, which is particularly visible for financial institutions (Zerbib (2019), The effect of pro-environmental preferences on bond prices: Evidence from green bonds, *Journal of Banking & Finance*, 98, 39-60). Moreover, other studies examine the abnormal stock returns following a green bond issue and find that issuer’s stock prices increase significantly following the announcement of a green bond issue (Dragon Yongjun Tang, Yupu Zhang (2020), Do shareholders benefit from green bonds, *Journal of Corporate Finance*, 61).

The various studies’ results also try to explore whether the issuer type has an impact on green bond issue result (eg whether institutional issuers benefit the same or even more from a green bond issue than private issuers) and whether a third party verification (often called as the green label) has an impact on market’s reaction to green bonds issue.

This thesis aims to critically examine various studies around the issues stated above in terms of data structure, methodology, results found as well as parameters explored in order to present a concrete compilation of some of the results and concerns around the matter. The green bond market is still at an infancy stage and therefore there is no clear consensus on whether green bonds are indeed beneficial for issuers and their shareholders. The present thesis aims to take a further step with respect to the studies in this field.

1.4. Thesis’ structure and methodology

This thesis consists of 4 chapters which analyse the main subject as follows: the first chapter, introduction, contains a summary of green bonds definition and history and highlights the matters arising from green bond issues for firms. The second chapter aims to capture the environment in which green bonds are issued: the ESG framework; thus, it includes a global overview of the ESG framework and the European regulatory framework in particular, since the European Union is considered to be a leader in the field of green and ESG regulation. The third chapter analyses the studies chosen for this thesis, which consist of studies examining a potential green bond premium as well as

studies trying to explore market's reaction to green bond issuer's stock returns. The fourth chapter contains the conclusions which came out of the review of the studies included in chapter 3.

The methodology is literature review of the **eight** studies chosen for the thesis. This thesis takes a deep dive in such studies and tries to examine all parameters taken into account, in order to, among others, compare the results of each study with one another and conclude on the green bond premium issue, as well as to highlight any areas that are in need of further research.

Literature

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Zerbib (2019), The effect of pro-environmental preferences on bond prices: Evidence from green bonds, Journal of Banking & Finance, 98, 39-60

Διαδικτυακοί τόποι

Climate Bonds (2020), \$1Trillion Mark Reached in Global Cumulative Green Issuance: Climate Bonds Data Intelligence Reports: Latest Figures, [Access: March 2023], <https://www.climatebonds.net/2020/12/1trillion-mark-reached-global-cumulative-green-issuance-climate-bonds-data-intelligence>

ICMA, Green Bond Principles (2021), [Access: March 2023], <https://www.icmagroup.org/sustainable-finance/the-principles-guidelines-and-handbooks/green-bond-principles-gbp/#:~:text=The%20GBP%2C%20updated%20as%20of,issuance%20of%20a%20Green%20Bond.>

2. ESG framework

2.1. ESG overview

ESG is consisted of three components: environmental, social and (corporate) governance. As regards the “E” element, environmental considerations relate to climate change mitigation and relevant risks. As regards the “S” element, social considerations relate to issues of inclusiveness, diversity, labour relationships and firm’s commitment to invest in human capital and communities. Last, the “G” element is related to firm’s corporate governance of public and private institutions (including management structures, employee relations, beneficial ownership) and is also related to taking into account environmental and social issues when a firm makes a decision.

There are several studies examining potential benefits and especially financial performance for firms with high ESG scores. That beings said, although maximization of profit is the leading concern of investors, ESG ratings, i.e. Sustainability Ratings and Corporate Social Ratings can play a major role in investors’ choices.

To begin with, B. Cheng, I. Ioannou, and G. Serafeim find that “*firms with better CSR performance face lower capital constraints*”. They explain this result through two mechanisms: first, better CSR performance is related to stakeholder engagement which minimizes opportunistic behaviors and builds longer-term relationships, eventually leading firms to orientate their decision-making processes towards longer periods. Second, firms with better CSR performance will possibly disclose to investors their CSR activities and will thus, become more transparent, eliminating information asymmetries. Such information asymmetries often lead firms to “*face upward sloping supply curves*”; therefore, when such asymmetries are reduced, the relevant firms with better CSR performance “*face a capital supply curve that is effectively less steep*” (Beiting Cheng, Ioannis Ioannou, and George Serafeim (2014), Corporate Social Responsibility and Access to Finance, Strategic Management Journal, 35, 1-23).

To that extent, and, not surprisingly since transparency plays a very important role in the market, other studies have found that disclosure on CSR issues is negatively related to the cost of equity capital and such results are more robust in countries that are characterized as more “stakeholder oriented” (Dan Dhaliwal, Oliver Zhen Li, Albert

Tsang, Yong George Yang (2014), Corporate social responsibility disclosure and the cost of equity capital: The roles of stakeholder orientation and financial transparency, *J. Account. Public Policy*, 33, 328-355).

On the other hand, it should be noted that the results of several studies conducted are not unanimous. For example, Gerhard Halbritter and Gregor Dorfleitner examine critically the relationship between the corporate social and financial performance based on ESG ratings and find that ESG portfolios do not show significant return differences between companies featuring high and low ESG rating levels. Moreover, the researchers note that the results vary depending on the specific ESG rating provider. In a nutshell, the study strongly questions whether a relationship between ESG ratings and abnormal returns can be found in the first place (Gerhard Halbritter and Gregor Dorfleitner (2015), *The wages of social responsibility — where are they? A critical review of ESG investing*, *Review of Financial Economics*, 26, 25-35).

In any case, firms are rather motivated to provide all data that show their ESG activities so that ESG ratings can be formed. The question is whether investors, on their part, are eager to use the data provided; after all, decreasing the information asymmetry could potentially decrease risk. To that extent, researchers have also studied whether investors actually use ESG information. Amir Amel-Zadeh and George Serafeim have found that approximately 82% of the investors asked (with no statistically important difference between large and smaller firms), consider ESG information in the investment decision making. Further, 63% of the investors asked, declared that they use ESG information because such information is “*financially material to investment performance*”. Surprisingly the results show that executives who are not ESG-specialists use ESG information for materiality reasons, meaning that the results do not derive from persons with particular ESG interest in the firm (Amir Amel-Zadeh and George Serafeim (2018), *Why and How Investors Use ESG Information: Evidence from a Global Survey*, *Financial Analysts Journal*, 74, 87-103).

In light of the above, it is evident that there is extensive literature examining the potential relationship between firms' ESG ratings and their financial performance. Further, it is a fact that firms are challenged by pressures of society and customers to re-consider their business in more sustainable ways and overall assist society with the changes required towards the envisaged sustainable future (Bogers Marcel, Chesbrough Henry and Strand Robert (2020), *Sustainable open innovation to address a grand challenge-Lessons from Carlsberg and the Green Fiber Bottle*, *British Food Journal*, 122, 1505-1517). As a result, companies report their ESG scores, and such disclosure may affect

investors, since it reduces information asymmetry. To that extent, it is crucial to provide an overview of ESG regulatory framework, within which companies develop their ESG activities.

2.2. ESG regulatory framework - The Paris Agreement

In 2015, the close to 190 parties attending the Paris climate conference proceeded with executing the Paris Agreement, which constitutes the first legally binding agreement with respect to global climate change. The Paris Agreement provides a global framework to mitigate dangerous climate change. This is envisaged to be carried out via limiting global warming to below 2°C and pursuing efforts to limit it to 1.5°C.

The respective governments agreed, among others, to the following, which play an important role as to the “E” element of ESG:

- (a) “a long-term goal of keeping the increase in global average temperature to well below 2°C above pre-industrial levels;*
- (b) to aim to limit the increase to 1.5°C, since this would significantly reduce risks and the impacts of climate change;*
- (c) on the need for global emissions to peak as soon as possible, recognising that this will take longer for developing countries;*
- (d) to undertake rapid reductions thereafter in accordance with the best available science, so as to achieve a balance between emissions and removals in the second half of the century”.*

(European Commission, Paris Agreement, [Access: March 2023], https://ec.europa.eu/clima/eu-action/international-action-climate-change/climate-negotiations/paris-agreement_en)

2.3. European regulatory framework

2.3.1. The EU Sustainable Finance Action Plan

Europe is deemed to be the worldwide leader in sustainable investing, therefore there have been various legislative actions taken towards building a regulatory framework with respect to ESG and in general, sustainable investing. The European Union ratified the Paris Agreement on 5 October 2016 and in 2018, by way of response to such agreement, launched the “Sustainable Finance Action Plan”, whose actions provide much of the conceptual framework for sustainable finance regulation.

The Sustainable Finance Action Plan was based on the following pillars:

1. reorienting capital flows towards sustainable investment;
2. managing financial risks arising from climate change; and
3. enhancing transparency and “long-termism” in financial and economic activity.

Several milestones were part of the Sustainable Finance Action Plan. To begin with, the Sustainable Finance Action Plan aimed to establish a common understanding of what can be deemed “sustainable”. Developing a unified EU classification system (or taxonomy) which would provide transparency on the content of sustainable activities was considered the most urgent action of the Sustainable Finance Action Plan. This was envisaged to provide certain guidelines on activities constituting part of climate change mitigation, thus, assisting investors in gathering information.

Further, the European Union considered enhancing the financial “green” market via labelling the respective financial products as green. This would establish trust among investors who wish to invest in sustainable financial products that the proceeds of such products are actually utilized towards sustainable investments. The Sustainable Finance Action Plan paid particular attention to green bonds, noting that, although the green bond market is expanding in a rapid manner, it was still counting for less than 1% of the global bond market. To that extent, a European green bond standard would allow investors, especially the retail ones, to gain access to more information as regards sustainable financial products, and eventually enabling such investors to fund sustainable-related projects.

Moreover, the Sustainable Finance Action Plan aimed to enhance transparency of the sustainable market. As rating agencies were now assessing firms’ ESG performance, developing certain standards as regards firms’ sustainability performance seemed of particular importance, since the respective assessments drive the capital allocation and reduce the information asymmetry between financiers and firms. The Commission was further focusing on how credit rating agencies consider and assess the ESG-related information since such assessment is possibly affecting investors’ decision to fund green projects.

Another interesting pillar of the Sustainable Finance Action Plan concerned banks and insurance companies which constitute the main source of external financing for the European Union economy. Such institutions could play a major role in the transition to the envisaged green economy, through providing funds and investing in green project. In this context, the said institutions may be exposed to certain risks which are related to climate-change. The European Union promised to assess whether the capital requirements set out in the Capital Requirements Regulation (the **CRR**) needed to include factors in connection with climate and other environmental risks European Commission (2020), Paris Agreement, [Access: March 2023], https://ec.europa.eu/clima/eu-action/international-action-climate-change/climate-negotiations/paris-agreement_en

2.3.2. The European Green Deal

The European Union, by way of response to the on-going challenges of climate change, presented its new brand-new roadmap plan on 11 December 2019: the European Green Deal.

The aim of the European Green Deal is for the European Union to become the first climate neutral continent by 2050, resulting in a cleaner environment, more affordable energy, smarter transport, new occupation position and an overall better quality of life. President of the European Commission, being at the time Ursula von der Leyen had stated: *“The European Green Deal is our new growth strategy – for a growth that gives back more than it takes away. It shows how to transform our way of living and working, of producing and consuming so that we live healthier and make our businesses innovative. We can all be involved in the transition, and we can all benefit from the opportunities. We will help our economy to be a global leader by moving first and moving fast. We are determined to succeed for the sake of this planet and life on it – for Europe's natural heritage, for biodiversity, for our forests and our seas. By showing the rest of the world how to be sustainable and competitive, we can convince other countries to move with us”* (European Commission (2019), Press release: The European Green Deal sets out how to make Europe the first climate-neutral continent by 2050, boosting the economy, improving people's health and quality of life, caring for nature, and leaving no

one behind, [Access: March 2023],https://ec.europa.eu/commission/presscorner/detail/en/ip_19_6691.

Some interesting milestones of the European Green Deal included climate action, buildings, sustainable mobility. To that extent, it is noted that the production and use of energy across economic sectors accounted for more than 75 % of the European Union's greenhouse gas emissions. Therefore, the European Green Deal set the roadmap to decarbonization via enhancing the offshore renewable energy strategy (i.e. by increasing the European Union's wind capacity) and exploring the possibility of clean hydrogen contributing to decarbonization (i.e. via clean hydrogen innovation and the installation of hydrogen electrolyzers). As regards buildings, since these are responsible for approximately 40 % of the European Union's energy consumption and 36 % of greenhouse gas emissions from energy, the European Green Deal provides for renovation of such buildings in order to improve their energy efficiency. When it comes to mobility, since transport emissions account for 25 % of the European Union's greenhouse gas emissions, the goal is to cut such emissions at 90 % percentage by 2050, via a series of measures, which include, indicatively, zero-emission cars and recycling and re-using batteries (European Commission (2019), Press release: The European Green Deal sets out how to make Europe the first climate-neutral continent by 2050, boosting the economy, improving people's health and quality of life, caring for nature, and leaving no one behind, [Access: March 2023],https://ec.europa.eu/commission/presscorner/detail/en/ip_19_6691).

2.3.3. From the Action Plan to actions

The EU Taxonomy Regulation

On a parallel note, the European Union kept the promises of the Sustainable Finance Action Plan and proceeded with the establishment of certain legislative tools in order to facilitate the way towards a more sustainable economy.

In particular, the European Union published the EU Taxonomy Regulation on 22 June 2020 (Regulation (EU) 2020/852 (Taxonomy) on the establishment of a framework to facilitate sustainable investment). The EU Taxonomy Regulation set out certain conditions that need to be met in order for the respective economic activity to be qualified

as “sustainable”. The definition of “sustainable activities is in principle based on the following terms:

- (a) it shall contribute to at least one of six environmental objectives listed in the EU Taxonomy Regulation; and
- (b) it shall not do significant harm to any of the other objectives, while respecting basic human rights and labour standards.

The six environmental objectives of the Taxonomy are: (1) climate change mitigation, (2) climate change adaptation, (3) sustainable use and protection of water and marine resources, (4) transition to a circular economy, (5) pollution prevention and control, and (6) protection and restoration of biodiversity and ecosystems.

As regards the “non cause harm” component of the definition, the technical screening criteria set out specific thresholds for each of the environmental objectives to define compliance with do no significant harm.

The EU Taxonomy Regulation further sets out two classification categories: enabling activities and transitional activities. The addition of such activities was made in order to include sustainable activities which may not have been included in this category of activities otherwise. More specifically, enabling activities allow other activities to make a substantial contribution to one or more of the EU Taxonomy Regulation’s six objectives but these shall also have a substantial positive environmental impact over the activity’s lifecycle. Moreover, transitional activities must contribute to climate change mitigation and a pathway to keeping global warming in line with Paris Agreement commitments and must also meet the following criteria:

- (a) has greenhouse gas emission levels that correspond to the best performance in the sector or industry;
- (b) does not harm the development and deployment of low-carbon alternatives; and
- (c) does not lead to a lock-in of carbon-intensive assets, considering the economic lifetime of those assets.

Finally, the EU Taxonomy Regulation provides for certain disclosure requirements as regards disclosing entities’ activities alignment with such regulation (REGULATION (EU) 2020/852 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 18 June 2020 on the establishment of a framework to facilitate sustainable investment, and amending Regulation (EU) 2019/2088).

The European Green Bond Standard

European Union's proposed regulation with respect to the establishment of a standard for the use of green bonds on part of firms and institutional issuers to raise funds while meeting certain sustainability requirements and ensuring investors on the utilisation of proceeds, was first published in July 2021. It was first introduced as a voluntary tool, for both issuers and investors with an ultimate goal of eliminating green washing. The key requirements under the proposed framework were envisaged as follows:

- (a) the funds raised via green bonds need to be utilized at an 100% basis for green projects aligned with the EU Taxonomy Regulation;
- (b) the issuers are required to be totally transparent with respect to the allocation of green bond's proceeds and this would be achieved via detailed reporting requirements;
- (c) all European green bonds are required to be labelled as such, i.e. reviewed by a third independent party.

Such third independent reviewer is required to be registered and supervised by the European Securities Markets Authority (ESMA) in order to ensure quality of services provided.

However, a few months later in December 2021, the rapporteur of the file at the European Parliament published his draft report in which some significant changes to the Commission's original regulation proposal are identified (European Parliament (2021), DRAFT REPORT on the proposal for a regulation of the European Parliament and of the Council on European green bonds, [Access: March 2023], https://www.europarl.europa.eu/doceo/document/ECON-PR-700638_EN.pdf).

As mentioned above, the European Green Bond Standard was envisaged as a voluntary standard in the sense that it would be the benchmark for "high-quality" green bonds in the European ESG market. By way of contrast, rapporteur's report proposed that the European Green Bond Standard would have to become mandatory for the bonds which were "labelled" as green, with a deadline up to 2028. ICMA responded immediately publishing its initial concerns in January 2022. According to ICMA's paper, a mandatory standard could lead in the fragmentation of the international green bond market and eventually discourage firms from raising funds through sustainable financial products (International Capital Markets Association (2022), ICMA analysis of the

amendments to the EuGB Regulation proposed by the Rapporteur of the EU Parliament, [Access: March 2023], <https://www.icmagroup.org/assets/ICMA-update-to-its-analysis-of-the-EuGB-Regulation-05012022.pdf>). Indeed, a mandatory standard whilst European sustainability classification system is still evolving, could lead to disruption of the green bond market instead of its growth.

Another important change is the extended scope of the documentation and reporting obligations required for all types of sustainable bonds rather than green bonds (i.e. social bonds, sustainability bonds and sustainability-linked bonds). ESMA would need to also supervise third party reviewers of such bonds as well. The goal of the proposed amendments according to the rapporteur is to provide a holistic view on all sustainable bond issues and therefore, enable the comparison of all types of sustainable bonds. To that extent, provision of information should be made through the bond prospectuses; this may be problematic for issuers who are not keen on including ESG information in their prospectuses (due to increased costs and possible liability relating to the disclosure). Since these changes extend initial European Green Bond Standard's scope immensely, relevant concerns have been raised by ICMA with respect to the major changes envisaged to take place as regards the liability and costs to be borne by the European sustainable bond issuers.

Further amendments relate to the alignment with the EU Taxonomy Regulation; in particular, sustainable issuers are required to provide annual intermediate targets for their taxonomy alignment plans, which also be reviewed by third party reviewers. Failure to meet the targets would result in disqualification of the "green bond standard" label and issuer may also face administrative sanctions.

The European Parliament's Committee on Economic and Monetary Affairs (ECON) Report on European regulation on green bonds followed in May 2022. The report aims to provide recommendations and guidance on how the European Union can support the development of the green bond market and encourage investment in sustainable and environmentally-friendly projects, and includes, as key recommendations, the harmonization of green bond standards across EY, the transparency and disclosure in the market as well as an integration of the green bonds issuance with ESMA.

Overall, the ECON Report provides a comprehensive overview of the green bond market in Europe and provides recommendations on how the EU can support its development and encourage investment in sustainable and environmentally-friendly projects (Report of the Committee on Economic and Monetary Affairs of the European Parliament, (A9-0156/2022), https://www.europarl.europa.eu/doceo/document/A-9-2022-0156_EN.pdf).

The European Green Bond Standard proposals are currently being assessed by the co-legislators. In particular, the competent bodies of the European Parliament and the Council will discuss the proposals and agree in their positions. Once such positions are agreed, negotiations with third parties will begin.

As a conclusion, the European Green Bond Standard is deemed to be a significant step towards the green bond market in Europe and aims to enhance transparency and promote credibility in the green bond market. Whether such tool will become mandatory and how it will affect the market, remains to be seen.

Transparency: disclosure of information

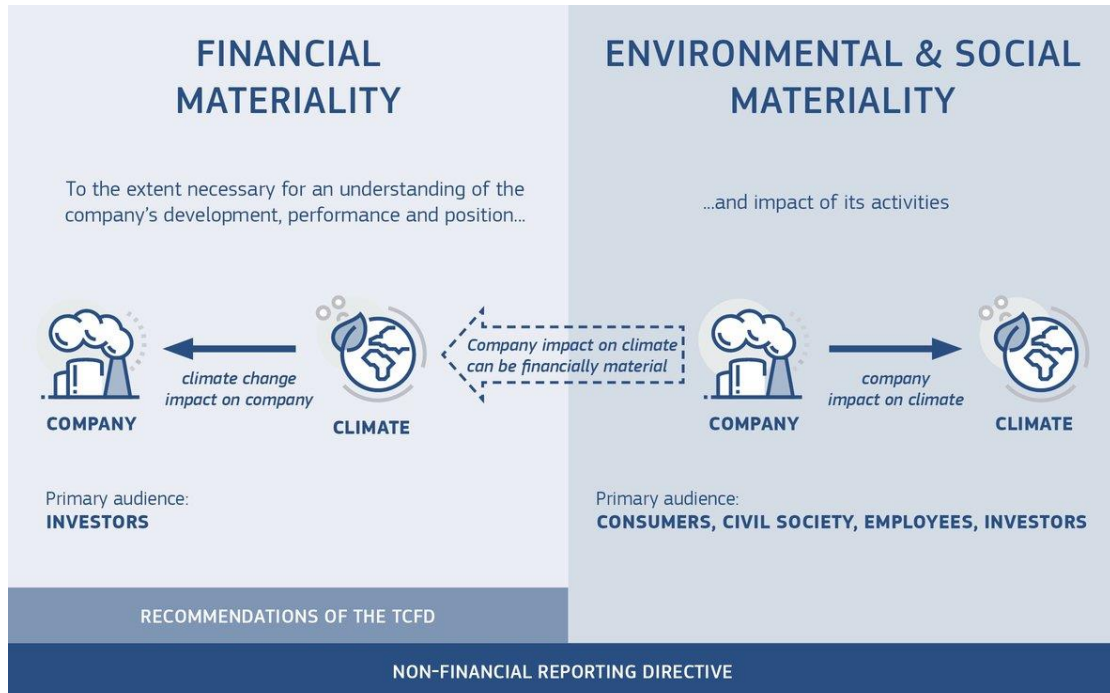
Back in 2014, the European Union published the European Union Directive on Non-Financial Reporting (2014/95/EU) which requires firms to provide non-financial statements in their annual reports or in a separate manner, from 2018 onwards, which shall include information relating to environmental protection, social responsibility and treatment of employees and other ESG-related issues (the **Non-Financial Reporting Directive**). The Non-Financial Reporting Directive requires firms to disclose such information “*to the extent it is necessary for an understanding of the company’s development, performance, position and impact of its activities*”. Therefore, the Non-Financial Reporting Directive provides a double materiality perspective relating to financial materiality as well as to social and environmental materiality, as per the communication of the Commission on guidelines:

“ -The reference to the company’s “development, performance [and] position” indicates financial materiality, in the broad sense of affecting the value of the company. Climate-related information should be reported if it is necessary for an understanding of the development, performance and position of the company. This perspective is typically of most interest to investors.

-The reference to “impact of [the company’s] activities” indicates environmental and social materiality. Climate-related information should be reported if it is necessary for an understanding of the external impacts of the company. This perspective is typically of most interest to citizens, consumers, employees, business partners, communities and civil society organisations. However, an increasing number of investors also need to know about the climate impacts of investee companies in order to better understand and measure the climate impacts of their investment portfolios.” (Eur-Lex (2019)Communication from the Commission — Guidelines on non-financial reporting:

Supplement on reporting climate-related information, [Access: March 2023], [https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52019XC0620\(01\)](https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52019XC0620(01))).

The double-materiality effect provided in the Non-Financial Reporting Directive is illustrated as per the below:



* Financial materiality is used here in the broad sense of affecting the value of the company, not just in the sense of affecting financial measures recognised in the financial statements.

Diagram 3: Non-Financial Reporting Directive

Source: [https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52019XC0620\(01\)](https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52019XC0620(01))

Further, as part of the deliverables of the Sustainable Finance Action Plan the Commission published in June 2019 its guidelines on reporting climate-related information. Such guidelines are of supplementary nature to any national legislation implementing the Non-Financial Reporting Directive.

The guidelines highlight the need for firms and financial institutions to contribute to a lower carbon future through disclosing climate-related information, since such disclosure enables efficient allocation of capital towards sustainable investments within the financial sector. According to such guidelines, an improved disclosure of climate-related information could potentially benefit firms, since it would result in better risk-management and lower cost of debt for the firm, via expanding firm's investor base, decreasing

information asymmetry between firms and investors and eventually improving firms' credit ratings.

The guidelines are non-binding for firms and since methodologies of climate-related reporting are evolving fast, companies are highly encouraged to continue with innovations in this field so that best practices are always adapted. To that extent, the guidelines provide further guidance with respect to risks affecting the climate (eg company's industrial production) or the firm itself (eg policy and legal risks) in a negative manner. In any case, it is noted that the respective disclosure of information should not be made on a stand-alone basis but should be part of other financial and non-financial reports of firms.

2.4. ESG framework in the UK and the USA

The United Kingdom published in July 2019 its "Green Finance Strategy" paper which sets out the path to alignment of the financial flows of the private sector with sustainable growth towards an environmentally cleaner future. United Kingdom's new goal is to reach net zero greenhouse gas emissions by 2050 and to cut such emissions by 78% by 2035. According to the Green Finance Strategy paper, this can be achieved on the basis of three pillars: (a) greening finance, namely incorporating sustainability risks in firms' decision making; (b) financing green, namely allocation of investors' financial flows to green projects; and (c) capturing the opportunity, namely support of the private sector towards said goals by governmental institutions (GOV.UK (2019) Policy paper: Green finance strategy [Access: March 2023], <https://www.gov.uk/government/publications/green-finance-strategy>). In October 2021, the United Kingdom proceeded with publishing the "Roadmap to Sustainable Investing" paper which sets out the government's strategy to achieve market participants' information with respect to environmental sustainability (from corporate entities to financiers) (Policy paper: Greening Finance: A Roadmap to Sustainable Investing, (GOV.UK (2021), [Access: March 2023], <https://www.gov.uk/government/publications/greening-finance-a-roadmap-to-sustainable-investing>).

By way of contrast to the European Union and the United Kingdom, there are currently no mandatory rules applying to ESG activities in the United States of America. Further, the United States Securities and Exchange Commission (SEC) has not yet published

guidance to companies on corporate disclosures and only requires that disclosure of ESG risks be made if they are “material” (Forbes, The SEC On Climate Disclosure (2022), [Access: March 2023],<https://www.forbes.com/sites/carriemccabe/2022/01/18/the-sec-on-climate-disclosure/?sh=2a6c0a5b6daf>).

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REGULATION (EU) 2020/852 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 18 June 2020 on the establishment of a framework to facilitate sustainable investment, and amending Regulation (EU) 2019/2088

3. Studies and researches examining green bonds

3.1. First study examined: Do shareholders benefit from green bonds?

The article under the title “Do shareholders benefit from green bonds?” (Dragon Yongjun Tang, Yupu Zhang (2020), Do shareholders benefit from green bonds, Journal of Corporate Finance, 61) provides an international empirical study of green bonds. The study attempts to examine market’s reaction to green bond issuance by examining a wide dataset of bonds issued during a period of a decade. The study further attempts to interpret the results found through examination of different hypotheses in order to conclude on whether green bonds can be deemed as beneficial for the existing shareholders of the issuer.

3.1.1. Sample construction

The dataset used for the study includes combined data from both the Climate Bond Initiative (**CBI**) and Bloomberg green labeled bonds, noting that CBI is working with Bloomberg to enrich the green bond database. The study argues that the combination of CBI with Bloomberg database results in a comprehensive green bonds dataset due to the following reasons: (a) first, CBI and Bloomberg have consistent definitions of green bonds, enabling the researchers to cross-validate the accuracy of the data used; and (b) Bloomberg provides further information in relation to green bonds, including announcement date, issue amount, coupon, and maturity, that can be missing from the CBI data (Dragon Yongjun, *et. al.* 5).

As regards assessment of CBI as database, this has a wider coverage (eg it includes the first green bond issued by the European Investment Bank (EIB) in 2007, which is not included in the Bloomberg database). Green bonds are defined as per CBI “as *instruments created to fund projects that have positive environmental and/or climate benefits*”, whereas as per Bloomberg “*instruments for which the proceeds are exclusively applied (either by specifying the use of proceeds, direct project exposure, or securitization) toward new and existing green projects, defined as projects and activities that promote climate or other environmental sustainability purposes*”. The CBI dataset

covers the period from June 2007 to July 2017 and the Bloomberg dataset covers the period from March 2010 to December 2017 and contains ISIN, issuer name, issue date, maturity date, amount issued, currency, bond type and domicile of the issuer. The total number of green bonds obtained from CBI is 1181 with an outstanding amount of USD 248 billion and a mean issue amount of USD 211 million. 42.8% of the bonds are denominated in US dollars with 14% of the sample being denominated in Euros (Dragon Yongjun Tang, *et. al.* 5).

On the other hand, Bloomberg includes four types of green bonds, i.e. the Green Use of Proceeds Bond, the Green Use of Proceeds Revenue Bond, the Green Project Bond, and the Green Securitized Bond. In terms of sample construction, the CBI dataset is supplemented by Bloomberg bond information (eg Bloomberg provides announcement dates) (Dragon Yongjun Tang, *et. al.* 5).

The sample includes only financials and industrial corporations, which proceeded with 665 issuances in total. Out of these corporations, only public listed companies were selected, with a differentiation between first-time issuers and repeated ones, since the media attention hypothesis suggests that investors' attention will be drawn upon a firm's first green bond issuance and not every time it proceeds with a green bond issuance. As analysed below, this is because the firms have already been disclosed to the public and their announcement are not expected to draw the same attention as per the first issuance.

Following exclusion of subsequent issuances, the sample is reduced to 132 unique public issuers. At this point the sample concludes with **1510 bonds worldwide**, which consist of 209 commercial banks, 456 corporations, 489 development banks, 41 state-backed entities, 209 municipal bonds, 4 sovereigns and 85 green asset-backed securities, with a mean issuance amount of USD 285 million, an average coupon is 3.26% and a maturity of 7.6 years (Dragon Yongjun Tang., *et. al.* 7).

As regards event selection, the date of the announcement is based on Bloomberg, other official reports (eg press releases) or directly by the lead manager, whereas all other cases (i.e. whose cases are not included in Bloomberg) are searched manually. Asset-backed green bonds and private placement are excluded from the study, due to the fact that asset-backed green bonds are different from simple green bonds in structural terms and market's reaction to green bonds funded by private placement cannot be observed (Dragon Yongjun Tang, *et. al.* 8).

The study is conducted under the following hypotheses:

3.1.2. Hypotheses

Hypothesis 1: Green benefits.

This test hypothesis is based on the positive effect of media attention on issuers' stock prices following a green bond announcement. "Green label" is of great significance for this hypothesis, in the sense that it will qualify as a certificate or evidence that issuer's "green intentions" have been verified by an independent party, therefore decreasing information asymmetry between the issuer and investors. Under this hypothesis, formal press releases in relation to a successful green bond issue (with the bond also having been labeled as such) have a positive market impact, meaning a significantly increased media exposure (compared with conventional bond issuance). This means that stock investors will pay attention to the green issuance, which may potentially lead to an extension of issuers' investor base, and a positive announcement return. Therefore, an increase in institutional ownership and stock liquidity improvement are expected. The study argues that the market will only be strongly appealed to first-time green bond issuance rather than every time a bond is labeled green.

Hypothesis 2a: The investor attention channel.

Hypothesis under n. 2 is based on the assumption that green bond issuance reduces information asymmetry, since it includes more information about the investment. This means that green bond issuers will provide potential investors more details regarding the use of proceeds and also provide information in relation to their existing or upcoming projects. Such information will be further cross-checked by an independent party in order for the bond to be "green labeled", ie qualified as green. Conventional bonds do not normally include this kind of information. Said channel suggests that every green bond issuance will contain additional information which will be valued by potential investors resulting in a positive market's reaction. Furthermore, and on the assumption that investors believe in the firm's long-term high valuation, such investors will prefer to retain the stocks rather than proceed with liquidation thereof.

Hypothesis 2b: Fundamental.

This hypothesis is based on the general positive impact of ESG on firm's value and financial scores in the long run. Green bonds will indicate issuer's dedication to sustainable projects, which has led as shown by the relevant literature to a lower cost of capital and improved credit rates. The study states that green bonds are usually oversubscribed. That being said, investors who are dedicated to sustainable finance projects and may also wish to improve or retain their ESG scores, will invest in green bonds and push up the bond's price. According to the study, green bond issuers who are new to the green bond market charge a premium because of the increased demand. Increased demand for green bonds implies the lower cost of capital for issuers. Thus, it is expected that green bonds will be priced at a premium (i.e., investors will be willing to give up a higher yield) in the primary market.

Hypothesis 2c: Financing cost.

Investors with a green mandate and socially responsible funds are particularly appealed to green bond issuance, which will push up the bond price and subsequently reduce the cost of capital for the firm.

3.1.3. Event study analysis – Methodology

The study uses conduct 10 and 21-day event windows. The beta of each firm is estimated using estimation windows starting from 300 trading days to 50 trading days prior to the announcement date and then the study uses event windows from 10 days before and 10 days following the announcement. Then a robust check for event windows from 5 days before and 10 days following the announcement is being run. The study uses the CAPM model to estimate abnormal returns, based on index of the stock market on which the firm's stock is listed. Market premium is index return minus treasury bond yield.

The results on stock market reaction are shown in the following table:

Panel A: First-time vs. subsequent issues

	First-time issue		Subsequent issues	
	(1)	(2)	(3)	(4)
Event window	[-10,10]	[-5,10]	[-10,10]	[-5,10]
CAPM_CAR (%)	1.39** (2.36)	1.04** (2.12)	0.12 (0.21)	0.61 (0.99)
P(Sign-test)	0.0171**	0.0303**	0.5661	0.8667
FF3_CAR (%)	1.41** (2.42)	1.06** (2.24)	0.10 (0.14)	0.31 (0.60)
P(Sign-test)	0.0247**	0.0225**	0.7723	0.7846
FF5_CAR (%)	1.29** (2.19)	1.01** (2.07)	0.50 (0.76)	0.23 (0.40)
P(Sign-test)	0.0513*	0.0492**	0.3014	0.7253
Observations	132	132	109	109

Panel B: Corporates vs. financials

	Corporate		Financial	
	(1)	(2)	(3)	(4)
Event window	[-10,10]	[-5,10]	[-10,10]	[-5,10]
CAPM_CAR (%)	1.88** (2.40)	1.51** (2.22)	0.44 (0.55)	0.15 (0.26)
P(Sign-test)	0.0132**	0.0264**	0.5962	0.5962
FF3_CAR (%)	1.96** (2.54)	1.59** (2.42)	0.36 (0.45)	0.09 (0.15)
P(Sign-test)	0.0160**	0.0152**	0.6820	0.6114
FF5_CAR (%)	1.86** (2.36)	1.53** (2.25)	0.22 (0.27)	0.04 (0.08)
P(Sign-test)	0.0302*	0.0342*	0.8741	0.8058
Observations	86	86	46	46

Table 1, Stock market reaction to green bond issuance announcement.

Source: Dragon Yongjun Tang et. al. 7, 2020, 9

Analysing the results above, the researchers find a positive stock market reaction to green bond issuance which is also statistically significant (1.39%, t-statistic 2.36). Positive reaction results are statistically important not only during the time window between ten days before the announcement date and ten days following such date, but also during the time window between five days before the announcement date and ten days following same date. The study argues that long event windows are of significance since firm's announcements regarding green bond issuance tend to have a longer impact. According to the study, longer period results are more significant, so that one can assume that "green label" is more important than green setting.

The study considers also subsequent green bond issuance and finds that the stock market reaction is not significant. Investors will not pay the same attention to green bond issuance following the first issue and first "green label" disclosed to them. To that extent, the "fundamental" hypothesis does not seem to work, since under such hypothesis, investors will be appealed to every issue.

The study further differentiates the green bond issuers based on their business. To that extent, financials issuing green bonds to grant green loans to their debtors or invest in other firms' green projects do not seem to enjoy the same positive market reaction. On

the other hand, the results suggest that only firms conducting green projects, being the core competency of their business, will benefit from increasing valuation. It should be noted however that financiers proceed with fewer issues but of larger amounts. The study argues that the cross-industry effect needs to be further analysed.

3.1.4. Interpretation of results

The study attempts to explain the positive reaction of the market to an announcement of a green bond issuance, through the test hypotheses analysed above.

Green premium: The “financing cost” channel suggests that increased demand for green bonds will push up the price, leading to a lower cost of capital for green bond issuers.

In order to examine whether there is indeed a green premium, the study runs a firm-to-firm comparison between conventional corporate bonds and green bonds, issued within the same year. Yield spread at issuance is examined to this effect. The relevant dataset is comprised of data downloaded from the SDC Platinum New Issues database, filled in by Bloomberg. The sample finally includes 41 firms during the period from 2007 to 2017.

Similar firms are matched according to size, market to book and stock liquidity. The fixed effects considered are (i) year by month, (ii) country and (iii) issuer fixed effects. The results are show in the following table:

	Yield Spread			
	(1)	(2)	(3)	(4)
Green	-0.0694** (-2.19)	-0.0639* (-1.81)	-0.0588 (-1.62)	-0.008 (-0.02)
Equity volatility	45.365*** (5.76)	47.383*** (5.90)	19.707* (1.95)	3.144 (0.16)
Bond rating (BBB or worse)	0.274** (2.57)	0.252** (2.30)	0.058 (0.49)	-0.198 (-1.63)
Maturity	0.057*** (6.97)	0.059*** (7.14)	0.059*** (6.59)	0.054*** (5.98)
Issue size	-0.256*** (-11.06)	-0.240*** (-9.67)	-0.221*** (-8.21)	-0.205*** (-7.67)
Firm size			-2.976*** (-7.73)	-0.350 (-0.69)
Leverage			0.772*** (4.98)	-0.095 (-0.47)
Profitability			0.150 (1.27)	-0.148 (-0.98)
Tangibility			0.175 (1.58)	0.189 (1.52)
Country FE	YES	NO	NO	NO
Issuer FE	NO	YES	YES	YES
Year by month FE	NO	NO	NO	YES
No. firms issue both bonds	41	41	41	41
R-squared	0.311	0.356	0.278	0.386
Observations	2435	2435	2435	2435

Table 2, Green bond yield spread

In case country fixed effects are the only ones included, a 6.9 bps premium will be found. This can be considered as strong evidence of a green premium over conventional green bonds. However, when firm fixed effects and year by month fixed effects are added, examining only bond yield spread differences issued by the same issuer within the same year and month, the study finds the yield spread no longer statistically significant. Therefore, though the market implies that green bond issuers may enjoy a lower yield spread and consequently, lower cost of capital, the “financing cost” channel does not seem to interpret market’s positive reaction to green bond issuance.

Investor attention: As mentioned above, this channel suggests that green bond issuance will attract increased media attention, sending positive signals to the market and eventually expanding the issuer’s investor database.

The study examines whether institutional ownership is actually increased in green bond issuers. The data used are from FactSet (LionShares) database for the period from 2007 to 2017 and include mutual funds, pension funds, hedge funds, banks and insurance companies. Country and year fixed effects are used in all the specifications.

The results are shown in the following table:

	(1)	(2)	(3)	(4)
	IO	IO	Log(IO_USD)	Log(IO_USD)
Green*Post	0.056* (2.03)	0.079** (2.71)	0.099*** (5.40)	0.097*** (4.71)
Post	0.093*** (3.02)	0.085*** (3.19)	0.0843*** (9.52)	0.0973*** (4.52)
Green	-0.034*** (-10.85)	-0.020*** (-3.95)	-0.0409*** (-8.73)	-0.0134* (-1.85)
Size		-0.018*** (-5.91)		0.384*** (26.68)
Leverage		0.144*** (5.52)		1.981*** (7.45)
ROA		0.512*** (4.36)		7.435*** (11.57)
Cash		-0.127** (-2.22)		-2.299*** (-5.03)
Profitability		0.116*** (10.59)		0.006 (0.05)
Dividend		-0.251*** (-5.79)		-0.565** (-2.50)
Country FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Robust	YES	YES	YES	YES
R-squared	0.042	0.195	0.100	0.267
Observations	7179	6739	7179	6739

Table 3, Institutional ownership diff-in-diff analysis.

The results show that there is a higher stock market turnover around the green bond issuance month. More specifically, institutional ownership increases by 7.9% following green bond issuance, compared with conventional bonds issued by the match firms. Further, the study finds that domestic investors are more subject to the attention-driven effect compared to foreign investors. In particular, as the study states, only domestic investors and domestic independent investors increase their holdings in firms that issue green bonds by 8.5% and 7.6% respectively, which is deemed to be statistically and economically significant.

Stock liquidity: The study runs stock liquidity tests in order to highlight a segregation between the “fundamental channel” and the “investor attention” channel, since according to the latter, an announcement of a green bond issuance will give the market a signal as regards firm’s green projects and the investors will not seek to proceed with liquidation of their stocks, but rather hold them.

To run the relevant checks, the study uses the Amihud illiquidity measure, which is calculated as the “*average ratio of the daily absolute return to the (dollar) trading volume on that day*” (Y. Amihud (2002), Illiquidity and stock returns: cross-section and time-series effects *Journal of Financial Markets* 5, 34). To that extent, the study uses the quoted bid-ask spread divided by the mid-point of the bid-ask price as a proxy for stock liquidity and on top of that, in order to represent the illiquidity of stock, the study uses the absolute return divided by dollar trading volume on the relevant date. Following said measures, the study finds an increased liquidity following a green bond issuance. The sample at this point is now constructed with data regarding the period from one year before and one year after issuing green bonds.

The results relating to the stock liquidity tests show that green bond issuers' stock liquidity improves significantly in the one-year horizon. The study attempts to verify further said results by analysing a matching sample of conventional corporate bonds issued within the same year. Such sample is matched according to size, market-to-book, previous year liquidity and in the same industry, same country and same exchange. After green bond issuance, the results show that green bond issuers' liquidity increases much more than conventional corporate bonds issued by firms included in the matched sample and specifically, it increases by more than 1.27% whereas in the Amihud measure, it increases by 2.2%.

3.1.5. Conclusions

The study finds indeed a positive market reaction to green bond issuance, which, however, cannot be interpreted through the “financing cost” channel, meaning that although there is anecdotal evidence of green bonds constituting lower cost of capital, the results of the study cannot indicate that relevant bonds enjoy a lower yield. Nevertheless, the study’s results suggest that increased media attention benefit first time green bond issuers, which leads to an expanded institutional ownership and improved stock liquidity of the firm.

3.2. Second study examined: Stock market reaction to green bond issuance

The article under the title “Stock market reaction to green bond issuance” (Vishaal Baulkaran (2019), Stock market reaction to green bond issuance, Journal of Asset Management, 20, 331-340) provides an empirical study around green bonds and attempts to examine whether green bond issue creates value for issuer’s shareholders through the analysis of stock market to green bond issuance announcement. To that extent the study uses firms’ and bonds’ characteristics to explain the results.

3.2.1. Sample construction

The initial dataset is 72 listed firms out of which the author excludes firms with less than 5 billion US dollars in market capitalisation and firms which had some confounding events during the 21-day window. First criterion for inclusions is that green bond issuers have at least 250 trading days returns data prior to the green bond issuance announcement. At this point the sample is consisted of **54 firms**, the majority of which being registered in Europe. The sample also comprises of one Canadian bank (TD bank), 10 US corporate green bonds, 8 Chinese and 3 Australian issuers in the sample. Green bonds are mostly issued by utilities, power generation, and green technology firms,

however, real estate firms, banks, and automakers (eg Toyota, issuing green bonds to finance car loans for hybrid electric cars) have also issued green bonds.

The announcements of date of issuance have been collected manually via newspapers and official press releases, whereas return data and stock prices information have been obtained by Factset database (Vishaal Baulkaran (2019), 334-335).

3.2.2. Event study analysis – Methodology

The study first estimates a market model for expected returns in relation to each issuer, on the basis of daily returns recorded during the time window from 250 days prior to the announcement to 21 days prior to same announcement. Said market model is estimated with the domestic market index and the global market index. Then the study estimates the abnormal returns by using parameters from the market model, individual stock and market returns during the event window.

Abnormal returns model has been formed as follows:

$$CAR_i = a + \gamma'X + \delta'Y$$

Vector X is estimated with the use of various bond characteristics, which are deemed as explanatory variables. These are oversubscription, second review, bond ratings, coupon and maturity. Such vectors are used in the model as follows:

- 1) In case the issue is oversubscribed, oversubscription is an indicator variable equal to 1 and zero otherwise. Oversubscription is particularly significant for the model, because it measures investors' demand for green bonds;
- 2) In case the bond is certified as "green" by an ESG rating company, second review is an indicator variable equal to 1 and zero otherwise. This is because it is expected that investors will be more appealed to green bonds which have been labeled as such by a third independent party;
- 3) In case the bond is rated A- and above bond ratings are an indicator equal to 1 and zero otherwise. This is because the researcher followed studies which showed that bond ratings contain pricing relevant information;
- 4) Coupon is the coupon rate; the researcher did not include yield to maturity because some green bonds included in the sample were subscribed through private placement; and

- 5) Maturity is defined as the log of time to maturity, since the market may react to green bonds based on their term.

Vector Y controls for firms' characteristics, such as size, cash flow ratio, financial leverage, profitability, Tobin's Q, and asset growth. Cash flow ratio is calculated as operating cash flow divided by total assets and financial leverage calculated as total debt divided by total assets. The researcher examines the possibility of market's negative reaction to firms with strong operating cash flow because firm may misuse excess free cash flow. Firm size is defined as the log of total assets and profitability is calculated as EBIT divided by total assets (return on assets). Tobin's Q is calculated as market value of equity plus book value of debt divided by total assets and asset growth is geometric growth in total assets during a 5-year period. Through these growth measures the study attempts to examine whether the market view is that the green bonds' proceeds are used for investment in sustainability projects.

3.2.3. Summary statistics

The summary statistics of the final sample examined are stated in the following table:

US\$	Mean	Median	SD	Min	Max
Panel A: Firm characteristics					
Total assets \$B	544.20	99.19	807.23	5.53	2654.06
Market Cap. \$B	62.59	34.67	86.33	5.02	539.97
Sales \$B	55.30	31.66	68.06	1.08	266.13
EBIT	7.17	3.15	11.38	- 0.20	66.63
Return on assets-%	0.04	0.03	0.04	0.00	0.23
Total debt	385.15	67.71	593.89	1.75	2273.34
Financial leverage-%	0.66	0.66	0.15	0.29	0.92
Growth (total assets)-%	0.05	0.03	0.08	- 0.06	0.42
Tobin's Q	1.15	1.02	0.44	0.45	2.45
Cash flow/total assets-%	0.06	0.05	0.05	- 0.01	0.28
Panel B: Green bond characteristics					
Second review-%	62.96	100.00	48.74	0.00	100.00
A-rated bonds-%	44.44	0.00	50.16	0.00	100.00
Investment grade-%	66.67	100.00	47.58	0.00	100.00
Oversubscription-%	33.33	0.00	47.58	0.00	100.00
Maturity-years	6.18	5.50	2.50	3.00	10.00
Amount issued \$m	872.41	533.90	893.60	48.60	4400.00
Coupons-%	2.49	2.24	1.82	0.13	9.55
Fixed coupon only-%	2.47	2.50	1.58	0.13	8.85

Table 4, Summary Statistics

Panel A describes firms characteristics and panel B describes green bonds' characteristics, both of which have been analysed at a high-level above. Starting from Panel A, the mean of total assets is 544.2 billion US dollars with a minimum 5.53 billion US dollars and a maximum of 2.654 trillion US dollars. In terms of firm's size, with the use of sales, the mean is 55.3 US billion dollars (with the largest firm in the sample being Toyota). As regards profitability, the mean earnings before interest and taxes (EBIT) is 7.17 billion dollars. Mean return on assets is 4% whereas the minimum ROA is 0.32%, with the maximum being set at 23%. Total growth is set between -6% and 42%. As regards debt, the mean is 385 billion US dollars and the mean financial leverage is set at 66%, with the maximum being at 92%. These high rates are justified due to the inclusion of financial institutions in the sample, which are deemed to be highly leveraged firms with less than 10% common equity. In terms of growth, the mean growth rate is set at 5%.

Following on to Panel B and in relation to the "green label" effect, the mean of the issuers requesting a relevant certification is 62.96%. The mean of the green bonds rated A- and above is set at 44.44% with a mean maturity of 6.18 years. 33.33% were oversubscribed. Out of these bonds, only 11.11% had a floating rate; the remainder coupons have a mean coupon of 2.47%.

3.2.4. Results

On the assumption that there may be important information leakage prior to the announcement of green bond issue, the study claims that it is significant to examine the period preceding the issue. The results are shown in the following table:

%	Mean	Median	SD	Min	Max	t-stat
Announcement day returns	-0.17	-0.21	1.04	-2.29	1.80	-1.21
CAR – 10 to 10	1.48	1.65	4.45	-6.93	9.61	2.45**
CAR – 10 to 20	1.46	1.92	6.09	-11.00	16.81	1.76*
MSCI CAR – 10 to 10	1.42	1.56	4.55	-7.773	9.39	2.29**
MSCI CAR – 10 to 20	1.33	2.26	6.01	-10.94	14.19	1.68*

The abnormal returns are estimated using a market model and the market model with both the domestic stock index returns and the MSCI world index returns

*, ** and *** denote statistical significance at the 10%, 5% and 1% level, respectively

Table 5, Abnormal returns

Source: Vishaal Baulkaran, 2019, 337

The above hypothesis regarding information leakage can be verified from the table above which shows that on the announcement date cumulative abnormal returns (**CAR**) is set at -0.17 and is not statistically significant. The CAR during the 21-day window is statistically significant at the 10% level and positive. Apart from domestic market index, the researcher uses a global market index (MSCI world index) and the results are not different, indicating a positive CAR with a mean of 1.42% statistically significant at the 5% level.

Regression analysis results for bond and firm characteristics are showed in the following table:

	I		II		III		IV	
	Coef.	t-stat	Coef.	t-stat	Coef.	v-stat	Coef.	t-stat
Oversubscription	-0.017	-0.98	0.002	0.10	-0.016	-1.05	-0.001	-0.04
Log of maturity	-0.001	-0.06	-0.016	-1.01	0.004	0.30	-0.012	-0.79
Coupon	-0.830	-1.69*	-0.890	-1.96**	-0.890	-2.25**	-0.936	-2.22**
Second review	0.012	0.70	0.017	1.03	0.018	1.25	0.021	1.33
A-rated bonds	-0.004	-0.28	-0.023	-1.39	-0.009	-0.65	-0.024	-1.47
CF ratio	-0.523	-2.40**	-0.595	-2.32**	-0.376	-2.03**	-0.567	-2.21**
Firm size	0.007	1.38	0.016	2.44**	0.006	1.46	0.015	2.60**
Financial leverage	-0.020	-0.38	-0.037	-0.42	-0.002	-0.05	-0.026	-0.33
ROA	-0.753	-1.50	-0.131	-0.29	-0.629	-1.45	-0.064	-0.15
Tobin's Q	0.106	3.42***	0.098	1.92*	0.077	3.37***	0.084	1.84*
Growth	0.233	1.69*	0.267	2.41**	0.223	1.96**	0.262	2.48**
Intercept	-0.057	-1.45	-0.071	-1.33	-0.054	-1.52	-0.073	-1.42
R ²	31.94%	35.65%	32.58%	36.20%				
Obs.	54	54	54	54				

Table 6, Regression of cumulative abnormal returns on bond and firm characteristics

where the dependent variable in columns I and II is the cumulative abnormal returns of the – 10 to 10 window and – 10 to 20 window using the domestic market index. The dependent variable in columns III and IV is the cumulative abnormal returns of the – 10 to 10 window and – 10 to 20 window using the domestic market index and MSCI world index returns.

As shown in the above table, in relation to bond characteristics, coupon rate is the only one which is statistically significant. The results suggest that the market may not react to green bond issuers with higher cost of debt in the same way it is supposed to react to the ones which have a lower cost of debt, in the sense that a lower reaction is expected.

In relation to firm's characteristics, the study finds more factors as statistically significant. For example, during the 21-day window, the cash flow rate is negative and statistically significant at the 5% level. This is in line with the argument that the investors will be less appealed to issuers with strong operating cash flow. As regards firm's size, the results show that the market's reaction is positive and statistically significant at the 21-day window for columns II and IV, indicating a more positive reaction to larger firms. Asset growth measure which is positive and statistically significant shows that the market will react in a stronger way to firms with growth opportunities and further suggests that firms proceed with issuing green bonds in order to finance project leading to their growth and not firms which just issue debt targeted at investors who are ESG-sensitive.

The study at this point attempts to examine whether green bond reduces firm's risk. To that extent the researcher conducts beta analysis by estimating beta before and after the announcement. The following tables shows the mean and median tests for the difference in beta before the announcement and after the announcement:

	Mean	Median	SD
Beta before	0.99	1.01	0.34
Beta after	0.79	0.76	0.54
Test for difference	- 3.26***	- 2.88***	
Total risk before	1.73	1.61	0.64
Total risk after	1.54	1.51	0.50
Test for differences	- 2.16**	- 1.79*	

Beta is estimated using Eq. 1. Total risk is the standard deviation of daily returns 1 year before the announcement and 1 year after the announcement

Table 7, Regression of cumulative abnormal returns on bond and firm characteristics

Source: Vishaal Baulkaran, 2019, 33

The above results show that firm's risk decline following a green bond issuance, suggesting that it is possible that firm's reputational risk also declines as a result of the green bond issuance.

3.2.5. Conclusions

The study finds a positive market reaction to green bond issuance with Cumulative Abnormal Returns positive and statistically significant during the time which follows the green bond issuance announcement. The only statistically important indicator of green bond's characteristics is coupon rate: market's reaction is more intense to issuers with a lower cost of debt. Further, the study finds that investors are more attracted to larger issuers with lower percentages of operating cash flow and growth opportunities. Finally, firm's risk declines following a green bond issue.

3.3. Third study examined: The green advantage: Exploring the convenience of issuing green bonds

This article under the title "The green advantage: Exploring the convenience of issuing green bonds" (G. Gianfrate, M. Peri (2019), The green advantage: Exploring the convenience of issuing green bonds Journal of Cleaner Production, 219, 127-135) examines 121 European bonds issued during the period from 2013 to 2017 and attempts to investigate how the market prices green bonds and whether there is indeed a green

advantage in funding for green bond issuers. To that extent the study compares green bonds to their conventional peers.

3.3.1. Sample construction

The dataset comprises of two samples: conventional green bonds and green bonds. The data is obtained from Bloomberg (“Bond Radar”) and initially, it contains all the bonds issued during the period from January 2007 to December 2017, ie 7589 public EUR denominated bonds, of which 154 are labeled as green. To eliminate the sample for the purposes of the study, at this point the bonds with the following characteristics are excluded: bonds (a) with variable interest payments, (b) which do not have available returns, (c) with a size lower than EURO 200 million, (d) which are at high risk of default and (e) not priced in EUR. The sample now is comprised of **121 green bonds**, issued by different entities (corporates, financial institutions, sovereign states etc).

The study defines two sub-samples by segregating (from the initial observations) corporate issuers from non - corporate issuers (all entities other than corporate). Corporate issuers’ sample includes 781 observations of which 43 are classified as green, whereas non-corporate issuers’ sample includes 2155 observations of which 78 are classified as green (G. Gianfrate, *et. al.* 128).

3.3.2. Methodology

To compare the returns of green bonds with those of their matching corporate ones, the study uses “propensity score matching” techniques (**PSM**). To that extent, “getting the green label” is the treatment, “green bonds” is the treatment group, and “conventional bonds” is the untreated group. The treatment effect is the change in the outcome variable (i.e. the return at issuance) due to the treatment (i.e. the green label).

Treatment effect would normally require observing the bonds being priced in both states. Since this is not feasible, the study estimates thorough PSM techniques the “average treatment effect on the treated” (**ATT**).

Now a control group (i.e. a group of conventional bonds) needs to be built, which has to be identical to the treated group (i.e. the group of green bonds) with the exception of the treatment status (i.e. the green label).

To obtain the best possible estimation of the counterfactuals and ATT, the researchers would need to build a control group (a group of conventional bonds) that is ideally identical to the treated group in everything but for the treatment status. However, since bonds will differ in more ways than the green label, the study uses propensity score, which makes it possible to achieve unbiased estimates of the treatment effect in the same way as matching on all covariates. The process is as follows: first, the study estimates a propensity score to predict the probability of bonds being green. Then, green (treated units) and conventional bonds (control units) are matched and the treatment effect is estimated by computing the difference in returns between matched units (G. Gianfrate, *et. al.* 128-129).

3.3.3. Results

The results show that green label has a significant impact on bonds pricing in the primary market and confirm the existence of a relative convenience of issuing green against conventional bonds in the primary market. Green bonds are on average a lower cost of capital compared to conventional bonds. As regards the segregation in relation to issuer type, the negative premium which the study finds for both types of issues, is more marked for corporate issuers. This implies that private sector enjoys lower yields and consequently better results in the long run when they issue a green bond, despite the increased costs relating to the certification of bond as green and monitoring the use of proceeds.

The study also attempts to explore the green advantage in secondary market, with the disclaimer that it does not address the problem of a possible different liquidity between bonds. The results find green bonds retain an advantage in pricing in the secondary market as well, although lower than in the primary market (G. Gianfrate, *et. al.* 128).

3.3.4. Conclusions

The results show that indeed investors pay a premium when a bond is labelled green, in the sense that green bonds enable firms to achieve a lower cost of capital. This is in line with the increased demand for such bonds. Additionally, the market tends to react more positively to corporate issuers in contrast with non-corporate (eg financial institutions, sovereign states etc). An independent certification of the green label is significant for investors in accordance with the study. Further, the green advantage seems to be preserved in the secondary market as well. However, it should be noted that the study examines a relatively limited sample of European bonds, whereas it is indicated that the definition of green label should be examined further.

3.4. Fourth study examined: The Green Bonds Premium Puzzle: The Role of Issuer Characteristics and Third-Party Verification

The study under the name “The Green Bonds Premium Puzzle: The Role of Issuer Characteristics and Third-Party Verification” (Maria Jua Bachelet, Leonardo Becchetti and Stefano Manfredonia (2019), *The Green Bonds Premium Puzzle: The Role of Issuer Characteristics and Third-Party Verification Sustainability*, Sustainability, 11, 1908, 1-22) focuses on examining whether green bonds differentiate from conventional corporate bonds in terms of yields, liquidity, and volatility. Further, the study attempts to find the impact of the issuer characteristics, i.e. if the issuer has institutional or private characteristics and also the impact of a third party “green label” certification.

3.4.1. Sample construction – Methodology

The green bonds included in the sample are those which are “self-defined” by the issuer as such and are also listed in the Climate Bonds Initiative website. Within this group, a subgroup is defined in relation to the “green label” certification, by identifying the bonds which met either the CBI requirements or they have been certified by an independent third party. The study highlights that such certification relates to verification of use of proceeds and also to management of proceeds and relevant reporting obligations.

The queries of the research are

- (a) whether the green bond issuance creates a difference in terms of pricing, liquidity, and volatility on secondary market; and
- (b) the impact of the issuer's characteristics on a possible green bond premium.

To that extent the study compares green bonds with their conventional corporate counterparts. However, since both effects (i.e. examine a green bond on the assumption that it is not green) cannot be observed, the study uses econometric specifications in order to compare bonds which have the same characteristics with each other, apart from the "green" characteristic. At this point the study uses "the exact matching method", requiring that the two "matching" bonds meet the following criteria: (a) were issued by the same organization; (b) are denominated in the same currency; (c) had the same rating (Moody's or S&P rating, as available); (d) were structured in the same manner; and (e) had both fixed coupon rate. Since it is impossible to find two bonds with exactly the same characteristics, the study used some thresholds. In particular, for the maturity date, a maximum two-year lead/lag was considered, for the amount, amounts four times larger or smaller were considered and for the coupon rate, values at most 0.25 higher or lower than the green bond rate were accepted.

The sample is now comprised of **89 bond couples** in relation to which the study uses daily observations of ask price, bid price, and redemption yield for the period from 1 January 2013 to 31 December 2017. The sample as structured enables the researcher to examine green and conventional corporate bonds with similar characteristics which were traded on the same day. Thus, their yields are not expected to differ since the bonds were exposed to the same market events. By doing so, we could compare green and brown bonds with similar characteristics that were traded in the same day. These bonds had the same credit risk, bond characteristics, and were exposed to the same market shocks. Thus, their yields do not differ because of credit risk, taxes, or market risk (Maria Jua Bachelet, *et. al* 6-8).

3.4.2. Summary statistics

The summary statistics of the sample (which are independent of the matching couples above) are shown in the following table:

Green Bonds	Count	Mean	SD	1st Perc.	25th Perc.	50th Perc.	75th Perc.	99th Perc.
Yield	39,333	2.03	2.55	-0.45	0.39	1.54	2.45	11.82
Price ask	38,435	100.87	4.71	79.68	99.55	100.62	102.40	115.53
Price bid	38,513	100.64	4.69	79.63	99.41	100.41	102.16	115.02
Liquidity	38,435	-0.22	0.34	-1.75	-0.26	-0.13	-0.08	-0.011
ZTD	39,333	0.053	0.225	0	0	0	0	1
Yield SD	39,329	0.06	0.074	0.01	0.033	0.049	0.075	0.42
Coupon	39,333	1.93	1.66	0.12	0.75	1.62	2.3	8.5
Amount (\$)	39,333	0.169	1.32	0.0003	0.00032	0.005	0.006	4.45
Time to Maturity	39,333	3219.02	2833.80	77	862	2743	2745	9936

Brown Bonds	Count	Mean	SD	1st Perc.	25th Perc.	50th Perc.	75th Perc.	99th Perc.
Yield	39,333	2.01	3.21	-0.45	0.44	1.51	2.32	11.93
Price ask	38,869	101.14	4.71	80.94	99.67	100.70	102.16	116.08
Price bid	38,964	100.85	4.85	79.02	99.50	100.51	101.94	115.82
Liquidity	38,869	-0.27	0.44	-2.5	-0.27	-0.13	-0.07	-0.01
ZTD	39,333	0.056	0.23	0	0	0	0	1
Yield SD	39,329	0.11	1.80	0.01	0.032	0.049	0.08	0.49
Coupon	38,778	2.01	1.66	0.12	0.75	1.62	2.5	8.5
Amount (\$)	39,333	0.26	3.07	0.00013	0.0031	0.0075	0.011	0.78
Time to maturity	39,333	3248.82	3102.90	45	700	2292	4322	11,360

Table 8, Descriptive statistics for green and brown bonds. Perc. = percentile

Source: Maria Jua Bachelet et. al, 2019, 9

The summary statistics above indicate that the green bond yield is slightly higher (2.03 against 2.01) and that conventional bonds have higher volatility. In terms of issuer's characteristics, 34% of the issuers were institutional (national government, municipality, or supranational institution) and 22% issuers were financial institutions. As regards bonds' rating, 62% of the sample were rated AAA.

3.4.3. Hypotheses

Hypothesis 1: No green bond premium.

Under this hypothesis, no negative premium should be expected in respect of green bonds. Such a premium would be expected on the assumption that investors are willing to receive a lower yield for a green bond and/or that the increased demand will push

down the price. This can also be affected by the certification from a third independent party, in the sense that when a green bond is self-labeled as such, investors may require a premium.

Hypothesis 2: No difference in liquidity in the secondary market.

Under this hypothesis, there should be no difference in liquidity between green and conventional bonds. For such difference to exist in favour of green bonds, these would need to appeal more investors and due to this fact, they would also need to be more liquid compared to their conventional peers.

Hypothesis 3: No difference in yield volatility in the secondary market.

This hypothesis implies that there should be no difference in terms of risk between green and conventional bonds. Greenwashing (i.e. misuse of proceeds) could create an additional risk for green bond issuers. On the other hand, green bond issuers are less exposed to stakeholder risk in relation to CSR.

3.4.4. Results and interpretation

The results find that green bonds have a positive green premium between 2.06 and 5.9 bps with the yield differentiation being positively correlated with differences in coupon, maturity, and standard deviation. Further, the results show that green bonds are more liquid in the secondary market (around 5 bps) in relation to their conventional counterparts. In terms of volatility, study's results suggest that green bonds are significantly less volatile.

Since the issuers' characteristics could contribute to the interpretation of results, the sample is divided in private and institutional issuers. Green bonds issued by private sector have significantly higher returns, whereas when the "green label" is added, the premium is enhanced. Institutional issuers had lower yields. In terms of liquidity, green bonds issued by private sector were significantly but slightly more liquid with respect to

their conventional peers but only in the case where the green bonds were certified. Institutional green bond issues are found to be more liquid.

As regards volatility, green bonds from private issuers have lower volatility than the conventional bonds when they are certified.

3.4.5. Conclusions

The results show that green bonds have higher yields and higher liquidity and are also less volatile than their conventional counterparts. However, green bonds from institutional issuers show a negative yield premium and are more liquid than the matching conventional bonds. In case that the private issuer does not obtain a third-party verification, the premium is significantly higher. This could possibly be explained by the fact that large institutional issuers reduce information asymmetries through their transparency procedures and regulations, whereas the private sector can reduce said asymmetries and consequently reduce bond's yield by obtaining the "green label". Therefore, the study suggests that lower cost of capital may be achieved in cases of institutional issuers or private issuers who receive a third-party verification.

3.5. Fifth study examined: Green bonds: shades of green and brown

The study under the name "Green bonds: shades of green and brown" (Moritz Immel, Britta Hachenberg, Florian Kiesel, Dirk Schiereck (2021), Green bonds: shades of green and brown Journal of Asset Management, 22, 96-109) attempts to examine whether there is a green bond negative premium (i.e., whether green bonds show a lower yield) in the first place. As a second step, the study aims to explore whether ESG ratings, as means of decreasing information asymmetry between the issuer and investors, lead to lower yields, meaning that higher ESG ratings should lead to lower yields. Finally, the study examines whether the "E" component of the "ESG" has a stronger impact on bonds' yields in relation to social and governance components.

3.5.1. Sample construction – Methodology

Data is obtained from Bloomberg and is dated as of 31st October 2019. The study uses secondary bond spreads in order to reduce the possible macroeconomic influence. From the overall initial dataset, the study uses bonds labelled as green, with an issue amount greater than 100 US million which are all “at maturity” or “callable” with fixed coupon rates. Bonds without a credit rating are also excluded from the sample. The sample is now consisted of **466 bonds** (Moritz Immel *et. al.*, 101-102).

The queries of the research are:

- (a) whether a negative green bond premium exists in the first place;
- (b) if this is the case, whether ESG ratings have an impact on green bond pricing;
and
- (c) whether any of the ESG components affects stronger bond pricing.

To address the first query, the study examines the dataset as created above. To address, however, queries under (b) and (c), the study uses only bonds issues from firms with an ESG rating. In case of subsidiaries without an ESG rating, the ultimate parent’s rating is used. If a subsidiary who is not rated issued the bond, we used the ultimate parent’s ESG rating. This creates some issues with government-related issuers, therefore the subsample is further divided into corporate and non-corporate issuers (Moritz Immel, *et. al.* 101-102).

3.5.2. Test hypotheses

Hypothesis 1: Existence of an ESG rating leads to higher credibility

Under the assumption of Hypothesis 1, and ESG rating reduces the information asymmetry among the issuer and investors, despite the fact that it does not constitute a “third-party” verification. To that extent, investors may be willing to receive a lower yield in order to hold a green bond which they are ascertained it is not issued for greenwashing.

Hypothesis 2: The better the ESG rating, the lower the spread

The assumption under this hypothesis is, since ESG influences green bonds pricing, a better ESG rating should mean lower spreads. Thus, the study attempts to examine whether investors truly care about the green element or the green label is enough for them to invest (Moritz Immel, *et. al.* 101).

Hypothesis 3: For green bonds, environmental criteria dominate social and governance criteria

According to this hypothesis, a green bond issued with a better E-rating (from the ESG) shall have a lower spread than a bond issued with a lower ESG rating. The study expects that the E-score shall have an influence and in particular it should lead to a lower yield. The researchers make the assumption that the social score is less whereas G should be also having some influence on the yield, on the basis that it should be related to the use of proceeds (Moritz Immel, *et. al.* 101).

3.5.3. Results

The variables used for conduct of the study are shown in the following table:

Variable	Description
<i>ESG related variables</i>	
ESG rating	Dummy variable which takes value 1 if the issuer has a MSCI ESG rating, 0 otherwise
E-score	Environmental pillar of ESG Score from 0 (worst) to 10 (best)
S-score	Social pillar of ESG Score from 0 (worst) to 10 (best)
G-score	Governance pillar of ESG Score from 0 (worst) to 10 (best)
Weighted average ESG score	Combined ESG score from 0 (worst) to 10 (best)
<i>Control variables</i>	
Credit rating	Bloomberg composite rating (expanded if not available with S&P or Moody's rating.) AAA equals 1, AA+ equals 2 etc
Amount issued	Issue size in USD
Amount outstanding UP	Amount outstanding (all bonds) of the ultimate parent in USD.
Time to maturity	Remaining time to maturity in years measured from October, 31, 2019
Callable	Dummy variable which takes value 1 if the bond is callable, 0 otherwise
USD	Dummy variable which takes value 1 if the bond is denominated in USD, 0 otherwise
Governm. related	Dummy variable which takes value 1 if the bond is issued by a government-related issuer, 0 otherwise
Green bond	Dummy variable which takes value 1 if the bond has a Green Instrument flag, 0 otherwise
China	Dummy variable which takes value 1 if the issuers country of risk is China, 0 otherwise
Payment rank	Normalized payment rank of the bond where 1 equals 1st lien Secured, 2 equals Secured, 3 equals Sr unsecured, 4 equals Subordinated, and 5 equals Jr Subordinated

Table 9, Variable definitions

Source: Immel et. al 105, 2020, 103

Hypothesis 1

Using the above variables, the results regarding Hypothesis 1 are shown in the following table:

Model	Green bonds characteristic only		Green bond characteristic and ESG Yes/ No		Green bond characteristic and E-,S- and G-Score	
	Corporates	All	Corporates	All	Corporates	All
	1	2	3	4	5	6
Green bond	-9.704*** (1.909)	-8.030*** (1.630)	-12.777*** (1.883)	-11.061*** (1.618)	-13.713*** (2.158)	-12.215*** (2.066)
ESG			-22.140*** (0.929)	-20.829*** (0.838)		
E-score					-2.495*** (0.204)	-2.467*** (0.201)
S-score					-1.407*** (0.267)	-1.281*** (0.267)
G-score					-1.543*** (0.310)	-1.205*** (0.303)
Credit rating	13.176*** (0.174)	12.206*** (0.155)	13.410*** (0.174)	12.412*** (0.155)	11.775*** (0.204)	11.248*** (0.197)
Amount issued	-4.621*** (0.617)	-5.220*** (0.422)	-2.710*** (0.611)	-2.794*** (0.432)	-2.130*** (0.624)	-1.858*** (0.483)
Time to maturity	41.111*** (0.463)	38.214*** (0.428)	40.607*** (0.456)	37.891*** (0.420)	43.980*** (0.506)	41.341*** (0.482)
Callable	-23.596*** (0.802)	-20.413*** (0.784)	-18.791*** (0.777)	-16.185*** (0.756)	-16.911*** (0.825)	-15.484*** (0.825)
USD	37.409*** (0.733)	39.404*** (0.684)	36.931*** (0.712)	38.573*** (0.664)	27.166*** (0.772)	29.210*** (0.746)
Payment rank	-3.193 (0.521)	-1.954*** (0.494)	-2.004*** (0.525)	-0.644 (0.498)	-2.743*** (0.685)	-2.149*** (0.680)
Intercept	16.237 (12.536)	33.006*** (8.626)	-12.921 (12.330)	-7.771 (8.756)	-3.119 (13.065)	-7.099 (10.253)
N	14,170	16,046	14,170	16,046	10,705	11,543
Adjusted R ²	0.65	0.67	0.67	0.68	0.68	0.69

Standard errors are reported in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 10: Regression results Hypothesis 1

Source: Immel et. al 105, 2020, 105

As a first step, the research notes that the results suggest that there is a negative green bond premium of 8 to 14 bps. Therefore, according to the study, we can assume that investors are willing to receive lower yields in order to hold a green bond.

Under hypothesis 1, an ESG rating should lead to lower yields. To that extent, the study examines if a missing ESG rating results in higher yields.

Depending on the estimated model, ESG rating leads to lower yields by 9 to 19 bps. A deterioration in *Credit Rating results* in a higher spread of 28.66 bps (Model 1). This is

line with the fact that lower rating means more risk, thus investors are expected to ask for a premium. The *Amount Issued* is statistically significant at the 5% level. For the green bond index (Model 1 and 2), the results are not statistically significant, but these may be biased from the threshold used. The *Amount Outstanding* variable shows only minor significance for the green dataset including all bonds (Model 2). As regards *Time to Maturity*, the results show a positive relationship with spread (the longer the time to maturity, the higher the spread). The researcher suggests that the results show that (ceteris paribus) a 1-year increase of the time to maturity is leads to a higher spread between 6.808 bps to 22.737 bps.

Further, the results imply that government-related issuers achieve a lower yield (7 to 14 bps). As regards Chinese issuers, the study notes that these show a higher spread of 295 bps, whereas the whole sample shows a higher spread of 64 bps. This can be explained by the different characteristics Chinese green bonds have. In addition, non-government related Chinese issuers seem to be deemed riskier, which may be explained by the government's influence on the economy.

As a conclusion on the first hypothesis, it seems that ESG rating leads to a lower spread. This is explained by the fact that ESG rating decreases information asymmetry and therefore, investors settle for a lower yield.

Hypothesis 2

To examine whether a higher ESG rating results in a lower spread, the study now examines only bonds with ESG rating, using the Weighted Average ESG Score. The results are shown in the following table:

Model	Custom universe		Green bond index		Global aggregate index	
	Corporates	All	Corporates	All	Corporates	All
	1	2	3	4	5	6
Weighted average ESG score	-13.570*** (3.426)	-10.603*** (2.918)	-6.091*** (1.811)	-6.444*** (1.719)	-9.634*** (1.701)	-8.918*** (1.684)
Credit rating	14.128*** (3.280)	12.739*** (2.333)	4.669*** (1.006)	5.251*** (0.795)	7.886*** (1.020)	7.370*** (0.970)
Amount issued	-17.469*** (6.064)	-16.462*** (5.870)	-16.951*** (3.589)	-16.485*** (2.524)	-16.698*** (4.043)	-18.384*** (3.880)
Amount outstanding	-2.745* (1.461)	-1.921* (1.147)				
Time to maturity	25.535*** (4.096)	19.763*** (4.583)	32.125*** (3.055)	28.731*** (2.725)	27.967*** (3.927)	26.675*** (3.407)
Callable	-11.059 (6.801)	-3.450 (7.449)	-0.905 (3.934)	0.384 (3.880)	-9.797* (5.213)	-8.559* (5.011)
USD	46.769*** (8.736)	52.413*** (8.469)	37.905*** (4.336)	41.350*** (4.106)	33.406*** (4.745)	34.858*** (4.447)
Governm. related		0.957 (7.896)		-19.288*** (5.098)		-9.467 (6.010)
Payment rank	0.996 (11.332)	7.830 (9.484)	39.400*** (4.027)	38.987*** (3.855)	-1.326 (3.986)	-0.625 (4.076)
Intercept	417.476*** (125.317)	353.842*** (113.736)	229.635*** (71.932)	223.608*** (49.807)	348.581*** (85.167)	380.701*** (81.310)
N	163	211	192	228	193	208
Adjusted R ²	0.65	0.64	0.76	0.78	0.74	0.74

Standard errors are reported in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 11: Regression results Hypothesis 2

Source: Immel et. al 105, 2020, 106

The results indicate that an increase to the ESG rating of 1 point results in a decrease of the spread by 6 to 13 bps. On the other hand, a decrease in the Credit Rating leads in a higher spread of 5 to 14 bps. Further, the higher the time to maturity, the higher the spread, whereas a higher amount issued seems to result in a lower spread.

As a conclusion in relation to the results of Hypothesis 2, we can assume that a higher ESG rating leads to a lower spread of the green bonds.

Hypothesis 3

Under hypothesis 3, the researchers expect that the environmental factor (i.e. the “E” component of the ESG) is the main factor which leads to lower yields. Surprisingly, the study finds no statistically significant results as regards the E factor of the ESG. Therefore, hypothesis 3 needs to be rejected. However, the study does find that the governance component of the ESG is probably the main factor leading to lower spread. This may be explained by the fact that the G part stands for trust and since the main characteristic of a green bond is the different use of proceeds (for a “green” purpose), an enhanced “G” rating could probably signal to investors that the issuer is trustworthy and will use the proceeds for the green purpose for which these have been raised.

3.5.4. Conclusions

The study does find a green bond negative premium, therefore it concludes that, overall, green bonds do show a lower yield. Further, the study also concludes that ESG ratings have a strong impact on such yields, in the sense that higher ESG ratings lead to lower yields. This can be explained by the fact that companies with ESG ratings come public as regards their data and thus, investors are willing to give up a higher yield for more information. Finally, the study finds that governance scores have stronger influence on bonds' yields. This may be due to the fact that investors find companies with higher governance scores more trustworthy.

3.6. Sixth study examined: Is there a green premium in the Green Bond market? Systematic literature review revealing premium determinants

The study under the name "Is there a green premium in the Green Bond market? Systematic literature review revealing premium determinants" S. MacAskill, E. Roca, B. Liu, R.A. Stewart, O. Sahin (2021), Is there a green premium in the Green Bond market? Systematic literature review revealing premium determinants, *Journal of Clean Production*, 280) examines the following queries: 1) what are the social, economic, and environmental aspects influencing the demand for green bonds, 2) whether there is a general agreement that a green premium exists within the primary and secondary green bonds markets and 3) what traits of green bonds most frequently have a green premium.

3.6.1. Methodology

To investigate these three issues, the said study initially examines available literature to establish an understanding of the motivating forces and detractors controlling demand for green bonds and the potential for a green bond premium. These factors are classified as social, economic, and environmental drivers that either encourage or derogate from pro-environmental preferences among green bond issuers and investors around the

world. As a second step, a review of fifteen group academic and industry research on the green premium is conducted in order to reach a broad general understanding on whether a green bond premium occurs in these research findings, and to which extent. This section covers papers published between 2007 and 2019 which investigate both private and public green bond issuances. Many of these research findings make use of global datasets from developed as well as emerging markets. Finally, the circumstances under which the green premium has been most commonly observed are explored. Findings from the systematic examination of the literature are organized into data sample characteristics, which are further structured into subgroups such as study timeframe, bond type, credit rating, and governance. Lastly, to identify green premium factors, impactful bond characteristics are organized and ranked using a correlation analysis.

3.6.2. Drivers of the green bond premium

Social drivers

In general, the expansion of the green bond market corresponds with an uptrend towards corporate social responsibility and investors increasingly interested in socially responsible investment products. These developments supplement the expansion of the social and sustainability bond markets, which are combined with the green bond market, in order to encourage beneficial social and environmental change. Connected with those trends is the occurrence of '*ethical consumerism*,' as evidenced by some individuals' proclivity to rationalize purchase decisions, even at a higher cost, ever more associated with concern for the environment based on personal values. The social and cultural norm of challenging the environmental sustainability of the status quo, as well as widespread agreement on the risk of worldwide climate change, are undoubtedly dominating an increasing belief in a moral obligation for more sustainable investment choices among market players.

Economic drivers

The common oversubscription of new green bonds issues around the world (especially in cases where tax incentives are provided) shows that there are also economic driving factors with respect to the increasing demand for green bonds. Further, green bonds contribute to the diversification of an investor's portfolio, thus, mitigating investors' risk. Also, the study provides that the market players in the green bond market are usually

long-term investors which may suggest that there is lower liquidity in such market which shall eventually lead to price stability.

Environmental drivers

Environmental drivers are also contributing to the growth of the green bond market. Further, issuance of green bonds is accompanied with voluntary disclosure of proceeds and allocation thereof; this is a factor affecting the market prices for green bonds. The study also finds that independent third-party review also leads to a significant green bond premium.

The study suggests that all three above factors have cumulatively contributed to the green bonds market.

3.6.3. Data sample

The study focuses on journal articles and industry reports published within the 2007–2019 period and finally examines 15 studies since only studies that examine green bonds in the primary and/or secondary market with quantitative results are eligible for the research. The articles examined for the purposes of the study provide several observations in relation to green bonds pricing; where the respective analysis is accompanied with a robust analysis, the findings are dealt with as separate observations in the study. Thus, 30 observations have been included.

The studies examined are summarised as follows:

Author	Green premium?	Description
(Agliardi & Agliardi, 2019)	Yes	Yield curve comparison to assess green bond performance over time from 1 corporate EU utility provider. 338 observations are assessed from the issuance date in 2017. 1 secondary market observation is carried forward.
(Bachelet et al., 2019)	Mixed	A global sample of 89 private and institutional bond couples were assessed controlling for bond characteristics. Ordinary Least Squares (OLS) and Fixed Effects (FE) regression methodologies were used. The time frame of the study was between 2013-2018. 3 secondary market observations are carried forward.
(Baker et al., 2018)	Yes	A US sample of 2,083 green municipal bonds issued between 2010-2016 and 19 corporate green bonds issued between 2014-2016 are examined using an OLS regression. 3 secondary market observations are carried forward.

(Preclaw & Bakshi, 2015)	Yes	A global dataset of green bonds issued between 2014-2015 are assessed using a OLS regression. 1 secondary market observation is carried forward.
(Bour, 2019)	Yes	The yield spreads of a synthetically matched global sample of 536 bonds were analysed. The sample examined performance over the 2014-2018 period. 1 secondary market observation is carried forward.
(Harrison, 2019)	Mixed	Yield curve comparison of 61 EU and US green bonds issued in the first half of 2019. 3 primary market observations are carried forward.
(Ehlers & Packer, 2017)	Yes	Analysis of the credit spread on issuance of a cross-section of 21 EU and US green bonds between 2014-2017. 1 primary market observation is carried forward.
(Gatti & Florio, 2018)	Mixed	Investigated issue spreads on a broad sample of 246 bond couples between the 2007-2015 period. 3 primary market observations are carried forward.
(Gianfrate & Peri, 2019)	Yes	European (EU) focused study score matching a broad sample of 121 green bonds issued between 2013-2017. 2 primary market and 1 secondary market observations are carried forward.
(Hachenberg & Schiereck, 2018)	Mixed	Analysis of the i-spreads (using a yield curve) between a global sample of 617 matched corporate bonds between 2015-2016. 4 secondary market observations are carried forward.
(Hyun et al., 2019)	Yes	A global dataset of 60 green bonds, paired with synthetic conventional counterparts. Yield-spreads and regression (fixed effects and cross-sectional) methodologies were used. The sample included 1,365 bond-month observations between the 2010-2017 period. 3 secondary market observations are carried forward.
(Karpf & Mandel, 2018)	No	A large sample of 1,880 US municipal bonds were assessed between the 2010-2016, using the Oaxaca-Blinder decomposition method. The study noted observations in latter years trended towards a green premium. 1 secondary market observation is carried forward.
(Nanayakkara & Colombage, 2019)	Yes	A mixed, global dataset 82 green bond issues representing 52 companies in 25 countries formed the basis of the study. Bonds were matched and compared using a panel data regression over the 2016-2017 period. 1 secondary market observation is carried forward.
(Tang & Zhang, 2018)	Mixed	A global dataset of 665 corporate issuances are examined between the 2007-2017 period. 2 secondary market observations are carried forward.
(Zerbib, 2019)	Yes	A global study of 110 green bonds following a matching procedure and a two-step (fixed effects and cross-sectional) regression. The analysis examined corporate issuances from the same issuer over the 2013-2017 period. 1 secondary market observation is carried forward.

Table 12: Literature investigating the green bond premium

Source: S. MacAskill et al, Journal of Cleaner Production, 280

3.6.4. Results

The study aims to first explore whether there is a green bond premium in the primary and/or the secondary market. The results are mixed, with an 56% of the studies confirming the green bond premium in the primary market and 70% of such studies confirming such premium in the secondary market.

The average green bond premium varies widely in the primary green bond market, since the spreads are found between -85 to +213 bps. The relevant results are more consistent in the secondary market, where it is found that the spreads are set between -1 and -9 bps, essentially indicating that investors are willing to receive lower yields in order to hold green bonds in the secondary market.

The study examines further under which conditions the green bond premium occurs. To examine that, a correlation analysis is conducted through which specific bond characteristics are identified as driving factors of the green bond premium. The study finds that green bonds with a certification label, which are investment grade, and issued by governmental organisations present most notably a green bond premium. These findings suggest that the standardization of the green bond issuance which consequently reduces the information asymmetries, contributes to the green bond premium that investors are willing to pay (up to 15 bps in some cases in the secondary market). In relation to green bonds ratings, investment grade bonds provide green bond premium in a more predictable manner.

3.6.5. Conclusions

As regards the first question of the study, namely the factors affecting the demand for green bonds, the said study finds that it is clear from the correlation analysis that investors are influenced by social and environmental factors (e.g. third party assessment and labelling) and secondary, the lower volatility of green bonds. As regards the second question of the study, which is the existence of the green bond premium itself, the researchers find that overall, a green bond premium exists, which however, is more

persistent in the secondary green bond market. That being said, the researchers point out the need for further studies to be conducted in the primary market. Lastly, the final question of the study is which bond characteristics are more frequently related to a green bond premium; to that extent, the study finds that green bonds with strong governance procedures (i.e. certification and third party assessments) are associated with a green bond premium more consistently.

3.7. Seventh study examined: Corporate Green Bonds

The study under the name “Corporate Green Bonds” (Caroline Flammer (2021), Corporate Green Bonds, Journal of Financial Economics, 142, 499-516) aims to explore the rationales for issuing green bonds; these are the following: the “signaling” argument, which means that the issue of green bonds will indicate to the market that the firm is committed towards green projects and the environment; the “greenwashing argument”, which implies that the firm’s claims would be misleading and the proceeds will not be finally allocated to green purposes; and, finally, the “cost of capital argument” which refers to the green premium that part of the literature attributes to green bonds.

3.7.1. Data sample

The researcher uses 565 green bonds of public companies which relate to 22 unique observations (to be noted that some of these firms may proceed with green bond issues multiple times a year). The data at firm level are obtained by several sources; for the stock market data, the researcher uses the daily stock file of Compustat North America (including data for US and Canadian firms) and Compustat Global (including data for all other publicly traded companies).

3.7.2. Event study analysis-Methodology and results

The researcher uses the event study methodology, which examines the stock price reaction in relation to the announcement of an event; to this end, the day that each firm announces that it intends to issue a green bond is the day 0, whereas the actual issuance date is of no influence. The researcher also explores scenarios including intervals

several days before and after the announcement, mainly to capture the possibility of information leaking to the public prior to the announcement.

Then the abnormal returns are calculated as follows:

$$R_{it} = \alpha_i + \beta_i \times R_{mt} + \varepsilon_{it}, \text{ where:}$$

R_{it} is the return on the stock of company i on day t ;

R_{mt} is the daily market return;

and ε_{it} is the residual.

$\alpha_i + \beta_i$ are calculated by ordinary least squares.

The estimated stock return on day t is calculated as follows:

$$R_{it} = \alpha_i + \beta_i \times R_{mt}.$$

The abnormal daily return (AR) are calculated as the difference between the return which is implied by the theoretical asset pricing model and the actual return.

As regards the cumulative abnormal returns (CARs), these are calculated as the sum of the abnormal returns within the various time intervals.

The results are shown in the following table:

Event time	CAR	Std. err.
[-20, -11]	-0.129	0.157
[-10, -6]	0.051	0.245
[-5, 10]	0.489**	0.241
[11, 20]	-0.029	0.218

[21, 60] -0.122 0.645

Table 13: Stock market reaction to the announcement of green bond issuance.

Source: Caroline Flammer (2021), Journal of Financial Economics, 142, 507

The average CAR in the event window [-5, 10] is c. 0.49% whereas all other time intervals before and following this specific CAR are insignificant. The results are consistent with the respective literature showing that the stock market is positively responsive to green bond issues whereas it shows no particular interest in conventional bond issues.

The study further examines which characteristics affect the stock returns following the announcement. The results are found in the following table:

	CAR [—5, 10]	Std. err.
Panel A. Certified vs. noncertified		
Certified green bonds (<i>N</i> = 192)	0.710* *	0.292
Non certified green bonds (<i>N</i> = 192)	0.268	0.535
Panel B. First-time issue vs. seasoned issue		
First-time green bond issue (<i>N</i> = 169)	0.798 **	0.322
Seasoned green bond issue (<i>N</i> = 215)	0.246	0.512
Panel C. Financial materiality of the environment		
SASB score above median (<i>N</i> = 172)	0.699***	0.143
SASB score below median (<i>N</i> = 212)	0.318	0.303

Table 14: Cross-sectional heterogeneity

Source: Caroline Flammer (2021), *Journal of Financial Economics*, 142, 508

The results in Panel A show that the market reaction is aligned with the signaling argument: since companies undergoing a third-party assessment bear significant costs (including administrative costs to comply with the relevant rules of the assessment) such process gives the market a strong signal regarding the firm's commitment to the environment.

The results in Panel B are also consistent with the signaling argument since first time green bond issuers have larger abnormal returns than the seasoned issuers; this is explained by the fact that the market has already been informed about the firm's intentions in relation the environment, and, thus, the abnormal returns are insignificant, more similar to the ones relating to the conventional bonds.

Finally, the results in Panel C show that the abnormal returns of green bonds are significant in markets where the natural environment "*is financially material to the firm's operations*". This means that in cases where shareholders cater for firm's intentions towards the environment, stronger market reactions should be expected where the natural environment to the firm's financial operations.

The researcher performs robustness tests in order to validate the above results. Indicatively, the study uses the MSCI World Index in order to calculate the abnormal returns instead of the market index of each country (the MSCI World Index captures large and mid-cap representation across 23 developed markets countries). Another robustness check is the selection of an asset pricing model other than the market model. In particular, the study uses the three-factor model of Fama and French in order to calculate the abnormal returns (the Fama and French model has three factors: the size of firms, book-to-market values, and excess return on the market). As part of the robustness checks, the researcher excludes green bonds issues by financial institutions and dates on which companies have proceeds with other relevant announcement (e.g. conventional bonds). The results of these tests are consistent with the study's results, in the sense that the abnormal returns for the time window [-5, 10] still show a positive market reaction to the green bond issuance.

The study further examines the evolution of the ownership structure of the company following a green bond issue. By this analysis, the researcher expects to confirm whether

green bonds issues lead to an attraction of specific categories of investors. The researcher uses four measures to this end:

Institutional ownership is the percentage of shares held by institutional investors.

Ownership by long-term investors (duration) is the percentage of shares held by institutional investors whose holding duration is above the median across all investors.

Ownership by long-term investors (churn rate) is the percentage of shares held by institutional investors whose churn rate is below the median across the total of investors.

Ownership by green investors is the percentage of shares owned by investors that are members of the Ceres Investor Network on Climate Risk and Sustainability.

The researcher finds that institutional ownership changes slightly following the issuance of a green bond. Further, the study confirms that ownership percentages by long term investors and green investors changes, increasing by 0.4% for the first ones and by 2.9% for the latter. Yet again, the signaling argument is re-confirmed by these results; namely they indicate that by issuing green bonds, the relevant firms show their green commitment, which then attracts investors with a particular interest in the environment.

The study further checks the role of third-party assessments in the context of green bond issues; the results relating to ownership structure of the firms (as well as the environmental rating and the actual environmental performance thereof) are again significant for the certified bonds, once again confirming the signaling argument.

In order to examine the existence of so called “green bond premium”, the researcher compares green bonds with conventional ones of the same issuer. To that extent, the study matches every green bond to the most similar of the conventional bonds issued by the same issuer on the basis of the four following characteristics:

- The issuance amount;
- The maturity;
- The coupon; and
- The number of days between the day of the conventional bond issuance and the green bond issuance.

The results are shown in the following table:

Yield at issue (in%)		
Ob	Mean	Median

Green bond	152	3.654	3.600
Matched	152	3.673	3.600
Difference		-0.019	0.000
<i>p</i> -value (difference)		0.942	1.000

Table 15: Is there a premium on corporate green bonds?

Source: Caroline Flammer (2021), *Journal of Financial Economics*, 142, 514

The above results show that the median difference between green and conventional bonds is precisely zero, whereas the mean difference is set at 0.019% with a *p*-value statistically insignificant (0.942).

These results show that any positive market reaction is not driven by a lower cost of capital effect. The researcher highlights that these results are consistent with the finding of the study by Larcker, D.F. and Watts, E.M., (Larcker, D.F. and Watts, E.M., (2020). Where's the greenium? *Journal of Accounting and Economics*, 69, 101312). The latter study again uses the matching methodology and finds no significant difference between the pricing of green bonds and conventional ones.

In order to examine the "greenwashing argument" the study also attempts to check the environmental performance of the green bond issuers following the green bond issue. To that extent, the researcher uses the Asset4 database (which is a database of transparent, objective and auditable environmental, social and governance (ESG) information) to examine the environmental ratings of each issuer. However, since issue of a green bond is not technically connected to the assessment of the environmental rating of the firms is Asset4, the researcher uses a second measure of environmental performance: the ratio of CO2 emissions to the book value of assets.

The study finds that, following the issue of the green bonds, the environmental performance is improved over time, in the sense that the environmental ratings are increased, and the CO2 emissions are reduced. The results are inconsistent with the greenwashing argument since they show that companies do intend to improve their commitment towards the environment following the issue of a green bond.

The researcher further revisits the role of the third-party assessment. In order to check the third-party certification significance, the study interacts green bonds with dummy variables that are classified into green bonds which are assessed by third parties and green bonds which are assessed by third parties.

The results are presented in the table that follows:

	Environment rating (1)	CO2 emissions (2)	Institutional ownership (3)	Ownership by long-term investors (duration) (4)	Ownership by long-term investors (churn rate) (5)	Ownership by green investors (6)
Green bond x certified	7.656— (2.737)	-14.392*** (5.154)	0.012 (0.013)	0.020** (0.010)	0.018 ** (0.008)	0.034*** (0.014)
Green bond x noncertified	2.224 (2.445)	-2.051 (4.476)	0.010 (0.011)	0.012 (0.009)	0.007 (0.008)	0.015 (0.012)
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Country-year fixed effects	Yes	Yes	-	-	-	-
Industry-year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1466	1196	361	361	361	361
R-squared	0.88	0.90	0.80	0.62	0.56	0.70

Table 16: Certification

Source: Caroline Flammer (2021), Journal of Financial Economics, 142, 515

The above results show that the estimates are statistically significant for certified green bond issuers; this is not the case for non-certified ones. Yet again, these results are consistent with the “signaling argument” in the sense that, in case the issuer elects to proceed with an independent third-party assessment, it will have to bear material costs

(including compliance costs). This gives the signal to market that the respective issuer has a strong commitment towards the environment.

3.7.3. Conclusions

The study finds a positive stock market reaction to the issuance of green bonds. Such reaction is stronger for the “first time” green bond issuers than the issuers who proceed with further issues of green bonds. The green bond issuers also improve their environmental results following the green bond issue. However, the yields between green bonds and brown bonds do not show a significant difference.

On the basis of the above, the study confirms the signaling argument; the greenwashing argument and the cost of capital argument, as described above, are not consistent with the results of this study.

3.8. Eighth study examined: Are green bonds priced differently from conventional bonds

The study under the name “Are green bonds priced differently from conventional bonds?” (Britta Hachenberg, Dirk Schiereck (2018), Are green bonds priced differently from conventional bonds?, Journal of Asset Management, 19, 371-383) aims to explore whether investors indeed receive lower spreads in comparison with conventional bonds.

3.8.1. Data sample – Methodology

The researcher uses data from Bloomberg dated as of August 2016. The green bonds examined are of a values of US dollars 150 million minimum, given that liquidity of the bonds affects the pricing thereof. Municipal bonds and asset-backed securities as well as structured bonds are excluded, so that the bonds included in the sample are the most comparable to the conventional bonds.

In order to determine whether the green bonds trade with lower yields than the conventional bonds, namely whether a green premium exists, the study uses the i-spreads from Bloomberg. Such i-spreads are defined by Bloomberg as follows: *“I-Spread is the interpolated bond spread to a benchmark curve. The I-Spread is calculated by taking the interpolated, maturity matched yield on a benchmark curve, and subtracting that value from the selected bond’s yield to worst. This differs from a standard benchmark spread, where the selected bond’s yield is compared to the nearest already existing point on a curve, rather than an interpolated point”*. Therefore, the i-spreads are calculated in bps over a risk-free benchmark (which is often the swap rate). As opposed to yields, the i-spreads include the interest and the credit part of the yield separately. Thus, the researcher examines the credit part of the yield with the aim to determine whether a similar conventional bond trades differently (in terms of pricing) in relation to a green bond.

The final data sample consists of 63 bonds, out of which 39 have been issued from governmental institutions, 12 from financial institutions, 8 from corporate companies and 4 from real estate firms. The average remaining maturity of the bonds is 5 years. Non investment grade bonds are excluded.

In order to determine whether there is a green bond premium, the author uses the method of “matched pairs”. Each green bond is matched with two conventional bonds, one with shorter maturity and one with longer maturity (than the relevant green bond).

The conventional bonds must meet the following requirements so as to be eligible for the matching pair:

- they must be issued from the same (green bond) issuer;
- they must enjoy the same ranking with the green bond;
- they must be denominated in the same currency as the green bond;
- they must be “plain vanilla” bonds, fixed or floating;
- their size must be €150mio (minimum);
- the secured conventional bonds are matched to the secured green bonds; the same applies for the unsecured bonds.

The following table shows the descriptive statistics for the sample:

	Green	Non-
Issuer	39	39
Government-related	39	78
Financials	12	24
Corporates	8	16

	Green	Non-
Real estate	4	8
Median rating	3.05 (AA)	3.05
ESG rating (issuer)	11	11
Amount issued (mean)	810 million	1.7
Amount issued (mean)	959 million	2.1
Amount issued (mean)	689 million	1.8
Amount issued (mean)	708 million	1.2
Amount issued (mean)	593 million	535
Remaining maturity	5 years	5 years
Countries	15	15
Currencies	8	8
Total (issues)	63	126
Total (observations)	7032	14,064

Table 17: Descriptive statistics of green and non-green bonds

Source: Britta Hachenberg et al, (2018), Journal of Asset Management, 19, 376

3.8.2. Hypotheses

The study is structured around the following hypotheses:

1. Green bonds offer lower yields than conventional bonds; in the case of green bonds, investors are able to verify the use of proceeds; this means that investors are able to select the projects that meet their criteria and essentially invest into a second product (i.e. the project) apart from the bond loan itself; on the basis of the above, it seems fair that investors would be willing to accept a lower yield in comparison with the brown bonds; however investors are exposed to the risk of “greenwashing”. The pool of green bond issues includes institutional investor, whose bond issuances enjoy lower yields as opposed to entities with lower ratings; this results in the second and third hypotheses.
2. Bonds with lower ratings show larger differences in pricing.
3. Different industries show different pricing results.

3.8.3. Results

The study separates the bonds in rating groups from AAA to BBB. The daily delta (i_d) between green and conventional bonds is shown in bps in the table below. Further,

spreads for green (i_g) and conventional bonds (i_M) are shown in bps above the bond's respective benchmark for fixed rate bonds and sicount margin for floating rate bonds.

Rating	n bonds	Tightest daily i_d	Widest daily i_d	Mean i_d	Median i_d	t tighter	t wider	Mean	Mean M
AAA	29	-14.51	8.60	0.45	0.64	1,300	1,941	12.91	12.47
AA	14	-15.90	10.12	-0.99	-0.64	934	511	40.83	41.82
A	15	-48.70	43.60	-3.88	-0.83	883	808	79.62	83.50
BBB	5	-32.15	24.57	-2.69	-1.00	367	288	150.84	153.54
Total	63	-48.70	43.60	-1.18	0.04	3,484	3548	47.54	48.72

Table 18: I-spreads of green bonds versus non-green bonds

Source: Britta Hachenberg et al, (2018), Journal of Asset Management, 19, 377

The matched pairs method shows that green bonds with single A rating have a lower yield of 3.88 bps, bonds with AA ratings have a lower yield of 0.99 and bonds with BBB rating a lower yield of 2.69 bps compared to their conventional pairs. In general, green bonds trade at 1.18 bps lower than the brown ones; however, green bonds with AAA rating have a mean i-spread of 0.45 bps higher than their conventional peers.

In order to test the results, the researcher uses the “Wilcoxon rank sum” test, which is a non-parametric statistical test that compares two paired groups. This test calculates the difference between sets of pairs and analyses such differences to establish if they are statistically significantly different from one another. Moreover, the sample is separated per industry type.

The results are shown below:

	Total sample	AAA	AA	A	BBB
N	14,064	6482	2890	3382	1310
p value rank sum	0.107	0.312	0.387	0.000	0.316
p value t test	0.209	0.474	0.489	0.002	0.419
$r_{\text{green, non-green}}$	0.989	0.993	0.994	0.936	0.986
	Total sample	Government related	Financials	Corporates	Real estate
N	14,064	9222	1,906	1,888	1048
p value rank sum	0.107	0.753	0.000	0.000	0.126
p value t test	0.209	0.732	0.000	0.071	0.566
$r_{\text{green, non-green}}$	0.989	0.995	0.947	0.957	0.995

Table 19: Results Wilcoxon rank sum and t test for ratings and industries

Source: Are green bonds priced differently from conventional bonds?

Britta Hachenberg et al, (2018), Journal of Asset Management, 19, 378

These results indicate that, except for the BBB bonds, the difference between the i-spread of green bonds and conventional bonds is higher for bonds with lower ratings, but only at an absolute level; therefore, the second hypothesis is rejected.

The results are statistically significant for financial institutions and corporate firms, which shows that the results may vary across industries. In order to examine the influence of the various features of the green bonds over their pricing characteristics, the study runs a panel regression with the daily differences between the spreads of green bonds and conventional bonds as the dependent variable and the ISIN of the bonds as the cluster variable.

The author uses two models as follows:

- **Random effects model:**

$$Y_{i,t} = \beta_1 \text{Size green}_{it} + \beta_2 \text{Size nongreen}_{it} + \beta_3 \text{Financials}_{it} + \beta_4 \text{Government} + \beta_5 \text{Currency}_{it} + \beta_6 \text{Maturity}_{it} + a + u_{it} + \varepsilon_{it}$$

where the study provides that “ $Y_{i,t}$ is the delta of the daily i-spread i_g of the green bonds and the respective model spread of the interpolated non-green bonds i_M at date t , *Size green* is the logarithmized issue size of the green bonds recalculated at new issue date in U.S. dollars, *Size non-green* is the logarithmized issue size of the non-green bonds recalculated at new issue date in U.S. dollars, *Financials* is a dummy variable, which takes value one if the issuer is a financial company and zero otherwise, *Government* is dummy variable, which takes value one if the issuer is a government-related firm and zero otherwise, *Currency* is a dummy variable, which takes value one if the issue is in Euro or U.S. dollars denominated and zero otherwise, *Maturity* is the remaining maturity of the issue, β is the coefficient for the independent variables, a is the intercept, u_{it} is the between-entity error and ε_{it} is the within-entity error.”

- **Population averaged model:**

$$Y_{i,t} = \beta_1 \text{Size green}_{it} + \beta_2 \text{Size nongreen}_{it} + \beta_3 \text{Financials}_{it} + \beta_4 \text{Government} + \beta_5 \text{Currency}_{it} + \beta_6 \text{Maturity}_{it} + \alpha + r_{it}$$

where α is the intercept and r_{it} is the error term.

The results clustered per issuer are shown in the table below:

	Model 1.1	Model 1.2	Model 2.1	Model 2.2	Model 3.1	Model 3.2	Model 4.1	Model 4.2
Size green	0.276	0.285	0.274	0.268	.690***	.723**	.687***	.709*
Size non-green	-1.352***	-1.310***	-1.354***	-1.319***	-.630***	-.682**	-.636***	-.706**
Financials	-5.297	-5.209**	-3.395	-3.356				
Government	3.549	3.561*	8.007*	7.991***	23.315***	22.109***		
Currency	2.718***	2.614***	2.726***	2.652***	1.580***	1.495**	1.565***	1.435*
Maturity	-0.000	-0.000	-0.000	-0.000	-.0007***	-.001***	-.001***	-.000**
ESG			5.732	5.697**	10.731**	10.347***	-3.546	-2.941
AAA					-6.098	-5.396	2.062	2.552
AA					-14.530***	-13.291***	-12.824***	-10.940**
A					8.047*	7.352**	9.386*	8.152*
N	7032	7032	7032	7032	7032	7032	7032	7032
Rho	0.740		0.730		0.722		0.734	

Table 20: Random-effects and population-averaged panel regression (clustered by issuer)

Source: Are green bonds priced differently from conventional bonds?

Britta Hachenberg et al, (2018), Journal of Asset Management, 19, 381

The above results indicate that the size, the denomination and the maturity of the bonds do not affect the pricing thereof. However, results differ among industries, and this supports Hypothesis 3. Further, the results imply that if an issuer has an ESG rating, investors may invest in a conventional bond instead of a green one, if the former has an ESG rating. Moreover, green bonds issued by financial institutions offer lower yields in comparison with their conventional peers; this is not the case, however, for governmental green bond issuers. A possible explanation could relate to the fact that governmental issuers would want to be more attractive (i.e. offering higher yields), given that they are in the active process of developing the green bond market. Lastly, the results show that green bonds with single A rating and green bonds issued by financial institutions have the so-called “green bond premium”.

3.8.4. Conclusion

The study concludes that green bonds with single A ratings trade at a lower point than their conventional peers (3.88 bps). Further, green bonds issued from financial institutions offer lower yields in comparison with governmental issuers. Overall, the study supports that, despite the fact that green bonds are more expensive to issue, especially when the issuer elects a third party certification, such issue may end up as a rewarding choice for the issuer due to the green bond premium.

3.9. In a nutshell

Study	Data sample	Conclusions
Do shareholders benefit from green bonds?" (Dragon Yongjun Tang, Yupu Zhang (2020))	132 unique public issuers, 1510 bonds worldwide , which consist of 209 commercial banks, 456 corporations, 489 development banks, 41 state-backed entities, 209 municipal bonds, 4 sovereigns and 85 green asset-backed securities	<ul style="list-style-type: none"> • No significant "green bond premium" • Expanded institutional ownership due to increased media attention, thus, improved stock liquidity
Stock market reaction to green bond issuance (Vishaal Baulkaran (2019))	54 firms , the majority of which are registered in Europe, including one Canadian bank (TD bank), 10 US corporate green bonds, 8 Chinese and 3 Australian issuers	<ul style="list-style-type: none"> • Positive market reaction to green bond issuance • Such reaction is more intense to issuers with lower cost of debt in general • Decrease of firm's risk in the long run
The green advantage: Exploring the convenience of issuing green bonds" (G. Gianfrate, M. Peri (2019))	121 green bonds , issued by different entities (corporates, financial institutions, sovereign states etc)	<ul style="list-style-type: none"> • The green label affects pricing in the primary market • Green bonds constitute overall lower means of raising capital • Private entities enjoy lower yields
The Green Bonds Premium Puzzle: The Role of Issuer Characteristics and Third-Party Verification (Maria Jua Bachelet, Leonardo Becchetti and Stefano Manfredonia (2019))	89 bond couples issued by various entities, in relation to which the study uses daily observations of ask price, bid price, and redemption yield for the period from 1 January 2013 to 31 December 2017.	<ul style="list-style-type: none"> • Green bonds have in principle higher yields and less volatility • However, institutional issuers and certified private issuers enjoy a green bond premium
Green bonds: shades of green and brown (Moritz Immel, Britta Hachenberg, Florian Kiesel, Dirk Schiereck (2021))	466 bonds, issued by various entities	<ul style="list-style-type: none"> • Green bonds enjoy the green premium • Higher ESG ratings lead to lower yields
Is there a green premium in the Green Bond market?	Literature review of 15 papers published between 2007 and 2019	<ul style="list-style-type: none"> • Green bonds are less volatile

<p>Systematic literature review revealing premium determinants (S. MacAskill, E. Roca, B. Liu, R.A. Stewart, O. Sahin (2021))</p>		<ul style="list-style-type: none"> • Investors are driven by social and environmental factors • The green bond premium exists • Third party certification enhances the green bond premium
<p>Corporate Green Bonds (Caroline Flammer (2021), Corporate Green Bonds, Journal of Financial Economics)</p>	<p>565 green bonds of public corporate firms</p>	<ul style="list-style-type: none"> • Positive stock market reaction • First time issuers attract more attention • Greenwashing argument and cost of capital argument (i.e. the green bond premium) are rejected
<p>Are green bonds priced differently from conventional bonds? (Britta Hachenberg, Dirk Schiereck (2018))</p>	<p>63 bonds, out of which 39 have been issued from governmental institutions, 12 from financial institutions, 8 from corporate companies and 4 from real estate firms</p>	<ul style="list-style-type: none"> • A rated bonds trade at a lower point • Financial institutions enjoy a lower yield in comparisons with governmental issuers • Third party certification enhances the green bond premium

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4. Conclusions

Green bonds are a relatively new financial instrument for firms via which issuers can raise capital to fund projects with sustainable-related objectives. Literature has been quite curious about the way the issue of green bonds interferes with firm's financial performance and especially whether (a) the issue of a green bond constitutes lower cost of debt for the firm and (b) such issue has a positive effect on the firm in general, i.e. whether it eventually leads to positive stock returns for the firm.

On a parallel note, ESG marks a new era for companies, in the sense that investors seem to be particularly interested in ESG disclosures, whereas literature shows an interest in exploring the potential relationship between a firm's ESG activities and its financial performance. To that extent, the ESG regulatory framework is expanding rapidly, however it is still fragmented, and no unified legislative tool or otherwise exists, despite European Union's extensive actions in this regard.

The studies that have been examined show that green bonds may in some cases constitute a lower mean of raising capital for firms in comparison with conventional (corporate) bonds. However, the incentives behind any lower yields that investors are willing to receive in exchange of a green bond, the "green bond premium", are not unanimous. Literature shows that overall, the market has a positive reaction to green bond issues, but most probably the first time a firm reveals its "green" intentions. What could possibly interpret the market's positive reaction to green bond issues which may push up such bonds' price is the fact that firms, when issuing a green bond, disclose all relevant information to investors, especially information regarding the use of proceeds, either in their prospectuses or in more informal ways, such as their press releases. Such disclosure decreases the information asymmetry between investors and issuers, and therefore could potentially lead to an extended investor database for the firm and thus, lower yield. In this regard, ESG ratings which are formed based on firms' disclosure may play an important role in pricing of the bond as well, in the sense that the better the ESG rating, the lower the bond's spread. Moreover, stock market reaction seems also positive following the issue of a green bond and stock's liquidity may increase.

Further, third party verification, i.e. "the green bond label" plays a very important role in literature; it affects the green bond issue and may lead to lower yields, since investors can be assured that the green bond is not issued for greenwashing. Said green label is of particular importance to legislators as well, since the European Green Bond Standard

envisages not only a third-party verification, but also a supervision of third party reviewers by ESMA so that the quality of services provided is guaranteed.

An area of further research may be related to the role of the issuer in the green bond market. Whereas corporate issuers seem to enjoy lower yields in some studies, especially in comparison with financial institutions, other studies show that institutional issuers' green bonds do have lower yields compared to corporate issuers. These contradictory results may be explained by the fact that institutional issuers are already under disclosing obligations and in many cases are supervised by third parties, so investors trust their green bond issues; private sector and corporate issuers may fill this gap via a third-party verification. As a conclusion, the cross-industry effect has to be examined more, whereas more studies are expected in the field of pricing, upon green bond market's expansion.

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