



NHH



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and  
Vytautas Magnus University  
Faculty of Economics and Management

**THE ASSESSMENT OF SOCIALLY RESPONSIBLE INVESTMENT: GREEN  
BONDS CASE**

Research Master's Thesis submitted by:  
Pulkit Gupta

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Supervisor:

Assoc. Prof. Jørgen Haug (NHH)

Dr. Evelina Bendoraitienė (VMU)

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## **FOREWORD**

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## ABSTRACT

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Based on the theoretical analysis of investment in green bonds to identify and assess differences in the pricing between Green bonds and conventional bonds. Part 1 of the research paper, the theoretical framework of green bonds and its characteristics, In this chapter all the concepts and basic terminologies related to topic has been described in details then in addition with the description of previous researches , lastly there is an overview of the empirical research done related to this topics and finding have been mentioned In chapter 2 research methodology is defined asses the green bond premium . overview context for the empirical research , next chapter is about aim and relevance and aim then moving forward with empirical hypotheses generation ,empirical research method and sample and then ending with the limitation 3rd part aims to analyze and define the outcome, which is obtained during the empirical research of green bond premium, this part of the paper is organized based on methodology background . a primary assessment of models is tested, next to the results of the imperial analysis consisting in line with the hypothesis testing formulated into the methodology section. Finally, the find of the paper discusses theoretical underpinning.

## Glossary of Terms

**CAPM- Capital Asset Pricing Model:** It is a simple-logic-pleasing prediction on how to measure risk and about the relationship between risk premiums on individual assets and their systematic risk or expected return. It is also used in estimating the cost of equity capital for firms and evaluating the performance of managed portfolios.(Fama & French, 2004)

**CSR- Corporate Social Responsibility:** is an action of firms that contribute to social welfare required for profit maximization. It is a self-regulating business model and an important element for strategic management. (McWilliams, 2015 )

**ESG- Environmental, Social, and Governance:**It is the set of standards adopted by the firms to enjoy increased efficiency and higher valuations of the firm, that socially conscious investors use to screen potential investments. Environment criteria consider how a company performs as a steward of nature. Social criteria examine the relationship of the firm with employees, suppliers, customers, and the communities. Governance deals with a company's leadership, executive pay, audits, etc.( Chen & Scott, 2020)

**Green bond:** It is one of the financing options available to private firms and public entities to support climate and environmental investments. It was first launched by the world bank and European investment banks in 2007. (World Bank, n.d)

**Green Bond Principles:** The voluntary process guidelines that recommend transparency and disclosures and promote integrity in the development of the green bond market by clarifying the approach for issuance of a green bond.(ICMA,2015)

**Yield Spread:** It is the difference between yields on differing debt instruments of the same maturities, risk level, issuer, or credit ratings, expressed in basis points (bps) or percentage points. It is extra compensation investors receive for bearing credit risk.( BIS, n.d)

**Yield Spread Premium:** Yield spread premiums are the payments that are given to any mortgage or

broker by issuing institutions which are built on the interest rate charged on any loan, in which higher interest rates lead to higher yield spread premiums. (Burlingame & Jackson, 2009)

# TABLE OF CONTENTS

ABSTRACT	4
Glossary of Terms	5
INTRODUCTION	8
I.THEORETICAL ASPECTS OF SOCIALLY RESPONSIBLE INVESTMENT	10
<b>1.1 The concept and content of socially responsible investment</b>	10
<b>1.2. Green bonds Concept and its characteristics</b>	12
<b>1.2.1 The concept and content of Green bonds</b>	12
<b>1.2.2 Certification of Green bonds</b>	14
<b>1.2.3. Assessment of Green Bond market</b>	16
<b>1.3 Empirical aspects of socially responsible investment</b>	18
<b>1.3.1 Empirical aspects of Corporate social performance influence on bond yield</b>	18
<b>1.3.2 The empirical results of investment in green bonds</b>	20
II. METHODOLOGY FOR THE ASSESSMENT OF THE YIELD SPREAD PREMIUM	26
<b>2.1 The need of the research</b>	26
<b>2.2 Empirical research Hypothesis</b>	29
<b>2.3 Empirical research stages and logic</b>	32
<b>2.4 Empirical research data sample and methods</b>	33
<b>2.5 Limitations of the empirical research</b>	43
III. EMPIRICAL RESULTS OF THE ASSESSMENT OF YIELD SPREAD PREMIUM	44
<b>3.1 Overview of the collected sample and dynamics</b>	44
<b>3.2 Identification of Green bond yield spread premium</b>	47
<b>3.3 Assessment of yield spread premium</b>	49
<b>3.4 Empirical research hypotheses testing results</b>	52
<b>3.5. Generalization of findings and discussion in the context of the previous research</b>	53
CONCLUSION AND RECOMMENDATION	56
REFERENCES	60
APPENDIX	66

## INTRODUCTION

Climate change is accelerating and the green bond market has also been growing worldwide since its inception in 2007. Green bonds, a new type of financing instrument, emerged in the International financial market, is not an innovative financing model in the deal structure. Green Bond Principles (GBP) explains that the green bonds are the financing instruments which can be financed or refinanced, in part or full, under the new or existing green projects with environmental benefits. (ICMA, 2017) Green bonds increased demand with less supply can be because of the influence of The Paris Agreement's aims to bring security and to strengthen the response globally. Efforts have been made to limit the increase in temperature even further to 1.5 degree Celsius from the pre industrial level of 2 degree celsius. (Tolliver, K., & Managi, 2019). Today the green bond yield doesn't concern the issuing institutions, but to debt security. And the yield of the green bonds might be lower than that of a conventional bond, suggested by the recent cases. Looking in the previous research, it had mixed results, in accordance with research of Karpf and Mandel (2018) they found a positive yield premium and according to Zerbib, 2018; Anderkrans . & Johannesson P 2019; Ehlers and Packer, 2017 they found negative green yield premium in the green bonds comparing with conventional bonds .the studies were to the overall consideration of Globally , different currency, number of bonds,() Being green bonds as a new financial instrument that came in 2007. Thus, authors have examined the green bond premium, and still, there are a plethora of studies that could be done in this field. There are fewer articles on the EURO denominated currency market . Nevertheless, Research is relevant, especially looking towards the new form of the financial instrument; there can be many factors that can be taken into consideration to do research.

**The Research Problem:** Till to what extent the yield Spread premium of green bond is different from conventional bonds?

**Research object:** Yield Spread premium

**The Aim of the research:** Based on the theoretical analysis of investment in green bonds to identify and assess differences in the Yield Spread premium between Green bonds and conventional bonds

The following **objectives** were formulated to reach the purpose of analysis:

1. To analyze and synthesize theoretical approaches to socially responsible investment and green bonds phenomena to conduct a comparative analysis of scientific Research and distinguish determinants for empirical analysis



2. To develop the methodology of socially responsible investment and to adjust it to evaluate the yield spread premium for green bonds.
3. To measure and compare differences between green and conventional bonds yield spread premium.
4. To discuss and compare the research results with previous research results and to provide a recommendation

**The Structure of the Research:** The master thesis has divided into three parts. In the first part of the paper, the theoretical underpinnings of the research are presented. Firstly analysis of sustainability concepts and importance of green bonds. In the chapter Sustainability definition analysis in content with sustainable investing and responsible investing. Next to explaining the definition analysis of green bonds and their valuation certification method with market outreach. Then, moving forward with bond premium literature research done till now. The second part, the methodology for the analysis of yield spread in green bonds. It includes an overview of the context of the analysis, the definition of relevance and aim, determination of research logic, description of Research, hypothesis development, raised description of data sample and restriction, and method used in Research and, finally, limitation presented. The third part of the master thesis is empirical Research, and finding of Yield spread difference in green bonds and conventional bond

**Research methods and sources.** The research method for literature review of the study is based on the different sources such as scientific articles online databases In the Empirical Research is done through Correlation analysis and Panel Regression is used. Theoretical and methodology parts of the paper is mainly there backgrounded and calculated by scientific articles and empirical researches of various authors. The central part of the research part is based on data which is both qualitative and quantitative retrieved from the Thomson Reuters Eikon (2020). The tools used to analyze these data were GRETL and MS Excel (2020).

# **I.THEORETICAL ASPECTS OF SOCIALLY RESPONSIBLE INVESTMENT**

In the 1<sup>st</sup> part of the research paper, the theoretical framework the concept and content of social responsible Investment is explained , then explaining the green bonds concept and its characteristics Then explaining the empirical aspects of Socially responsible investing. Empirical aspects of Corporate social performance influence on bond yield and results of investment in green bonds

## **1.1 The concept and content of socially responsible investment**

A plethora of research has been done on sustainability developing terminology, and also have gained prominence in the last decade (Galvic P., Lukman R. 2006 ) Terminology of sustainability is becoming popular as a number of terms continue to come and increase the awareness of sustainability. As per UCLA, "sustainability is a complex concept, "and the UN Brundtland Commission and world commission on environment and development define it as “sustainability development meets the need of the present without compromising the future requirements.”

**Sustainability** is not just environmentalism. Embedded in most definitions of sustainability, we also find concerns for social equity and economic development. Sustainability is based on three main pillars (Purvis, B., Mao, Y. & Robinson, D. 2019), which includes environmental sustainability. Economics sustainability and social sustainability. All the definitions of sustainability round around those three pillars, which means directly or indirectly, to create meaningful conditions under which humans and nature can exist in productive harmony to present and future generations. (EPA,2019) the definition revealed by UNDP, OECD, EEA, EPA, helps us to understand the definition on the border scale so the terms can be ambiguous.

Sustainable investing is an investment approach considering Environmental, Social, and Governance (ESG) factors in selection of the portfolio and the management of the entity. Sustainable investing is investing in progress and looking for a corporation to solve the world's biggest challenges and problems that can be best positioned to grow. (GSIA, 2012). Sustainable investing is one of the pioneering better ways of pursuing the business, and while doing so, it also created a momentum (Blackrock, 2018), which encourages more and more people. This can be done through investment approaches with environmental, social, and governance (ESG ) insights.

As per GSIA Sustainable investment encompasses seven strategies which included

1. Negative/exclusionary screening - the exclusion from a fund or portfolio of certain sectors, companies, or practices based on specific ESG criteria.
2. Positive/best-in-class screening - investment in those companies and projects which have positive ESG comparing their Peer companies.
3. Norms-based screening is based on business norms exclusively made and Issued by OECD, ILO, UN, and UNICEF.
4. ESG integration - taking consideration of environmental, social, and governance factors into financial analysis by Managers.
5. Sustainability themed investing - the specific asset which is related to sustainability (Clean energy, green technology).
6. Impact/community investing.
7. Corporate engagement and shareholder action.

According to a wide range of academic articles, there are several definitions of **Responsible investment** (Bostrom & Sandberg, 2009). A universally agreed-upon definition is missing there are many terms used by media and experts, such as "ethical investments," "socially responsible investments," "impact investments" and "ESG investments" (Dumas and Louche, 2015). The succession of different historical phases could explain the existence of a variety of meanings, each reflecting its declination of responsible investing: from the ethical conception typical of "civil rights" years to the professionalization of RI, from the environmental purpose of "green niche" years to impact investing which is more focused on positive outcomes for society. In recent years, experts define RI as the combination of social, ethical, environmental, and governance factors as part of the investment decision making (Sandberg, 2009). This general definition, according to which RI is "an approach to managing assets that see investors include environmental, social, and governance (ESG) factors" (UNPRI 2019). Furthermore, Euros if better details that the ESG factors are respectively combined with the portfolio analysis and engagement "in order to capture long term returns for investors" and "to benefit society by influencing the behavior of companies" (European SRI studies, 2018)

**Sustainable, responsible impact investment (SRI)** has grown exponentially over the decades with almost making 10% of all the investment funds 1995-2007, sustainable, responsible impact investment SRI considers ESG retreat to generate long term financial profits and to bring positive impact on society. (USSIF, 2019)

Sustainable investment assets in unified have reported around 12.00 trillion or more was invested in a sustainability project, and companies by the year-end of 2017 (US SIF Trends, 2018). SRI depends on the nature of activities that are carried out by the business and on which investments made it includes exclusion factor ( e.g., gambling, alcohol industries ) or acceptance factor (e.g., clean energy, sustainability, social justice, ) ( Kofiduo et al., 2019 ). There have been several motivations for participating in the SRI investment, which included personal values and goals, institutional mission, and the demand of clients and others. It aims to provide a robust financial backbone; however, it also believes in positively impacting society. From 2016 to 2018, sustainable investing enjoyed more than 38 percent, increasing from \$8.7 trillion in 2016. Almost 1 dollar out of every 4 dollars under professional management in the United States today—26% of the \$46.6 trillion in total assets under management tracked by Corelli Associates—is involved in sustainable investing. (USSIF,2020) In this chapter , I tried to understand and explain different terminologies of Social Responsible Investment. Call it Social Responsible Investment or sustainable, responsible impact investment (SRI) or responsible investing or sustainability investment they sound different terminology however they almost mean the same which is basically making better choices for the future. While not disrupting environmental, social and corporate governance.

## **1.2. Green bonds Concept and its characteristics**

### **1.2.1 The concept and content of Green bonds**

Bonds are the corporate debt units, a fixed income instrument to debt holders. Investors are the creditors to the entity who has issued it, then with that, they get a fixed interest, which is also known as a coupon, and at the time of maturity, they get back the principal amount. As Bonds pay the fixed interest, they are often referred to as fixed-income securities. Bonds can be issued privately by the companies, by institutions like multilateral banks and public entities such as State cities or municipalities. There are different kinds of bonds, such as Government bonds. These bonds are issued by the public government entity, which includes the city or state; they are used to finance the activities in the city or state. One of the Examples is 2014, The Bay Area toll authority Bond, which amounts to \$811,4 million, had a rating of AA/Stable by Credit agency (Standard & Poor). These bonds were issued to find the improvement and make the bridge and roads for the San Francisco bay area. The companies issue the next corporate bonds. These bonds are mainly designed for institutional investors, including banks, hedge funds, insurance companies, or retail investors. Lastly, multi Development bank bonds are the bonds issued by multilateral

development banks (MDBs) and other institutional supranational agencies such as the world bank. (world bank,2019)

Investing in tomorrow has a significant impact on the world today (NASDAQ). Green bonds are the instrument that issues to finance the green project that delivers environmental benefits. These bonds have earned favorable responses in the last years as one of the best ways to support the low carbon emission project. (OECD,2017) Green bonds are an essential element of "green finance" that aims to "internalize environmental externalities and adjust risk perceptions" for the sake of increasing environmentally friendly investments (G20 GFSG (2016). The green Project includes which potential effects the temperature, perception pattern, sea level, and frequency of weather-related disaster pose a risk for agriculture, food, and water supplies.

As per the world bank, Green bonds are bonds that are a debt instrument which is issued to raise capital for the environmental projects and climate related projects, and that is what makes it different from the standard bonds. The fund raised is to support the financing of specific projects which distinguish the green bonds from the regular bonds, in green bonds, investors have access to the environmental purpose of the project that the bond intended to support.

However, as per till now, there is no universal Definition for the green bonds. as the growing consensus has come out on what their objective is. (German Development Institute, 2016).The critical difference stated in green bond and conventional bond is with the due diligence process where the issuer is expected to work under specific frameworks and obligations of the bond, for example, ESG, SDG goals, and so on. The bonds are thus made to finance or refinance, as per the requirement of the environmental projects for the societal benefits. Several frameworks are presented by the issuer of the bond, to certify the "greenness" of the bond which are given as (GBP) green bond principles and CBI climate bond Index and other private agencies also like Moody's and Standard and poor So, the authenticity of the green bond is an asymmetric information, stemming from its 'invisible' characteristics.(Bachelet et al. 2019). GBP is the most frequently used framework, which are the voluntary guidelines promoting transparency and integrity in the development of the market globally by clarifying the issuance of a green bond. GBP guidelines recommends issuer to always get a review from the third party and the certification of the applied framework policis, which mitigates asymmetric information between issuers and investors. Given in the recent study of the GBP, Zerbib (2019) argues that green bonds are a standard asset class that provides both Issuers and investors with cash flow and collateral, which is suitable for the established investment of large institutional investors.

### **1.2.2 Certification of Green bonds**

To make an investment to be certified as a green bond debt instrument, the managers and their essential need to identify that the bond they want to issue is related to environmental benefits or some climate benefits. The financial stability board has a task force that helps to make disclosures related to the climate. Indeed, it aims to provide good environmental information available for reading. (FSB TCFD,2016). However, there are a plethora of external Certifications that have been exciting now which help asset managers in providing additional Certification for the green bond investment, they are also cost-effective. (see Annex 5)

The Green Bond Principles (GBP) are voluntary process guidelines that recommend the best transparency and disclosure and promote integrity in the development of the Green Bond market by clarifying the approach for issuance of a Green Bond. ICMA green bond principle has four core elements: (1) form proceeds, (2) project evaluation (3) management of proceeds, (4) Reporting. If green bonds do not align with these principles, four elements, then they should not be considered a bond with fungible.

As though the international standard Certification for green bonds which were available to issue, many jurisdictions have set up their requirement and national taxonomies for the eligibility of green bonds. In 2015, the Green bond Endorsed project catalog was issued by this green bond finance committee (Table 1).

Table 1 : *Characteristics of different green bond certification*

	CBI Climate Bonds Certification	Green bond indices <sup>1</sup>	CICERO Second Opinions	MOody's Green Assessments	Standard & Poor's Green Evaluations
Use of funds must be tied to green investment	Yes	Yes	Yes	Yes	Yes
Eligibility criteria differ by sector					Yes
Ex post monitoring/assessment	Yes	Yes		Yes	
Granular assessments of greenness			Yes	Yes	Yes
Quantitative weights for specific factors				Yes	Yes

*Source: BIS , based on Bank of America Merrill Lynch, Barclays, MSCI, Standard & Poors, and Selective.*

In the 2015 Edition of the Green bond principles of ICMA, it was recommended to use some external Reviewers or assurances to confirm the alignment with the ICMA green bonds features. Which includes Second opinion and verification. However, by 2016, the Green bond principles named it to external reviews than external assurance. And the recommended list was expanded to include rating agencies (ICMA 2015)

CICERO (center for international Climate and Environmental Research - Oslo) provides second opinions on institutions' framework and guidance for assessing and selecting eligible projects for green bond investments. It assesses the framework's robustness in meeting the institutions' environmental objectives. The second opinion is based on documentation of rules and frameworks provided by the institutions themselves (the client) and information gathered during meetings, teleconferences, and e-mail correspondence with the client. (CICERO, 2016) CICERO Second Opinions have a framework and mechanisms to evaluate the project at the general level. CICERO takes the long-term view of the project,

which is a low-carbon climate-resilient society. The technology that reduces emission results in net emission use of high emitting infrastructure in the long run. Their model is more based on green bonds financing, refinancing for new or exciting green projects. So that it can meet the expectation for a low carbon and climate-resilient future.(Table 1: Characteristics of different green bond identification and certification schemes.) (Bank of America Merrill Lynch, 2017)

Moody's Green bond Assessments – Moody's was the first credit rating agency which issued the general methodology for the green bond assessment in March 2016. Green Bond Assessments (GBAs) are intended to "assess the relative likelihood that bond proceeds will be invested to support environmentally friendly projects" they have a lot of quantifiable factors for determining the green bonds assessments, which increase the transparency and replicability.

Standard and poor Green Evaluation: Standard and Poor's green evaluation were being introduced in 2017. Their main focus was a broader concept, then Green bonds assessments as they also include technical, environmental impact assessment components ( Ehlers T, 2017 ). They have a score of 0 to 100 to evaluate the relative ranking of overall relative impact over a lifetime on the environment to maintain the status quo.

The certification fee for the Climate Bonds Initiative's green-labeled bond is a flat rate of 0.1 bps of the value which is issued .

As for the green assessments form the different major rating agencies, as if they are to be as expensive as a regular credit rating which is around 3–5 basis points of the volume of green bond issued (White,2002), it will lead the costs would be far less than 18 basis points the Research done by BIS of the yield spread.

### **1.2.3. Assessment of Green Bond market**

The first green bond was issued in 2017 by European investment bank (EIB) and was called a "climate awareness bond." From 2007 that time

the market has grown exponentially not just in total issue but also in other respects like geographical base. Poland issued the first green sovereign bonds in 2016, and France was the second country to do it in January 2017. Looking at market capitalization, United States government agency Fannie Mae issued the largest USD green mortgage-backed securities (MBS) in 2017 for 24.9 Billion dollars. Malaysia also issued and launched a green Islamic bond called Green Sukuk to finance resilient climate growth. Other issue types include supranational organizations like the world bank and IFC,



development banks like ADB and AFDB, nonfinancial institutions like REIT, corporations like Apple, Tesla, and commercial banks like Bank of America and HSBC. 2019 marked a record year for Green Bonds. According to Climate Bond Initiative (CBI), global annual Green Bond issuance increased by 49% from 171.1 billion to 254.9 billion US-Dollar. It is the first time in the history of the green bond market, the new issue volume already broke through the 100 billion US-Dollar marks in the first half of the year. In September, new issue volume surpassed previous year volume, and in October, it exceeded the 200 billion US-Dollar mark. (Pratsch, 2020) new issuance of ESG, Sustainability, and SDG Bonds continued to support the growth of the overall Sustainable Bond market. By 2019 Green bond issuance has reached 257.7 billion USD, which is the new global record and is 51% more than 2018 green bonds, which was 170.6 billion USD. In 2019 45% of all the bonds issued were primarily driven from European Union followed by 25% by Asia Pacific and 25% by North America. Looking at the year to year, there is an exponential increase in the European market by 74% year to year by reaching 116 USD billion.

In 2019 the USA, China, and France were the top-ranked countries, which accumulated almost 44% of all the global bond issuance. "US 9. US issuers contributed USD51.3bn to the total, whereas their Chinese and French counterparts brought USD31.3bn and USD30.1bn to market". (Climate Bond Initiative 2020). Where else were new entrants to the green bond market from insurance from countries like Russia, Kenya, Ukraine, Saudi Arabia, Barbados, Panama. In 2019 there was a plethora of geographical diversification, and all the new entrants are Emerging markets. While talking about the top countries there were also top issues which include Fannie Mae, KfW and The Dutch State Treasury Agency (DSTA), Fannie Mae was the pioneer of issuing agency Green Mortgage-Backed Securities (MBS) which remained the most significant green bond issuer in 2019 with USD22.9bn issuance (or 9% of the total). The second was KfW, the German state-owned development bank. It brought almost 9 billion USD worth of green bonds in the market in 2019; they will be providing financing to renewable energy and green building projects. The third-largest issuer in 2019 was Dutch state treasury agency, and they debuted in the sovereign green bond, which meets the requirement of multiple sectors under CBI (climate bond standard) including, Marine Renewable Energy, Low Carbon Transport Solar Low Carbon Buildings (Upgrades), Water Infrastructure.

Even though the green bond market is overgrowing, there are still disputes regarding definitions, guidelines, and green taxonomy. In general, there are two green bonds "standards": Green Bond Principles (GBP) and the Climate Bond Initiative (CBI) GBP is a voluntary guideline established in 2014 by investment banks, including Bank of America Merrill Lynch, Citi, JPMorgan, BNP Paribas, and

HSBC. GBP requires transparency and disclosure, and the market widely accepts its four green bond components (use of proceeds, the process of project evaluation and selection, management of proceeds, and reporting). Regardless of GBP's generality, CBI provides eligible criteria and a detailed green taxonomy by sector that third parties can adopt to assess a green bond qualification. Therefore, we select the CBI database as a baseline to construct our international green bond database.

In this chapter, understand the concept of green bonds and the conventional bonds as the green bonds are the new type of instrument which, Green bonds are bonds that are a debt instrument which is issued to make capital to support climate-related or environmental projects, and that is what makes it different from the standard bonds. Then include all the framework which is used in the green bond such as green bond principle, as green bonds also need some certification it is given by Climate bond initiative and other external certification providers, the finding also suggests then external certification lead to an expense of around 3 - 5 base points (White,2002) comparing with Climate bond initiative with a flat rate of 0.1 base point on issue value. Then the green bond market has been explained which has been growing exponentially from the beginning, including major statistics which showed that from 2018% green bonds have increased by 51% by this year.

### **1.3 Empirical aspects of socially responsible investment**

In this chapter, In-depth research gone by the previous has done our two aspects of this part are Corporate social performance on yield bonds and then The empirical results of investment in green bonds where we have found out about the research which had a positive and negative effect on the Yield premium of a green bond.

#### **1.3.1 Empirical aspects of Corporate social performance influence on bond yield**

CSP and bond yield have established consensus results in past studies. The study was done for 332 firms from 2005 - 2009 which showed a positive relationship between the cost of debt and CSP (Maganelli and Izzo, 2017). In the finding, they also align their study with the shareholder theory, which reflected that CSR is not a driver to reduce the risk for the firm and also not a value enhancer. However, it is an expense that was mentioned as wasteful with notable opportunity costs. The study was done between 498 European bonds. The time of the study was between 2004 to 2005. They found out that bond risk premiums for the socially responsible firms have higher bond risk premium compared with no

socially responsible firms. It tells us that CSR has not yet had an impact on the pricing of corporate bonds. Another research finds out that the firm with proper steps and management to the environmental risks can also bear a higher debt cost. They have, however, decreased the weighted Cost of Capital (Sharfman and Fernando, 2008). research of samples with 873 corporate bonds from European Union countries with the time frame of 2006 to 2012, finding show the weak evidence CSP results in systematically less credit risk. Else wise, there has been numerous research that shows the significant result for the relationship between CSP and cost of debt being negative. one of the studies showed lower firm default risk with a sample of 303 firms and 829 observations. (Sun and Cui, 2014) another study with 2516 firms, observation from 1995 to 2007, found that CSR, such as credit rating, improves some of the variables, it depended mainly on risk-mitigating features having a strong CSP. (Jiraporn et al., 2014) another research based on our bond for 3240 U.s bonds issued by 742 firms between 1994 and 2007 finds out that CSP is rewarded with bond yield spread being lower than usual. This was one of the long-term studies done by (Oikonomou, Brooks, and Pavelin 2014). They also find that a higher level of CSP can improve credit quality and lowers the risk of credit. the CSR and cost of debt financing analysis of 1632 bonds issued between 1986 and 2014, was done in the Canadian market of bonds and the finding where lower bond yield spread helps in better corporate governance structure (Ghouma, Ben-Nasr, and Yan 2018) another study done with the same theory in the Chinese market between 2011 and 2015 finds out that there is a negative relationship between the yield spread and CSR. Researchers urge that CSR plays a significant role in reducing the risk of the bond premium with the help of the insurance effect. However, as mentioned above by researchers, there has been a big trend and finding which indicates that the bond market has rewarded CSP and also helps in reducing the overall risk of the associated firm. The price of the green bonds can be analysed by focusing on the CSP of the entity. While there is strong growth in the green bond market, the same in the research; however, the finding of yield has mixed expression. Research with a sample of less than 50 green bonds and conventional bonds ( HSBC, 2016; Braclays, 2015; climate bond initiative, 2016 ) has the conclusion that investors are unwilling to pay an interest for green bond issuance. In other research, the 21 euro-denominated bond study between 2014 to 2017 found out that there is a negative premium of an average of 18 base points in the primary market (Ehlers and packers, 2017 ). other studies were done in the secondary market find out that there is a significant average negative yield premium in the secondary market with 17 phase points (Barclays, 2015 ) while doing the study with 110 bonds the study find out the fundamental difference of yield by two base point tributing the

discrepancy to the excess demand and an insufficiently large volume of green bond issuances. He further adds that the credit rating and issuer type determines the magnitude of the premium. (Zerbib, 2019).

### 1.3.2 The empirical results of investment in green bonds

As much empirical research has already been published on measuring the yield difference between green bonds and conventional bonds, it takes different considerations. For instance, the paper of Zerbib 2019 was based on Mortgage structures bonds, and another form from (Anderkants, R. & Johannesson, P. 2019) finds the investor's behaviors. Green bond premium or yield difference is used to reflect the market price greenness. However, studies done by (Hyun et al., 2019) shows that they are related more to "excess demand." However eco-friendly green bonds should make issuers and investors demand match, by which effect can be seen on Yield, volatility, liquidity which matters in creating market growth. In the paper of Ehlers and Packer 2017, they compared the credit spread of green-labeled bonds and conventional bonds to find out that green bonds are priced at issuance premium on average, although green bonds still perform the same like conventional bonds in the secondary market.

**Table 2 :** *Summary of main components of the previous research*

Author(s)	Main characteristics	Research data and method	Findings
Barclays (2005)	The global market, taking secondary market data, maturity control no, liquidity control from date of issuance	Sample of 25 green bonds with conventional bonds, using simple OLS regression method	There was a negative green bond premium with 17 base points comparing with conventional bonds

HSBC (2016)	Market scope EURO and the US, the market took both primary and secondary, with no liquidity control, no natural control.	Sample of 34 bonds from the primary and secondary markets. The time frame of 2015 - 2016. using the comparison method	There was a negative green bond premium with - 15 base points compared with conventional bonds
Climate bonds Initiative (2017)	Market scope in euro and USD denomination govt related and corporate bonds in the primary market. With no liquidity control, maturity control.	Sample of 14 bonds with the time frame of 2016 to 2017, using the comparison method	There was no difference.
Ehlers and packer (2017)	Market scope of euro and us in the primary market with no maturity control and no liquidity control	Sample of 14 bonds in the primary market with the time frame from 2014 - 2017	There was the yield premium from 18 negative base points
Karpf and Mandel (2018)	Market scope of US municipal bonds with a Bloomberg green flag in the secondary market with liquid control as per no . of transactions, with stick maturity	Sample of 1880 bonds with the time frame of 2010 - 2016. Using Oaxaca blinder decomposition method	There was a positive yield premium with a +7.8 base point.

Baker et. al. (2018)	Market scope of US corporate bonds and municipal bonds with Bloomberg green flags with liquidity control on issue amount and strick maturity control in the primary market	Sample of 2083 bonds with the time frame of 2010 -2016 using the OLS regression model.	There was a negative yield premium by 7 base points.
Hachenberg and Schreck (2018)	Market scope being GLobal in the secondary market having liquidity control on issue amount and having stick maturity control	Sample of 63 bonds, with the time frame of 2015 - 2016 by suing matching method and panel regression	There was a negative yield premium of 1 base point
Zerbib (2019)	Market scope of euro and USD currency bond in the secondary market with strict maturity and liquidity control on issue amount	Sample of 120 bonds with the time frame of 2013 - 2017 by using the matching method and panel regression.	There was a negative yield premium of 2 base points
Anderkrans and Johannesson (2019)	Market scope globe in the primary market with stick maturity control and liquidity control	Sample of 4170 bonds with the time from 2010 - 2016 and using the matching method with panel regression	There was a negative yield premium of 16 b ase points.

Larcker (2019)	Market scope of government bonds in the US , with stick materially and liquidity control	Sample of 2896 bonds with the time frame 2013 - 2017 with the OLS regression with the matching method	There was a negative yield premium that was zero if risk and payoff are held by a contract from the same issuer.
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*Source: created by the author, based on the analyzed scientific articles: Barclays (2005), HSBC (2016), Bloomberg (2017), Climate bonds Initiative (2017), Ehlers and packer (2017), Karpf and Mandel (2018), Baker et. al. (2018), Hachenberg and Schreck (2018), Zerbib (2019), Anderkrans and Johannesson (2019), and Larcker (2019).*

While Zerbib 2019 used a matching method to compare the yield spread between green label bonds and conventional bonds while performing a two-factor regression model on green bond premium, and the study showed negative base point yield spread in USD and euro-denominated bonds. (Karpf and Mandel 2018 ) compared regression of bonds details, issuer creditworthiness, Yield, US treasury bond rates and transaction of green and conventional bonds, with their Research they found out that green bonds trade at a lower price in the secondary market and municipal bonds have higher Yield while comparing to conventional bond which has higher returns on average than green bonds. Finally, in the last Research by generating and peri 2019 while using the propensity score matching method to figure out that green bond creates a compelling and significant impact pricing of the bond, as negative bond premiums make green labels bonds only issued by a corporation are more convenient while comparing it to conventional bonds. Additionally, (Anderkrans R and Johannsson 2019) Research was based on a shift in investors preference have created negative risk premium in the green bond pricing, and they find out that average there is the significant negative green bond premium which is around -4 to -5 base points and also finds out that the attractiveness of the asset as has been significantly increased from 2014 to 2018. In (Wiśniewski M and Zielinski J, 2019) article, the authors talked about the emerging and evolution green bonds market and which have attempted to assess the potential effects of green bonds' issuances, taking into account governments issues in the result " Green bonds are the next stage of market growth" (Wiśniewski M and Zielinski J, 2019 ). The author talks about "the benefits of green bonds and the positive impact that their issuance has on the issuer and investors' image as socially responsible

entities".(Wiśniewski M and Zielinski J, 2019 ), and the result was that influential investor. Demand can lead to oversubscription. Thus, green bonds can be attractive for investors and can increase potential issue size, which lower costs to finance green tasks. In another study by (Reboredo 2018 ) Compile a model to measure co- volatility between green bonds and financial markets where the Research find out that green bond market, treasury bond, and corporate bond are little bit depended else on stock, and other comply like energy with almost no effect on green bond prices. Also, it helps investors to have diversification in their portfolio while having a green bond other than holding stocks and energy markets.

The first part is all about to understand the theoretical aseptic of socially responsible investment where our case is based on green bonds so here it is tried to explain all the respect and characteristics of the green bonds which are important fo the research, also explain the future In 1.1 chapter, finding shows that to understand and explain different terminologies of Social Responsible Investment. Call it Social Responsible Investment or sustainable, responsible impact investment (SRI) or responsible investing or sustainability investment they sound different terminology however they almost mean the same which is basically making better choices for the future. While not disrupting environmental, social, and corporate governance. In 1.2 chapter, understand the concept of green bonds and the conventional bonds as the green bonds are the new type of instrument which, Green bonds are bonds that are a debt instrument which is issued to make capital to support climate-related or environmental projects, and that is what makes it different from the standard bonds. Then include all the framework which is used in the green bond such as green bond principle, as green bonds also need some certification it is given by Climate bond initiative and other external certification providers, the finding also suggests then external certification lead to an expense of around 3 - 5 base points (White,2002) comparing with Climate bond initiative with a flat rate of 0.1 base point on issue value. Then the green bond market has been explained which has been growing exponentially from the beginning, including major statistics which showed that form 2018% green bonds have increased by 51% by this year. In 1.3 chapter, had empirical literature renown on Empirical aspects of Corporate social performance influence on bond yield showed a positive relationship between the cost of debt and CSP ( Magnanelli and Izzo,2017 ) It tells us that CSR has not yet had an impact on the pricing of corporate bonds in with proper environmental risk management also has a higher cost of debt. Else wise, there has been numerous research that shows the significant result for the relationship between CSP and cost of debt being negative (Sun and Cui, 2014; Jiraporn et al. ,2014) next it also find out that a higher level of CSP can provide improved credit quality and lower credit risk ( Ghouma, Ben-Nasr, and Yan 2018) then in green bonds the study showed that some positive



effect on yield premium comparing with a conventional bond ( Karpf and Mandel (2018) in other there was a negative yield premium between -1 to -18 base points, as studies also had their sample and limitation which created a big difference but in total, the more researches find negative yield premium in green bonds then positive

## **II. METHODOLOGY FOR THE ASSESSMENT OF THE YIELD SPREAD PREMIUM**

The second part is all about understanding the methodology and aspect of green bond yield spread, in general, the Yield of a bond can vary due to various aspects including, but not limited to, maturity duration, country risk, liquidity risk, and various other factors. To analyze the negative yield premium of green bonds compared with conventional bonds. In 2.1 explains the need explaining the aim and relevance of the study for the green bond yield spread in the 2.2 chapter explaining the empirical research Hypothesis to see the yield difference between green bonds and conventional bonds as the green bond premium. The next chapter 2.3 is about the logical framework and main stages of research are defined. As outlined in the previous chapter, empirical research is testing the hypothesis raised. In Chapter 2.4 the logical framework and main stages of research are defined. As outlined in the previous chapter, empirical research is testing the hypothesis raised. Then in chapter 2.5 explaining the sample representative of the empirical research next also explaining the various methods which are used to calculate the variable for the research and then making the final variable list and ending with the econometric models to use in the paper. Lastly ending chapter 2.5 with the limitation for the empirical research.

### **2.1 The need of the research**

Before moving towards the sample context and full analysis of the sample, it is essential to outline the relevance of the empirical part and define the main aim of the research. Looking at the Green bond yield premium is much past research has made it quite a good to study more in this field as many studies are not done with a big time frame, or there is a small amount of green bond in its contrast to conventional bonds. However, empirical studies have shown both Protiviti and negative. The results were lower yield compared to the conventional. The release of this study is to take a more significant sample and make the study more niche while only performing study on EURO denominated currency bonds also including some different variables such as Rating, repo ECB, ECB asset eligibility programme to know if that also effect to make a difference in the yield of green and conventional bonds. Only a couple of studies have some of these exogenous variables, and the study was done for a different market, so doing this kind of study will add new research in the field of the Green bonds yield spread . Correspondingly, various

aspects distinguished by previous research in the theoretical part of the paper, it is crucial to examine the topic's importance. Despite the existence of a variety of researches in this field, there are still a plethora of aspects that are less explored or not been used than others. This empirical research is relevant to development in the field of EURO currency bonds yield difference between green bonds and conventional bonds and sees if there is any green bond premium. The sample consists of global bonds issued in EURO currency. Concerning the idea of having EURO bonds was the reason that it is one of the most issued bonds around the globe and has a material impact on the whole bond market.

The **aim** of the empirical research is if the structural shifts in investor preferences have created a negative risk premium in the pricing of green bonds. Specifically, looking the yield spread differential between green bonds and conventional bonds which will lead us to the green bond premium as it will tell us if putting a green label or green flags makes a difference or not also aiming to establish whether investor preferences toward non-pecuniary factors such as sustainability bring investor utility, challenging the original CAPM assumptions to focus of this research was on euro bonds, because of data availability and distribution around the globe, it varies significantly depending on historical underpinnings of them. The attention of this research is on a state having high liquidity. Evaluation of variables enables us to receive different perspectives towards the same indicator impacting negative yield premium. To conclude with, this research contributes to the development of the investment strategy for the investors who are looking to invest in bonds and aiming to look for the difference in the yield premium in bonds leading to pricing.

First of all, talking about the EURO bonds, The eurocurrency market is the money market for currency outside of the country where it is legal tender. The eurocurrency market mainly consists of banks, multinational corporations, mutual funds, and hedge funds. They wish to circumvent regulatory requirements, tax laws, and interest rate caps often present in domestic banking, particularly in the United States. (Investopedia) These are all the bonds issued in the currency in euros. It does not matter if they are from Europe or any other part of the world. figure --- tell us more in detail about the bond market issuance in the last years from 2004 till 2018 and also 1 Global bond markets outstanding. In this, we have seen a tremendous increase in the value of outstanding by 2.2 % setting up around 100trillion dollars and issuance has still decreased by 4.1 percent to 17 trillion. (Figure 1 ) there is no specific data to compound about the euro bond market; however, as per the research from, it consists of around 26 % of market share is the second biggest after the USD bonds. In the last ten years, the bond outstanding has grown from 80 trillion dollars to 103 trillion ( bis, 2019) (see Figure 2 ).

Green bonds have come in recent years as a new financial instrument in the financial industry that offers investors an opportunity to invest and support climate-friendly investments. Projects funded by these bonds have been located across the world. They have a goal that focuses on a variety of interests related to climate and environment from increasing the resilience of water systems energy efficiency with renewable sources. The involvement of multilateral development banks (MDB) has expanded the interest in green bonds, municipalities, governmental agencies, corporations, and most recently utilities, finding ways to use the green bonds as financial instruments. ( climate bonds) Green growing demand can be seen from the recent growth in the bond market as from 2018; the market has grown by 51% with an issue of 257 billion USD of new green bonds. While issuance has grown in all the regions, however, the most of it is coming from European Union. Taking about the issuance certification At USD45bn, Certified issuance in 2019 surged by 86% from USD24bn in 2018, comprising almost a fifth (17%) of global volumes. (CBI, 2020). Figures explain the green bond issuance from 2017 - 2019 in which non-financial corporations have been increasing their share the most and have been increasing exponentially.

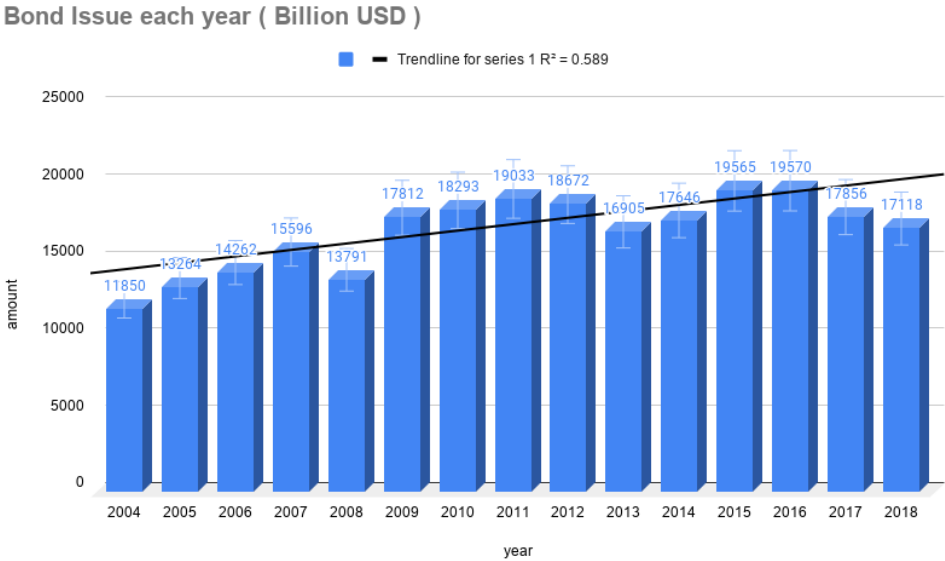


Figure 1. Bond Issue each year (Billion USD)

Source: created by the author, using MS Excel

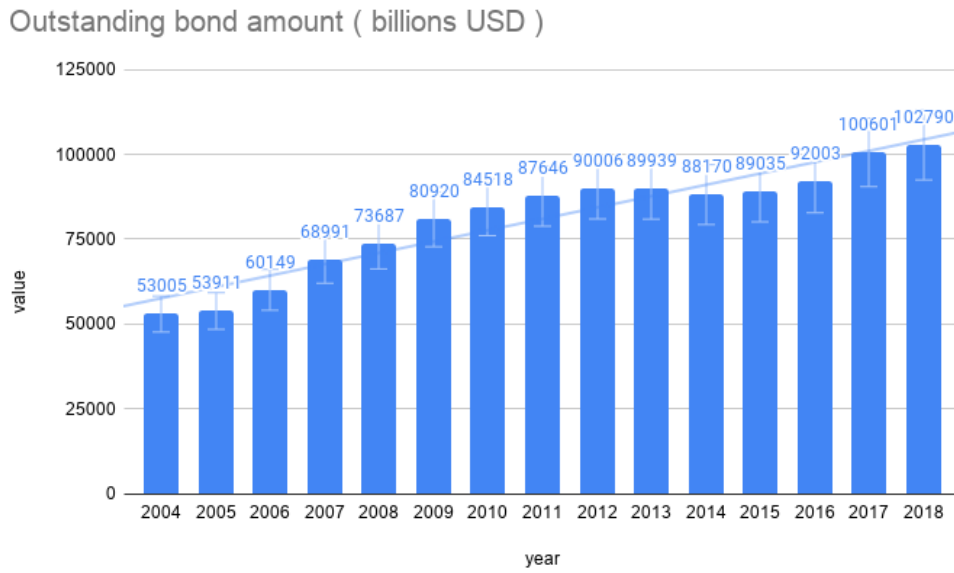


Figure 2. Outstanding bond amount (billion USD)

Source: created by the author, using MS Excel

While the market size being huge it is hard to explain the context as there are more than 5845246 bonds at present which included bond green bonds and also conventional bonds while the green bond size to be around 8049 in total without any maturity, issue date, active or inactive bias. Taking the bonds which are issued in euro currency, the size is reduced to 841916 bonds in total. Furthermore, looking for the green bonds, the size goes to 1966 bonds with Euro currency issue bonds. These are the bonds from which the sample is taken.

## 2.2 Empirical research Hypothesis

As it was described at the 2.1 chapter aim of the empirical research to see the yield difference between green bonds and conventional bonds as the green bond premium. Fulfilling it requires one hypothesis. theoretical analysis finding of a particular variable is mentioned—detailed backgrounding of the hypotheses provided in the following part of the chapter.

Green bonds have a negative yield premium compared to conventional bonds. In previous research, there have been mixed results related to the green bond premium. This statement is validated by the analysis of previous researches like Zerbib( 2019), Ehlers & packer (2017), Baker et al. (2018), Hachenberg & schiereck (2018) and Anderkrans & Johannesson (2019), Larcker (2019) whereas Karpf & Mandel( 2018

) found positive yield premium. Although that can be true, they are in yield premium, which exists. Moreover, empirical research can confirm this assumption.

The two predominant factors to consider in CAPM asset pricing theory are Return and risk. as the theory says, An increase in risk will increase Return as investors want to be repaid for the increased probability of loss. So because of this, the investor who is investing money or buying a bond with a higher probability of default will always be looking for and demand a higher return to makeup for taking on more risk in their portfolio. Investors will invest in bonds that are less likely to default and subsequently receive lower returns than their more risk-seeking counterparts. When evaluating asset prices with non-pecuniary clientele, investors are repaid not just by returns. Some of them are compensated by holding bonds and other securities aligning with their preferences and obtaining one or more utility by holding their bonds and other securities complying with their preferences. One of them is having positive ESG factors. (Fama and French, 2007)

To represent it, will be used the CAPM model based on the baker et al. ( 2018) research paper. Where he explained that there are two kinds of investors. First investor and second investor countenance an investment decision for their portfolio. Both the investors have the same risk aversion factor denoted by  $\gamma$  and matching expectation for securities return  $r$  and risk  $\Sigma$ . They also choose a vector of their portfolio weight denoted by  $w$  for every security in the decision of investment. The only difference between both the investors is that investor 2 aligns their investment with the ESG factor. This means that having an ESG factor in the portfolio gives an extra utility, which is greater than 0 ( $e > 0$ ). The following function is for 2 investors care calculations, as mentioned below.

$$\text{Investor 1:} \quad \max w_1' r - \frac{\gamma}{2} w_1' \Sigma w_1 \quad (1)$$

$$\text{Investor 2:} \quad \max w_2' r + w_2' e - \frac{\gamma}{2} w_2' \Sigma w_2 \quad (2)$$

The investor has a capital of  $a_1$  and  $a_2$ , respectively, which yields a total market portfolio.

$$\frac{a_1}{a_1+a_2} w_1 + \frac{a_2}{a_1+a_2} w_2 = w_m \quad (3)$$

Where  $w_m$  is the weight of the market portfolio in each security of both investors equal to its market value as a fraction of the total market value of all securities. In the extreme case in which ESG factor, which is  $e$  is always zero,  $a_2$  will be equal to zero as investor two will not invest. So only investor two

will invest in the securities which don't have ESG preferences. So this will be the following equation

$$w_1 = \frac{1}{\gamma} \Sigma^{-1} r = w_m \quad (4)$$

This equation can be used to calculate the Expected rate of the market with the substantiation of the inverse risk aversion  $\gamma$  to the market and at least leading to the CAPM model.

$$r = \frac{r_m}{\sigma_m^2} \Sigma w_m = \beta r_m \quad (5)$$

Then investor tow who gain extra utility for ESG factor, the portfolio of the investor will be

$$w_2 = \frac{1}{\gamma} \Sigma^{-1} (r + e) \quad (6)$$

However, if we make the ESG score to be zero then both last equations can be equal.

$$r = \frac{r_m}{\sigma_m^2} \Sigma w_m = \beta r_m - \frac{a_2}{a_1 + a_2} e \quad (7)$$

The above-explained shows that investors gain extra utility not only by the Return but also through the ESG factor is more than 0. which states that securities with positive ESG such as green bonds have a lower expected return comparing with which don't have ESG factor thought a lower  $\beta$ . So the utility perspective can be seen as a negative yield premium between green bonds and conventional bonds. As the rapid demand for green bonds in recent years, we can test the following hypothesis.

**H1:** Green bonds have a negative yield premium comparing with a conventional bond in Euro Currency

The hypothesis is tested with yield spreads, which is the most significant used measure to bond pricing as The null hypothesis will lead to the yield spreads of green bonds not having a negative yield premium compared to their conventional in euro currency bonds. On the other hand, the null hypothesis will be rejected if the green bond yield spreads will be lower than a conventional bond with the five percent statistical significance level. At last, fail to reject the null hypothesis if the yield spreads of the green bonds are higher or will be equal compared to the conventional bond, or there is no statistically significant on a five percent level in yield difference.

## 2.3 Empirical research stages and logic

In this chapter, the logical framework and main stages of research are defined. As outlined in the previous chapter, empirical research is testing the hypothesis raised. The research framework is divided into the below stages, which provide a detailed plan to conduct empirical research in a structured way. In order to understand the logic for the research stages are visualized figures. (see Annex 2 )

As shown in the figure, there are three preliminary stages, and the same number of empirical research stages are mentioned. Concerning literature, analyzed research logic enables us to create a comprehensive system to assure the relevance of the research. Preliminary stages have a significant influence on data structure and quality. The first step of the framework of the research is to choose sample size. During the collection process data of firstly, the data between 2010 till 2016 of bonds had been collected. For analysis, the period from 2017 - 2019 has been taken. A defined sample is always a crucial part of order to maintain scope, which is necessary and limitation to obtain relevant and reliable results. It was determined by choosing bonds, including conventional and green, which are available on Thomson Reuters Eikon terminal and looking specifically for a green bond, green bonds were chosen as per the Green bond principle bond listed on the Thomson Reuters Eikon . The research is only for EURO currency bonds so that the scope can be maintained.

The next stage is to explore data for empirical research and to combine it with the current data set using the Thomson Reuters Eikon database and Microsoft excel. During the collection process data of firstly, the data between 2010 till 2016 of bonds had been collected. For analysis, the period from 2017 - 2019 has been taken. Dependent variables analyzed in the research are provided. While in preliminary, all they were sorted and put manually while using formulas to calculate them, which are mentioned below, the same goes with the control variable. They all are separately collected through Thomson Reuters Eikon for analysis. In spite of that, it allowed us to generalize the final list of the indicators and generate a standard dataset for the next preparatory stage.

The third preliminary stage includes the elimination of all the data which is missing from bonds. Lack of data on the majority of indicators analyzed. Even though Thomson Reuters Eikon has a vast majority of data available for analysis, there is still some of the data for bonds that were unavailable, especially considering asking bid price for liquidity proxy or issue amount. After having the final sample and indicators for the research analysis is defined, it is essential to determine the linkage between the variable



of the research as well as present the descriptive analysis of dependent variables. In the 1st stage of empirical research on dependent variable

It will also include the correction matrix and analysis of yield spread indicator and other variables of that. If the result shows that there is no correlation between variables, research will not be continued.

The second stage of the research is highly dependent on previous results. In this stage, panel regression analysis will be used, there is a specific model made to test hypotheses presented in the previous chapter. To be more precise, look at all the variables in the next chapter. In the regression model, we will use four models, two old and two fixed effects, to see which has the best outcome. Adopt two-panel data methods to investigate the yield spread difference between green bonds and conventional bonds to determine if there is a negative premium. Used a fixed-effects estimation (FE) Chen et al. (2007) and Baker et al. (2018). Finally, findings from the research are summarized and discussed with the comparison of the previous researches. It is relevant to compare the results of this master thesis empirical research to other analyses that were conducted by other authors. Reasoning if results received after the analysis is in line with theoretical assumptions made from the explored scientific literature.

## **2.4 Empirical research data sample and methods**

This empirical research is based on Bonds issued in euro Denominated currency; thus, there are a lot of different countries and indexes where they are listed. As mentioned in the previous chapter, a sample of this empirical research consisted of green and conventional bonds. Further, more samples consist of 249 bonds in which 98 are conventional and 151 green bonds. The whole sample is based on Baker et al. research ,2018 sample is builds on labeled green bonds issued between 1 Jan 2010 - 31dec 2016 from the Thomson Reuters Eikon definitive terminal, which derives their inclusion criteria from the Green Bond Principle made by Climate bond initiative they also convey as Green bonds are fixed-income instruments for which the proceeds will be applied towards projects or activities that promote climate change mitigation or an adaptation or other environmental sustainability purposes” (Bloomberg, 2015). This ended up on the list of 1936 green bonds, with restricting primary issued in euro-denominated as per the requirement of the hypotheses. The bonds don't have an initial rating of the credit risk from Moody's, Finch, S&P, have been removed. The bonds with fixed coupon rates have been taken, as the bonds with floating coupon rates restricted the data availability and incompatibility with the panel data methodology. The maturity date for liquidity bias creates unbalanced issuer-based panels of the same currency and the maturity date of the conventional bonds brought closest to the green bond.

It also eliminated all the bonds matured between 2017 and 2019 and only took the active bonds. So if the bond issued between 2010 and 2016 has been matured, it is also eliminated. Furthermore, we also took the ECB eligibility program bonds, which is yes and no, and also ECB repo and institutional variable. bonds, which is also in the form of it. After doing that, the last sample was left with 249 bonds, which included 151 green bonds and 98 conventional bonds. All the bonds were eliminated if the data was not available, and due to this reason, a lot of conventional bonds are eliminated. (See Annex 1 and 5 ) Finally, periods of research last from 2017-2019, and considering the final data sample, it might result in panel data type. That can be analyzed panel regression with fixed effect estimations. it is crucial to determine whether the linkage between variables exists. In order to find out, in the beginning, the correlation between factors is calculated. Moreover, there is a need to determine the econometric model of empirical research. The two panel data model (FE model) has been adopted to investigate the yield spread difference between Green Bonds and Conventional Bonds, and to determine the negative premium. (Chen et al., 2007 and Baker et al., 2018). It tends to yield inter-temporal stability in the independent and control variables, which means that the variables representing the bond characteristics have a low degree year to year variation of each bond, termed as credit ratings. The cluster-robust method is the main regressions to address the correlation between model variables and the residuals.

This method controls the dependence across observations over quarters and calculates standard errors correcting for heteroskedasticity. The pooled OLS method relies on weaker assumptions because it allows the residuals to be dependent within a cross-sectional unit. Additionally, the pooled OLS does not consider the difference between idiosyncratic issuer effects, which likely to have a significant effect on bond yield spreads. Hence, the FE model is used to compare bonds with themselves out of the sample period, generating an issuer estimator, as opposed to the OLS which compares bonds with others across the sample.

**Bond pricing and Yield Measurement** :In the line of the following studies (Zerbib (2019) and Baker et al. (2018)), the foremost vital step to quantify Green Yield Bond Premium is by establishing a proper dependent variable. Despite trading at market price, Bonds are complex financial instruments. The price of the bond can vary due to various factors. These factors can be Complex cash flow patterns, yields to maturity, maturity time, and many more. One of the most common and important factors to compare any bonds is to compare its yields. Yield could be described as the interest that the holder of the

bond receives for holding bonds till maturity. It could be calculated as the per-unit coupon rate divided by the bond's current market price.

Various researches have been done /documented /calculated /predicted to understand the determination of Yield, and how it is affected by various factors in the case of conventional. The cost of funding for the issuer and return for fixed income return-seeking investors are the reason for the use of Yield as it is the primary source of return for both classes of investors. They also hold conventional bonds. However, unlike conventional bonds, green label bonds have more factors in determining their premium due to their inherent nature. Under, Capital Asset Pricing Model (CAPM), Yield can be calculated using the following formula.

$$Y = \frac{C}{P} \quad (8)$$

Where,

P stand of the bond price (not including accrued interest, if any)

C stand for coupon rate of the bond mentioned with bond

Y stands for the Yield calculated for the bond.

**Yield to Maturity** -The coupon rate is the amount paid to the bondholder by the bond, but YTM is the actual internal rate of return that the person will get while holding the bond till maturity. Another way to define it could be as a measure of return while holding a bond till maturity while factoring in an intricate pattern in the form of coupon payments, time until maturity, and the capital gain (or loss) arising in the remaining life of the bond when it matures finally.

In case a bond is making an annual coupons payment, YTM can be calculated using the following formula

$$P_d = \sum_{n=1}^N \frac{C}{(1+rm)^n} + \frac{M}{(1+rm)^n} \quad (9)$$

If Needed, certain variations can be made to accommodate the half-yearly or quarterly payment.

Where in

$P_d$  stands for the price of the bond (including accrued interest, if any)

$C$  stands for rate of coupon

$M$  stand for the par or redemption payment

$rm$  stand for Yield to maturity (annually) (YTM)

$n$  stand for the number of payments to be received in the form of interest.

**Modified Duration** - The time to maturity, on which the bond's total return is earned does not reflect the true period, because of the cash flow schedules of bonds. Thus, time to maturity is insufficient to properly compare the characteristics between bonds with, for example, similar maturity structures.

Duration or also known as Macaulay's duration is the weighted average time of the present values of the cash flows, measured in years, until the bondholder receives cash flows from a bond, measuring the speed of payment of a bond. Hence, its price risk relative to other bonds of the same maturity by measuring the average maturity of the bond's cash flow stream. (Choudhry 2004) Duration is given by the formula below:

$$D = \frac{\sum_{n=1}^N \frac{nC_n}{(1+r)^n}}{p} \quad (10)$$

where

$P$  is the bond clean price (excluding any accrued interest)

$C$  is the bond cash flow at time  $n$

$r$  is the current yield

$n$  is the number of interest periods

$D$  is the duration of the bond (also known as Macaulay duration)

The Macaulay duration is measured in years, which carries low informational value and practical use. Therefore, we transform the measurement into the modified duration, one of the most commonly used risk and hedge calculation measures used in the markets (Choudhry 2004, p.31). Modified duration is given by the following formula:

$$MD = D (1 + r) \quad (11)$$

where

$D$  is the duration of the bond (also known as Macaulay duration)

$r$  is the current yield

$MD$  is the modified duration of the bond

The measure of cash-weighted average to maturity of the bond term is called Modified Duration. It is highly significant to consider as bonds with more durations, have higher price volatility, i.e. interest rate sensitivity. Considering the above mentioned factor, It has to be noted that, it is a measure that has to be

included when investigating yield spread. It could be explained as it measures the effect of the term of bond till maturity and its interest rate sensitivity.

**Yield Spread** Yield Spread; The research case study makes use of yield spreads being the dependent variable. This could be understood when, Yield of one bond is deducted from Yield of different bonds to find out yield spread. In this research case study, the standard benchmark is being deployed for matching the yields of different bonds in our sample with the "risk-free rate" of the similar characteristics (i.e., a sovereign bond yield). This help in capturing effective risk premia reward to investors, making it a right tool to measure and compare bond valuation (Choudhry 2004).This above help us to determinant the estimation of conventional bonds versus green label bonds using yield spread.To mitigate the risk of any biases (potential) in our research case study, from our benchmarking panel, and to ensure uniformity we collected mid-spread benchmark yield manually for bonds and calculated spread for benchmarked souvenir yields.

For example, 10-year EUR denominated bonds follow the calculation below

$$YS_s = Y_s - Y_{SB} \quad (12)$$

where

$Y_s$  the Yield of 10-year EURO denominated bond from sample

$Y_{SB}$  - the Yield of 10-year EUR denominated sovereign bond

$YS_s$  is the yield spread 10-year EURO denominated bond from the sample

**Green Bond Variable:** Green bond variable is the independent variable in this study which is known as a dummy variable indicating if a bond is Green or Conventional. Due to no clear universal framework and definition for the green bond market, most benchmarking criteria and reputation established by GBP is a criterion taken up in this study. Following the framework mentioned above, assure consistency and reliability in the bond sample taken up for study.

**ECB Asset Purchase programme** - In 2015 ECB joined some other central banks for implementing an asset purchase program for quantitative easing. As from 2015, they tend to extend the existing guidelines to enter in coverage bonds, too, as before it was just for private sector asset programs. The crisis of bond is correlated with the Asset purchase programme of ECB, as being the biggest central bond to purchase the asset in the whole world it also impacts pricing and liquidity in the bonds and other instrument markets. As per our Research for the literature, only one research has used it and has considered this variable in Research. "ECB's announcement effects of the bond purchase "program

(Georgiadis and Gräb, 2016). They found out that the yield difference was dull as there was a decrease in Yield by almost 20 base points. Additionally, ECB "Overall, while the amount of green bonds held by the Eurosystem remains relatively small, evidence suggests that through its purchases the Eurosystem has reduced yields of green bonds and supported their issuance by nonfinancial corporations". This indicates that the ECB asset purchase program impacts yield spreads. The ECB initiative is applied to any asset globally. It is not just restricted to only European union members, so that's why to consider this variable can increase the robustness in this study for finding

**Liquidity: Considering** the liquidity premium might affect the risk premium, the study compares and analyzes the liquidity of both the types of bonds and compares them in the sample to determine its effect on yield spreads. It has been done using a simple formula of bid-ask spread given below. One of the most critical methods to calculate liquidity in the market is **Bid-Ask spread**. It is also the most popular method to assess liquidity for the market of an instrument. The bid and ask difference is divided by average bid and ask price for each quarter of the year, as per Chen et al., the mean of proportional spread (quarterly) is bond years proportional bid-ask spread. To increase the sample size, even if there is a single quarter bid-ask spread quote, we calculate annual proportional spread for the year. This bond price data is collected from Thomson Reuters Eikon. following is the formula for bid-ask spread:

$$LIQ_{BA} = BA_{i,t} = \frac{Ask_{i,t} - Bid_{i,t}}{\frac{Ask_{i,t} + Bid_{i,t}}{2}} \quad (13)$$

Where

$BA_{i,t}$  = bid-ask spread of bond  $i$  in time  $t$

$Ask_{i,t}$  = asking price of bond  $i$  in time  $t$

$Bid_{i,t}$  = bid price of bond  $i$  in time  $t$

**Additional Control Variable** - Yield spreads might get affected by empirical control analysis for other variables. These are chosen to upsurge the robustness of models and explanatory degrees. Apart from the variable presented earlier, the study has included sector year. Currency, credit ratings, maturity. ECB asset, the amount issued by bond, purchase program eligibility, and institutional issuer in the study for the models, ECB repo rate. Most of the green-labeled bonds are yet to receive credit ratings that led to a restriction in primary the creator of selection. The sample has the credit rating from fitch, s&p and moody's, while in the sample we have taken the fitch as a benchmark and using the s&p and moody's rating for those for whom there is no rating going first with s&p and then moody's. and then creating a

dummy variable for rating. then creating a sector variable while looking at the bloomberg terminal for the sector there are mainly 6 sectors for on the bloomberg and hence given a particular no. as per the sector. these sectors basically as government agencies, corporate utilities , financials , corporate reit and other others . then also created a dummy variable for ECB repo and Asset purchase program ability ECB that is collected from Thomson Reuters. in which the bond which shows the eligibility has been said 1 nad other while being 0 as their representative no of for the regression model. then creating a GREEN dummy which represented the year dummy variable for green bonds to see the fluctuation of green bond yield spread premium year yield in 208, 2019. This study only had fixed rate coupons and all the other coupons have been deleted for the sample to have an explanatory effect. however as the coupons consist of yield spread so it will always lead to the endogeneity. only for the representativeness coupon is included in the summary statistic with other variables . and how it shows the variable summary for the research

### Variable Summary

**Table 3.** *Summary of Variables for the Research*

<b>Variable</b>	<b>Description</b>	<b>Source</b>
Amount	Amount Issued	(1)
Amount_Euro	The amount issued in Euro	(1)
LIQ_BA	The asking price (P ask) minus the bid price (Pbid) divided by the average (spread) of both prices	(1)
Country	Country of RISK (Domicile)	(1)
Coupon	Coupon rate	(1)
MDi,t	MD is modified duration of bond in year t	(1)
ECB	Dummy variable for ECB eligibility with 1 and other being zero	(1)

Green	Dummy variable while green bonds being 1 and their conventional bond being 0	(1)
Green x Year	Dummy variable interaction the Green variable with the Year variable (2017-2019)	(1)
Institutional	Dummy variable equal to 1 if the bond is issued by government agencies, municipalities, and supranational institutions like Reserve bank of India and 0 if private sector issuer	(1)
Issue_Date	Which date the bond is issued	(1)
Issue_Year	When year the bond is issued	(1)
Maturity Time	remaining life of bonds	(1)
Rating	Rating by finch scale	(1)
Sector	As per Bloomberg Sector on Bloomberg terminal	(2)
Year	Year Dummy (2017-2019)	(1)
YS	Basic Difference in yield bond to their relevant government bond	(1)
ECB_REPO	Dummy is 1 while ECB repo to be 0	(1)

*Source: created by the author, based on Thomson Reuters Eikon (1), Bloomberg (2) (The time period of interest: 2010-01-01 to 2019-12-31)*



As above mentioned table tell us more about all the variable which has been construed in this whole research thought which the research will be conduction, some of them have been directly taken from the Ekon terminal such as green\_dummy variable, Sector, ECB criteria and ECB repo Criteria other than that other have to be done and created through excel the calculation and the formula to create a variable for analysis had been constructed in this part which is available before the table where each and every variable importance where is it used has been explaining in detail. Through the variable construed and summary, these are the econometric model has been construed. The first model is based on OLS regression where some of the variables have been building a model and then the second one is the same model like model 1 however it will be testing in the Fixed effect regression. In model 3, there is been a try to change the variable to see the difference and also add some more variables in models 3 and 4 mainly sector had been removed and institutional variable has been introduced with that ECB asset program variable and ECB repo has been introduced. After that in the model 5 green dummy has been replaced with green X year which basically means to find out yield premium for each year to see the main fluctuation happened in the last years. Thought models 1 and 2 and modules 3& 4 the 4, model 5 would be decided which will be based on which model is more significant and show the better result.

### **Econometrics model**

Model 1 :  $YieldSpread_{i,t}$

$$= \beta_0 + \beta_1 Green_i + \beta_2 \log(Amount_{euro})_i + \beta_3 \log(MD)_{i,t} + \beta_4 LIQ_{BAi,t} + \beta_5 Rating_{i,t} + \beta_7 Sector_i + \beta_1 year_i + \mu_{i,t}$$

Model 2 :  $YieldSpread_{i,t}$

$$= \beta_0 + \beta_1 Green_i + \beta_2 \log(Amount_{euro})_i + \beta_3 \log(MD)_{i,t} + \beta_4 LIQ_{BAi,t} + \beta_5 Rating_{i,t} + \beta_6 Sector_i + \beta_7 year_i + \alpha_i + \mu_{i,t}$$

Model 3 :  $YieldSpread_{i,t}$

$$= \beta_0 + \beta_1 Green_i + \beta_2 \log(Amount_{euro})_i + \beta_3 \log(MD)_{i,t} + \beta_4 LIQ_{BAi,t} + \beta_5 Rating_{i,t} + \beta_6 ECB_i + \beta_7 ECBrepo_i + \beta_8 Institutionall_i + \beta_9 year_i + \mu_{i,t}$$

Model 4 :  $YieldSpread_{i,t}$

$$= \beta_0 + \beta_1 Green_i + \beta_2 \log(Amount_{euro})_i + \beta_3 \log(MD)_{i,t} + \beta_4 LIQ_{BAi,t} + \beta_5 Rating_{i,t} \\ + \beta_6 ECB_i + \beta_7 ECBrepo_i + \beta_8 Institutionall_i + \beta_9 year_i + \alpha_i + \mu_{i,t}$$

Model 5 :  $YieldSpread_{i,t}$

$$= \beta_0 + \beta_1 Green_{(yearDummy)} + \beta_2 \log(Amount_{euro})_i + \beta_3 \log(MD)_{i,t} + \beta_4 LIQ_{BAi,t} + \beta_5 Rating_{i,t} \\ + \beta_6 ECB_i + \beta_7 ECBrepo_i + \beta_8 Institutionall_i + \beta_9 year_i + \alpha_i + \mu_{i,t}$$

## **2.5 Limitations of the empirical research**

In consideration of the research question and scope of this thesis, along with factors such as time horizon and others, delimitations play an essential role in making this Research paper possible and contributing towards society. From the research question, it is clear that the scope of the study will only include bonds from the organization that has issued labeled green as well as conventional bonds. Hence, our findings and research paper would be of greater interest to people who have an interest in the secondary market of bonds. In particular, this study would benefit more people studying green label bonds and their yields in EURO currency. As the study focuses on EURO currency bonds. Delimitation enhances this paper to be more specific to this particular topic and avoid generalization. Hence, other similar such as green loans and others have been purposely avoided for this Research. Firstly, Information related to green-labeled bonds before 2010 was not considered as the study pertains to bonds issued on/after 1st Jan 2010 and expired before 1st December 2016 (maturity of the bond.). Green Bonds be labeled and received a certificate along with getting credit ratings before issuance have been included in the study on Thomson Reuters Eikon other have been removed next limitation is all the matured bond between 2010-2020 have been removed and also the bond which are active was used to be the part no non active bond is the part of it, the sample does not include any bond which does not have any rating to exclude the outliers of the study, on the bonds which are issued in the euro bond denomination. No other bond other than fixed coupon has been excluded from the study also the body who don't have sector-specific has also been reviewed lastly the bond which don't have any ask bid price for daily, quality, or yearly has been deleted too. The time horizon is strict to include from 2017-2019 only. Lastly, any also excluding the data which was not found on Thomson Reuters Eikon related to ECB sector or ECB repo for the bond and maturity. Lastly there is no consideration has been taken based on who is the buyer of the bonds and no such factor like other capital market reactions from stock markets or future derivative markets have been taken into consideration.

### **III. EMPIRICAL RESULTS OF THE ASSESSMENT OF YIELD SPREAD PREMIUM**

The 3rd part aims to analyze and define the outcome, which is obtained during the empirical research of green bond yield spread premium, which is known as green premium. Moreover, this part of the paper is organized based on methodology background on got, there is a similar type of studies found, together with stages presented at the methodology part, firstly, the sample is presented together with data modification implied, and then doing descriptive analysis of the variables are conducted. Secondly, yield spread premium has been measured using the correction analysis; in the chapter, 3.3 primary assessment of green bond yield spread premium models are tested, next to the results of the imperial analysis consisting in line with the hypothesis testing formulated into the methodology section. Finally, the find of the paper discusses theoretical underpinning.

#### **3.1 Overview of the collected sample and dynamics**

In this chapter, a short presentation of processing described at the preparatory stages, coupled with a synopsis of the dependent variable, is presented. First, it is essential to outline some aspects related to the data sample, even if it is always presented and described in section 2.5. here some things to highlight before conducting empirical research.

As was stated previously, the primary source of data was from the Thomson Reuters Eikon (2020) database. In brief, after amendments, due to lack of data and also missing data observation, the final sample was created with 248 bonds, including 98 conventional bonds and other green bonds issued in the currency euros. In addition to this, after modification, the period of analysis included time form 2017 - 2019. Thus, the initial period chosen was longer, and it shortened due to the same issue as the sample was missing many values in almost every variable. Another aspect to consider is the coding of a non-numerical variable. This process enables us to examine the qualitative variable impact. There are five variables encoded from qualitative to quantitative information such as rating, repo rate ECB, ECB asset purchase program, institutional, sectors. These factors, together with other variables, can influence yield spread. Starting first with the smart status of the variable. Presented in table 4

**Table 4 :** *Summary Statistics of collected sample*

<b>Variable</b>	<b>Mean</b>	<b>Median</b>	<b>Minimum</b>	<b>Maximum</b>
YS	125.93	87.540	5.0700	1677.7
GreenBonds1	0.58871	1.0000	0.0000	1.0000
institutional1	0.28629	0.0000	0.0000	1.0000
Rating	2.6573	3.0000	1.0000	5.0000
RepoECB1	0.044355	0.0000	0.0000	1.0000
ISSUEprice	102.28	101.28	73.091	134.66
LIQ_BA	-0.036944	0.0024771	-2.0000	0.11501
ECB1	0.70968	1.0000	0.0000	1.0000
l_ModifiedDuration	1.5413	1.6270	-3.3382	3.5128
l_OriginalAmountIssued	20.097	20.030	16.524	21.822
l_Coupon	-0.29349	-0.13353	-4.6052	2.1401
<b>Variable</b>	<b>Std. Dev.</b>	<b>C.V.</b>	<b>Skewness</b>	<b>Ex. kurtosis</b>
YS	169.45	1.3455	5.3597	35.602
GreenBonds dummy	0.49240	0.83640	-0.36056	-1.8700
institutional	0.45233	1.5800	0.94556	-1.1059
Rating	1.2154	0.45740	0.070162	-1.2280
Repo_ECB	0.20602	4.6448	4.4263	17.592
ISSUEprice	6.5706	0.064243	0.79876	7.0684
LIQ_BA	0.28186	7.6294	-6.8215	44.564
ECB	0.45422	0.64003	-0.92387	-1.1465
MDi,t	0.79261	0.51424	-1.4347	6.2275
Amount_euro	0.64010	0.031851	-2.3687	10.113

l_Coupon	1.0948	3.7304	-1.3033	3.1507
<b>Variable</b>	<b>5% Perc.</b>	<b>95% Perc.</b>	<b>IQ range</b>	<b>Missing obs.</b>
YS	27.567	331.14	77.145	0
GreenBonds Dummy	0.0000	1.0000	1.0000	0
institutional	0.0000	1.0000	1.0000	0
Rating	1.0000	4.0000	2.0000	0
RepoECB1	0.0000	0.0000	0.0000	0
ISSUEprice	95.212	114.85	5.0742	0
LIQ_BA	-0.0016186	0.0093847	0.0031070	0
ECB	0.0000	1.0000	1.0000	0
MDi,t	0.14911	2.6626	0.74170	0
Amount_euro	19.432	20.946	0.40547	0
l_Coupon	-2.0794	1.0116	1.0986	0

*Source: created by the author, using GRETL*

**Summary statistics** summarize and provide information about your sample data. It tells you something about The values in our data set with the necessary detail of the variables. As provided summary statistics, we find similar characteristics between the variables of the study of the variables. Most bonds are rated less than three, so it means that the sample is more highly rated than speculative bonds. There is ECB\_repo, which is a purchase agreement, and in the data, there are so few bonds that have it. Then, issue price varies between 73 and 135; however, the mean is around 102 and s.d 6.57. liquidity has a negative mean, which means the difference between ask and bids price. However, liquidity is one of the biggest reasons for yield spread as it is seen as unfavorable. We can assume that yield spread will also be negative for a green bond. Looking at the ECB asset program variable, it looks like almost the majority is eligible for the program. The coupon has been negative, which means the bond's current yield can only be negative if the investor received a contrary interest payment, so it goes with a coupon as the current yield of many bonds has been negative. Greenbond\_dummy, institutional, rating, and ECB

are highly Skewness. Furthermore, others are suffering from skewness in their residuals. Looking in Green bonds the means shows that there are more Green bonds than Conventional bonds. While institutional being less than 1/3<sup>rd</sup> of all the bonds. Looking next at the rating where all the average of the bond is less than 3 which basically means that majority of bonds are high grade bonds thn looking at ECB repo it looks like that is less likely seen any signified as the amount is really less while mean being less then 0.3, while looking just at ECB there is a majority by .70. Lastly liquidity is being negative which can also tell that the Yield spread could be Negative too however this is not the only one to determine the negative yield spread premium. Next issue prices been between 74 to 134 with the mean of 102. There is no observation missing as all og them were omitted before construing the data set to eliminate any bias.

### 3.2 Identification of Green bond yield spread premium

In this chapter, Stage 1 provided the methodology, in which the particular correlation of variables is analyzed, in order to determine whether variables used in the research have an impact. Besides, correlation analysis enables us to define the direction and strength of the existing relationship. In the following table correlation between variables used in the analysis are presented

Table 5 : *Correlation coefficients of Selected data sample*

YS	Green Bonds Dummy	institutional	Rating	ECB repo	
1.0000	-0.0227	-0.2160	0.5076	-0.1235	YS
	1.0000	-0.0689	0.0677	0.1005	GreenBond Dummy
		1.0000	-0.4823	0.3402	institutional
			1.0000	-0.2617	Rating
				1.0000	ECB_repo

ISSUEprice	LIQ_BA	ECB	MDit	Amount_euro	
-0.4661	0.6092	-0.3693	-0.0842	-0.0660	YS
-0.0651	-0.0033	-0.1013	0.0073	0.1358	GreenBond dummy
0.3696	0.0488	0.2479	0.2349	-0.0505	institutional
-0.3628	-0.0457	-0.2829	-0.0732	0.0873	Rating
0.2115	0.0302	0.1378	0.0300	0.1654	ECB_repo
1.0000	0.0600	0.3103	0.3971	-0.1218	ISSUEprice
	1.0000	0.0538	0.0274	-0.0144	LIQ_BA
		1.0000	0.1356	0.0304	ECB
			1.0000	0.0323	MDit
				1.0000	Amount_euro
				l_Coupon	
				0.4277	YS
				-0.0525	GreenBond dummy
				-0.0525	institutional
				0.5294	Rating
				-0.0937	ECB_repo



				0.1083	ISSUEprice
				0.1180	LIQ_BA
				-0.1675	ECB
				0.0798	MDit
				-0.1648	Amount_eur o
				1.0000	l_Coupon

*Source: Created by author, using GRETL.*

Most important to discuss whether the bond in the hypothesis is correlated with dependent variables. It was found that all the critical control variables such as rating, institution, ECB have a statistical correlation with the dependent variable yield spread. As correlations are low to moderate in the sample, not more than  $-90$  to  $+90$  that has indicated the problem of Multicounty..we saw that strongest negative correlation with yield spread in find institutional issuers, issue size and ECB asset purchase program eligibility, REPO ECB, issue price, issue amount, and modified education, they all create impact negative on yield spread which tell us the more risky the bond is it will have lower yield. it can also be seen that there is a negative correlation between yield spread and green bonds dummy. So while looking at the green bond correlation which is negative it can't be said that and have a conclusion for the risk. as there is no statistical significance which tells the liquidity , rating and issuers intuition. it was also found that there was a lower coupon rate. as yield spread is also propelled by other factors like ECB, and ECB repo. While looking at the positive correlation it was found in coupon rate, liquidity and rating which lead to high yield spread.

### **3.3 Assessment of yield spread premium**

In this chapter, the stage of the empirical analysis is conducted. It was already discussed in the methodology section, where it was mentioned o use fixed effects panel model for reaching better outcome as it does not estimate the effect of variables whose value don't change as per time also it removes omitted

variable bias by measuring the changes in the group access the time zone while including a dummy variable for the missing characteristics.

**Table 6 : Multivariable Regression Analysis for 5 model**

Dependent variable: yield Spread	Model 1	Model 2	Model 3	model 4	Model 5
	POLS	FE	POLS	FE	FE
Constant	<b>16707.4*</b>	<b>5434.89</b>	<b>16808.8**</b>	<b>5534.2**</b>	<b>236.08***</b>
GreenBonds Dummy	-18.105**	-18.5665**	-24.4150* *	-25.3135***	
Amount_euro(log g)	-11.1641	-18.1766*	-10.2090	-16.1922*	-3.7625**
MD (log )	-43.8280* **	-35.3323* *	-39.6393* **	-31.9559***	-6.51132***
LIQ_BA	23119.7** *	15411.3***	22129.1***	15223.1***	14205.9***
Rating	51.42***	62.6799***	46.8725***	56.2626***	
Sector	-3.64396	-7.09975			
institutional Dummy			9.58324		
ECB_repo Dummy			33.8642**	37.4932**	-23.9607**
ECB Dummy			-68.7452* **	-78.9209***	-106.988***
Green Year Dummy 2018					-26.1575***

Green Year Dummy 2019					-12.5933**
Adjusted R Square	<b>0.556</b>	<b>0.398</b>	<b>0.576</b>	<b>0.413</b>	<b>0.395</b>
Observations	<b>744</b>	<b>744</b>	<b>744</b>	<b>744</b>	<b>744</b>

*Source: Created by Author, using GRETL.*

This table reports the results of fixed effect and pooled OLS Estimations of the yield spread, is a function to the green bond l dummy and its characteristic control which is used to see green bond yield premium. The dependent variable is in the bps, which is the base point and let know the investor is more than beyond the sovereign bond yield benchmark. This time of study was 2017-2019 and included bonds that are issued between 2010 - 2016. Model 1 is based on basic pooled ols base model. Model 2 is based on FE base model. Model 3 is the extended version of the model, including additional control variables such as ECB repo, ECB, Institutional issuers. Model 4 is a FE model which will be same as model 3 identical. Model 5 add the variable of green bond with years for the interaction to measure the premium in last years. Also included are sectors six ( table - 6 ), 3-year dummies, and 15 rating controls based on finch long term credit rating.

Our base **Model 1 and 2** has represented the base model and has shown significant results for the variable with the p-value 0.14 and other control variable Liquidity ( LIQba with p-value <000.1 but it has been seen that Amount\_euro(Log) is not significant . As the result it displays that green bonds in our sample on average have a lower yield spread that is known or called as a negative yield premium than other bonds which are conventional, during the first 2 model studies we find out the difference of 18.105 base point for model 1 and 18.566 for the model 2. These models also tells us that with Average ( $\sigma$ ) increase in LIQBA also take to an increase in yield spread .next amount\_log which is also statistically significant (p <0.001 ) in second models , model 2 that The models display one % increase in amount issued on average, ceteris paribus, has negative impact on the yield spreads with 0.11 bps in this study with the Study time period mentioned. Finally, the modified duration variable ( MD\_log ) statically significant, too, with the value ( <0.001) in models 1 and 2. which tells us that 1% increase in MD\_log , with average, ceteris paribus, create a negative yield spreads with 0.43 and 0.35 bps in our study period.

**Model 3 and 4** As seen in the table above, we have included some other control variables in the 3 and 4 models, which are institutional, ECB, ECB\_Repo. As seen in ols, similar results from the base model as it is the extended one from the base model .The model indicates the adjusted R square of 0.576 and 0.413 .When controlling the variables mentioned earlier, find institutional variables did not find any statistical significance. At the same time, ECB and ECB\_repo were statistically significant, with the P-value of 0.0462 and 0.361 having a positive impact on the yield spread for ECB\_Repo with 37.493 and 33.86 base point increase. Moreover, for ECB p-value is ( $< 0.001$  ) and having a negative impact on the yield spread with 68.74 and 78.9209 base point impact on yield. Spread. While Institutional was omitted from the model 4 because of Collinearity. For

**Model 5** Alternatively, Model has the yearly difference in the green bond yield spread Premium (model 5) shows the result aligned with model 4. With lower value in LIQ\_BA,MD, ECB. The Green year dummy tells us to disentangle the green year bond premium for each year in the study period for the year 2018 and 2019. The observation year was 2018, And 2019 shows the statistical significance with p-value ( $< 0.001$  and 0.0412). Model 5 also indicates that on average, these green bonds in this sample also have lower yield in 2018 2019 with conventional bonds with **-46.1575** base points and **-12.593 base points**. These results are based on with 95% confidence level and \*\*\*/\*\*\* tell us about the statistical significance.

In the research, while making a correlation matrix, the issue of Multicollinearity with the variables was potentially seen—, where all the variables in our model can be predicted linearly from some other variables. To control this issue, the variance inflation factor (VIF) test was runned on regression. The test for all the variables showers the value range between 1.08 to 3.50, which indicates a low to moderate degree of Multicollinearity. Another thing which is run is that paper could suffer from heteroskedasticity, which do not have a constant variance in the independent and error terms and control variables.so did Modified Wald test for models 2, 4, and 5 and Breusch-Pagan test for models 1 and 3 that can controls for heterogeneity in our models. And with the result we reject the nul hypothesis as heteroskedasticity was found To control for biases in the estimations, breach - Godfrey and Wooldridge test are done for Ols and Fixed effect panel data. so, failing to reject the null hypothesis as there was no first-order autocorrelation on a was found on significant level in all model specifications.

### **3.4 Empirical research hypotheses testing results**

The quality of the model and consistency of the model's specification in OLS to Fixed effect has

on the range of the factors. In part 2 and with the previous research that the characteristics of data and the empirical approach make the FE cluster robust standard error models. FE is appropriate with being the least as possible biased for conducting hypothesis testing. For reducing the risk risks for omitted variable bias, we proceed with Model 4. Our Hyposties was concern the presence of green bond yield premium on the secondly labeled bonds market based on the investor's preferences and utility and issued in Euro currency

*H1: Green bonds have a negative yield premium compared to conventional bonds in EURO Currency*

Model 4 has a t-stat of **1.8207** (see annex 3) for the green-labeled bonds in the relationship with the yield spread in this sample. So, that is why there is a null hypothesis that there is no green bond yield premium compared to conventional bonds in EURO currency. Moreover, this displays the support to our explanation from Baker et al 2018 theory for revised CAPM, which said that and indicates that investors with non-pecuniary, which is money find utility from green bonds and also subsequently requiring lower returns from such investments.

### **3.5. Generalization of findings and discussion in the context of the previous research**

This paper aims to summarize the main result of empirical research and compare it with other previous scientific research and analysis. This research contributes to the field of the Yield spread premium between green bonds and conventional bonds. While all models find that there is green bond premium is -18 to -25 base points while comparing with the conventional bond between 2017 - 2019. These results also go and align with the stakeholder theory, as previous literature indicates that the relationship between funding costs and sustainability due to lower overall risk levels Is negative. ( Oikonomou et al. 2014; Ghouma et al. 2018) . This finding also relates to the previous literature and scientific research done by various authors such as study one in the secondary market (Zerbib, 2019; Anderkrans J. 2019) study done in the primary market for u.s municipal bonds ( Baker et al. , 2019 ). Where they all find a negative yield premium, however, there are mode studies done showing negative yields such as by lacker et al., 2019 and Karpf and Mandel, 2018 vast majoring of studies are done in different markets and have different data sets and samples. Furthermore, homogeneous samples are less affected by factors and sectors (Karpf and Mandel, 2018).

In our study it was found out with two year green x dummy year where there is a massive gap between the yield spread also seen the same thing in other research green bonds are not stable ( Zerbib, 2019; Anderkrans J. 2019) one the study revealed the fluctuation where the yield spread moved quickly from positive to negative in 4 years, the study was done in global level concerning USD a Euro currency denomination. ( Anderkrans J. 2019). The market is evolving fast and rewarding green bonds. Sharpe introduced the CAPM model in 1964, known as Capital Asset Pricing Model (CAPM) the model relates to the concepts of systematic and idiosyncratic risk(Anderkrans J. 2019). In which the model stipulates that investors can delete their exposure to risk throughout diversifying their portfolio. Thus, investors will only be compensated for personal risk-taking. This refers to the risk premium that is returned more than the risk-free rate of return. The risk premium is equated as the utility investors find from holding a risky asset. Previously financial compensation was equivalent to investors' utility. This has been discussed in Fama and French paper (Fama and French, 2007). The original CAPM suggests that there is no difference in the pricing of idiosyncratic risk between conventional bonds and green bonds while being identical fundamentally in the asset class. However, in this reach introduces the concept of nonpecuniary investor preferences such as environmental sustainability green bond , it is significantly proved that these types of investors are willing to accept a lower financial return if they receive adequate utility from the 'environmental compensation' from the asset. (Baker et al. 2018)

The negative green bonds premia found and existence highlights that there is a buying pressure relative to the supply in the case of green bonds, which is more significant than conventional bonds. This may exist because attributes first is excess of investment demand due to the intrinsic value of green bonds, and another would be a large volume of bond issuance. At the start of the chapter, we mentioned that our research supports the stakeholder theory, which means better performance and an environmental decrease in the cost of capital. While this fast-growing fixed-income instrument, our results show investors' willingness and confidence to pay the extra called premium for sustainability has impact when the product is getting matured after while looking for institutional issuance, ECB repo, and ECB asset purchase program eligibility. It also displays the negative green premium. While this thing also challenges the traditional CAPM, the returns are not the only factor determining the risk appetite for some investors. As ESG - profile investors find utility in non-pecuniary compensation (Bakers et al., 2018 )

These findings also tell that the ECB has reduced yield spreads with almost -78 bps in this study period. In this study, the different scope and method have been used and also 61% of the green bonds are

ECB eligible. in this research it points that ECB is lowering yield spreads bonds. Moreover, this finding is also interesting for green bonds as the ECB initiative has been there since the existence of the green bond asset class. ECB also announced that in December that they will end this net purchase program for this asset class. As this announcement was important as it has made a question on the yield spread, how much it will be effective for both asset class green bonds and conventional bonds. As it is still unclear so the only pricing dynamics can speculate while going forward.in the phrase “net purchases” will allow continued purchasing.while this all going on green bond yield can be unchanged or maybe can get better than conventional bonds and as they are also biased from conventional bonds. We can also see the green market going further when the largest market participants reduce their support. At last, the study can't rule that ECB shift could create an impact on the validity of the findings while going forward, it can be an important factor for all academics, investors, issuers to consider.

Furthermore, investors finding utility in green-labeled bonds to such extent that has lowered their expected return, many investors will find it irrelevant to pay a premium for green bonds; however, the potential stakeholder theory effect such as attracting investors, marketing value and sustainability contribution. That leads to a more substantial monetary gain than the negative yield premium, which leads to the greenness effect as preference for return financially in the net.

These results also display that having green bonds is good for investors in recent years as many investors are ready to pay a premium price for this asset. Further, more attractive the green bonds will conquer in the coming years, and market sentiment with positivity will always continue. It can be concluded that liquidity risks relating to green bonds will not be an issue.

## CONCLUSION AND RECOMMENDATION

The object of this master's thesis was to find the green bond premium; Aim was to identify and assess the difference in the yield spread between green bonds and conventional bonds in euro currency bonds. After conducting theoretical analysis on essential aspects of the topic and previous research analysis and empirical analysis based on the methodology, the following conclusion and recommendations are provided.

1. The Socially Responsible Investment. Call it Socially Responsible Investment or sustainable, responsible impact investment (SRI) or responsible investing or sustainability investment they sound different terminology however they almost mean the same which is basically making better choices for the future. While not disrupting environmental, social, and corporate governance. then the concept of green bonds and the conventional bonds as the green bonds are the new type of instrument which, Green bonds are bonds that are a debt instrument which are issued to make funds while supporting environmental projects for climate projects. and that is what makes it different from the standard bonds. framework which is used in the green bond such as green bond principle, as green bonds also need some certification it is given by Climate bond initiative and other external certification providers, also it found suggests then external certification lead to an expense of around 3 - 5 base points (White,2002) comparing with Climate bond initiative with a flat rate of 0.1 base point on issue value. The green bond market has been growing exponentially from the beginning, including major statistics which showed that from 2018% green bonds have increased by 51% by this year. the had empirical literature on Empirical aspects of Corporate social performance influence on bond yield showed a positive relationship between the cost of debt and CSP ( Manganelli and Izzo,2017 ) It tells us that CSR has not yet had an impact on the pricing of corporate bonds in with proper environmental risk management also has a higher cost of debt. Else wise, there has been numerous research that shows the significant result for the relationship between CSP and cost of debt being negative (Sun and Cui, 2014; Jiraporn et al. ,2014) next it also find out that a higher level of CSP can provide improved credit quality and lower credit risk ( Ghouma, Ben-Nasr, and Yan 2018) then in green bonds the study showed that some positive effect on yield premium comparing with a conventional bond ( Karpf and Mandel (2018) in other there was a negative yield premium between -1 to -18 base points, as studies also



had their sample and limitation which created a big difference but in total, the more researches find negative yield premium in green bonds then positive

2. To develop the methodology of socially responsible investment and to adjust it to evaluate the green bonds premium methodology is defined to assess the green bond premium. While using the variable which creates impact on the yield spread using the panel regression model ols and fixed effect which get us the better output.
3. Our findings were an average significant negative green bond premium of approximately -18 to -25 base points. This also suggests previous analysis while aligning the previous research that green bonds are unstable. However, their attractiveness is increasing day by day. Also, there was an average green premium of -12 and -46 base points in the 2018 and 2019, respectively. Our result explains the potential explaining for the demand and supply, investors refreshes, and risk. We also want to conclude that there is a need to revise the traditional CAPM model as investors find utility in sustainability. (Baker et al., 2018) This has been discussed in Fama and French paper (Fama and French, 2007 ). The original CAPM suggests that there is no difference in the pricing of idiosyncratic risk between conventional bonds and green bonds while being identical fundamentally in the asset class. However, if we introduce the concept of nonpecuniary investor preferences such as environmental sustainability, it could be argued that these types of investors are willing to accept a lower financial return if they receive adequate utility from the 'environmental compensation' from the asset. (Baker et al. 2018) applies these arguments to green bond pricing and hypothesizes that securities such as green bonds have lower expected returns than their conventional counterpart. Thus, arguing that the CAPM needs to be revised to capture the effect of non-pecuniary factors on expected returns.
4. Yield difference has other factors which also infuse significantly other than liquidity measure, as looking at ECB asset purchase program and Repo while both impacted oppositely. However, it can also help develop and create a better roadmap for the green bonds; as per the theoretical framework, there are many certification fees and programs of the green bonds, so there is a need for improved guidance of these bonds.

5. This negative green bond Yield tells us that is also a favorable situation as a green bond issuer which could be taken as an advantage. as this condition will not only pinnacle volume of the market to take green debt issuance more and more, however, it also indicates that there is potential throughout the secondary market structure for the green bond for offering bonds that have a lower yield than with conventional bonds. This condition is favorable for the companies who are thinking to launch the green market project as they can take advantage of it the most while lowering down their cost while comparing it with conventional bonds. As green bonds are right now issued at a yield same to that of conventional bonds with the similar characteristics
6. These findings also tell us that green bonds demand had increased exponentially, and there is no supply, so it is an opportunity for regulators to take measures for further updates in green bond issuance. In this research, the focus was investors and CAPM. as CAPM was an exciting element to idiosyncratic risks and investor preferences. As the study reflects deeper understanding for lower riskiness or green bond premium results sustainably.
7. Limitation of the research has been the quality of data since a lot of data and bonds are not frequently traded, so the bond yield was wholly not acquired at some time to reflect the fair value. However, as the market grows and large no. of green bonds are issued, more extended historical data can provide us a better understanding and more accurate results. Lastly, at low carbon and family energy prices, green bonds are becoming highly attractive, focusing on environmental transactions.
8. EU Action plan taking action can help the green bond market to have a better short term and the medium-term prospect that can help to harmonize the green bonds around the countries. While being the major drawback that there is a lack of the compatible. the framework, enforcement, and subsequent risks for greenwashing and fraud for the green bond. Other than that, as ECB takes less intervention in upcoming time it will lead to a reduction in the repurchase in the global market for green bonds. which will lead to impact the spread and liquidity while going further. shifting the environment in which green bonds are always issued. At least with the most natural understanding of the whole, it will lead to the subset of investors who are willing to sacrifice their return to hold these green bonds

9. Finally, growing no. of studies in Green bond premium, future research can be conducted in the emerging markets and also comparing the country to country green bond premium, however, the only limitation is liquidity as the data is still not prompt and not easy to find. Also, this research only tells us about the euro-denominated bond market so it can be the battle against climate change requires all the participants from all the society. while green bonds have emerged as the taking charge presented by the financial markets

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## **APPENDIX**

## Annex 1 – Creating sample for Research

Table 1: Creating sample for the Research

### *Sample*

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#### **Selecting Green Bond**

Thomson Reuters Eikon

<b>Particulars</b>	<b>Bond Numbers</b>
Bonds (only active)	584526
Green Instrument Indicator- Yes	8049
Issue date between 1/1/2010 - 31/1/2016	5005
Rating	3200
Fixed coupon rate bonds	1500
Currency: euro-denominated	
Maturity before 1-1-2020	976
<b>Outcome: 976 Green bonds</b>	

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#### **Selecting Conventional Bond**

Thomson Reuters Eikon

<b>particulars</b>	<b>Bond Numbers</b>
bonds active conventional bonds	584526
Currency: euro	841916

Issue date between 1/1/2010 - 31/1/2016	15,000
Rating	6000
Fixed coupon rate bonds	3300
Maturity before 1-1 2020	1500

**Outcome: 1500 Conventional bonds**

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### **Data Gathering**

*Study period: 1/1/2010 - 31/12/2016*

Daily, quarterly, yearly from data collected via Thomson Reuters Eikon .

976 green and --- conventional bonds excluded due to lack of bond price data via Thomson Reuters Eikon .

**Finally: 151 green and 98 conventional bonds..**

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*Source: created by the author, using MS Excel.*

**Table 2** : Selecting the Sector for the Bonds through Industry segment

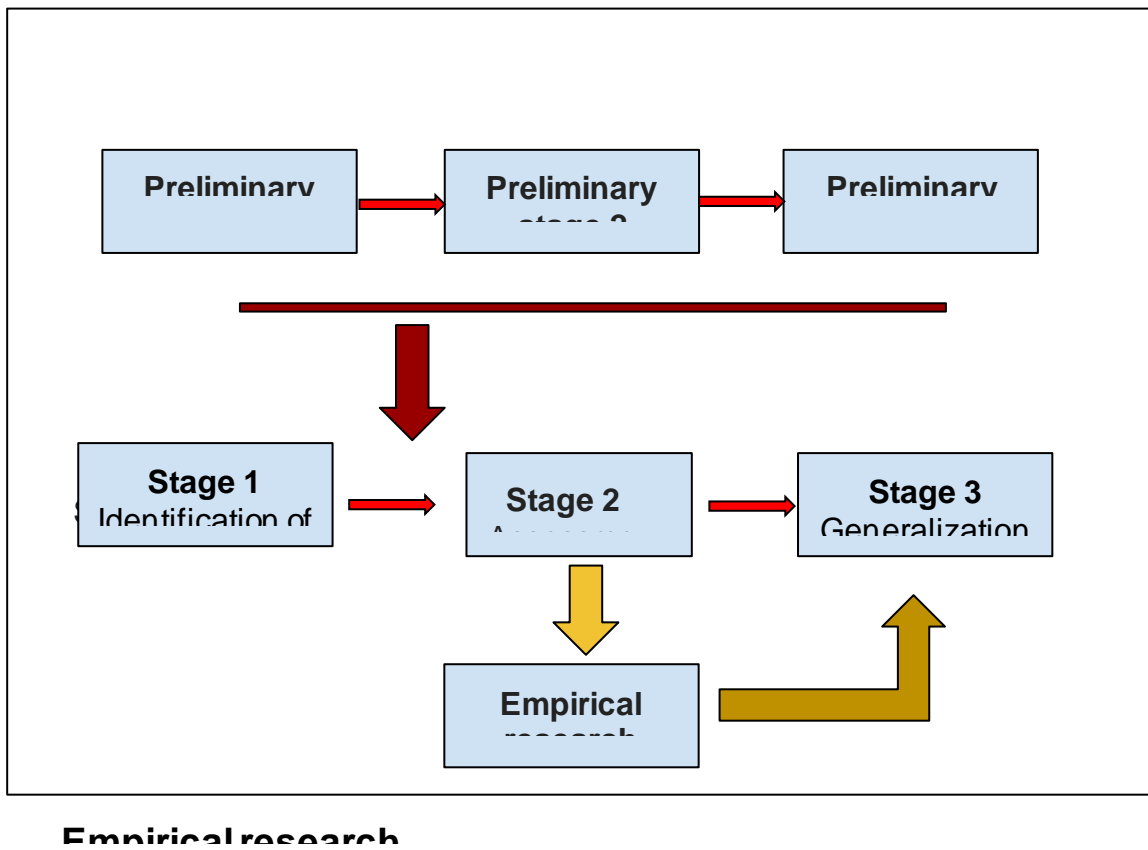
*Issuer 'Industry' to Sector*

Sector	B CLASS Level 3
Supranational	Supranational
Governmental Agency	Banking
	Treasury
	Local Authority
	Governmental Owned, No Guarantee
	Sovereign
	Mortgage Assets
	Government-Sponsored
	Government Guaranteed
Financials	Mortgage Assets
	Local Authority
	Government Owned, No Guarantee
	Government-Sponsored
	Banking
	Other Financial
Corporate Utilities	Insurance
	Public Sector Loans
	Government Owned, No Guarantee

	Local Authority
	Natural Gas
	Electric
	Other Utility
	<hr/>
	Basic Industry
	Consumer Cyclical
	Consumer Non-Cyclical
Corporate Other	Governmental Owned, No Guarantee
	Capital Good
	Technology
	Other Industrial
	<hr/>
	Cyclical
RIET	REITs
	Other Industrial
	<hr/>

Source: Anderkrans(2019)

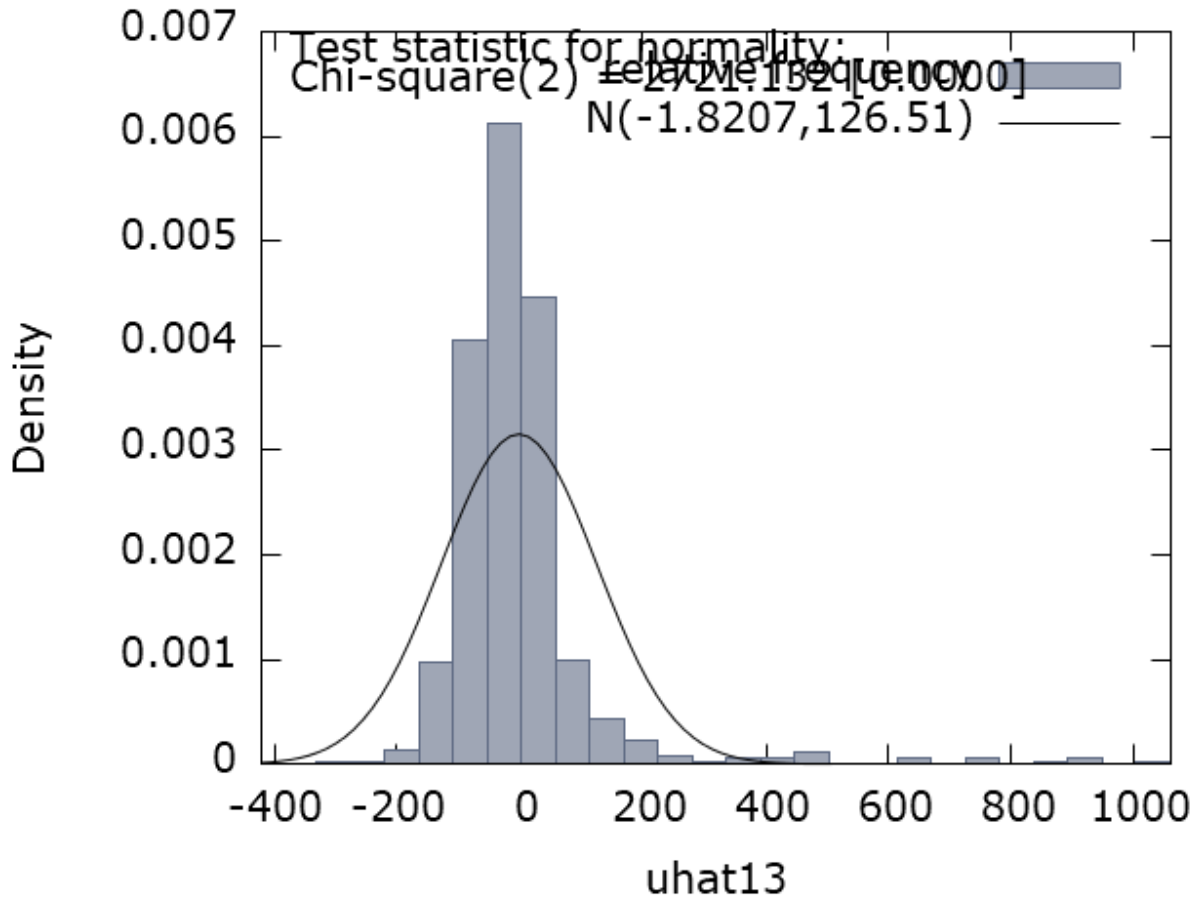
**Annex 2 - Empirical Research framework and stages**



*Figure 3. Empirical Research framework and stages.*

*Source: created by the author.*

**Annex 3 – T-stat for Rejecting Null hypothesis**

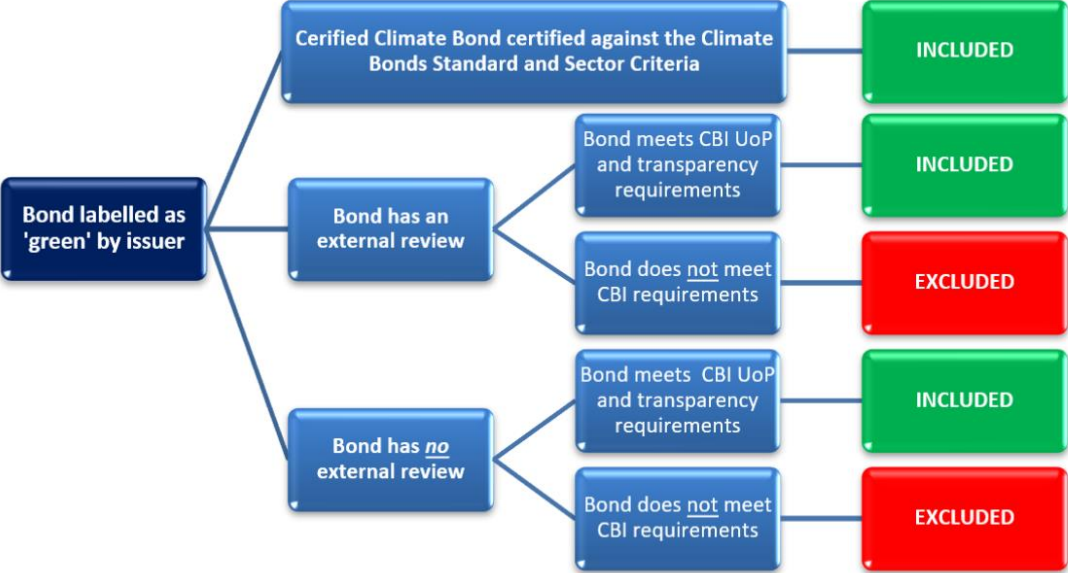


*Figure 4. T-Stats for normality..*

*Source: created by the author.*



**Annex 4 – Overview of Selection criteria for green bonds.**



**Figure 5. Bond labels**

*Overview of section criteria for Green bonds*

*Source: CBI(2017)*

Annex 5 – Converting Qualitative rating data to Qualitative data and Additional Sample statistics

**Credit Rating Scales by Agency, Long-Term**

Moody's	S&P	Fitch	
Aaa	AAA	AAA	Prime
Aa1	AA+	AA+	High grade
Aa2	AA	AA	
Aa3	AA-	AA-	
A1	A+	A+	Upper medium grade
A2	A	A	
A3	A-	A-	
Baa1	BBB+	BBB+	Lower medium grade
Baa2	BBB	BBB	
Baa3	BBB-	BBB-	
Ba1	BB+	BB+	Non-investment grade speculative
Ba2	BB	BB	
Ba3	BB-	BB-	
B1	B+	B+	Highly speculative
B2	B	B	
B3	B-	B-	
Caa1	CCC+	CCC	Substantial risk
Caa2	CCC		Extremely speculative
Caa3	CCC-		Default imminent with little prospect for recovery
Ca	CC	CC	
	C	C	In default
C	D	D	
/			
/			

*Figure 1 : Credit Rating Scales by agency, Long Term*

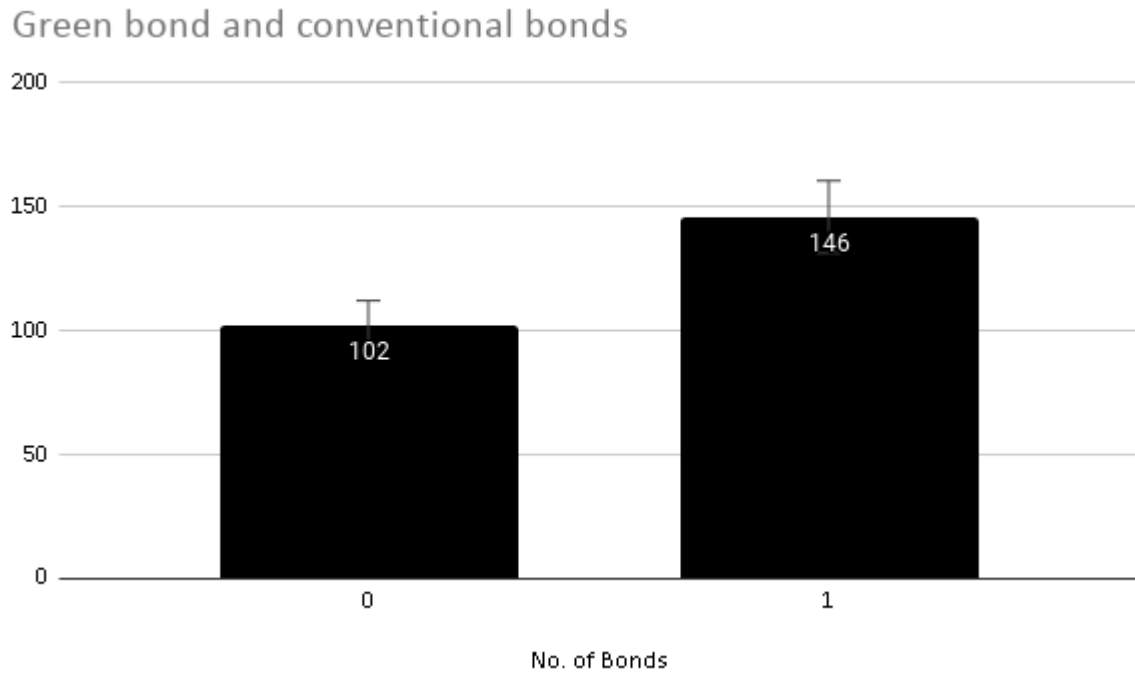
Source: Wolf street(2015)

*Table 1: Rating Quantativate*

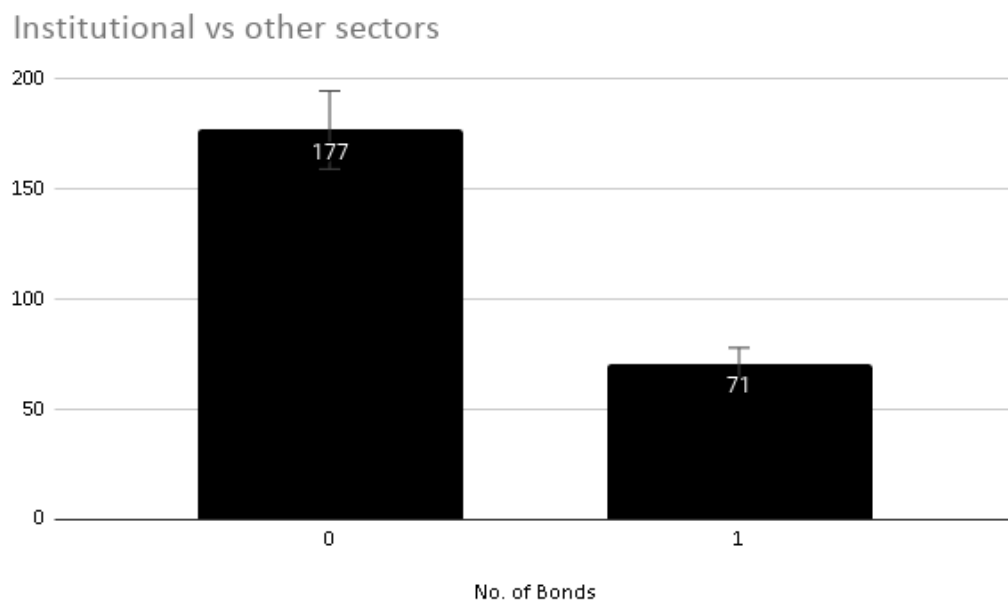
Prime	Denoted
High grade	1

Upper medium grade	2
Low medium grade	3
Non-investment grade	4
Highly speculative	5
Substantial risk and other	6

*Source: created by author, using MS Excel.*

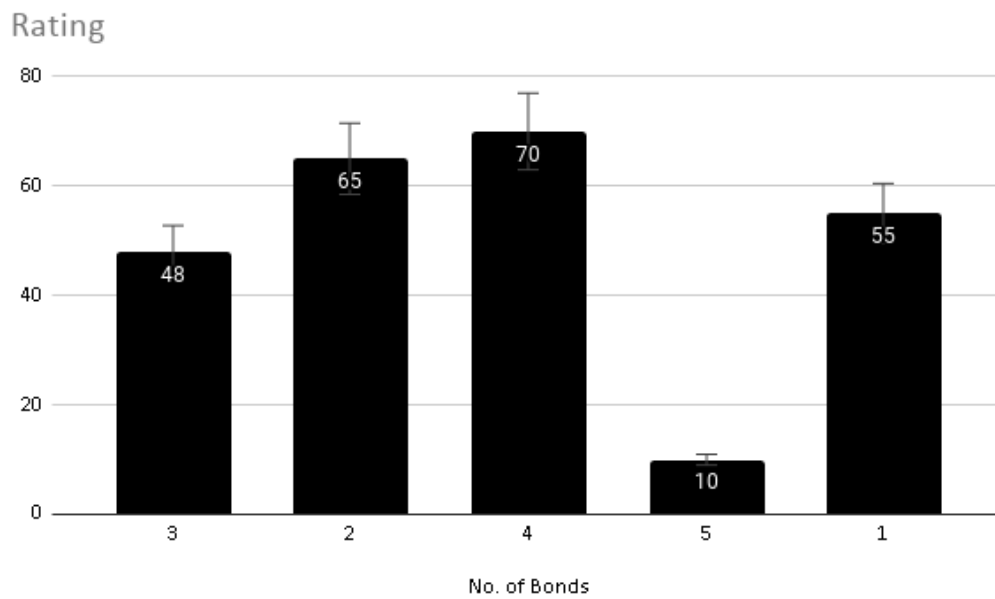


***Figure 2. Green bond and Conventional bonds.***  
*Source: created by the author, using Ms. Excel.*



***Figure 3. Institutional vs. other sectors.***

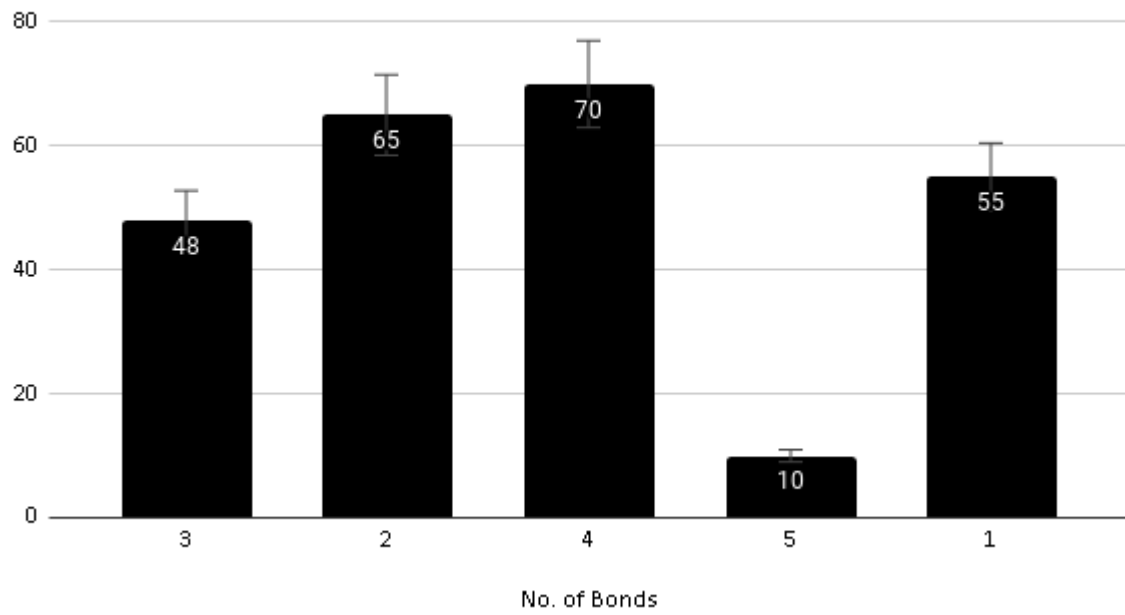
*Source: created by the author, using MS Excel.*



**Figure 4. Rating**

*Source: created by the author, using MS Excel.*

### Sector Representation



***Figure 5 Sector Representation.***

*Source: created by the author, using Spreadsheet.*

### **Non-numerical Data coding**

One or more non-numeric variables were found.

These variables are as follows.

String code for ECB Asset Programmer:

1 = 'Yes'

0 = 'No'

String code for ECB Repo:

1 = 'Yes'

0 = 'No'

String code for Institutional Issuer:

1 = 'Yes'

0 = 'No'

Source: Compiled by the author, using GRETl program,