
Are green bonds and their comparable conventional bonds issued at a different yield in the European Market?

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Dissertation

Master in Finance

Supervised by

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2020

Candidate Introduction

My name is Carolina Hipólito Fernandes and I am currently enrolled in a Master in Finance at the Faculty of Economics of the University of Porto.

I have a bachelor degree in Management at ISG Business and Economics School in Lisbon. Throughout the bachelor studies I had the chance to do an exchange semester at the Faculty of Economics and Business in University of Barcelona.

After completing my bachelor's degree, I did an internship (from July 2017 up to July 2018) in one of the most important financial institutions in the world, Deutsche Bank. Working in Custody Services Department (GBS PBC Operations International) has given me the opportunity to have my first contact with financial markets and financial products. I worked full time for a year, and I gained both experience in a fast-paced, high pressure environment and the ability to work with many different types of people.

In addition to my enthusiasm for finance, I have also developed a passion for sports and helping others. During my lifetime, I have tried to be active by helping others in any way I could. I volunteered and joined a group of scouts. This has helped me to be more human, concerned and interested in the world around. Moreover, I practiced artistic swimming which helped me to work as a team. Nowadays, running during the weekends helps me to set goals and strive to achieve them. All over, my successes and my defeats have put my abilities to the test, and most important of all, I have built the belief that hard work and determination will pay off in the future.

Acknowledgments

Firstly, I would like to thank to my thesis advisor Professor Cláudia Ribeiro for all the support and availability for meeting. For your helpful insights and valuable guidance throughout this research.

I would also like to thank the Climate Bond Initiative for providing us the green bond database which made our study more reliable. However, this partnership would not have been possible without the help of the staff of the Faculty of Economics of the University of Porto.

Last but not the least I am thankful to my family and my friends, without their support this would not have been possible.

Abstract

An increase in the awareness about the climate change has led more and more investors to concentrate their capital solely on the market of green bonds. At the same time, companies are more interested in incorporating environmental issues into their businesses. For this reason, the funding needs for green projects have suffered an exponential rise. Thereby, companies are able to attract a new segment of investors.

From an investor perspective, our research addresses whether the green bonds offer at least the same yield than their comparable conventional bonds. In addition, we aim to analyse whether there are any differences across countries, sectors, currency of issue, rating and term of maturity and whether the Paris Agreement and the SDGs had any influence in yields. This study provides a thorough European green bond market analysis which may encourage new participants to enter into the market.

We focused our investigation in the European primary market from 2012 up to 2019. After matching each green bond with two conventional bonds, we built a synthetic conventional bond. Our final sample is composed by 119 green bonds and 119 synthetic conventional bonds. The next step was to determine the average yield difference between green bonds and their comparable synthetic pair. After, we ran a paired t-test to calculate the significance of results. We found a negative premium of 20 bps for green bonds in the whole sample. Supranational and agency entities also presented a negative premium as well as institutions rated with AAA. Along the same line, green bonds issued in EUR and with intermediate and long term of maturity also have a lower yield. On the other hand, we found a higher yield for green bonds issued in Spain. Furthermore, we have noticed that since 2015, the year of both the Paris Agreement and SDGs, the premium has been decreasing and, on the other hand, the number of issuances has been increasing. These findings confirm that Europe is following the same way as the rest of the markets.

Keywords: Green Bonds, Conventional Bonds, Matching Method, Paris Agreement, 2030 Agenda for Sustainable Development Goals, Green Premium.

JEL-codes: G12, G14, G20.

Resumo

O aumento da consciencialização por partes dos investidores em relação às alterações climáticas tem levado a um aumento substancial na procura por títulos verdes no mercado. Ao mesmo tempo, existe uma maior preocupação por parte das empresas em incorporar questões ambientais nos seus negócios. Esta realidade levou a que existissem mais empresas a precisar de financiamento para projetos sustentáveis e assim, uma oportunidade de atrair um novo segmento de investidores.

Com foco no investidor, o nosso estudo visa perceber se o retorno das obrigações verdes é pelo menos o mesmo que o das obrigações semelhantes não verdes. Além disso, pretendemos analisar se existe diferença quando dividimos a nossa amostra por países, setores, moeda de emissão, rating e maturidade e se o acordo de Paris e a Agenda 2030 para o Desenvolvimento Sustentável tiveram impacto nos retornos.

Neste estudo pretendemos fazer uma análise detalhada do mercado de obrigações verdes na Europa e com isso, poder ajudar potenciais investidores.

A nossa investigação é centrada no mercado primário Europeu entre 2012 e 2019. O nosso primeiro passo foi criar uma obrigação sintética comparável com cada obrigação verde a partir de duas obrigações convencionais. A nossa amostra final é composta por 119 obrigações verdes e 119 obrigações sintéticas. O passo seguinte foi calcular a diferença média entre os retornos das duas obrigações. Foi utilizado um teste t para verificar a significância dos valores. A primeira conclusão é que as obrigações verdes apresentam um valor de retorno inferior. O mesmo acontece com as instituições supranacionais e agências bem como com instituições com AAA de rating. As obrigações verdes emitidas em EUR e com uma maturidade média e longa também seguem esta mesma linha. Por outro lado, Espanha apresenta um retorno maior para as obrigações verdes. Por fim, desde 2015 que a diferença entre os dois tipos de obrigações está a diminuir. Sendo esse o ano do Acordo de Paris e da Agenda 2030 para o Desenvolvimento Sustentável. As nossas conclusões confirmam que o mercado Europeu está a seguir o mesmo caminho que o resto dos mercados.

Palavras-chave: Obrigações Verdes, Obrigações Convencionais, Metodologia de Matching, Acordo de Paris, Agenda 2030 para o Desenvolvimento Sustentável, Prémio para Obrigações Verdes.

JEL-codes: G12, G14, G20.

Index

Chapter 1. Introduction	1
Chapter 2. Literature Review	5
2.1. Impact of Corporate Social Responsibility on companies' performance.....	5
2.2. Previous literature on green bonds.....	6
Chapter 3. Data Selection: Green Bond Market	10
Chapter 4. Methodology	14
4.1. Matching Method and Rules.....	14
4.2. Descriptive statistics of the green and the conventional bonds.....	16
4.3. Paired t-test: overall sample	18
4.4. Paired t-test: sample segments.....	19
4.5. Paired t-test: before and after Paris Agreement and SDGs	20
Chapter 5. Results	22
5.1. Results from Matching Method: overall sample	22
5.2. Results from Matching Method: sample segments.....	23
5.2.1. Country.....	25
5.2.2. Sector	25
5.2.3. Currency of issue.....	26
5.2.4. Rating.....	26
5.2.5. Maturity at issuance.....	26
5.3. Results from Matching Method: before and after Paris Agreement and SDGs.....	27
Chapter 6. Conclusion	29
References.....	31
Annexes.....	33

List of Graphs

Graph 1- Number of Green Bonds domiciled in Europe.	11
Graph 2- Evolution of the green bond market in European countries between 2007 and 2019.	11
Graph 3- Number of green bonds per issuer.	12
Graph 4- Distribution of Yields throughout the years.	18

List of Tables

Table 1- Top 10 of European issuers between 2007-2019.	12
Table 2- Matching Characteristics.	15
Table 3- Descriptive Statistic of our final dataset.	17
Table 4- Results of paired two tail t-test of the whole sample.	22
Table 5- Results of paired two tail t-test of divided by segments.	24
Table 6- Results of paired two tail t-test of the two subsamples.	27
Table 7- Results of paired two tail t-test of each year after Paris Agreement and SDGs.	28

Chapter 1. Introduction

"There can be no Plan B because there is no planet B" (Ban Ki-moon, 2014).

Climate change has been one of the most discussed topics throughout the 21st century. Despite this being one of the main problems of the current century, since the year of 1992 the United Nations Framework Convention on Climate Change (UNFCCC) has been making efforts to keep concentration of greenhouse gases (GHG) at steady levels. These efforts have been made through negotiations with different countries to reduce their GHG emissions. But this is not being an easy task. In order to evaluate the progress being made by each country, it was created the Conference of the Parties (COP), which takes places each year and where it is decided what aspects are needed to be improved. It was at one of these conferences, more specifically in 2015, that a new cycle began with the Paris Agreement (Savaresi, 2016). The main goal of the Paris Agreement was to keep global warming below 2 degrees Celsius and to limit the temperature rise to 1.5°C (Rogelj, den Elzen, Hohne, Fransen, Fekete, Winkler, Chaeffer, Ha, Riahi, and Meinshausen, 2016).

In addition to the Paris Agreement, countries have adopted the 2030 Agenda for Sustainable Development Goals (SDGs), which are two major steps towards environmental and economic growth, respectively. For these two reasons, there has been an expansion of the green products and also an increase in sustainable projects (Tolliver, Keeley, and Managi, 2019). In their study about this field, Glomsrød and Wei (2018) found a potential growth in worldwide GDP (Gross Domestic Product) and a reduction on GHG emissions when the investment on green finance, namely in green bonds, is diverted from fossil industries.

An increase in the awareness about the climate change has led more and more investors to concentrate their capital solely on the market of green bonds. At the same time, companies are more interested in incorporating environmental issues into their businesses. For this reason, the funding needs for green projects have suffered an exponential rise. Thereby, companies are able to attract a new segment of investors.

In 2007, the first green bond was issued and after that the total market size has been \$521 billion¹. In 2017 it was \$162.1 billion and in 2018 it was \$167.6 billion (Filkova, Frandon-Martinez, and Giorgi, 2018).

¹Cumulative issuance since 2007. See for more information https://www.climatebonds.net/files/reports/cbi_gbm_final_032019_web.pdf.

The solid growth of the green bond market has led many authors to study this market and their expansion. As the green bond market is a recent market, there are some literature gaps that need to be fulfilled namely the performance of green bonds compared to the conventional bonds. Compared to the conventional bonds, green bonds have additional costs to issuers to ensure that the funding is for sustainable projects (EY, 2016). Although a third-party certification is not required, it attracts more investors since it protects them from greenwashing².

From an investor perspective, the first purpose of our study is to detect if there is any difference in average yields between green bonds and their comparable conventional pairs. Our study is focused on Europe primarily because the green bond market is growing in this region. Climate Bonds Initiative (2020) reports that, between 2018 and 2019, the Europe continent represents 57% of the global market expansion. Moreover, there are not many studies that focus on this market. The vast majority of the studies analysed are focused on global market (Bos, 2018; Fatica, Panzica, and Rancan, 2019; Hachenberg and Schiereck, 2018; Larcker and Watts, 2019; Preclaw and Bakshi, 2015; Zerbib, 2019). In addition, our investigation is relevant for comparing the European bond market with other bond markets as well as to understand if there are differences in returns for investors.

In order to deepen our analysis, we will also verify if the potential difference is the same when we divide by categories our sample. Therefore, we will group our sample according to country of issue, sector, currency, rating and term to maturity. This will help us to identify the segments with the greatest influence in the green bond market.

Nevertheless, we also purpose to study if the Paris Agreement and SDGs had any influence on the investor's returns. Paris Agreement and SDGs are two relevant steps towards this transition and for this reason it is significant to analyse the behaviour of green bonds after these agreements and, at the same time, to compare with the previous ones. This analysis will demonstrate if these two steps really had an impact on investors returns. In order to study this, we will split our sample into two subsamples. As Paris Agreement and SDGs were adopted in 2015, one subsample is regarding issuances from 2012 to 2015 and the other is focuses on the years between 2016 and 2019.

² By definition, greenwashing occurs when a company announce a product as being more sustainable than it really is.

In summary the main research topics of our research aims to understand whether: the green bonds offer at least the same yield than conventional bonds; there is any difference across countries, sectors, currency of issue, rating and term of maturity; the Paris Agreement and the SDGs had any influence in yields.

As our main focus is in the European market and as there are not many studies that focus on this market, our research may help potential participants to enter into the market or even contribute to those who are already there. In addition, since our green bond data was provided by the Climate Bond Initiative, we are sure that the funding is for sustainable projects and there is no possibility of greenwashing.

The procedure that we followed on our study is the matching method which compares similarities between a treated group (green bond) and a control group (conventional bond) with the same characteristics except the one that we are interested in. Since finding a conventional bond with all the same characteristics of a green bond on our sample is unlikely, we matched each green bond with two conventional bonds according to a certain matching criteria in order to have the most accurate possible comparison. After this matching, we built a synthetic conventional bond from these two conventional bonds. At the end, our sample was composed by 119 green bonds and 119 synthetic conventional bonds.

The next step was to determine the average yield difference between green bonds and their comparable synthetic pair. After, we verified the significance of results through a paired t-test.

In this paper, we investigated the difference in yield in the primary market from 2012 up to 2019. The first finding was that on average the green bonds are issued at a lower yield than their correspondent synthetic bonds. The premium was 20 bps, approximately.

Once we have categorised the sample by different countries, sectors, currency of issue, rating and term of maturity, our first conclusion is that Spain have a higher yield at issuance for green bonds. Moreover, regarding the sector, we found a premium for green bonds issued by agencies and supranational institutions. However, supranational institutions are traded at an even greater premium. Along the same line, we identified that green bonds rated with AAA are also traded at lower yields. This is expectable since most agencies and supranational entities are rated with the triple A. In our sample, the majority of bonds are issued in EUR. Thus, green bonds issued in this currency had a lower yield than their comparable conventional pairs. In the same way, green bonds with intermediate-term of maturity and also long-term of maturity presented a negative premium, as well.

Our last analysis focused on the impact that Paris Agreement and SDGs had on green bonds. After 2015, the premium started to decrease. In 2019 the difference was, approximately, 25 bps while in 2016 the difference was, roughly 92 bps. Although the yield for green bonds is even lower than the yield of conventional bonds, the number of issuances is growing, and the premium is decreasing.

Our findings contribute to the increase of the literature available on this topic. We considered that it was an extremely relevant topic to investigate because the green bond market is constantly growing, and it will have more and more impact on the bond market. As I mentioned before, there are not many studies that focus in the European market, and for this reason, it is an opportunity to promote new findings. Our study found that the European market is following the same way as the other markets.

The dissertation is organized as follows. In the next chapter, we will provide a review of the relevant studies on this topic and their respective conclusions. In chapter three, the data selection process and sources will be explained in detail, and, in addition, we will also analyse the European bond market. The chapter four is dedicated to the methodology followed in our study. The results are presented in the chapter five. The sixth and final chapter is focused on the conclusion of our study on green bond and their comparable pairs.

Chapter 2. Literature Review

2.1. Impact of Corporate Social Responsibility on companies' performance

Following Schoenmaker and Schramade (2019), the current generation have to think about the future in the same way they look at the present. Thus, it is important to make sure, that neither now nor in the future, our resources will lack. The challenge of being more sustainable is to incorporate a long-time horizon on the decision-making process and to allocate the funding in the most productive way.

Corporate Social Responsibility (CSR) has been increasingly studied by academic researchers over the last decades. According to Porter and van der Linde (1995), if the companies focus on having a better environmental performance, that does not mean that the costs will increase. Although, this motivation may lead to an increase on economic and financial benefits. In a more recent literature, Sun and Cui (2014) also concluded that CSR leads to growth of economic benefits and consequently a decrease in default risk. Many other authors determined that there is a positive relationship between CSR and company performance regarding operating, valuation and financing cost effects (Oh, Hong, and Hwang, 2017; Saeidi, Sofian, Saeidi, Saeidi, and Saaeidi, 2015; Tsoutsoura, 2004). In addition to their conclusion, Oh et al. (2017) affirmed that CSR has no longer been considered as an option but as a requirement.

On the other hand, Xiao, Faff, Gharghori, and Lee (2013) had a neutral position and they did not found a relation between CSR and companies' performance. The authors argued that the implementation of environmental measures is a choice of the investor or/and the institution and this will have no implication for returns. The study of Chen, Hung, and Lee (2017) had another viewpoint which consisted that the impact of CSR in low value firms is not the same as on high value firms. The capacity to implement CSR procedures on high value firms is high and consequently there will be an increase in stock prices and market value as well. On the other hand, low value firms do not have this capacity. The costs will increase and this will lead to a decrease in stock returns (Chen et al., 2017). In an opposite point of view, Ziegler, Schröder, and Rennings (2007) found a significantly negative relationship between CSR and firm performance. Furthermore, Bauer and Hann (2010) and Chava (2014) understood that the cost of debt financing in companies with sustainable concerns was higher. Besides that, Chava (2014) added that investors who invest in this type of companies

expect higher returns. Despite that, Flammer (2015) determined positive announcement returns when a company incorporate sustainability in their strategy.

For companies the main sources of rising capital are through bond financing and stock financing. Companies issue green bonds when they need capital to invest in environmental or climate-related projects and these issuances will have impact on companies' stock prices. In their study about the effects of green bonds issuances have in companies Zhou and Cui (2019) identified a positive impact on companies stock prices as well as on companies profitability and operational performance following green bonds issuance. In addition to having a positive influence, they concluded that the issuances help companies to incorporate CSR in their values, promote environmental development and also captivate more investors. In the same line, Tang and Zhang (2020) found that green bonds issuance have a positive impact on stock prices and a greater stock liquidity. Moreover, it is also advantageous for currently shareholders. Flammer (2020) also suggest that stock market have a positive response to green bond issuances and companies benefit from an evolution of their environmental performance.

The studies above indicate that there is still no consensus on the real impact that CSR has on company's performance. However, it is unanimous in several studies that there is a positive impact the conduct of the company when a green bond issuance is announced. On the other hand, green bonds are not dependent on the relationship between company's performance and CSR but on the projects financed by companies. For this reason, our study aims to analyse the differences that may exist in yields when the same company issues a green and a non-green bond.

2.2. Previous literature on green bonds

Despite of the bonds being green, this should not have any impact on their prices because they are subjected to the same market conditions as the conventional bonds are. However, in some markets there are evidences that green bonds have a higher price (Harrison, 2019). As a result of additional costs, green bonds are more expensive to issuers (Karpf and Mandel, 2018).

According to Bos (2018), there are two possible aspects that may describe the differences between yields on secondary markets. The first one is associated with a mismatch between demand and supply. This is due to the greater demand for green bonds by investors in comparison to the number of issues with green label. On the other hand, green bonds

may be less volatile than non-green. The investor who invests in this type of bonds have a long-term horizon and for this reason the investor does not trade frequently, and this reduces the price volatility. In addition to the prior conclusions, the author observed that green bond yield is on average 1.1 basis points (bps) lower than conventional peers between 2014 and 2017. Within the same scope of global secondary market, but during the years of 2014 until 2015, Preclaw and Bakshi (2015) found there existed 17 bps yield difference between green bonds and their conventional peers. In the same line as the previous study, Preclaw and Bakshi (2015) suggested the same reasons to explain the differences between green bonds and non-green bonds in the secondary market. More studies show that green bonds are paying a premium on the secondary market (Hachenberg and Schiereck, 2018; Partridge and Medda, 2018; Zerbib, 2019).

In parallel to the aspects found by Bos (2018) explaining the differences between yields, Zerbib (2019) concluded that the lack of bond issuances are one of the reasons of the negative premium. In addition, the author also understood that higher costs of labelling and the difficulty of creation new green bond projects are two barriers to the expansion of this market.

On the other hand, Karpf and Mandel (2018) focused their analysis only in U.S municipal bonds between the years of 2010 and 2016 and concluded that green bonds trade at a discount on the secondary market. However, in the same market scope, from 2013 to 2017, Partridge and Medda (2018) analysed the secondary market and primary market. In both cases, the authors found a negative small premium between green bonds and conventional. Moreover, the difference in the secondary market was more significant. They also suggested that the lower yield presented by green bonds in the primary market is more beneficial to financing green projects because the capital costs would be cheaper. It is advantageous for issuers since the green bond issuance has additional costs regarding green assessment and reporting.

If we aim our attention at the primary market, the market of our study, Kapraun and Scheins (2019) identify a significant negative premium of about 20-30 bps between green bonds and conventional bonds after 2009. This difference varies across issuers and currencies. They found that investors are willing to pay higher price for green bonds issued by governments and supranational institutions. Moreover, in their study green bonds revealed a higher negative premium for USD than EUR. They suggested that investors are willing to pay a higher premium for credible entities.

Along the same lines, Fatica et al. (2019) evaluated supranational, financial and non-financial institutions on the primary market. The authors found that from 2007 to 2018, green bonds are issued at a lower yield than non-green bonds. This premium was not identified in the entire sample because of the diversification of issuers that exists in the market. In addition, they also evaluated their results according to different categories. They found out a negative premium for green bonds issued by supranational and non-financial institutions. On the other hand, there is no statistical significance difference between yields when bonds are issued by financial institutions. They suggested that the possible reason to explain the difference in entities yield is that it is easier for non-financial companies to prove in a more transparent way that the project is green than for financial institutions. The information in the use of proceeds statement is essential for investors.

In a similar way, Baker, Bergstresser, Serafeim, and Wurgler (2018) focused their study on the U.S corporate and municipal green bonds market from 2010 to 2016. They confirmed that the green bonds have a lower yield than conventional bonds. This means that, a certain group of investors are willing to give up of some return to invest in green bonds. They also investigated what is the impact of external review on the pricing of green bonds and concluded that the premium is higher for bonds that are CBI certified. This could be explained by the inherent costs of certification.

The study of Larcker and Watts (2019) found out that from 2013 up to 2018 there are no significant differences between U.S. municipal green bonds and conventional peers in the primary market. Furthermore, the authors discovered that the U.S. municipal investors are not willing to sacrifice returns. In their studies, the authors understood that the green bonds and their conventional peers are almost perfect substitutes.

The previous authors, who studied primary market, used different methods to reach these conclusions. Kapraun and Scheins (2019) used a yield curve analysis. This analysis was possible because the authors focused their study in the U.S. municipal bonds and the bonds in this market are commonly issued in series. Thereby, it is easy to find bonds with the same issuer, credit rating, time of issue, official statement and use of proceed. On the other hand, a model of asset pricing was adopted by Fatica et al. (2019), Kapraun and Scheins (2019) and Baker et al. (2018) to detect differences between green bonds and conventional bonds.

The most common methodology in secondary market is through a matching method (Bos, 2018; Hachenberg and Schiereck, 2018; Zerbib, 2019). Following this approach, we avoid some issues regarding pooled regressions. In this methodology, we can compare

securities with same identical features and thus it is possible to isolate the only parameter that we are interested in (Crabbe and Turner, 1995). In our study we will follow Larcker and Watts (2019). They adopted the matching method and complemented it with a t-test and Wilcoxon tests to assess the statistical significance of results in the primary market. The matching criteria that we will apply on our methodology is the one shaped by Zerbib (2019). The idea consists in grouping green bonds with conventional bonds under the same specified characteristics. Thereby, we will find two conventional bonds with the same issuer, currency, rating, seniority, coupon type and approximately the same maturity, issue amount and issue date of each green bond. After this, we will build a synthetic bond from the two conventional bonds in order to get the best possible match for the respective green bond.

After reviewing the literature available and completing this analysis, it is possible to conclude that the studies about green bond markets have been increasing. The vast majority of the studies analysed are focused on global market (Bos, 2018; Fatica et al., 2019; Hachenberg and Schiereck, 2018; Kapraun and Scheins, 2019; Larcker and Watts, 2019; Preclaw and Bakshi, 2015; Zerbib, 2019) or in the U.S municipal bonds (Karpf and Mandel, 2018; Partridge and Medda, 2018) and corporate bonds (Baker et al., 2018).

For this reason, we consider that our study will complement the literature available and, at the same time, it will fulfil some gaps that might still exist.

Chapter 3. Data Selection: Green Bond Market

As we have already mentioned, this study is focused on three main points. The first topic dwells on the differences between yields of green bonds and conventional bonds. The second one consists in if these differences in yields varies across countries, sectors, currencies, ratings and term to maturity. And the last one focus on the influence that Paris Agreement and SDGs could have in yields.

In this chapter we will first explain the selection of the appropriate data concerning the green bonds used in this study. This choice consists of two different steps. We started by receiving a list of 5,837 green bonds issued until December 31, 2019 from the Climate Bond Initiative³ (CBI) database. The bonds available on the CBI database are those that at least 95% of their investment is to finance or refinance green projects and furthermore those that are certified under the Climate Bonds Taxonomy (Climate Bonds Initiative, 2019). The total data regarding these green bonds was partially received from the CBI database and then completed using the data available on Eikon.

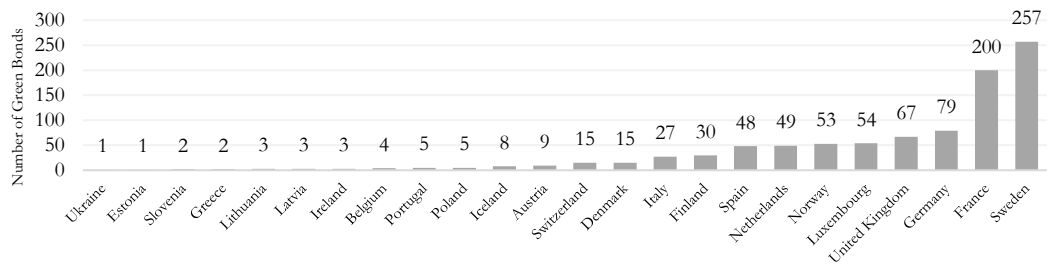
The first step consists of eliminating all the bonds that are not from European issuers⁴. After this selection, only 940 out of the almost 6,000 bonds fulfilled this requirement.

Before proceeding to the second step, we will first explain into more detail, with the help of **Graph 1**, how the green bond issuances are distributed across Europe and its evolution. The first green bond in Europe was issued in 2007 by European Investment Bank (EIB), a supranational institution with its headquarters in Luxembourg. Between June 2007 and May 2010 only supranational institutions issued green bonds. After that, a public agency for local government funding, in Norway, issued their first green bond. In 2012, Île-de-France, in France, was the first region in Europe to issue this type of bonds. According to **Graph 1**, Sweden is the country with the highest number of green bonds issuances. In the

³ Climate Bond Initiative is an international organisation focusing on the transition to a low carbon and climate resilient economy.

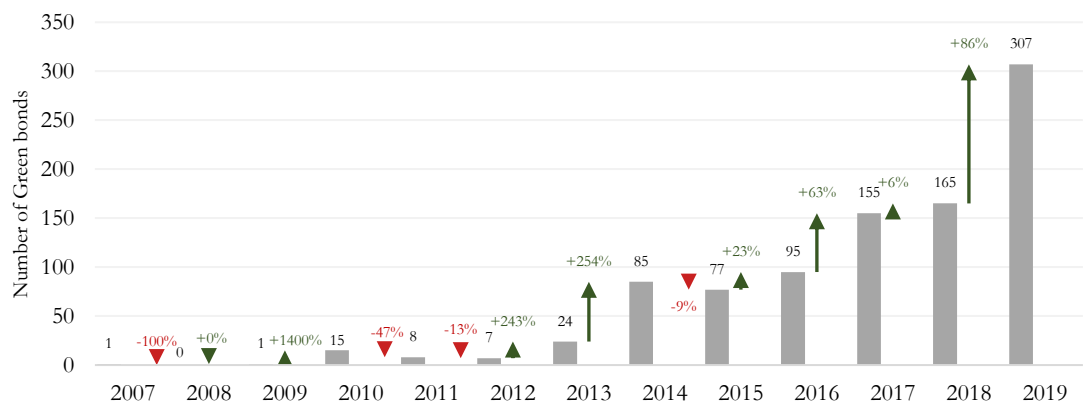
⁴ We assumed that an institution is European domiciled if in Eikon database their domicile is part of a European country. On CBI database were found 24 European issuers from Austria, Belgium, Denmark, Estonia, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Netherlands, Norway, Poland, Portugal, Slovenia, Spain, Sweden, Switzerland, United Kingdom and Ukraine.

same country were issued the first green city bond, by Gothenburg, and the first corporate bond, by Vasakronan, a real estate company. Both of them in 2013.



Graph 1- Number of Green Bonds domiciled in Europe. Between the first green bond issued, in 2007, and 2019, Sweden was the country where there were more issuances of green bonds.

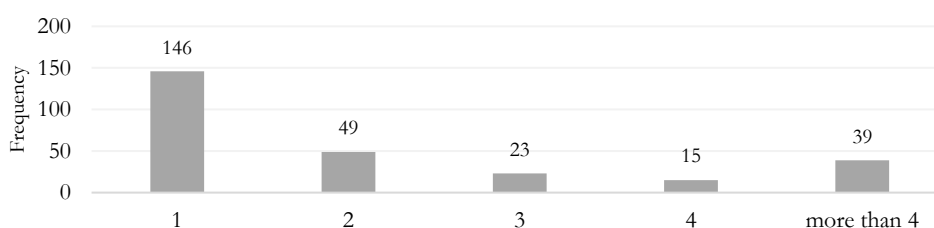
During the first years, the green bond market grew slowly as we can observe on **Graph 2**. This was a consequence caused by the 2007-2008 financial crisis. After a period of some fluctuations, the market started recovering between the years of 2013 and 2014 with a steep rise of 254%. In the following years the market continued to grow and expanded to more European countries. After 2015, the year when both the Paris Agreement took place and the SDGs were purposed, the market reacted positively, and the growth was significant. This evolution is an encouraging sign that the number of green projects is increasing every year.



Graph 2- Evolution of the green bond market in European countries between 2007 and 2019. In the first years the market suffered with the financial crisis but in 2013 started their recovery.

From 2007 to 2019, green bonds were issued by 272 European entities. **Graph 3** helps us to verify the number of issuances by each entity. The majority of issuers, more precisely 54%, issued only one green bond. This suggests that many issuers have started to introduce sustainability into their businesses.

On the other hand, 39 issuers issued more than four green bonds. **Table 1** completes this information with the 10 main European issuers. Credit Agricole is by far the entity with more issuances with a total amount of 111.



Graph 3- Number of green bonds per issuer. The majority of the issuers issued only one green bond. On the other hand, 126 issuers issued more than 2 bonds. It is a positive sign for the evolution of green bond market.

Issuer Name	Number of Issuances	Issuer Type
Credit Agricole CIB	111	Corporate
Vasakronan	58	Corporate
EIB	47	Supranational
EBRD	40	Supranational
KfW	24	Agency
NIB	19	Supranational
Fabege AB	18	Corporate
Iberdrola	15	Corporate
KBN	14	Agency
Atrium Ljungberg	11	Corporate

Table 1- Top 10 of European issuers between 2007-2019. Credit Agricole CIB issued its first green bond in 2013. In this year, a total of 10 green bonds was issued by this entity. The highest number of green bond issuances by this issuer was in 2014 and 2017. In both years were issued 29 green bonds.

In addition to the number of issuances, we can observe in the above table that corporate issuers are leading the top 10 of European issuers between 2007-2019.

Now that we have covered the evolution of the European market, we will now focus on the second and last step of our data selection. After removing all the green bonds that were not from companies domiciled in Europe, the final step consists in excluding all those bonds that are not plain vanilla fixed coupon bonds. After this selection, we ended up with a total number of 572 green bonds. This will match with an amount of 217,759 conventional bonds issued by institutions in Europe. The data concerning conventional bonds was extracted from Eikon database.

Chapter 4. Methodology

In this chapter, we will explain the methodology that we used on our study. This chapter is divided into five subchapters. We will start by defining what the matching method is and the rules that we took into consideration to choose the best possible match for each green bond. After building our final sample with green bonds and their correspondent synthetic bonds, we will do a summary of our final dataset. The last three subchapters will be focused on the methodology that we used to obtain the results to answer properly to our three research questions. Therefore, these subchapters are dedicated to the overall sample, the sample divided by segments and the sample before and after the Paris Agreement and SDGs, respectively.

4.1. Matching Method and Rules

The procedure that we will follow on our study is the matching method which compares similarity between a treated group (green bond) and a control group (conventional bond) with the same characteristics except the one that we are interested in studying (Stuart, 2010). One can consider this method straightforward, being this its major advantage. One of the main concerns of matching green bonds with conventional bonds is to lose too many observations that could influence our study. In fact, this approach could reduce the power of the analysis, however, groups similarity reduces extrapolations and increase comparison accuracy.

There is more than one matching method. We consider that the nearest neighbour matching is the most suitable for our study. Since finding a conventional bond with all the same characteristics of a green bond on our sample is unlikely, it is necessary to define some fair conditions to take into account and to have the most accurate possible comparison. To determine which fair conditions should be considered for our sample, we will follow the procedure that Zerbib (2019) used in his study about green bonds and conventional bonds in the secondary market. Although our restrictions and a part of our methodology will be similar to the ones adopted by Larcker and Watts (2019) in their analyse of primary market, we consider that Zerbib (2019) added more fair conditions to his study.

When it comes to matching, there are three main characteristics to be concerned with: issue date, maturity date and issue amount. As a workaround, we search for two conventional bonds with the smallest distance from green bond in order to build a synthetic

conventional bond. To control this distance, each conventional bond could not have a maturity date neither greater nor smaller than two years. This is due to the fact that, we found a conventional bond up to two years greater than a green bond and another one bond up to two years smaller. In the same way, the issue date could not exceed the 6 years. To avoid having bonds with a large difference in dimension, we defined that the issue amount had to vary between one-quarter and four times the green bond amount.

On the other hand, we define that green bonds and conventional bonds had to have the same issuer, currency, credit rating, seniority and coupon type. As we mentioned in the previous chapter, we excluded all the bonds that are not plain vanilla fixed coupon bonds, consequently the coupon type criterion was met. It is important to take into account the exchange-rate risk and idiosyncratic risk of comparing different countries and institutions and, for this reason, the issuer and currency should match (Piva, 2017). It should be also considered that a bond can be from the same issuer without the credit rating and seniority being always the same. Thus, we make sure that the bonds have the same seniority and at least the same credit rating from at least two different rating agencies (S&P, Moody's or Fitch)⁵. **Table 2** summarizes all the restrictions of our matching criteria.

Specific Characteristic	Condition
Issuer	Exact
Currency	Exact
Rating	Exact
Seniority	Exact
Coupon Type	Exact (fixed rate)
Maturity	± 2 years
Issue Amount	$\frac{1}{4} \leq GB \leq 4$ times
Issue Date	± 6 years

Table 2- Matching Characteristics. These are the characteristics that we took into consideration in choosing the two conventional bonds to build a synthetic one.

⁵ In order to avoid losing more observations, we considered bonds that have only one credit rating as well as bonds that have no credit rating. Therefore, we included, respectively, 14 bonds and 19 bonds under these conditions.

After applying all these restrictions, we find out that 119 green bonds matched with 238 conventional bonds⁶.

Hereupon, we are able to build a synthetic conventional bond with the same maturity of its comparable green bond. Thus, the next step is to find the yield at issuance of each synthetic bond. In order to do that, we linearly interpolate the two conventional bonds' yield⁷ to estimate the synthetic conventional bond according to the following equation:

$$\text{Yield}_{\text{SB}} = \text{Yield}_{\text{CB1}} + \frac{\text{Yield}_{\text{CB2}} - \text{Yield}_{\text{CB1}}}{D_1} * D_2$$

Where Yield_{SB} = Yield of the synthetic bond; $\text{Yield}_{\text{CB1}}$ = Yield of the first conventional bond; $\text{Yield}_{\text{CB2}}$ = Yield of the last conventional bond; D_1 = number of days between the two conventional bonds; D_2 = number of days between the first conventional bond and synthetic conventional bond.

After completing all these steps, we isolate the only parameter that we are interested in studying.

4.2. Descriptive statistics of the green and the conventional bonds

Table 3 summarizes the descriptive statistics of the sample that we used on our study. Looking for maturity rows, the average values of the two bonds are approximately the same, having green bonds an average of 7.36 years between the issuance and the maturity date, and synthetic bonds an average of 7.98 years. This indicates that our sample is coherent and well matched. Regarding the coupon rate, synthetic bonds present a slightly higher rate than green bonds. On average, the coupons are 1.29% and 1.07%, respectively. If we analyse the price difference between these two types of bonds, the first point is that on average both trade above par. The mean values are 99.64% for the green bonds and 99.84% for the synthetic ones. Another point is that across all the percentiles the values are similar.

In this table we have a primary preview of the differences between the yield of green bonds and synthetic bonds. On average, the synthetic bonds represent a higher yield than green bonds. The yield value of green bonds and their correspondent pairs is approximately

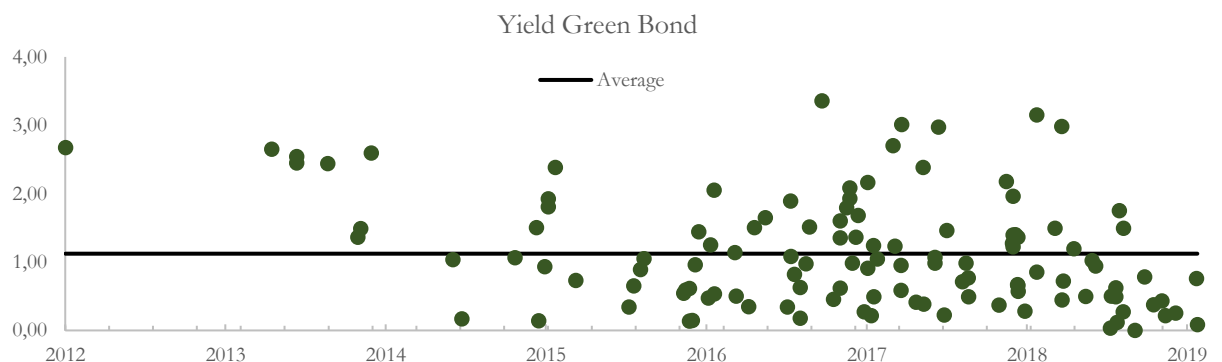
⁶ See **Annex 1** for more details including issuer characteristics, ISIN, amount issued, issue date, maturity date, years to maturity, coupon rate, yield, price and rating of all bonds.

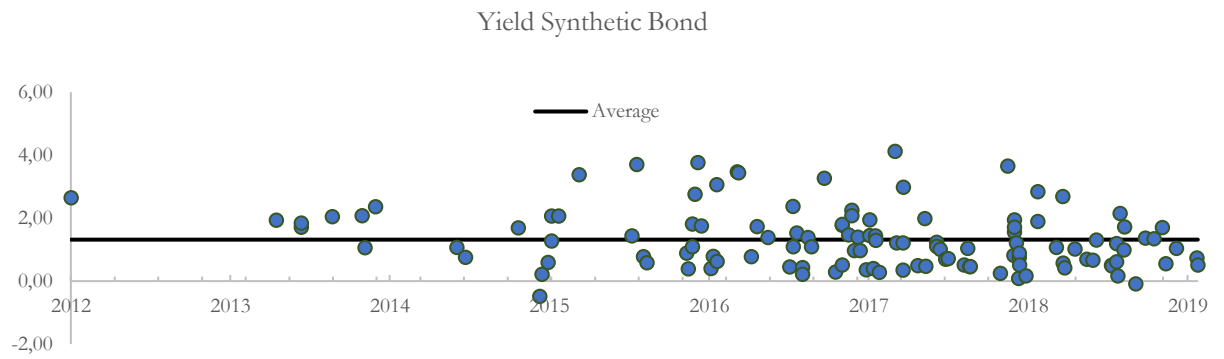
⁷ All the information about yields at issuance of green bonds and conventional bonds was downloaded from Thomson Reuters Eikon and bonds prospectus when available.

112 bps and 132 bps, respectively. The dispersion of the values to the mean are represented in the last column through the standard deviation. **Graph 4** is useful to complete this information and, at the same time, to have an overview of the dataset throughout the years. The behaviour is the same across the sample. A small standard deviation suggest that the values are not spread out. On our sample, the yield of synthetic bonds tends to be more disperse to the mean than the yield of green bonds.

	Min	P25	P50	Mean	P75	Max	SD
Green Bond							
Coupon Rate (%)	0.01	0.47	0.89	1.07	1.50	3.30	0.80
Yield (bps)	0.00	49.25	97.10	112.24	150.00	335.50	79.80
Price (% Par)	97.75%	99.45%	99.74%	99.64%	99.98%	100.71%	0.43%
Maturity (Years)	2.00	5.00	6.00	7.36	10.00	30.00	-
Synthetic Bond							
Coupon Rate (%)	0.08	0.57	1.09	1.29	1.76	4.03	0.91
Yield (bps)	-49.09	57.58	109.16	131.77	180.26	411.99	93.82
Price (% Par)	96.96%	99.45%	99.69%	99.84%	100.00%	119.49%	1.88%
Maturity (Years)	2.02	5.00	7.47	7.98	9.62	30.00	-

Table 3- Descriptive Statistic of our final dataset. Coupon rate is the yield paid by issuers on the bond's face value until maturity; Yield is the yield that the issuer will receive at maturity; Price is the price at which bond was seller at issuance; Maturity represents the number of years between issue date and maturity date.





Graph 4- Distribution of Yields throughout the years. Each graph represents the relationship between the mean and the issued yields.

4.3. Paired t-test: overall sample

In the previous subchapter we observed a slightly higher yield to synthetic conventional bonds when compared with green bonds. This indicates that the difference between the two means are negative (-20 bps). The equation to find the difference between the means was the following:

$$\text{Yield Difference} = \text{Yield}_{\text{GB}} - \text{Yield}_{\text{SB}}^8.$$

In order to assess the significance of the differential average yield between green and synthetic conventional bonds, we will run a t-test. In this approach, we will follow Larcker and Watts (2019) who used t-tests and Wilcoxon tests, for the mean and median, to find whether their sample had statistical significance or not. They also studied the difference between green bonds and conventional bonds in the primary market, but their paper was focussed on U.S. municipal market while our study focuses on European market. Our dataset is composed by 119 green bonds and 119 synthetic bonds computed through a linear interpolation between the two nearest conventional bonds.

⁸ We considered Yield_{GB} as the yield of green bonds and Yield_{SB} as the yield of synthetic bonds.

As our final sample follow a normal distribution⁹, we are able to run a paired t-test. Paired t-test is useful to compare the mean of two populations which one observation from one sample can be matched to another one from the other sample (Altman, 1990). Remember that this match was done at the beginning of this chapter following the characteristics summarized in **Table 2**.

Firstly, we have to state the hypotheses to be tested in our study. We define the null hypothesis as if there is no yield difference between green bonds and their correspondent synthetic bonds. On the other hand, the alternative hypothesis is the opposite.

Null Hypothesis (H_0): Average Yield_{Green Bond} – Average Yield_{Synthetic Bond} = 0

Alternative Hypothesis (H_1): Average Yield_{Green Bond} – Average Yield_{Synthetic Bond} \neq 0

Since we defined our alternative hypothesis without any specific condition, we will run a paired two tail test and the results are presented in the next chapter. The results will be essential to answer properly to our first research question.

4.4. Paired t-test: sample segments

After considering our main sample as a whole, we will divide the observations into five segments such as: country, sector of activity, currency, rating and term to maturity at issuance. This division will help us to understand how our sample is distributed as well as analyse the differences in yield between green bonds and conventional bonds according to the respective category. Thus, we will follow the same procedure defined to analyse the whole sample.

Therefore, the first step is to group our sample according to the different segments. Each segment is composed by 119 green bonds and 119 synthetic bonds. In the next step, we have to state the hypotheses of our tests in our study. Along the same line of the overall sample, we define our null hypothesis as if there is no yield difference between green bonds and synthetic bonds in each different segment. Thereby, the alternative hypothesis is described as if there is any difference.

Null Hypothesis (H_0): Average Yield_{Green Bond} – Average Yield_{Synthetic Bond} = 0

⁹ To determine whether our sample is normally distributed or not, we use EViews to run Jarque-Bera test. As the probability value (equals to 0.366720) is greater than 0.05 (significance level) we accept the null hypothesis which means that our sample follow a normal distribution.

Alternative Hypothesis (H_1): $\text{Average Yield}_{\text{Green Bond}} - \text{Average Yield}_{\text{Synthetic Bond}} \neq 0$

After defining the hypotheses, we are able to run a paired t-test in order to assess the significance of our results. The results of this test will be fundamental to draw conclusions to our second research question.

4.5. Paired t-test: before and after Paris Agreement and SDGs

As we have already mentioned, our investigation is focused on three main points. The methodology that we will follow on the first and second topics was defined in the previous two subchapters. Hence, this last subchapter is dedicated to the last research question. Here, we want to understand the influence that the Paris Agreement and SDGs may have had in yields. In this regard, we will split our sample in two subsamples. These two events occurred in 2015. For this reason, one subsample will contemplate issuances from 2012 to 2015 and the second one from 2016 up to 2019. Thus, the first step is to divide our sample into two others. The subsamples are composed by 17 bonds and 102 bonds, respectively. For a more thorough analysis, we will additionally analyse each year of the second subsample.

In order to assess the significance of the differential average yield between green and synthetic conventional bonds, we will run a paired t-test. For this, it is necessary to first define our null and alternative hypothesis. The null hypothesis is described as if there is no yield difference between green bonds and their synthetic correspondent. This means that the yield of green bonds is equal to the yield of their comparable non-green bonds. On the other hand, our alternative hypothesis is defined as there is a difference between both average yields.

Null Hypothesis (H_0): $\text{Average Yield}_{\text{Green Bond}} - \text{Average Yield}_{\text{Synthetic Bond}} = 0$

Alternative Hypothesis (H_1): $\text{Average Yield}_{\text{Green Bond}} - \text{Average Yield}_{\text{Synthetic Bond}} \neq 0$

In the next chapter, we will present the results of this methodology. These tools will help us to answer properly to our third research question.

Before moving on to the results of our methodology, it is important to remember what the goals of this study and what has been done so far to achieve them. Therefore, we started this chapter by defining the fair conditions which will be used to compare green bonds and conventional bonds. After applying all the restrictions, we found 119 green bonds

to be matched with 238 conventional bonds. Subsequently, we calculated through a linear interpolation the yield of each comparable synthetic conventional bond in order to have the same maturity of green bond. Finally, we summarized, through a descriptive statistic our final data and defined how we are going to test the significance of our results. This will help us to conclude if there is any yield differential between green bonds when comparing with conventional bonds in the general market and afterwards in the specific market segments. And lastly, we will analyse the influence that Paris Agreement and SDGs may have had in yields.

Chapter 5. Results

This chapter reports the findings of our methodology. This information will help us to answer appropriately to our research questions. The first subchapter will be a whole sample analysis of the difference between green bonds and synthetic conventional bonds. In addition to considering the sample as a whole, we will split the sample according to five segments: country, sector of activity, currency, rating and term to maturity at issuance. In the last section, we will assess the influence that Paris Agreement and SDGs may have had in yields. Therefore, we will divide our sample in two subsamples and analyse the results. As Paris Agreement and SDGs were adopted in 2015, one subsample is regarding issuances from 2012 to 2015 and another part focus on 2016 up to 2019.

5.1. Results from Matching Method: overall sample

In order to reach this stage, it was fundamental to complete some steps to ensure that our two samples were in the appropriate conditions to be compared. After matching all the bonds, we runned a paired t-test to determine if the difference between the average yields of green bonds and synthetic conventional bond is significant. We defined our null hypothesis as the mean difference being equal to zero. This means that the null hypothesis is always assumed as true until evidence suggests otherwise. The results of our first test are available in **Table 4**.

	Green Bonds	Synthetic Bonds
Mean (bps)	112.24	131.77
Variance	0.64	0.88
Observations	119	119
Difference (bps)		-19.53
p-value		0.09
t-statistic		-1.70

Table 4- Results of paired two tail t-test of the whole sample. This table tests the significance of the difference in the mean yield between green bonds and synthetic conventional bonds with null hypothesis $\text{Average Yield}_{\text{Green Bond}} - \text{Average Yield}_{\text{Synthetic Bond}} = 0$. The results are focussed on the whole sample from 2012 and 2019.

The difference between means indicate that on average synthetic conventional bonds have higher yield than green bonds (approximately 20bps). The p-value analysis suggests that the difference was not identified in the whole sample. Nevertheless, in our sample the difference of means in the yield of green and conventional bonds differ from zero with a statistical significance of 10 percent. Therefore, the majority of green bonds are issued at a negative premium when comparing with their paired matches.

Our results are consistent with Baker et al. (2018). They found out that US green municipal bonds are issued at a negative premium in the primary market. Moreover, they also suggest that the difference between bonds is more substantial when the green bonds are certified by CBI. In the same line, a study conducted by Fatica et al. (2019), who focus on all markets, indicate that green bonds trade at a moderate premium but this is not precise in the full sample. Considering green bonds issued worldwide as well, Kapraun and Scheins (2019) concluded that green bonds have lower yields (between 20 and 30 bps) than their comparable bonds.

On the other hand, Larcker and Watts (2019) found a statistically significant small negative difference (0.459 bps) between green bonds and conventional bonds. However, they considered the differences to be economically small as well as the results are affected by a few outliers. For this reason, they treated their results as if there is no evidence of premium.

5.2. Results from Matching Method: sample segments

After considering our main sample as a whole, we divided the observations in five segments. The first one is the country where each paired of bonds was issued. In our sample we have fifteen different countries in Europe. In addition, we analysed the difference between means by sectors. We found six different sectors to take into account. Another important segment is the currency of issue, and here, we have seven different types of currencies to explore. The rating is also part of this division and we found five different ratings to analyse. Lastly, we split our sample by three types of maturity: short term (less than five years), intermediate term (between five and twelve years) and long term (more than twelve years). The results about each country, sector, currency, rating and maturity are available in **Table 5**.

	Number	Average GB (bps)	Average SB (bps)	Average Difference (bps)	P-value
Countries					
Belgium	1	98.10	103.31	-5.21	-
Denmark	1	81.70	152.18	-70.48	-
Finland	3	47.77	57.73	-9.96	0.57
France	17	128.62	141.69	-13.08	0.40
Germany	26	75.67	81.23	-5.56	0.54
Ireland	1	139.90	121.20	18.70	-
Italy	8	142.54	176.58	-34.04	0.39
Luxembourg	14	171.25	220.79	-49.54	0.16
Netherlands	6	148.12	260.02	-111.90	0.11
Norway	4	127.95	116.85	11.10	0.49
Portugal	2	119.35	169.94	-50.59	0.63
Spain	4	167.00	112.56	54.44	0.03
Sweden	28	93.54	102.41	-8.87	0.54
Switzerland	3	27.74	71.39	-43.66	0.18
United Kingdom	1	192.90	207.37	-14.47	-
Sector					
Agency	26	109.15	134.20	-25.04	0.06
Corporate	62	102.72	114.44	-11.72	0.28
Government	1	139.90	121.20	18.70	-
Municipal	6	110.30	99.12	11.18	0.52
Other Government	6	110.97	136.47	-25.50	0.28
Supranational	18	145.71	197.87	-52.16	0.07
Currency of issue					
AUD	4	202.55	213.78	-11.23	0.65
CHF	3	27.74	71.39	-43.66	0.18
EUR	67	101.77	123.46	-21.69	0.06
GBP	1	150.00	173.14	-23.14	-
NOK	2	138.00	126.71	11.29	0.67
SEK	31	107.52	119.38	-11.86	0.40
USD	11	165.99	201.16	-35.17	0.13
Rating					
AAA	54	117.77	141.47	-21.93	0.04
AA	14	96.64	113.85	-17.22	0.47
A	21	112.02	133.95	-23.70	0.29
BBB	11	130.06	144.68	-14.61	0.51
NR	19	104.77	120.58	-15.81	0.44
Maturity at issuance					
Short (< 5 years)	14	133.56	134.01	-0.45	0.97
Intermediate (5 to 12 years)	96	107.91	128.67	-20.77	0.02
Long (> 12 years)	9	125.36	161.35	-36.00	0.06

Table 5- Results of paired two tail t-test of divided by segments. This table tests the significance of the difference in the mean yield between green bonds and synthetic

conventional bonds with null hypothesis $\text{Average Yield}_{\text{Green Bond}} - \text{Average Yield}_{\text{Synthetic Bond}} = 0$. The results are divided into five different segments: countries, sector, currency, rating and term to maturity. The second column presents the number of bonds issued in each subsegment. The next three columns indicate the average yield in basis points of green bonds (GB) and synthetic bonds (SB), respectively, and the difference between them. The p-value are presented in the last column.

5.2.1. Country

Belgium, Denmark, Ireland and United Kingdom just have one paired of bonds issued in our sample, and thus we cannot draw any type of conclusion about these countries. In all other countries, except from Spain, we cannot reject the null hypothesis because there is no statistical significance difference between green bonds and synthetic conventional bonds. Regarding Spain, the difference between means are statistically significant different from zero. This suggest that green bonds have a higher yield (approximately 54 bps) than synthetic conventional bonds. Despite being a small size sample, we consider this positive difference a hopeful prediction.

5.2.2. Sector

Green bonds issued in agency and supranational institutions present a statistically significant negative difference (approximately 25 bps and 52 bps, respectively) when compared with synthetic conventional bonds. Fatica et al. (2019) found out the same negative premium in the case of supranational institutions. Their study only focused on supranational, non-financial and financial institutions. Regarding non-financial and financial institutions, we included both institutions in corporate sector. The results in the corporate sector are not statistically significant, that is, we cannot identify the difference in the whole sample. Fatica et al. (2019) reached out the same conclusion about financial institutions but the opposite regarding non-financial institutions. Similarly, to the corporate sector, in municipal and other government sector there is no statistical significance in our results. In the same line, Kapraun and Scheins (2019) found a negative premium for bonds issued by supranational institutions as well as governments. For governments we only have a single paired of bonds.

5.2.3. Currency of issue

In our sample, EUR is the only currency with a statistically significant value different from zero. This fact suggests that the green bonds issues in this currency present a negative premium (approximately 22 bps). Kapraun and Scheins (2019) found out that green bonds revealed a higher negative premium for USD than EUR. We cannot confirm this conclusion because the result of USD is not statistically significant.

5.2.4. Rating

In our matching rules, we ensured that our comparable bonds have the same credit rating from at least two different rating agencies (S&P, Moody's or Fitch). We followed Zerbib (2019) to attribute just one rating to each paired of bonds. We started by defining that the final rating of each bond could be AAA, AA, A, BBB, BB or Non-rated (NR). The next step was to remove all positive and negative signs that S&P and Fitch ratings had. Lastly, we analysed and selected the highest rating in the three rating agencies. For example, let us suppose that a certain pair of bonds is rated as BBB+, Baa1 and A- by S&P, Moody's and Fitch, respectively. In this case, we attribute A as the final rating¹⁰. In the **Table 5**, the ratings are ordered from the highest rating to the worst rating (not rated in this case). Only the green bonds rated with triple A show a difference in means significantly different from zero. This difference indicates that synthetic conventional bonds have a higher yield (approximately 22 bps) than green bonds. Most institutions rated with AAA are agencies and supranational. As we analysed before, these two institutions also issued green bonds at a negative premium. Therefore, this result is expectable. Regarding other ratings, the value is not statistically significant.

5.2.5. Maturity at issuance

Maturities are divided in three subsamples: short-term includes all bonds with a maturity less than five years, intermediate-term maturity between five and twelve years and bonds with more than twelve years are considered to be long-term. Both the intermediate term and long term present a statistically significance in their maturities. In both cases, the negative mean

¹⁰ See **Annex 1** for all sample.

suggest that green bonds are issued at a negative premium. On the other hand, there is no statistical significance between the average yield for bonds issued with a short-term maturity.

5.3. Results from Matching Method: before and after Paris Agreement and SDGs

In this last subchapter we analysed the influence that Paris Agreement and SDGs may have had in yields. These two events took place in 2015. Therefore, we divide our sample in two other subsamples, one from 2012 to 2015 and another for bonds that started in 2016 up to 2019. After dividing the sample, we run a paired t-test in order to calculate the statistical significance difference between mean yield of green bonds and synthetic conventional bonds. The results are available in **Table 6**.

	2012-2015		2016-2019	
	Green Bonds	Synthetic Bonds	Green Bonds	Synthetic Bonds
Mean (bps)	171.22	146.38	102.41	129.34
Variance	0.71	0.69	0.56	0.91
Observations	17	17	102	102
Difference (bps)		24.83		-26.92
p-value		0.14		0.00
t-statistic		1.56		-3.36

Table 6- Results of paired two tail t-test of the two subsamples. This table tests the significance of the difference in the mean yield between green bonds and synthetic conventional bonds with null hypothesis $\text{Average Yield}_{\text{Green Bond}} - \text{Average Yield}_{\text{Synthetic Bond}} = 0$. One subsample is regarding the years 2012-2015 and the other one regarding 2016- 2019.

After considering the first subsample from 2012 to 2015, we conclude that there is no statistical significance between the average yield and for this reason, we cannot draw any type of conclusion about this period of time. On the other hand, the mean has statistical significance between the years 2016 until 2019. During these this years, green bonds present a smaller yield (approximately 27 bps) than synthetic conventional bonds. The second period (2016-2019) is consistent with results obtained in the matching method. This could be explained by the substantial higher number of observations during the second period. For a more thorough analysis, we additionally ran a paired t-test for each year after 2015. This

supplementary test helped us to identify if the green bonds issued a negative premium in all the years after Paris Agreement and SDGs. **Table 7** shows the results.

	2016	2017	2018	2019
Observations	16	31	31	24
Difference (bps)	-92.22	-23.14	1.22	-24.63
p-value	0.01	0.11	0.91	0.01
t-statistic	-3.00	-1.67	0.11	-2.74

Table 7- Results of paired two tail t-test of each year after Paris Agreement and SDGs. This table tests the significance of the difference in the mean yield between green bonds and synthetic conventional bonds with null hypothesis $\text{Average Yield}_{\text{Green Bond}} - \text{Average Yield}_{\text{Synthetic Bond}} = 0$.

After analysing the table, we found out a statistically significant negative yield difference in the years of 2016 and 2019. On the other hand, the p-value for the years of 2017 and 2018 are not strong enough to reject the null hypothesis of the difference between means being zero.

In this chapter, we analysed all the results obtained from our matching method applied to three different situations. Firstly, we consider the total sample, then the case where we divided our sample into five distinct categories, and finally we observed what was the impact that the Paris Agreement and the SDGs had.

Chapter 6. Conclusion

In this century, the concerns about climate change has been increasing and therefore it is making people much more aware about this problem. A change to a more sustainable world needs capital and investments. Thus, the financial system can have an important role and contribute to this transition. During the last years, there has been an expansion of the green bond market and this has led to a growth of studies about this field. Thereby, our analysis helps to fulfil some gaps that exist in the available literature.

Our study is focused on three main points. The first topic dwells on the differences between yields of green bonds and conventional bonds. The second one consists in if these differences in yields varies across countries, sectors, currencies, ratings and term to maturity. And the last one focus on the influence that Paris Agreement and SDGs could have in yields.

The findings will enrich the literature available on the performance of green bond market when compared with conventional bonds. Since our main focus is in the European market and as there are not many studies that focus on this, our research may help potential participants to enter into the market or even contribute to those who are already there. In addition, since our green bond data was provided by the Climate Bond Initiative, we are sure that the funding is for sustainable projects and there is no possibility of greenwashing.

In order to compare green bonds with conventional bonds in some appropriate way, we matched each green bond with two conventional bonds according to a certain matching rule. After this matching, we built a synthetic conventional bond from these two conventional bonds. At the end, our sample was composed by 119 green bonds and 119 synthetic conventional bonds.

The next step was to determine the average yield difference between green bonds and their comparable synthetic pair. After, we ran a paired t-test to calculate the significance of results. Along the same line of previous studies, we found a significant small premium of 20 bps, approximately. This means that a group of investors are willing to give up of some return to invest in green bonds.

In order to deepen our investigation, we divided our sample in five different segments: country, sector of activity, currency, rating and term to maturity at issuance. Despite having a small sample, green bonds issued in Spain had a higher yield when comparing to conventional ones. Only this country presented statistical significance between the average yields.

Regarding the sector, only the difference between bonds issued by agencies and supranational institutions are statistically significant. We found a premium for green bonds issued by these two types of institutions. However, supranational institutions are traded at an even greater premium. Most institutions rated with AAA are agencies and supranational. For this reason, the premium was also negative for green bonds.

In our dataset, the majority of bonds are issued in EUR. Green bonds issued in this currency had a lower significant yield than their conventional pair. In the same way, green bonds with intermediate-term of maturity and also long-term of maturity presented a negative premium, as well.

The Paris Agreement and the 2030 Agenda for Sustainable Development Goals, adopted in 2015, are two relevant measures towards the transition for a sustainable low carbon future. To meet these agreements, it is necessary investment and the issuance of green bonds can help to finance projects of this nature. Our last analysis focused on the impact that these two events had on green bonds. After 2015, the negative premium started to decrease. In 2019 the difference was, approximately, 25 bps while in 2016 the difference was, roughly 92 bps. Although the yield for green bonds is even lower than the yield of conventional bonds, the number of issuances is growing, and the premium is decreasing. Therefore, it is a hopeful prediction.

Our findings agree with other studies which use a data sample greater than ours. However, our green bond sample only counts 13% of the total European green bond issuances before December 31, 2019. For this reason, we consider that the sample size is a limitation for more accurate conclusions. In addition, we found that European market is following the same path as other markets. This means that the investors are willing to sacrifice some return in order to invest in this type of bonds.

Nonetheless, our study contributes to the increase of the literature available on this field. We considered that it was an extremely relevant topic to study because the green bond market is constantly growing and attracting new investors to the market. There are not many studies that focus in European market and for this reason it is an opportunity to promote new studies in this field. Since we focused our study in the primary market, our first recommendation for future study is to analyse the secondary one. Along the same lines, it will be also interesting to study other markets where the green bond market is growing. I hope that the literature in this field advances in order to keep up the expansion of the green bond market.

References

- Altman, D. G. (1990). *Practical Statistics For Medical Research*. London: Taylor & Francis Ltd.
- Baker, M., Bergstresser, D., Serafeim, G., and Wurgler, J. (2018). Financing the Response to Climate Change: The Pricing and Ownership of U.S. Green Bonds. *NBER Working Paper*.
- Ban Ki-moon, U. S.-G. (2014). *Climate Week NYC*. Paper presented at the Climate Week NYC, New York City.
- Bauer, R., and Hann, D. (2010). Corporate environmental management and credit risk. *SSRN Electronic Journal*.
- Bos, B. (2018). *Unravelling the Green Bond Premium*. NN investment partners.
- Chava, S. (2014). Environmental externalities and cost of capital. *Management Science*, 60(9), pp. 2223-2247.
- Chen, R. C. Y., Hung, S.-W., and Lee, C.-H. (2017). Does corporate value affect the relationship between Corporate Social Responsibility and stock returns? *Journal of Sustainable Finance & Investment*, 7(2), pp. 188-196.
- Climate Bonds Initiative. (2019). *Climate Bonds Taxonomy*. Climate Bonds Initiative.
- Climate Bonds Initiative. (2020). *Green Bonds Global State of the Market 2019*. Climate Bonds Initiative.
- Crabbe, L. E., and Turner, C. M. (1995). Does the Liquidity of a Debt Issue Increase with Its Size? . *The Journal of Finance*, 50(5), pp. 1719-1734.
- EY. (2016). *Green Bonds: A fresh look at financing green projects*. EY.
- Fatica, S., Panzica, R., and Rancan, M. (2019). The pricing of green bonds: are financial institutions special? *JCR Working Papers in Economics and Finance*, 2019/07.
- Filkova, M., Frandon-Martinez, C., and Giorgi, A. (2018). *Green Bonds: The state of the market 2018*. Climate Bonds Initiative.
- Flammer, C. (2015). Does Corporate Social Responsibility Lead to Superior Financial Performance? A Regression Discontinuity Approach. *Management Science*, 61(11), pp. 2549-2824.
- Flammer, C. (2020). Corporate Green Bonds. *SSRN Electronic Journal*.
- Glomsrød, S., and Wei, T. (2018). Business as unusual: The implications of fossil divestment and green bonds for financial flows, economic growth and energy market. *Energy for Sustainable Development*, 44(3), pp. 1-10.
- Hachenberg, B., and Schiereck, D. (2018). Are green bonds priced differently from conventional bonds? *Journal of Asset Management*, 19(6), pp. 371–383.
- Harrison, C. (2019). *Green Bond Pricing in the Primary Market July-December 2018*. Climate Bonds Initiative.
- Kapraun, J., and Scheins, C. (2019). (In)-Credibly Green: Which Bonds Trade at a Green Bond Premium? *SSRN Electronic Journal*.
- Karpf, A., and Mandel, A. (2018). The changing value of the 'green' label on the US municipal bond market. *Nature Climate Change*, 8(2), pp. 161-165.
- Larcker, D. F., and Watts, E. (2019). Where's the Greenium? *SSRN Electronic Journal*.
- Oh, S., Hong, A., and Hwang, J. (2017). An analysis of CSR on firm financial performance in stakeholder perspectives. *Sustainability (Switzerland)*, 9(6), pp. 1023.
- Partridge, C., and Medda, F. (2018). Green Premium in the Primary and Secondary U.S. Municipal Bond Markets. *SSRN Electronic Journal*.
- Piva, E. (2017). *The Added Value of Green Bonds*. (Master degree). Erasmus University Rotterdam, Semantic Scholar. Retrieved from <https://api.semanticscholar.org/CorpusID:199403891> accessed on April 15, 2020.

- Porter, M. E., and van der Linde, C. (1995). Toward a New Conception of the Environment-Competitiveness Relationship. *The Journal of Economic Perspectives*, 9(4), pp. 97-118.
- Preclaw, R., and Bakshi, A. (2015). *The Cost of Being Green*. Barclays.
- Rogelj, J., den Elzen, M., Höhne, N., Fransen, T., Fekete, H., Winkler, H., Chaeffer, R. S., Ha, F., Riahi, K., and Meinshausen, M. (2016). Paris Agreement climate proposals need a boost to keep warming well below 2 degrees C. *Nature*, 534(7609), pp. 631-639.
- Saeidi, S. P., Sofian, S., Saeidi, P., Saeidi, S. P., and Saaeidi, S. A. (2015). How does corporate social responsibility contribute to firm financial performance? The mediating role of competitive advantage, reputation, and customer satisfaction. *Journal of Business Research*, 68(2), pp. 341-350.
- Savaresi, A. (2016). The Paris Agreement: A New Beginning? *Journal of Energy & Natural Resources Law* 34(1), pp. 16-26.
- Schoenmaker, D., and Schramade, W. (2019). *Principles of Sustainable Finance* (O. U. Press Ed.).
- Stuart, E. A. (2010). Matching methods for causal inference: A review and a look forward. *Statistical Science*, 25(1), pp. 1-21.
- Sun, W., and Cui, K. (2014). Linking corporate social responsibility to firm default risk. *European Management Journal*, 32(2), pp. 275-287.
- Tang, D. Y., and Zhang, Y. (2020). Do shareholders benefit from green bonds? *Journal of Corporate Finance*, forthcoming.
- Tolliver, C., Keeley, A. R., and Managi, S. (2019). Green bonds for the Paris agreement and sustainable development goals. *Environmental Research Letters*, 14(6), 064009.
- Tsoutsoura, M. (2004). *Corporate Social Responsibility and Financial Performance*. UC Berkeley. <https://escholarship.org/uc/item/111799p2>.
- Xiao, Y., Faff, R., Gharghori, P., and Lee, D. (2013). An Empirical Study of the World Price of Sustainability. *Journal of Business Ethics*, 114(2), pp. 297-310.
- Zerbib, O. D. (2019). The effect of pro-environmental preferences on bond prices: Evidence from green bonds. *Journal of Banking & Finance*, 98(C), pp. 39-60.
- Zhou, X., and Cui, Y. (2019). Green bonds, corporate performance, and corporate social responsibility. *Sustainability (Switzerland)*, 11(23), pp. 27.
- Ziegler, A., Schröder, M., and Rennings, K. (2007). The effect of environmental and social performance on the stock performance of european corporations. *Environmental and Resource Economics*, 37(4), pp. 661-680.

Annexes

Issuer	Type	ISIN	Amount millions	Issue Date	Maturity	Y R	Cpn (%)	Yield	Rating			
									S&P	Moody's	Fitch	
ABN Amro Bank												
Domicile: Netherlands	G	XS1422841202	500	31/05/2016	31/05/2022	6	0.62	0.65	A	A1	A+	
Sector: Corporate	C	XS1856791873	1250	17/07/2018	17/07/2023	5	0.5	0.61	A	A1	A+	
Currency: EUR	C	XS0765299572	1250	28/03/2012	28/03/2022	10	4.13	4.18	A	A1	A+	
Seniority: senior preferred												
ADF												
Domicile: France	G	XS1111084718	1000	17/09/2014	17/09/2024	10	1.38	1.49	AA	-	AA	
Sector: Agency	C	XS0936339208	1000	27/05/2013	27/05/2025	12	2.25	2.29	AA	-	AA	
Currency: EUR	C	FR0013220902	850	29/11/2016	30/04/2024	7	0.38	0.38	AA	-	AA	
Seniority: senior unsecured												
Akademiska Hus												
Domicile: Sweden	G	XS2015238855	1000	20/06/2019	20/06/2024	5	0.23	0.27	AA	-	-	
Sector: Agency	C	XS2153613653	600	08/04/2020	11/04/2023	3	0.17	0.50	AA	-	-	
Currency: SEK	C	XS1170575002	500	26/01/2015	26/01/2026	11	2.65	1.65	AA	-	-	
Seniority: senior unsecured												
ALD SA												
Domicile: France	G	XS1892240281	500	11/10/2018	11/10/2022	4	1.25	1.27	BBB+	-	A-	
Sector: Corporate	C	XS1647404554	600	18/07/2017	18/07/2022	5	0.88	0.92	BBB+	-	-	
Currency: EUR	C	XS2029574634	500	18/07/2019	18/07/2023	4	0.38	0.46	BBB+	-	A-	
Seniority: senior unsecured												
BBVA												
Domicile: Spain	G	XS1820037270	1000	14/05/2018	14/05/2025	7	1.38	1.46	A-	A3	A-	
Sector: Corporate	C	XS2101349723	1250	14/01/2020	14/01/2027	7	0.5	0.62	BBB	Baa2	A-	
Currency: EUR	C	XS1678372472	1500	11/11/2017	11/09/2022	4	0.75	0.87	BBB	Baa2	A-	
Seniority: non-preferred												
Berlin Hyp												
Domicile: Germany	G	DE000BHY0GP5	500	05/05/2015	05/05/2022	7	0.13	0.17	-	Aaa	-	
Sector: Corporate	C	DE000BHY0BC4	500	22/02/2016	22/02/2023	7	0.25	0.29	-	Aaa	-	
Currency: EUR	C	DE000BHY0AJ1	500	23/04/2014	23/04/2021	7	1.00	1.35	-	Aaa	-	
Seniority: senior secured												
Berlin Hyp												
Domicile: Germany	G	DE000BHY0GU5	500	26/09/2016	26/09/2023	7	0.5	0.59	-	A2	A+	
Sector: Corporate	C	DE000BHY0A56	750	22/01/2015	22/01/2025	10	1.25	1.26	-	A2	-	
Currency: EUR	C	DE000BHY0BR2	200	09/08/2019	09/08/2022	3	0.01	-0.36	-	A2	A+	
Seniority: senior unsecured												
Berlin Hyp												
Domicile: Germany	G	DE000BHY0GH2	500	14/06/2017	23/10/2023	6	0.13	0.17	-	Aaa	-	
Sector: Corporate	C	DE000BHY0BC4	500	22/02/2016	22/02/2023	7	0.25	0.29	-	Aaa	-	
Currency: EUR	C	DE000BHY0MT5	500	05/09/2017	05/01/2024	6	0.13	0.19	-	Aaa	-	
Seniority: senior secured												

Berlin Hyp Domicile: Germany Sector: Corporate Currency: EUR Seniority: senior secured	G	DE000BHY0GC3	500	22/10/2018	22/10/2025	7	0.63	0.67	-	Aaa	-
	C	DE000BHY0B14	500	17/02/2020	17/02/2027	7	0.01	-0.20	-	Aaa	-
	C	DE000BHY0BE0	325	03/05/2016	03/05/2024	8	0.38	0.40	-	Aaa	-
Berlin Hyp Domicile: Germany Sector: Corporate Currency: EUR Seniority: senior secured	G	DE000BHY0GL4	500	17/07/2019	19/07/2027	8	0.01	0.00	-	Aaa	-
	C	DE000BHY0B14	500	17/02/2020	17/02/2027	7	0.01	-0.20	-	Aaa	-
	C	DE000BHY0BQ4	502	29/05/2019	29/05/2029	10	0.34	0.42	-	Aaa	-
BNG Bank Domicile: Netherlands Sector: Agency Currency: AUD Seniority: senior unsecured	G	AU3CB0260321	25	31/01/2019	31/07/2029	10	2.95	2.98	AAA	Aaa	AAA
	C	XS1984950003	36	21/05/2018	17/07/2028	10	3.30	2.65	AAA	Aaa	AAA
	C	XS1969695359	63	27/03/2019	27/03/2030	11	2.20	2.71	AAA	Aaa	-
BNP Paribas Domicile: France Sector: Corporate Currency: EUR Seniority: senior preferred	G	XS1527753187	500	01/12/2016	01/06/2022	5	0.50	0.53	A+	Aa3	AA-
	C	FR0013417326	165	20/04/2019	30/04/2022	3	0.11	0.11	A+	Aa3	AA-
	C	XS0847433561	1000	24/10/2012	24/10/2022	10	2.88	2.90	A+	Aa3	AA-
BNP Paribas Domicile: France Sector: Corporate Currency: EUR Seniority: senior non-preferred	G	XS1808338542	500	17/04/2018	17/04/2024	6	1.00	1.07	A-	Baa1	A+
	C	XS1637277572	750	27/06/2017	27/06/2024	7	1.00	1.08	A-	Baa1	A+
	C	XS1823532640	700	22/05/2018	22/11/2023	5	1.13	1.15	A-	Baa1	A+
BNP Paribas Domicile: France Sector: Corporate Currency: EUR Seniority: senior non-preferred	G	FR0013405537	750	28/02/2019	28/08/2024	5	1.13	1.19	A-	Baa1	A+
	C	XS1637277572	750	27/06/2017	27/06/2024	7	1.00	1.08	A-	Baa1	A+
	C	FR0013444759	1000	04/09/2019	04/09/2026	7	0.13	0.23	A-	Baa1	A+
Canton of Geneva Domicile: Switzerland Sector: Other Government Currency: CHF Seniority: senior unsecured	G	CH0387879049	200	29/11/2017	28/11/2031	13	0.5	0.49	AA-	-	-
	C	CH0149317056	175	05/03/2012	05/03/2032	20	1.5	1.44	AA-	-	-
	C	CH0485261579	160	29/04/2020	27/02/2030	9	0.36	0.31	AA-	-	-
Cassa Depositi e Prestiti SpA Domicile: Italy Sector: Agency Currency: EUR Seniority: senior unsecured	G	IT0005346579	500	27/09/2018	27/09/2023	5	2.13	2.18	BBB	Baa3	BBB
	C	IT0004968332	250	15/11/2013	15/11/2023	10	4.13	4.29	BBB	Baa3	BBB
	C	IT0005408080	500	20/04/2020	20/04/2023	3	1.50	1.55	BBB	Baa3	BBB
City of Gothenburg Domicile: Sweden Sector: Municipal Currency: SEK Seniority: senior unsecured	G	XS1433082861	1000	15/06/2016	15/06/2022	6	0.89	0.89	AA+	Aaa	-
	C	XS1405911576	1350	10/05/2016	10/05/2021	5	0.83	0.83	AA+	Aaa	-
	C	XS1696665048	350	11/10/2017	11/10/2022	5	0.75	0.75	AA+	Aaa	-

City of Gothenburg Domicile: Sweden Sector: Municipal Currency: SEK Seniority: senior unsecured	G	XS1627778316	1200	14/06/2017	14/06/2023	6	0.63	0.63	AA+	Aaa	-
	C	XS2010158710	300	12/06/2019	12/06/2024	5	0.27	0.27	AA+	Aaa	-
	C	XS1578283712	3000	14/03/2017	16/03/2022	5	0.63	0.74	AA+	Aaa	-
City of Gothenburg Domicile: Sweden Sector: Municipal Currency: SEK Seniority: senior unsecured	G	XS2054601369	1500	24/09/2019	24/09/2025	6	0.21	0.21	AA+	Aaa	-
	C	XS1900629616	500	05/11/2018	05/11/2024	6	1.0	1.05	AA+	Aaa	-
	C	XS2084423925	1000	27/11/2019	27/11/2025	6	0.46	0.46	AA+	Aaa	-
City of Malmo Domicile: Sweden Sector: Municipal Currency: SEK Seniority: senior unsecured	G	XS1732404063	650	07/12/2017	07/12/2023	6	0.75	1.04	NR	NR	NR
	C	XS1488415438	500	12/09/2016	13/09/2021	5	0.22	0.24	NR	NR	NR
	C	XS2072775765	250	29/10/2019	14/03/2025	5	0.25	0.29	NR	NR	NR
City of Oslo Domicile: Norway Sector: Municipal Currency: NOK Seniority: senior unsecured	G	NO0010752702	1500	04/12/2015	04/09/2024	8	2.4	2.38	AAA	-	-
	C	NO0010727829	1500	11/12/2014	14/03/2024	9	2.4	2.31	AAA	-	-
	C	NO0010867575	2000	31/10/2019	31/10/2024	5	2.1	1.99	AAA	-	-
City of Paris Domicile: France Sector: Municipal Currency: EUR Seniority: senior unsecured	G	FR0013054897	300	18/11/2015	25/05/2031	15	1.75	1.81	AA	-	AA
	C	FR0012612588	110	16/03/2015	25/05/2030	15	1.21	1.21	AA	-	AA
	C	FR0013144052	300	06/04/2016	12/01/2032	15	1.25	1.31	AA	-	AA
Commerzbank Domicile: Germany Sector: Corporate Currency: EUR Seniority: non-preferred	G	DE000CZ40NG4	500	23/10/2018	23/10/2023	5	1.25	1.36	BBB	Baa2	BBB
	C	DE000CZ40K07	500	21/09/2015	21/09/2022	7	1.50	1.57	BBB	Baa2	BBB
	C	DE000CZ45VB7	500	16/09/2019	16/09/2024	5	0.25	0.32	BBB	Baa2	BBB
Credit Agricole CIB Domicile: France Sector: Corporate Currency: EUR Seniority: senior preferred	G	FR0013385515	1000	05/12/2018	05/12/2023	5	0.75	0.85	A+	Aa3	AA-
	C	FR0013416047	350	24/04/2019	24/04/2026	7	0.74	0.75	A+	Aa3	AA-
	C	XS0953564191	1250	17/07/2013	17/07/2023	10	3.12	3.17	A+	Aa3	AA-
Credit Agricole CIB Domicile: France Sector: Corporate Currency: EUR Seniority: senior secured	G	FR0013465010	1250	06/12/2019	06/12/2029	10	0.05	0.08	AAA	Aaa	AAA
	C	FR0013411600	750	29/03/2019	29/03/2029	10	0.63	0.68	AAA	Aaa	-
	C	FR0013487071	1000	03/03/2020	03/11/2031	11	0.01	0.05	AAA	Aaa	AAA
Deutsche Hypo Domicile: Germany Sector: Corporate Currency: EUR Seniority: senior secured	G	DE000DHY4887	500	23/11/2017	23/11/2023	6	0.13	0.21	-	Aa1	-
	C	DE000DHY4614	750	22/02/2016	22/02/2023	7	0.25	0.32	-	Aa1	-
	C	DE000DHY4960	500	29/06/2018	29/06/2026	8	0.50	0.63	-	Aa1	-

Deutsche Hypo Domicile: Germany Sector: Corporate Currency: EUR Seniority: senior secured	G C C	DE000DHY4994 DE000DHY5066 DE000DHY4861	500 500 750	10/09/2018 11/09/2019 20/06/2017	10/12/2024 12/09/2022 20/06/2025	6 3 8	0.25 0.01 0.38	0.37 -0.53 0.42	- - -	Aa1 Aa1 Aa1	- - -
DNB Boligkreditt Domicile: Norway Sector: Corporate Currency: EUR Seniority: senior secured	G C C	XS1839888754 XS1485596511 XS1719108463	1500 1500 1500	19/06/2018 14/01/2019 20/11/2017	19/06/2025 14/01/2026 20/11/2024	7 7 7	0.63 0.63 0.38	0.71 0.65 0.38	AAA AAA AAA	Aaa Aaa Aaa	- - -
E.ON Domicile: Germany Sector: Corporate Currency: EUR Seniority: senior unsecured	G C C	XS2047500926 XS1616411119 XS2103014457	750 750 500	28/08/2019 22/05/2017 16/01/2020	28/02/2030 22/05/2029 18/12/2030	10 12 10	0.35 1.63 0.75	0.37 1.74 0.92	BBB BBB BBB	Baa2 Baa3 Baa4	A- A- A-
EBRD Domicile: Supranational Sector: Supranational Currency: USD Seniority: senior unsecured	G C C	US29874QDG64 US29874QDK76 US29874QCT94	500 1950 1000	05/10/2017 26/04/2018 02/11/2016	15/07/2021 26/04/2021 02/11/2021	3 3 5	1.88 2.75 1.50	1.93 2.78 1.53	AAA AAA -	- - -	AAA AAA AAA
EDP Domicile: Portugal Sector: Corporate Currency: EUR Seniority: senior unsecured	G C C	XS1893621026 XS1222590488 PTEDPNOM0015	600 750 750	12/10/2018 21/04/2015 15/04/2020	13/10/2025 22/04/2025 15/04/2027	7 10 7	1.88 2.00 1.63	1.96 2.01 1.72	BBB- BBB- BBB-	Baa3 Baa3 Baa3	BBB- BBB- BBB-
EDP Domicile: Portugal Sector: Corporate Currency: EUR Seniority: senior unsecured	G C C	XS02053052895 XS1846632104 PTEDPNOM0015	600 750 750	16/09/2019 26/06/2018 15/04/2020	16/09/2026 26/01/2026 15/04/2027	7 7 7	0.38 1.63 1.63	0.43 1.67 1.72	BBB- BBB- BBB-	Baa3 Baa3 Baa3	BBB- BBB- BBB-
EIB Domicile: Supranational Sector: Supranational Currency: SEK Seniority: senior unsecured	G C C	XS0852107266 XS1171476143 XS0634914071	750 800 750	13/11/2012 23/01/2015 01/06/2011	13/11/2023 12/05/2025 01/06/2022	11 10 10	2.75 1.25 4.25	2.67 0.95 4.29	AAA AAA AAA	Aaa Aaa Aaa	AAA AAA -
EIB Domicile: Supranational Sector: Supranational Currency: SEK Seniority: senior unsecured	G C C	XS1346202184 XS0517604681 XS1395081810	1000 1000 1200	20/01/2016 14/06/2010 14/04/2016	20/01/2021 14/01/2021 14/04/2021	5 10 5	0.63 3.5 0.5	0.73 3.58 0.58	AAA AAA -	Aaa Aaa Aaa	AAA AAA AAA
EIB Domicile: Supranational Sector: Supranational Currency: SEK Seniority: senior unsecured	G C C	XS1551293019 XS0634914971 XS2102889453	3000 750 3000	19/01/2017 01/06/2011 17/01/2020	19/07/2022 01/06/2022 17/01/2023	5 10 3	0.50 4.25 0.13	0.50 4.29 0.20	AAA AAA AAA	Aaa Aaa Aaa	AAA - AAA

EIB Domicile: Supranational Sector: Supranational Currency: SEK Seniority: senior unsecured	G C C	XS1572222526 XS1751359016 XS1347679448	750 1000 3000	02/03/2017 22/01/2018 21/01/2016	02/03/2027 12/05/2028 12/11/2026	10 10 10	1.50 1.38 1.75	1.50 1.26 1.85	AAA AAA AAA	Aaa Aaa Aaa	AAA AAA AAA
EIB Domicile: Supranational Sector: Supranational Currency: SEK Seniority: senior unsecured	G C C	XS1757428088 XS1171476143 XS2102889453	1500 800 3000	30/01/2018 23/01/2015 17/01/2020	30/01/2025 12/05/2025 17/01/2023	7 10 3	0.88 1.25 0.13	0.95 1.35 0.20	AAA AAA AAA	Aaa Aaa Aaa	- AAA AAA
EIB Domicile: Supranational Sector: Supranational Currency: AUD Seniority: senior unsecured	G C C	AU3CB0245884 AU3CB0235612 AU3CB0253821	200 600 250	03/08/2017 17/02/2016 18/06/2018	03/02/2028 17/08/2026 25/05/2029	10 10 10	3.30 3.10 3.30	3.36 3.15 3.37	AAA AAA AAA	Aaa Aaa Aaa	AAA AAA AAA
EIB Domicile: Supranational Sector: Supranational Currency: AUD Seniority: senior unsecured	G C C	AU3CB0249787 AU3CB0265163 AU3CB0198034	750 300 650	12/01/2018 25/07/2019 22/08/2012	12/01/2023 25/01/2024 22/08/2022	5 4 10	2.70 1.45 5.00	2.77 1.45 5.13	AAA AAA AAA	Aaa Aaa Aaa	AAA AAA -
EIB Domicile: Supranational Sector: Supranational Currency: AUD Seniority: senior unsecured	G C C	AU3CB0263945 AU3CB0228823 AU3CB0265163	400 200 300	11/06/2019 17/04/2015 25/07/2019	15/11/2024 17/10/2025 25/01/2024	5 10 4	1.70 2.90 1.45	1.75 2.93 1.45	AAA AAA AAA	Aaa Aaa Aaa	AAA AAA AAA
EIB Domicile: Supranational Sector: Supranational Currency: EUR Seniority: senior unsecured	G C C	XS1107718279 XS0807336077 XS1503043694	500 500 500	10/09/2014 23/07/2012 12/10/2016	13/11/2026 15/09/2025 14/09/2029	12 13 12	1.25 2.75 0.25	1.36 2.79 0.32	AAA AAA AAA	Aaa Aaa Aaa	AAA AAA AAA
EIB Domicile: Supranational Sector: Supranational Currency: EUR Seniority: senior unsecured	G C C	XS1500338618 XS1989389041 XS0884635524	1250 500 500	05/10/2016 02/05/2019 10/02/2016	13/11/2037 15/09/2037 15/03/2040	21 18 24	0.50 0.95 2.75	0.61 0.97 2.77	AAA AAA AAA	Aaa Aaa Aaa	AAA AAA AAA
EIB Domicile: Supranational Sector: Supranational Currency: EUR Seniority: senior unsecured	G C C	XS1641457277 XS1505567088 XS1753042743	1000 500 2500	05/07/2017 17/10/2016 18/01/2018	15/11/2047 13/09/2047 16/10/2048	30 30 30	1.50 0.88 1.50	1.51 1.00 1.58	AAA AAA -	Aaa Aaa Aaa	AAA AAA -
EIB Domicile: Supranational Sector: Supranational Currency: GBP Seniority: senior unsecured	G C C	XS2036242803 XS2099761376 XS2099761376	800 1000 250	08/08/2019 14/01/2020 17/04/2018	15/11/2024 14/07/2023 07/03/2025	5 3 6	0.75 0.75 1.38	0.78 0.86 1.48	AAA AAA -	Aaa Aaa Aaa	AAA AAA -

EIB Domicile: Supranational Sector: Supranational Currency: USD Seniority: senior unsecured	G C C	US298785GQ39 US298785GJ95 US298785GS94	1000 3500 3000	11/10/2014 29/01/2014 10/02/2015	15/10/2024 29/01/2024 10/02/2025	10 10 10	2.50 3.25 1.88	2.59 3.30 1.93	AAA AAA AAA	Aaa Aaa Aaa	AAA AAA AAA
EIB Domicile: Supranational Sector: Supranational Currency: USD Seniority: senior unsecured	G C C	XS1811852109 US298785JD98 US298785GS94	1500 3000 3000	25/04/2018 23/04/2020 10/02/2015	13/06/2025 25/07/2025 10/02/2025	7 5 10	2.88 0.63 1.88	2.97 0.69 1.93	AAA AAA AAA	Aaa Aaa Aaa	- AAA AAA
Enel Domicile: Italy Sector: Corporate Currency: EUR Seniority: senior unsecured	G C C	XS1550149204 XS2066706909 XS0842659426	1250 1000 1000	16/01/2017 17/10/2019 15/10/2012	16/09/2024 17/06/2027 17/04/2023	7 7 10	1.00 0.38 4.88	1.14 0.47 5.02	BBB+ BBB+ BBB+	Baa2 Baa2 Baa2	A- A- A-
Enel Domicile: Italy Sector: Corporate Currency: EUR Seniority: senior unsecured	G C C	XS1750986744 XS1425966287 XS2066706909	1250 1257.412 1000	16/01/2018 01/06/2016 17/10/2019	16/09/2026 01/06/2026 17/06/2027	8 10 7	1.13 1.38 0.38	1.23 1.50 0.47	BBB+ BBB+ BBB+	Baa2 Baa2 Baa2	A- A- A-
Engie Domicile: France Sector: Corporate Currency: EUR Seniority: senior unsecured	G C C	FR0013245867 FR0013344686 FR0012602761	800 750 750	27/03/2017 22/06/2018 13/03/2015	27/03/2028 22/06/2028 13/03/2026	11 10 11	1.50 1.38 1.00	1.65 1.42 1.07	BBB+ BBB+ BBB+	A3 A3 A3	A A -
Engie Domicile: France Sector: Corporate Currency: EUR Seniority: senior unsecured	G C C	FR0013428513 FR0013455821 FR0013284270	750 600 750	21/06/2019 24/10/2019 28/09/2017	21/06/2039 24/10/2041 28/09/2037	20 22 20	1.38 1.25 1.00	1.49 1.25 2.06	BBB+ BBB+ BBB+	A3 A3 A3	A A A
Handelsbanken Domicile: Sweden Sector: Corporate Currency: EUR Seniority: senior preferred	G C C	XS1848875172 XS1795254025 XS2013536029	500 750 1000	03/07/2018 21/03/2018 18/06/2019	03/07/2023 21/03/2023 18/06/2024	5 5 5	0.38 0.50 0.13	0.49 0.54 0.15	AA- AA- AA-	Aa2 Aa2 Aa2	AA+ AA+ AA+
Hera Spa Domicile: Italy Sector: Corporate Currency: EUR Seniority: senior unsecured	G C C	XS1084043451 XS0976307040 XS1504194173	500 500 400	04/07/2014 04/10/2013 14/10/2016	04/07/2024 04/10/2021 14/10/2026	10 8 10	2.38 3.50 0.88	2.44 3.34 0.98	BBB BBB BBB	Baa2 Baa2 Baa2	- - -
Iberdrola Domicile: Spain Sector: Corporate Currency: EUR Seniority: senior unsecured	G C C	XS1057055060 XS0990109240 XS1171541813	750 500 600	24/04/2014 13/11/2013 27/01/2015	24/10/2022 31/01/2022 27/01/2023	8 8 8	2.50 3.00 1.13	2.54 3.12 1.21	BBB+ BBB+ BBB+	Baa1 Baa1 Baa1	A- A- A-

Iberdrola												
Domicile: Spain	G	XS1682538183	750	13/09/2017	13/09/2027	10	1.25	1.35	BBB+	Baa1	A-	
Sector: Corporate	C	XS1726152108	300	29/11/2017	29/11/2029	12	1.62	1.62	BBB+	Baa1	A-	
Currency: EUR	C	XS1116408235	500	08/10/2014	08/10/2024	10	1.88	1.97	BBB+	Baa1	A-	
Seniority: senior unsecured												
Icade												
Domicile: France	G	FR0013281755	600	13/09/2017	13/09/2027	10	1.50	1.60	BBB+	-	-	
Sector: Corporate	C	FR0013181906	750	10/06/2016	10/06/2026	10	1.75	1.79	BBB+	-	-	
Currency: EUR	C	FR0013320058	600	28/02/2018	28/02/2028	10	1.63	1.80	BBB+	-	-	
Seniority: senior unsecured												
Ile de France												
Domicile: France	G	FR0011858323	600	24/04/2014	24/04/2026	12	2.38	2.45	-	Aa2	AA	
Sector: Other Government	C	FR0013242336	500	14/03/2017	14/03/2029	12	1.38	1.43	-	Aa2	AA	
Currency: EUR	C	FR0011512193	300	10/06/2013	10/06/2023	10	2.25	2.25	-	Aa2	AA	
Seniority: senior unsecured												
Innogy												
Domicile: Germany	G	XS1702729275	850	19/10/2017	19/10/2027	10	1.25	1.36	BBB	Baa2	A-	
Sector: Corporate	C	XS1761785077	1000	31/01/2018	31/07/2029	11	1.50	1.62	BBB	Baa2	A-	
Currency: EUR	C	XS1595704872	750	13/04/2017	13/04/2025	8	1.00	1.07	BBB	Baa2	A-	
Seniority: senior unsecured												
Intesa Sanpaolo												
Domicile: Italy	G	XS1636000561	500	27/06/2017	27/06/2022	5	0.88	0.97	-	Baa1	BBB	
Sector: Corporate	C	XS1197351577	1500	04/03/2015	04/03/2022	7	1.12	1.18	BBB	Baa1	BBB	
Currency: EUR	C	XS1873219304	1000	30/08/2018	30/08/2023	5	2.12	2.15	BBB	Baa1	BBB	
Seniority: senior preferred												
Intesa Sanpaolo												
Domicile: Italy	G	XS2089368596	750	04/12/2019	04/12/2024	5	0.74	0.76	BBB	Baa1	BBB	
Sector: Corporate	C	XS2022425297	1250	04/07/2019	04/07/2024	5	1.00	1.03	BBB	Baa1	BBB	
Currency: EUR	C	XS2118509145	300	20/02/2020	20/02/2025	5	0.58	0.58	BBB	Baa1	BBB	
Seniority: senior preferred												
Ireland												
Domicile: Ireland	G	IE00BFZRQ242	3000	17/10/2018	18/03/2031	12	1.35	1.40	AA-	A2	A+	
Sector: Government	C	IE00BH3SQ895	4000	16/01/2019	15/05/2029	10	1.10	1.12	AA-	A2	A+	
Currency: EUR	C	IE00BFZRZPZ02	4000	17/04/2018	15/05/2033	15	1.30	1.32	AA-	A2	A+	
Seniority: sovereign												
Iren												
Domicile: Italy	G	XS1704789590	500	24/10/2017	24/10/2027	10	1.50	1.68	-	-	BBB	
Sector: Corporate	C	XS1511781467	500	02/11/2016	04/11/2024	8	0.88	1.01	-	-	BBB	
Currency: EUR	C	XS2065601937	500	14/10/2019	14/10/2029	10	0.88	0.94	-	-	BBB	
Seniority: senior unsecured												
Jernhusen AB												
Domicile: Sweden	G	SE0011062801	1000	17/04/2018	17/04/2023	5	0.98	0.98	NR	NR	NR	
Sector: Corporate	C	SE0013359601	500	23/04/2020	23/04/2025	5	1.37	1.37	NR	NR	NR	
Currency: SEK	C	SE0009723117	600	17/03/2017	17/03/2022	5	1.15	1.15	NR	NR	NR	
Seniority: senior unsecured												

Jernhusen AB Domicile: Sweden Sector: Corporate Currency: SEK Seniority: senior unsecured	G	SE0012193688	750	18/04/2019	18/04/2024	5	0.93	0.94	NR	NR	NR
	C	SE0013359601	500	23/04/2020	23/04/2025	5	1.37	1.37	NR	NR	NR
	C	SE0009723117	600	17/03/2017	17/03/2022	5	1.15	1.15	NR	NR	NR
Jernhusen AB Domicile: Sweden Sector: Corporate Currency: SEK Seniority: senior unsecured	G	SE0012676567	150	18/10/2019	18/10/2022	3	0.25	0.25	NR	NR	NR
	C	SE0010440966	100	29/09/2017	29/09/2022	5	1.03	1.03	NR	NR	NR
	C	SE0013359601	500	23/04/2020	23/04/2025	5	1.37	1.37	NR	NR	NR
KBC Domicile: Belgium Sector: Corporate Currency: EUR Seniority: senior unsecured	G	BE0002602804	500	27/06/2018	27/06/2023	5	0.88	0.98	A-	Baa1	A
	C	BE0002272418	1250	01/03/2017	01/03/2022	5	0.75	0.75	A-	Baa1	A
	C	BE0002631126	750	25/01/2019	25/01/2024	5	1.13	1.16	A-	Baa1	A
KBN Domicile: Norway Sector: Agency Currency: USD Seniority: senior unsecured	G	XS1508672828	500	26/10/2016	26/10/2020	4	1.38	1.44	AAA	Aaa	-
	C	XS1633271397	1000	20/06/2017	15/09/2020	3	1.75	1.78	AAA	Aaa	-
	C	XS1361290825	1000	10/02/2016	10/02/2021	5	1.63	1.64	AAA	Aaa	-
KfW Domicile: Germany Sector: Agency Currency: EUR Seniority: senior unsecured	G	XS1311459694	1500	27/10/2015	27/10/2020	5	0.13	0.14	AAA	Aaa	AAA
	C	DE000A168Y06	5000	03/09/2015	01/06/2020	4	0.13	0.18	AAA	Aaa	AAA
	C	DE000A168Y22	3000	14/01/2016	15/03/2023	7	0.38	0.40	AAA	Aaa	-
KfW Domicile: Germany Sector: Agency Currency: EUR Seniority: senior unsecured	G	XS1414146669	1000	20/05/2016	30/05/2024	8	0.05	0.10	AAA	Aaa	-
	C	DE000A2LQH28	500	24/09/2018	28/02/2024	5	0.05	0.12	AAA	Aaa	-
	C	DE000A1R0709	3000	11/06/2014	11/06/2024	10	1.50	1.61	AAA	Aaa	AAA
KfW Domicile: Germany Sector: Agency Currency: EUR Seniority: senior unsecured	G	XS1612940558	2000	16/05/2017	30/06/2025	8	0.25	0.34	AAA	Aaa	-
	C	DE000A11QTD2	3000	15/01/2015	15/01/2025	10	0.63	0.66	AAA	Aaa	AAA
	C	DE000A2LQH10	4000	04/09/2018	15/09/2025	7	0.25	0.35	AAA	Aaa	-
KfW Domicile: Germany Sector: Agency Currency: EUR Seniority: senior unsecured	G	XS1897340854	1000	24/10/2018	28/09/2026	7	0.50	0.57	AAA	Aaa	-
	C	DE000A254PS3	4000	31/03/2020	31/03/2025	5	0.01	0.01	AAA	Aaa	-
	C	DE000A2DAR65	5000	21/02/2017	22/02/2027	10	0.63	0.64	AAA	Aaa	-
KfW Domicile: Germany Sector: Agency Currency: EUR Seniority: senior unsecured	G	XS1999841445	3000	22/05/2019	05/05/2027	7	0.01	0.03	AAA	Aaa	-
	C	DE000A254PS3	4000	31/03/2020	31/03/2025	5	0.01	0.01	AAA	Aaa	-
	C	DE000A2GSFA2	5000	12/09/2017	15/09/2027	10	0.50	0.58	AAA	Aaa	-

KfW Domicile: Germany Sector: Agency Currency: USD Seniority: senior unsecured	G C C	US500769GU24 US500769DZ48 US500769HQ03	1000 4000 3000	18/11/2015 08/09/2010 15/11/2017	30/11/2020 08/09/2020 15/12/2020	5 10 3	1.88 2.75 1.88	1.92 2.83 1.93	AAA AAA AAA	Aaa Aaa Aaa	AAA AAA AAA
KfW Domicile: Germany Sector: Agency Currency: USD Seniority: senior unsecured	G C C	US500769HD99 US500769EQ30 US500769HW70	1500 2000 4000	30/11/2016 25/08/2011 17/10/2018	30/11/2021 25/08/2021 15/12/2021	5 10 3	2.00 2.38 3.13	2.05 2.41 3.16	AAA AAA AAA	Aaa Aaa Aaa	- AAA -
KfW Domicile: Germany Sector: Agency Currency: USD Seniority: senior unsecured	G C C	US48245ACL35 XS1290070108 XS2024521838	200 50 200	28/09/2017 15/09/2015 12/07/2019	28/09/2020 15/09/2020 12/07/2021	3 5 2	1.79 1.45 1.82	1.79 1.45 1.82	AAA AAA AAA	Aaa Aaa Aaa	- AAA -
KfW Domicile: Germany Sector: Agency Currency: USD Seniority: senior unsecured	G C C	US500769HP20 US500769JB16 US500769FH22	1000 4000 3000	05/10/2017 11/07/2019 04/10/2012	29/09/2022 22/08/2022 04/10/2022	4 3 10	2.00 1.75 2.00	2.08 1.77 2.11	AAA AAA AAA	Aaa Aaa Aaa	- - -
KommuneKredit Domicile: Denmark Sector: Agency Currency: EUR Seniority: senior unsecured	G C C	XS1622415674 XS1756367816 XS0919246099	500 1000 150	01/06/2017 24/01/2018 19/04/2013	18/05/2027 24/01/2025 19/04/2029	9 7 16	0.75 0.50 2.34	0.82 0.54 2.34	AAA AAA -	Aaa Aaa Aaa	- - -
Kommuninvest Domicile: Sweden Sector: Agency Currency: USD Seniority: senior unsecured	G C C	XS1618289802 XS2003415382 XS1891195346	500 1250 1000	23/05/2017 29/05/2019 09/10/2018	01/06/2021 29/05/2021 16/11/2021	4 2 3	1.88 2.25 3.00	1.89 2.35 3.07	AAA AAA AAA	Aaa Aaa Aaa	- - -
Kommuninvest Domicile: Sweden Sector: Agency Currency: SEK Seniority: senior unsecured	G C C	XS1897258098 SE0009662943 SE0013745452	3000 3000 3000	23/10/2018 22/02/2017 04/02/2020	01/06/2023 22/02/2023 04/02/2026	4 6 6	0.63 0.75 0.75	0.65 0.75 0.75	AAA AAA AAA	Aaa Aaa Aaa	- - -
Kommuninvest Domicile: Sweden Sector: Agency Currency: SEK Seniority: senior unsecured	G C C	XS1968465572 XS1504236198 SE0013745452	3500 3000 3000	27/03/2019 13/10/2016 04/02/2020	27/03/2024 13/11/2023 04/02/2026	5 7 6	0.38 0.63 0.75	0.49 0.68 0.75	AAA AAA AAA	Aaa Aaa Aaa	- - -
Kungsleden AB Domicile: Sweden Sector: Corporate Currency: SEK Seniority: senior unsecured	G C C	SE0010599118 SE0013103793 SE0010442715	750 200 350	21/03/2018 06/12/2019 11/10/2017	21/03/2022 06/12/2024 11/10/2021	4 5 4	2.38 1.51 2.06	2.38 1.51 2.06	NR NR NR	NR NR NR	NR NR NR

LBBW												
Domicile: Germany	G	DE000LB2CHW4	750	24/05/2019	24/05/2024	5	0.38	0.50	-	A2	A-	
Sector: Corporate	C	DE000LB1DVL8	1000	07/06/2017	07/06/2022	5	0.50	0.53	-	A2	A-	
Currency: EUR	C	DE000LB2CLH7	500	29/07/2019	29/07/2026	7	0.38	0.42	-	A2	A-	
Seniority: senior non-preferred												
MunchenerHyp												
Domicile: Germany	G	DE000MHB21J0	500	08/11/2018	13/12/2023	5	0.25	0.28	-	Aaa	-	
Sector: Corporate	C	DE000MHB12J9	500	25/06/2014	25/06/2024	10	1.50	1.61	-	Aaa	-	
Currency: EUR	C	DE000MHB24J4	500	05/09/2019	05/09/2023	4	0.01	-0.57	-	Aaa	-	
Seniority: senior secured												
Naturgy Energy												
Domicile: Spain	G	XS1718393439	800	15/11/2017	15/05/2025	7	0.88	0.91	BBB	Baa2	BBB+	
Sector: Corporate	C	XS1170307414	500	21/01/2015	21/01/2025	10	1.38	1.49	BBB	Baa2	BBB+	
Currency: EUR	C	XS2156506854	1000	15/04/2020	15/01/2026	5	1.25	1.36	BBB	-	BBB+	
Seniority: senior unsecured												
NIB												
Domicile: Supranational	G	XS1494406074	1500	22/09/2016	22/09/2023	7	0.50	0.54	AAA	Aaa	-	
Sector: Supranational	C	XS1399311064	700	26/04/2016	26/04/2021	5	0.50	0.57	AAA	Aaa	-	
Currency: SEK	C	XS1768066729	500	12/02/2018	12/05/2025	7	1.05	1.09	AAA	Aaa	-	
Seniority: senior unsecured												
NIB												
Domicile: Supranational	G	XS1673097637	2500	29/08/2017	29/08/2022	5	0.45	0.45	AAA	Aaa	-	
Sector: Supranational	C	XS1399311064	700	26/04/2016	26/04/2021	5	0.50	0.57	AAA	Aaa	-	
Currency: SEK	C	XS2101485154	1000	16/01/2020	16/01/2023	3	0.20	0.20	AAA	Aaa	-	
Seniority: senior unsecured												
NIB												
Domicile: Supranational	G	XS1943607975	2000	01/02/2019	01/02/2024	5	0.38	0.44	AAA	Aaa	-	
Sector: Supranational	C	XS2154360478	4000	09/04/2020	11/04/2023	3	0.13	0.24	AAA	Aaa	-	
Currency: SEK	C	XS1768066729	500	12/02/2018	12/05/2025	7	1.05	1.09	AAA	Aaa	-	
Seniority: senior unsecured												
NRW.BANK												
Domicile: Germany	G	DE000NWB0AC0	500	10/11/2015	10/11/2025	10	0.88	0.93	AA	Aa1	AAA	
Sector: Agency	C	DE000NWB0634	1000	25/05/2018	26/05/2025	7	0.50	0.59	AA	Aa1	AAA	
Currency: EUR	C	DE000NWB0584	1000	11/05/2016	11/05/2026	10	0.50	0.58	AA	Aa1	AAA	
Seniority: senior preferred												
NRW.BANK												
Domicile: Germany	G	DE000NWB0AD8	500	17/11/2016	17/11/2026	10	0.38	0.47	AA	Aa1	AAA	
Sector: Agency	C	DE000NWB0584	1000	11/05/2016	11/05/2026	10	0.50	0.58	AA	Aa1	AAA	
Currency: EUR	C	DE000NWB2KW3	500	12/04/2019	12/04/2027	8	0.13	0.25	AA	Aa1	AAA	
Seniority: senior preferred												
NRW.BANK												
Domicile: Germany	G	DE000NWB0AE6	500	13/09/2017	13/09/2027	10	0.5	0.62	AA	Aa1	AAA	
Sector: Agency	C	DE000NWB0659	1000	16/05/2019	16/05/2029	10	0.38	0.41	AA	Aa1	AAA	
Currency: EUR	C	DE000NWB0584	1000	11/05/2016	11/05/2026	10	0.5	0.58	AA	Aa1	AAA	
Seniority: senior preferred												

NRW.BANK												
Domicile: Germany	G	DE000NWB0AF3	500	02/07/2018	30/06/2028	9	0.75	0.77	AA	Aa1	AAA	
Sector: Agency	C	DE000NWB0659	1000	16/05/2019	16/05/2029	10	0.38	0.41	AA	Aa1	AAA	
Currency: EUR	C	DE000NWB0584	1000	11/05/2016	11/05/2026	10	0.50	0.58	AA	Aa1	AAA	
Seniority: senior preferred												
NRW.BANK												
Domicile: Germany	G	DE000NWB0AG1	500	04/02/2019	02/02/2029	9	0.63	0.72	AA	Aa1	AAA	
Sector: Agency	C	DE000NWB0659	1000	16/05/2019	16/05/2029	10	0.38	0.41	AA	Aa1	AAA	
Currency: EUR	C	DE000NWB0584	1000	11/05/2016	11/05/2026	10	0.50	0.58	AA	Aa1	AAA	
Seniority: senior preferred												
NWB Bank												
Domicile: Netherlands	G	XS1284550941	1000	03/09/2015	03/09/2025	10	1.00	1.06	AAA	Aaa	-	
Sector: Agency	C	XS2079798562	1000	18/01/2017	18/01/2027	10	0.63	0.68	AAA	Aaa	-	
Currency: EUR	C	XS0706261368	500	16/11/2011	16/11/2023	12	3.00	3.01	AAA	Aaa	-	
Seniority: senior unsecured												
NWB Bank												
Domicile: Netherlands	G	XS1716989287	500	15/11/2017	15/11/2021	4	2.12	2.16	AAA	Aaa	-	
Sector: Agency	C	XS1573190946	1000	02/03/2017	02/03/2022	5	2.25	2.37	AAA	Aaa	-	
Currency: USD	C	XS2045885972	1500	28/08/2019	27/08/2021	1	1.50	1.62	AAA	Aaa	-	
Seniority: senior unsecured												
NWB Bank												
Domicile: Netherlands	G	XS1917719319	500	05/12/2018	05/12/2022	4	3.13	3.15	AAA	Aaa	-	
Sector: Agency	C	XS1218446059	1250	16/04/2015	14/04/2022	6	1.88	1.94	AAA	Aaa	-	
Currency: USD	C	XS2101563646	2000	15/01/2020	15/01/2025	5	1.75	1.76	AAA	Aaa	-	
Seniority: senior unsecured												
Rabobank												
Domicile: Netherlands	G	XS1502438820	500	11/10/2016	11/10/2021	5	0.13	0.15	A+	Aa3	AA-	
Sector: Corporate	C	XS1642738816	1000	06/07/2017	06/12/2022	5	0.50	0.53	A+	Aa3	-	
Currency: EUR	C	XS0576532054	2000	12/01/2011	12/01/2021	10	4.13	4.19	A+	Aa3	AA-	
Seniority: senior preferred												
Region of Pays de la Loire												
Domicile: France	G	FR0013371218	25	12/10/2018	12/10/2033	15	1.40	1.39	NR	NR	NR	
Sector: Other Government	C	FR0012382786	30	12/12/2014	12/12/2032	18	2.0	2.00	NR	NR	NR	
Currency: EUR	C	FR0013406626	20	15/03/2019	15/03/2035	16	1.2	1.20	NR	NR	NR	
Seniority: senior unsecured												
Region of Pays de la Loire												
Domicile: France	G	FR0013370871	50	12/10/2018	12/10/2030	12	1.22	1.22	NR	NR	NR	
Sector: Other Government	C	FR0011833011	53	11/04/2014	11/04/2029	15	3.00	3.00	NR	NR	NR	
Currency: EUR	C	FR0013467859	25	17/12/2019	17/12/2031	12	0.43	0.43	NR	NR	NR	
Seniority: senior unsecured												
Rikshem												
Domicile: Sweden	G	SE0009345630	500	22/11/2016	22/02/2022	5	1.25	1.25	NR	NR	NR	
Sector: Corporate	C	SE0008294185	350	22/04/2016	22/04/2021	5	1.59	1.59	NR	NR	NR	
Currency: SEK	C	SE0011643345	250	27/05/2019	27/05/2022	3	0.54	0.54	NR	NR	NR	
Seniority: senior unsecured												

SBAB Bank Domicile: Sweden Sector: Corporate Currency: SEK Seniority: senior unsecured	G	XS1436518606	1000	23/06/2016	23/06/2021	5	1.05	1.05	A	A1	-
	C	XS1801078194	500	05/04/2018	05/07/2021	3	0.45	0.45	A	A1	-
	C	XS1397032431	300	19/04/2016	19/04/2021	5	1.28	1.28	A	A1	-
SBAB Bank Domicile: Sweden Sector: Corporate Currency: SEK Seniority: senior unsecured	G	XS1697577556	1000	11/10/2017	11/10/2022	5	0.98	0.98	A	A1	-
	C	XS1626072273	1500	08/06/2017	08/06/2022	5	0.88	0.93	A	A1	-
	C	XS1820047824	800	15/05/2018	15/05/2023	5	1.00	1.04	A	A1	-
Skandinaviska Enskilda Banken AB Domicile: Sweden Sector: Corporate Currency: EUR Seniority: senior preferred	G	XS1567475303	500	17/02/2017	17/02/2022	5	0.30	0.35	A+	Aa2	AA
	C	XS1370669639	1000	24/02/2016	24/08/2021	5	0.75	0.86	A+	Aa2	AA
	C	XS1788951090	1000	13/03/2018	13/03/2023	5	0.50	0.59	A+	Aa2	AA
Societe Generale Domicile: France Sector: Corporate Currency: EUR Seniority: senior preferred	G	XS1500337644	500	05/10/2016	05/10/2021	5	0.13	0.14	A	A1	A+
	C	FR0013365491	2000	18/09/2018	18/01/2022	3	0.25	0.36	A	A1	A+
	C	XS0596704170	1250	02/03/2011	02/03/2021	10	4.75	4.81	A	A1	A+
SpareBank 1 Boligkreditt Domicile: Norway Sector: Corporate Currency: EUR Seniority: senior secured	G	XS1760129608	1000	30/01/2018	30/01/2025	7	0.50	0.58	-	Aaa	-
	C	XS1637099026	1000	26/06/2017	26/06/2024	7	0.38	0.40	-	Aaa	-
	C	XS1995620967	1000	14/05/2019	14/05/2026	7	0.13	0.23	-	Aaa	-
Specialfastigheter Domicile: Sweden Sector: Corporate Currency: SEK Seniority: senior unsecured	G	SE0010600270	750	28/11/2017	28/11/2024	7	1.13	1.24	NR	NR	NR
	C	SE0011643337	300	24/05/2019	24/07/2024	5	0.31	0.16	NR	NR	NR
	C	SE0006453189	200	19/11/2014	08/01/2025	10	1.85	1.85	NR	NR	NR
Stockholm County Council Domicile: Sweden Sector: Other Government Currency: SEK Seniority: senior unsecured	G	XS2004887761	1000	03/06/2019	25/02/2026	6	0.62	0.62	NR	NR	NR
	C	XS1181161511	600	03/02/2015	03/02/2025	10	1.45	1.45	NR	NR	NR
	C	XS2049411221	500	02/09/2019	02/09/2026	7	0.20	0.20	NR	NR	NR
Stockholm County Council Domicile: Sweden Sector: Other Government Currency: SEK Seniority: senior unsecured	G	XS2004887415	1000	03/06/2019	03/06/2025	6	0.49	0.49	NR	NR	NR
	C	XS2049411221	500	02/09/2019	02/09/2026	7	0.20	0.20	NR	NR	NR
	C	XS1181161511	600	03/02/2015	03/02/2025	10	1.45	1.45	NR	NR	NR
Swedbank Domicile: Sweden Sector: Corporate Currency: EUR Seniority: senior preferred	G	XS1711933033	500	07/11/2017	07/11/2022	5	0.25	0.27	A+	Aa3	AA-
	C	XS1573958409	750	06/03/2017	06/09/2022	5	0.30	0.34	A+	Aa3	AA-
	C	XS1870225338	500	29/08/2018	29/08/2023	5	0.40	0.44	A+	Aa3	AA-

Terna												
Domicile: Italy	G	XS1980270810	500	10/04/2019	10/04/2026	7	1.00	1.02	BBB+	Baa2	BBB+	
Sector: Corporate	C	XS2033351995	500	25/07/2019	25/07/2025	6	0.13	0.25	BBB+	Baa2	BBB+	
Currency: EUR	C	XS1652866002	1000	26/07/2017	26/07/2027	10	1.38	1.42	BBB+	Baa2	BBB+	
Seniority: senior unsecured												
Unibail-Rodamco												
Domicile: France	G	XS1038708522	750	26/02/2014	26/02/2024	10	2.50	2.65	A-	-	A	
Sector: Corporate	C	XS0942388462	700	12/06/2013	12/06/2023	10	2.50	2.60	A-	-	A	
Currency: EUR	C	XS1523192588	500	22/11/2016	21/02/2025	8	0.88	1.00	A-	-	A-	
Seniority: senior unsecured												
Unibail-Rodamco												
Domicile: France	G	XS1218319702	500	15/04/2015	14/03/2025	9	1.00	1.04	A-	-	A-	
Sector: Corporate	C	XS1523192588	500	22/11/2016	21/02/2025	8	0.88	1.00	A-	-	A-	
Currency: EUR	C	XS1074055770	600	04/06/2014	04/06/2026	12	2.50	2.53	A-	-	A-	
Seniority: senior unsecured												
Willhem AB												
Domicile: Sweden	G	SE0012012995	200	16/01/2019	16/01/2024	5	1.49	1.49	NR	NR	NR	
Sector: Corporate	C	SE0010599316	500	03/09/2018	03/09/2023	5	1.10	1.10	NR	NR	NR	
Currency: SEK	C	SE0012193985	700	22/01/2020	22/02/2025	5	0.98	0.98	NR	NR	NR	
Seniority: senior unsecured												
Zuercher Kantonalbank												
Domicile: Switzerland	G	CH0373476677	210	08/05/2018	08/05/2025	7	0.25	0.23	NR	NR	NR	
Sector: Corporate	C	CH0203872863	125	29/01/2013	29/01/2024	11	1.13	1.09	NR	NR	NR	
Currency: CHF	C	CH0398633799	130	25/01/2019	25/01/2027	8	0.15	0.14	NR	NR	NR	
Seniority: senior unsecured												
Zuercher Kantonalbank												
Domicile: Switzerland	G	CH0419041238	200	06/06/2019	06/06/2029	10	0.13	0.12	NR	NR	NR	
Sector: Corporate	C	CH0373476339	240	25/01/2018	25/01/2028	10	0.30	0.30	NR	NR	NR	
Currency: CHF	C	CH0461239045	265	05/02/2020	05/02/2031	11	0.05	0.01	NR	NR	NR	
Seniority: senior unsecured												
Vasakronan												
Domicile: Sweden	G	SE0007666136	267	22/10/2015	22/10/2020	5	1.50	1.50	NR	NR	NR	
Sector: Corporate	C	SE0004357192	450	13/12/2011	01/12/2020	8	4.00	-1.43	NR	NR	NR	
Currency: SEK	C	SE0011166818	500	23/04/2018	23/09/2020	2	0.19	0.19	NR	NR	NR	
Seniority: senior unsecured												
Vasakronan												
Domicile: Sweden	G	SE0009190606	100	18/10/2016	18/10/2021	5	0.94	0.96	NR	NR	NR	
Sector: Corporate	C	SE0010769208	200	16/01/2018	16/02/2021	3	0.47	0.47	NR	NR	NR	
Currency: SEK	C	SE0004298768	200	15/11/2011	15/11/2021	10	4.14	4.14	NR	NR	NR	
Seniority: senior unsecured												
Vasakronan												
Domicile: Sweden	G	SE0010948661	500	05/03/2018	05/03/2021	3	0.41	0.41	NR	NR	NR	
Sector: Corporate	C	SE0011166818	500	23/04/2018	23/09/2020	2	0.19	0.19	NR	NR	NR	
Currency: SEK	C	SE0009189483	200	11/10/2016	11/10/2021	5	0.88	0.88	NR	NR	NR	
Seniority: senior unsecured												

Vasakronan											
Domicile: Sweden	G	SE0011062298	450	23/03/2018	23/02/2021	2	0.38	0.38	NR	NR	NR
Sector: Corporate	C	SE0011166818	500	23/04/2018	23/09/2020	2	0.19	0.19	NR	NR	NR
Currency: SEK	C	SE0009189483	200	11/10/2016	11/10/2021	5	0.88	0.88	NR	NR	NR
Seniority: senior unsecured											
Vasakronan											
Domicile: Sweden	G	SE0009983810	600	24/05/2017	24/05/2022	5	1.08	1.08	NR	NR	NR
Sector: Corporate	C	SE0010297259	200	29/08/2017	29/08/2022	5	1.14	1.14	NR	NR	NR
Currency: SEK	C	SE0008963920	200	29/08/2016	15/12/2021	5	1.01	1.01	NR	NR	NR
Seniority: senior unsecured											
Vasakronan											
Domicile: Sweden	G	NO0010815202	200	31/01/2018	31/01/2028	10	3.01	3.01	NR	NR	NR
Sector: Corporate	C	NO0010793292	500	18/05/2017	18/05/2027	10	2.95	2.95	NR	NR	NR
Currency: NOK	C	NO0010842792	200	07/02/2019	07/02/2029	10	3.02	3.02	NR	NR	NR
Seniority: senior unsecured											

Annex 1- Matching Table. This table contains 238 conventional bonds, that complies with specific characteristics to match with 119 green bonds. Each green bond was matched with two conventional bonds in order to build a synthetic one. The first column corresponds to the description of the issuers including their domicile, sector, currency and seniority. The green bonds were classified as G and the conventional ones as C. The following columns contains the information about ISIN, amount issued in millions, issue date, maturity date, years to maturity, coupon rate in percentage, yield at issuance and rating. Years to maturity represents the number of years between issue date and maturity date. Rating is divided in three agencies: S&P, Moody's and Fitch.