Green Bonds

-A change in preferences toward green investments?

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Abstract

Green bonds are one of many new financial instruments related to climate change and other sustainability challenges that have emerged in recent years. The market has experienced a significant growth over the last four years, and there is evidence of high demand from investors in the market. However, there seems to be no real innovation other than the fact that green bonds are earmarked climate friendly or sustainability projects. Historically, green bonds have had the same risk and same return as conventional bonds. However, there are additional costs associated with the issuance of green bonds. We therefore need another ingredient to make sense of the growth in the new market. From traditional economic theory, since green bonds are associated with additional costs, the market for green bonds should not necessarily exist. This master's thesis tries to explain this puzzle. It does so by analyzing different economic aspects of green bonds and drivers behind changes in issuers', investors' and regulators' *preferences*. Hence, the key factor explored in this thesis is the change in preferences. If people's preferences have changed, financial benefits (profit) and risk are not necessarily the only things people or corporations care about when investing. Hence, the green bond market could make sense. Changes in preferences may be linked to both financial and non-financial benefits from green investments, e.g., environmental impacts, reputation etc. This thesis argues that green preferences need to be incorporated into economic models. To look closer at this, a theoretical model incorporating preferences for green investment into a household's/investor's maximization problem is presented. The thesis then analyzes different factors that may contribute to a shift in preferences toward green investments. The results of the model show that given sufficiently high preferences for green bonds, this can increase the total savings in the market for green bonds, and thus contribute to a growth in the market.

Keywords: Green bonds, conventional bonds, green investment, preferences.

Preface

I would like to thank my supervisor, Diderik Lund. Thank you for sharing the learning process with me and for tremendous help and support during the writing of this thesis. I could not have asked for a better supervisor. I am grateful to Kommunalbanken, who generously granted me a scholarship and provided great advice. I would also like to thank Jon Strand at the World Bank. Thank you, Dag Huse at NBIM, for supplying me with data material for the thesis. Thank you to my fellow students for feedback and help in times of desperation, Helene Onshuus, Mikkel Myhre Walbækken, Stine Sjursen Hauge and Iman Ghayoornia. Lastly, thank you mum, dad and Herman, for cheering me on and for cheering me up.

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Ane Hammer Langhelle

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1. Introduction

Green bonds are one of many new financial instruments related to climate change and other sustainability challenges that have emerged in recent years. This master's thesis takes a closer look at the growth in green bonds and attempts to make sense of this growth by analyzing different economic aspects of green bonds. The aim of the thesis is to explain the growth in green bonds and to map drivers behind changes in preferences among issuers, investors and regulators.

1.1 The context of green bonds

There are many definitions of green bonds, and there is no consensus when it comes to delimitations of green bonds as a financial instrument. It is however agreed that green bonds are like conventional bonds, with the special provision that the use of proceeds must be funding environmental and/or climate friendly projects. This definition will be more thoroughly explained later in the thesis. Climate change and other sustainability concerns represent key challenges to the world, and the call for a transition towards a more sustainable development path is gaining ground. In Norway, transition ("Omstilling") and The Green Shift ("Det grønne skiftet") have become new buzz-words. "Det grønne skiftet" was declared "the new word of the year 2015" by The Language Council of Norway in 2016.

The Paris Agreement of 12 December 2015 fueled this perceived need for a transition. It represents an international breakthrough in the global response to the threat of climate change. Building on the recent reports of the International Panel on Climate Change (IPCC, 2015), Article 2 in the Paris Agreement sets the target of:

> Holding the increase in the global average temperature to well below 2 °C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 °C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change (United Nations, 2015, p. 21).

In order to reach this (and other sustainability targets), financing the transition has become a key concern. The Paris Agreement is no exception. Paragraph c) of Article 2 points to the need of making "finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development" (United Nations, 2015, p. 21). In addition to a Green Climate Fund supporting the least developed countries and other developing country Parties, Article 9 states that "developed country Parties should continue to take the lead in mobilizing climate finance from a wide variety of sources, instruments and channels" (United Nations, 2015, p. 21).

The Paris Agreement reflects the conclusions of a number of international bodies who have argued that investments are key to solving both climate change and other sustainability challenges. Prior to the Earth Summit in Rio de Janeiro in 2012, United Nations Environment Programme (UNEP) outlined what they called a Green Economy, defined as:

> one that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities. In its simplest expression, a green economy can be thought of as one which is low carbon, resource efficient and socially inclusive" (UNEP, 2011, p. 2).

The report argued for investing two per cent of global GDP in greening central sectors of the economy in order to shift development and unleash public and private capital flows onto a low-carbon, resource-efficient path. The main problem as described by UNEP was what they saw as failed investments. Under the heading of "An Era of Capital Misallocation", UNEP argued that "the crisis in climate, biodiversity, fuel, food, water, and of late in the financial system and the economy" had a common denominator:

> Although the causes of these crises vary, at a fundamental level they all share a common feature: the gross misallocation of capital. During the last two decades, much capital was poured into property, fossil fuels and structured financial assets with embedded derivatives, but relatively little in comparison was invested in renewable energy, energy efficiency, public transportation, sustainable agriculture, ecosystem and biodiversity protection, and land and water conservation (UNEP, 2011, p. 1).

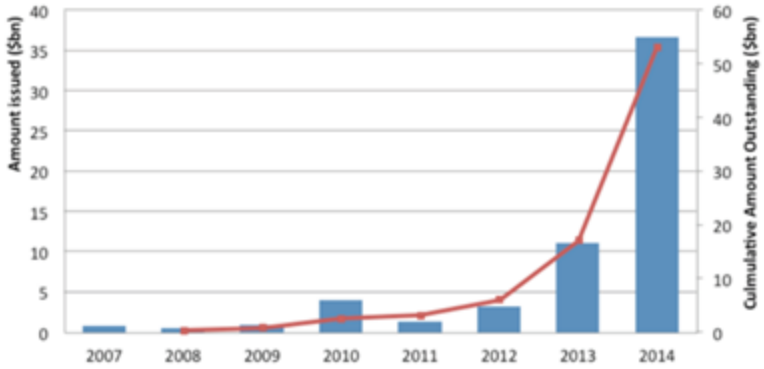
Likewise, the International Panel on Climate Change (IPCC) have argued that substantial reductions in emissions:

> would require large changes in investment patterns (high confidence). For mitigation scenarios that stabilize concentrations (without overshoot) in the range of 430 to 530 ppm CO2-eq by 2100, annual invest-ments in low carbon electricity supply and energy efficiency in key sectors (transport, industry and buildings) are projected in the scenarios to rise by several hundred billion dollars per year before 2030. Within appropriate enabling environments, the private sector, along with the public sector, can play important roles in financing mitigation and adaptation (medium evidence, high agreement) (IPCC, 2015, p. 30).

1.2 The growth and costs of green bonds

Green bonds should be seen in the above context. It represents one of several new types of financial instruments related to sustainability and climate change. According to the Climate Bonds Initiative (CBI) the first green bond was issued by the European Investment Bank (EIB) and the World Bank in 2007. This issue had a triple A investment grade. The first years were slow with below $5 bn.

issuances a year until 2012. 2013 became a milestone for the green bond market. In March, the International Finance Corporation (IFC) issued a bond for $1 bn., which was sold within one hour. The real turning point however came the following November when the first corporate green bonds were issued by Vasakronen, Bank of America and Électricité de France (EDF). From 2013 to 2014 the market size grew from $11 bn. in 2013 to $36.6 bn. in 2014 in issuances, as opposed to outstanding amounts, which is another measure of market size.



Amount issued per year (USD)	
2007	806,940,000
2008	414,284,450
2009	909,372,500
2010	3,904,688,904
2011	1,219,282,424
2012	3,101,960,463
2013	11,042,322,319
2014	36,593,334,453

Figure 1: Growth in the green bond market, 2007-2014

Source: Climate Bond Initiative (2015)

Based on this growth, the expectations for 2015 were high with an estimate of $100 bn. dollars (CBI, 2015). 2015 however turned out as a disappointing year with a moderate growth from 36.6 bn. to 41.8 bn. dollars (World Bank, 2016). However, SEB expects a boost in the 2016 market following the Paris agreement from COP21 (SEB, 2016). For 2016, CBI has set $100 bn. dollars as their target. The CBI is a registered charity in England and Wales. They are an investor focused, not-for-profit organization, working to develop a large and liquid Green and Climate bonds market, with aim of driving down the costs of capital for climate projects in developed and emerging markets. They are tracking every issuance of green bonds and when this thesis is handed in, the current state is: $ 23.2 bn. (CBI, 2016, 08.05.16)

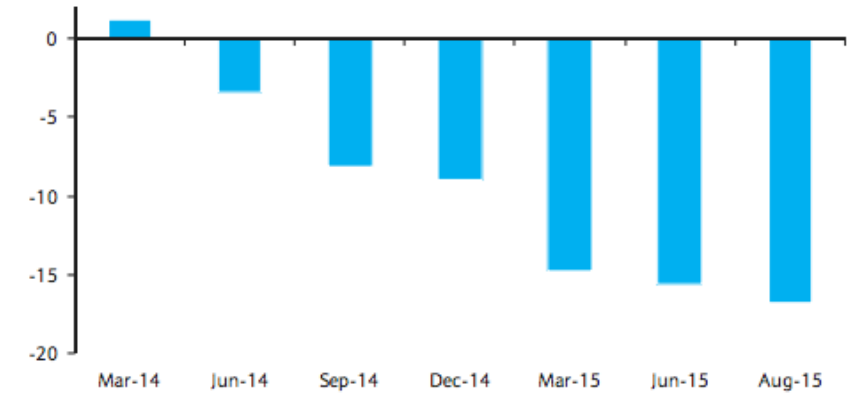
In addition, there are extensive expectations following an announcement from the Chinese government stating its commitment to environmental concerns and having stressed the development of a green bond market (Preclaw and Bakshi, 2015). Bloomberg forecasts $46 bn. in sales each year in China up until 2020. They expect that China's effort to build a market for green bonds may total $230 bn. for environmental projects and renewable energy, "potentially supercharging growth in a market that barely existed a few years ago" (Bloomberg, 2016). The Prime Minister of India has stated a goal

of $100 bn. in private investments with focus on solar growth and will offer governmental support for the green bond market (Preclaw and Bakshi, 2015).

An important question is whether green bonds have the same price and same return as conventional bonds. Gillis (2015) claims that this has been the case historically. However, in the case of green bonds the issuers experience additional costs concerning reporting to investors, buying second opinions from independent parties and tracking of bond proceeds.

In a recent analysis by Barclays, it is shown that investors are currently paying a premium of 20 basis points (bps) to acquire green bonds, at least this is what they find in the secondary markets (Alloway, 2015), and Figure 2 shows that investor premium has increased over time:

Figure 2: Growing price premiums in the secondary market



Note; Regression coefficient on green bond variable in seven cross-sectional samples of the Global Credit Index.
Source: Barclays Research

1.3 Problem statement and research questions

Arguably, the Paris agreement may contribute to the further expansion of the green bonds market and strengthen the momentum green bonds seemingly has in the market. The growth in green bonds, however, still represents a puzzle seen from an economic point of view.

→ If the green bonds have the same yield and risk as non-green bonds, why do we need a green bond market? Cannot these eligible climate friendly projects be funded through the traditional bond market?

→ And if they do not, why do people still show an interest? How can investments in green bonds be explained in cases with higher investment costs and possibly diminishing returns on investments?

There seems to be no real innovation other than the fact that green bonds are earmarked climate friendly or sustainability projects. Even with the same risk and the same return, we therefore need another ingredient to make sense of the new market. From traditional economic theory, the market for green bonds should not necessarily be of any interest.

This master's thesis tries to explain the above puzzles. It does so by analyzing different economic aspects of green bonds and drivers behind changes in issuers', investors' and regulators' *preferences*. Hence, the key factor explored in this thesis is the changing of preferences. If people's preferences have changed, financial benefits (profit) and risk are not necessarily the only things people or corporations care about when investing, the green bond market could make sense. Changes in preferences may be linked to both financial and non-financial benefits from green investments, i.e., environmental impacts, reputation etc. The third question posed is therefore:

→ How can this change in preferences be incorporated in a microeconomic model?

This thesis argues that green preferences need to be incorporated into economic models. A theoretical model incorporating preferences for green investment into a household's/investor's maximization problem is therefore presented. It then analyzes different factors that may contribute to a shift in preferences toward green investment. As argued by The Economist, "Markets may appear from nowhere, but they don't appear from nothing" (The Economist, 2014). Or as argued by HSBC, the "issuance of green bonds is being driven both by the capital needs of issuers as well as the commitment of institutional investors to climate finance and responsible investment" (HSBC, 2014).

1.3.1 Research questions

In order to provide an answer to the above puzzles, the following research questions are posed:

Why green bonds instead of conventional bonds?
What are the main criticism and challenges of green bonds?
What drives the growth of green bonds?
Can the growth of green bonds be explained by changing preferences?

The hypothesis to be explored is that some people will accept a lower expected return on green investment because the investment in itself will have an added value. This implies that investors with preferences for green products will always choose green, if the returns on green and brown investment are the same. This also implies that for a given level of investment, some people will have a higher willingness to pay for investments after the introduction of a green market, which in turn will give a

higher total level of investment. To explore whether or not green bonds give a lower return compared to conventional bonds, a regression on yield to maturity is performed.

1.4 Outline

In order to answer the above puzzles and research questions, Chapter 2 gives a brief description of the traditional bond market.[1] Chapter 3 describes the growth of green bonds and their characteristics in more detail. Chapter 4 develops the theoretical model incorporating preferences for green investment into a household's/investor's maximization problem. Chapter 5 will present a data analysis of yield to maturity for green bonds versus conventional bonds. Chapter 6 discusses the drivers that impact on or can explain changes in preferences, and answers the puzzles and research questions outlined above. Chapter 7 concludes.

[1] A more complete description is provided in Appendix 1.

2. The Bond Market

Before looking specifically at green bonds, it is important to have an underlying understanding of the bond market and how it differs from equity finance. Green bonds are known to have the same structure, risk and return as the traditional bonds. Because of this structure, the bond market overview is highly relevant when it comes to green bonds. Hillier and Clacher (2011) describe the basis of the bond market the following way. Corporations issue securities, and these can be roughly classified as equity or debt securities. A debt security, also called a bond, represents something that must be repaid. In other words, "A debt security is a claim on a specified periodic stream of income" (Bodie et al., 2011, p. 467). When for example corporations borrow money, the lender expects to get something in return (as do shareholders). Thus the principle of bond securities is that the corporation promises to make interest payments at a regularly scheduled basis and repay the initial amount at a predetermined date. Unlike equity securities, the debtor or borrowers of debt securities do not give away ownership to the firm and generally the creditors do not have voting rights.

What separates the debt securities from regular bank financed debt is that the investors buy a share of a debt. This means that the issuer of the bond has a higher number of creditors in contrast to bank debt, where the bank is your only creditor (Bøhren and Michalsen, 2012). Bonds are often labelled fixed-income securities. This is because the bonds are a contract between a borrower and a lender, with a fixed interest rate. When a government or a corporation is in need of capital, one way to get it is to issue debt securities. This way they borrow money from the public on a long term basis. Investors buy the bonds, or contracts, which say they are entitled to an annual or monthly interest. When the predetermined date of repayment arrives, the full amount is to be paid back by the issuer. If a corporation is unable to repay the debt with interest as promised, this can lead to renegotiation or bankruptcy. In the case of bankruptcy, i.e., debtholders have priority in their (limited) claim. On the other hand, shareholders are the residual claimants if the corporation makes profits above what is owed to debtholders. The standard type of bonds is often referred to as "plain vanilla bonds".

2.1 Credit rating

Some of the risk associated with investment in securities is connected to the issuers' ability to pay the promised coupon (i.e., the annual promised interest rate), as well as getting the predetermined principal at maturity. In other words, the highest risk of holding a bond is the issuer's credit risk. According to Moorad Choudhry (2006), the only debt that is entirely free from credit risk is some high quality government bonds and some supranational issuances. To determine the creditworthiness of the issuer of a bond, corporations frequently pay for external companies to have their debt rated. Of rating companies, the three leading firms are Fitch, Standard & Poor's (S&P) and Moody's. These companies define the creditworthiness based on the default risk of the companies. In other words, the

rating companies' asses the likelihood of the firms defaulting and how creditors are protected in a possible default. This means that risk concerning the interest rate is not taken into account when corporations are rated[2].

Figure 3: Credit rating systems

Sortable Table Key	Moody's	Fitch	S&P
Highest grade credit	Aaa	AAA	AAA
Very high grade credit	Aa1, Aa2, Aa3	AA+, AA, AA-	AA+, AA, AA-
High grade credit	A1, A2, A3	A+, A, A-	A+, A, A-
Good credit grade	Baa1, Baa2, Baa3, Baa4	BBB+, BBB, BBB-	BBB+, BBB, BBB-
Speculative grade credit	Ba1, Ba2, Ba3	BB+, BB, BB-	BB+, BB, BB-
Very speculative credit	B1, B2, B3	B+, B, B-	B+, B, B-
Substantial risks - In default	Caa1, Caa2, Caa3, Ca	CCC, CC, C, RD, D	CCC+, CCC, CCC-, CC, C, D

Source: OpSeeker, 2016

The table shows the three different rating companies' rating systems. An AAA or Aaa rating is the highest rating a bond issuer can achieve. These ratings are based on information given by the corporation or issuer, and the highest rating means that the bonds are of the best quality with the lowest degree of risk. These triple A rated bond is typically government bonds from any industrialized country such as Scandinavian countries, the UK, Germany or the U.S. Bonds below the "good credit grade" are generally referred to as "junk bonds". The junk bonds are regarded as speculative when it comes to repayment of the loan and with respect to the interest payments that are stated in the terms of the obligation (Hillier and Cacher, 2011 pp. 159-161). The bonds that are rated with a C, Ca and CC are regarded as the bonds with the highest degree of speculation.

2.2 The process of issuing bonds

When corporations or government bodies want to raise capital by issuing bonds to the public, they usually hire special parties to assist them or to do all the work for them. This is mainly because the issuing process is highly technical and complicated. In the U.S, this special party is often an investment bank. When hired, the investment bank works as an intermediary between the investors and the organization issuing the securities. The investment bank works as an advisor who analyzes the state of the marketplace. The relationship between the investment bank and the corporation or government agency often start a long time before the actual bonds are issued. This relationship may also continue after the issuance. It is not unusual that the investment banker is on the corporation's board of directors. Investment banks are specialized in capital markets. When the investment bank

[2] This type of risk is addressed in Appendix 1.

acts as an intermediary between a bond issuer and bond buyers, they typically act as an underwriter for the bonds. This means that they carry the risk of buying the newly issued bond and that they resell it to the public. Alternatively, they sell it to dealers who then sell it to the public. The profit the investment banker earns is based on the difference between the purchase price and the selling price. This difference is often called the underwriting spread. In general, when an investment bank works for a client corporation or government unit, they prepare the required documents for the Securities and Exchange Commission (for issuances in the U.S). They also help set a price on the issue and they form and manage an underwriting group to spread the risk of the new issue to improve the likelihood of selling all the bonds. Another alternative is when the investment banker markets the issue without underwriting it. In this case the investment banker works as a sales agent under a best effort agreement, where the investment banker works on commission. Another reason why the issuer goes through an investment bank is that the specialized banks usually have a well-developed framework and have the ability to identify sales forces and brokers that are best able to market a particular bond issue. They also have a network of investors and knowledge about which investors to reach out to dependent on the characteristics of the bonds issued (Morningstar, 2015).

2.3 The second hand market

After a bond is bought, the bondholders can buy or sell bonds in secondary markets. When a bond is sold before it matures, the value of the bond will be affected by the length of time to maturity and the current market interest rates (Morningstar, 2015). This results in a price that is constantly changing in response to changes in the interest rate. Because of the inverse relationship between interest rates and bond prices, the bond prices will fluctuate inversely with the interest rate in the market (Bodie et al., 2011). The total return an investor will receive from a bond is based on the coupon and any profit or loss realized on the sale of the bond in the secondary market (Morningstar, 2015). The secondary market consists of the over-the-counter (OTC) market and securities exchanges i.e., New York Stock Exchange and Oslo Børs. Most common of the two are OTC markets. This market consists of hundreds of brokerages and financial institutions that sell and buy bonds via computer networks or over the phone. In this market all prices are negotiable (Morningstar, 2015)[3].

[3] A more complete overview of the conventional bond market can be found in Appendix 1.

3. Green bonds

This chapter gives an in-depth literature review of the market for green bonds and its components.

To this date there is no specific definition of a green bond that is uniformly agreed upon. According to the International Capital Market Association (ICMA), green bonds are bonds where funds are raised for environmentally friendly projects or existing projects with environmental benefits (ICMA, 2016). The World Bank explains the financial instrument as an opportunity for "fixed income investors to support the World Bank lending for eligible projects that seek to mitigate climate change or help affected people to adapt to it" (World Bank, 2016). The Climate Bonds Initiative describes green bonds as: "… instruments in which the proceeds will be exclusively applied (either by specifying Use of Proceeds, Direct Project Exposure, or Securitization) towards new and existing Green Projects – defined here as projects and activities that promote climate or other environmental sustainability purposes" (Gogreenbonds, 2016). Thus green bonds are standard bonds with green as a bonus requirement feature. The first green bonds were issued as a response to an increase in demand from investors who wanted to engage in climate-related opportunities (SEB, 2016). According to the Climate Bonds Initiative the market reached $41.8 bn. in issuances in 2015 and they project that the market will reach 100 billion dollars by the end of 2016. So far, $23.2 bn. has been issued since January.

Apart from what is being financed, green bonds are often identical to the plain vanilla bonds explained in Chapter 2. The only exception is that the capital raised from these funds are specific to projects or companies who work with energy efficiency, low carbon transport, clean energy, natural resources, mitigation and so on. At the time of issuance, the green bonds are marketed and labeled as "green" (Gogreenbonds, 2016). Because of this, not all bonds that go to such projects are incorporated into the market, because the issuer has to market it as green from the very start. The green "use of proceeds" market has developed around the idea of flat pricing, which means that the price should be the same as ordinary bonds. CBI explains that the prices are flat because the credit profile for the bonds labeled green is the same as for conventional bonds from the same issuer (CBI, 2016). Today, in principle, everyone can call themselves green. This issue will be addressed later in this chapter. The focus here is on the market for labeled green bonds. At this stage the practice is self-labeling, where the issuer of the bond decides whether or not to label it green.

3.1 Criteria and types of green bonds (categories and features)

Green bonds are a broad category of bonds, but they all aim to address key areas of concern, such as climate change and biodiversity conservation (ICMA, 2015). These broad categories include among others: climate change adaptation and mitigation, sustainable water management, clean transportation,

sustainable land use (including forestry and agriculture), sustainable waste management, energy efficiency and renewable energy. There are also other types of projects/investments that are harder to categorize and for which it is difficult to determine if it belongs in the green bond category. Center for International Climate and Environmental Research – Oslo (CICERO) address this problem and exemplifies it by stating that energy efficiency of fossil fuel power plants may more likely lead to increased cumulative carbon emissions over time. They call this a "blind alley" when it comes to securing a low carbon and climate friendly future, and emphasize that such projects should be avoided when talking about green bonds (Clapp et al., 2015).

According to ICMA there are four types of green bonds, all of which will be explained in the following sub-sections:

3.1.1 Green use of Proceeds bonds

This is a standard debt-obligation with recourse-to-the-issuer. Recourse is a legal right to collect money. More specifically, if the borrower (the issuer) is unable to satisfy the debt obligation, the investors have the legal right to collect collateral (Business Dictionary, 2016).

3.1.2 Green use of Proceeds revenue bonds

The revenue bonds are non-recourse debt obligations. That they are non-recourse means that the bonds are not backed by the total assets of the issuer. Instead they are backed by specified pledged cash flows (CBI, 2016). Revenue bonds finance projects that produce income. The interest and coupon payments to the bondholders are generated by the income of the project. The bonds are thus secured by specific income of the issuer (Morningstar, 2016).

3.1.3 Green project bond

The proceeds that are raised from selling the bond are used to finance specific green projects. What differentiates the project bonds from other bonds are that the companies who issue these bonds do not carry the risk. The risk is solely tied to the project and not backed by the company. This means that the investor is directly exposed to the risk of the project.

3.1.4 Green securitized bond

A securitized bond is designated to bonds structured in different ways. When a bond has been securitized it has been bundled and repackaged. These bonds can include one or more green projects. This type of green bond includes covered bonds, which is debt securities backed by cash flows from mortgages or public sector loans, and asset-backed securities (Investopedia, 2016). These bonds have the coupons and thus their creditworthiness tied directly to cash flows that are generated from

specified assets e.g., loans to solar projects or wind energy farms. There is no established company guaranteeing, essentially the creditworthiness of the bond is tied to the assets expected performance (CBI, 2016).

3.2 The Green Bond Principles

The Green Bond Principles (GBP) are voluntary guidelines created with the aim of ensuring a credible market. According to the ICMA, the guidelines promote integrity in the development of the new market. The GBP clarifies the approach of issuing a bond and recommends disclosure and transparency in the process. The principles are a step in the direction of a more standardized market with common rules and common ground. The first draft of the Green Bond Principles came in January, 2014 (Ceres, 2014). The last edition of the principles was updated in London, March 27, 2015 at the first annual conference of the Green Bond Principles. Present at the conference was the ICMA, which functions as a secretary to the GBP. In addition, a GBP Executive Committee has been established. This is a collection of a representative group of issuers, intermediaries and investors in the green bond market. Among the participants in the committee there are representatives from the World Bank, IFC, JP Morgan Chase, Bank of America and SEB to mention a few.

The Green Bond Principles suggest a concrete process for issuers to use, so that investors, banks and others have the necessary tools to understand any given green bond. The GBP Executive Committee underlines the importance of transparency and integrity of the environmental aspect of the bond, and the principles aim to exclude bonds that are not sufficiently green. They emphasize that this reporting from the issuer will, at an increasing rate, be used by investors for strategic measures. The process has four categories. The following is a summary of the updated version of the Green Bond Principles:

3.2.1 Use of Proceeds

The use of proceeds of the bond should be properly described in a legal document for security. The principles also clearly state that clear environmentally sustainable benefits should be provided by the issuer. In addition to this it is to be expected, if possible, that the issuer will assess or quantify these effects.

The GBP advises the issuers to use existing criteria and categories of green bonds as a guide when issuing a green bond. These criteria and categories have already been presented in section 3.1. Finally, the GBP addresses the issue of refinancing. They state that in the case where an investment is to be used as refinance or a proportion of the proceeds is to be used for this purpose, the issuer should provide an estimate of the share intended for this use. Refinancing will be further addressed in the discussion in Chapter 6.

3.2.2 Process for Project Evaluation and Selection

During the process, it is important to be transparent about how the issuer determines eligibility of a project, how they determine whether a project fits the green bond category. This process should be outlined and include how the project fits with the categories in the GBP. It should also include which criteria the project fulfills and the environmental sustainable objectives of the project. The GBP also emphasizes that this selection can be supplemented with a review from a second party, or a so-called second opinion. This will be addressed in section 3.4.1.

3.2.3 Management of Proceeds

The recommendation for the management process is that the green bond proceeds are kept isolated or handled separately from other sources. Hence they should be credited to a sub-account or moved to a sub-portfolio. Alternatively, the proceeds should be tracked by the issuer in an appropriate manner. It is also pointed out the advantages of an auditor or a third party controller to verify the chosen method of internal tracking and to enhance transparency.

3.2.4 Reporting

The GBP encourages annual reporting as a minimum, in addition to reporting on the proceeds. These reports should include a list of the projects that have been allocated investment from the green bond proceeds, a description of the projects and expected environmental impact. Another recommendation from the GBP agreement is the use of qualitative performance indicators and measures of the expected environmental sustainability impact of the specific investment. However, if competition problems or confidentiality agreements limit the possibility of specific reporting, the information can be presented in generic terms. Examples of impact measures include; reductions in greenhouse gas emissions, how much deforestation avoided, how many people have increased access to clean water as a result of the project, etc.

3.3 The market for green bonds

The green bond market includes every bond which is *labeled* green. It is the issuer of the bond that decides whether or not to label it as a green bond. According to the Climate Bond Initiative, the *unlabeled* market for climate bonds and green bonds is $531.8 bn. which makes the labeled market small in comparison. In you compare it to the broader global bond market, which is estimated to around $80-100trn., the market for green bonds is fairly small (CBI, 2016).

Municipal and local government green bonds, including state bonds in a federal nation, are a growing trend. The first green muni bond was issued by Massachusetts in June 2013. Gothenburg issued the first Green City bond in October 2013. In the third quarter of 2014, the state of California issued its

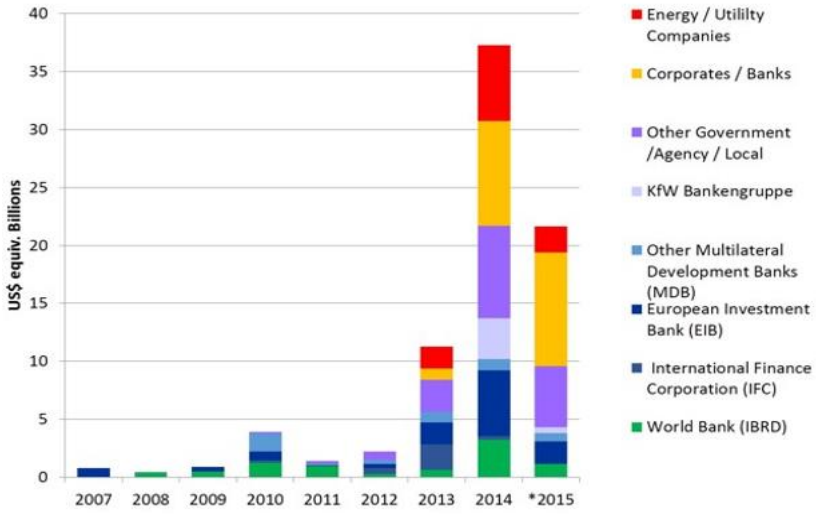
first green bond. Province of Ontario, New York State, City of Johannesburg and others have also issued green bonds.

In December 2014, Norway became the first country in the world to launch a green list on the stock/securities exchange. BKK was the first company to issue a green bond on this list in 2014. This was a bond issue of 1 bn. NOK. 11 investors showed an interest and after two hours BKK had sold the entire bond (EnergiNorge, 2015). To date there are eight Norwegian companies/municipalities that are issuers on the green list. Among these we find Kommunalbanken (KBN), the Norwegian municipal bank, owned by the government, which has been issuing green bonds from as early as 2010. These bonds were targeting Japanese personal savers. In total the issuances accounted for 300 million USD. In 2013 KBN became the first Nordic institution to issue a global green bond in the market, this accounted for 500 million dollars. They are now listed on the green list (KBN, 2016).

3.3.1 The issuers

Typically, the early issuers were the supranational sub-sovereign and agency sector (SSA), like the World Bank and IFC. As seen in figure 4, the green bond market today has a greater diversity in types of issuances. The issuers in the market today are a combination of SSA, municipals, and corporations like Apple, Toyota and China Industrial Bank (CBI, 2016).

Figure 4: Annual green bond issuance by issuer type



Source: Citylab, 2015

* the figure is from mid-2015.

3.3.2 Demand and Supply

There is evidence of high demand for green bonds from different investors. In 2013 the US state of Massachusetts issued both a conventional bond and a green bond. These issues were priced identically and yet the conventional bond was undersubscribed and the green bond was oversubscribed by 30 % (CBI, 2014). In September 2014, the state of Massachusetts issued a second green bond offering. Initially this issuance was $250 million, but in response to heavy investor interest, the par value was raised to $350 million. The green bond still got orders exceeding $1 bn. from both retail and institutional investors (Humphreys and Sanders, 2014). Recently Iberdrola raised 1 bn. EUR in green bonds to refinance onshore wind energy projects. The issue reported great response from investors who offered four times the issue size (Mahapatra, 2016). This indicates the possibility that the green bond could have been introduced at a somewhat higher price, and still attracted buyers. This will be further discussed in later chapters.

In a study conducted at Harvard Kennedy School (duPont et al., 2015), it was found that the green bond label does not yet allow issuers to access capital at a lower cost. In other words, investors are not yet willing to pay a premium for the green bond label, which in turn would give the borrower a lower interest rate. They argue, however, that since the green bond issuances has been significantly and consistently oversubscribed, they predict that such high levels of demand over time could increase the willingness to pay a premium for the green label. In relation to an issuance by DC Water, they observed slightly lower cost of capital than they would expect with a conventional bond issue. But it is difficult to observe a clear market trend given such few data points (duPont et al., 2015). As mentioned in the introduction, Barclays has found a high demand in the secondary market and observed growing price premiums over time (Preclaw and Bakshi, 2015). A strong demand for green bonds in the secondary market is positive news for investors with liquidity concerns (Ludvigsen, 2015).

In a report on the state of the green bond market of 2015, CBI and HSBC point to other signs of investor demand in addition to oversubscription. The first sign they emphasize is investor commitments. In 2015, a range of public pledges came from Zurich Insurance, Deutsche Bank treasury, KfW, Barclays treasury and ACTIAM to build €1 bn. green bond portfolios. They argue that this sends an important signal of high demand among investors. In addition, they mention an increased number of specialized green bond funds, such as SEB Asset Management, BlackRock and Calvert (CBI and HSBC, 2015). There are a limited number of investment opportunities in green bonds with quality offerings that fully commit to all four pillars of the GBP. This in part has allowed issuers to be selective, only selling to investors who are signatories to the GBP or to the Global Investor Statement on Climate Change (Ludvigsen, 2015).

3.4 Delimitations and rules

The market is today only regulated by the market itself and it is driven by voluntary principles. As mentioned, the GBP recommends second and third party evaluation to ensure a credible market. As a result of a demand for more structure and credibility, a market for second opinion evaluations has been created. There is also an increased demand from investors who want impact reports from the issuers of green bonds.

3.4.1 Second opinions

To ensure transparency to investors on potential investments on offer, there has been established a market to offer second opinions and to certify the use of proceeds from the issuances of green bonds. Ulrik Ross, global head of public sector and sustainable finance at HSBC Capital Financing, argues that investors appreciate knowing that these independent advisors, such as CICERO, DNV-GL and VIGEO, do not have an underlying self-interest in bringing these products to the market. Banks, investors and issuers need to protect themselves from being misled, which makes these external validations important to demonstrate sincerity and to underline that their actions are compliant with their promises. In addition, Ross argues that the validation bodies can function as a safeguard against greenwashing[4] (Ross, 2014). The process begins pre issuance by a company or institution issuing a self-labelled green bond. They explain how proceeds will be managed and how the issuance can be considered green. The Climate Bond Initiative strictly urges the issuer to buy a second review by an external party. This encouragement is specifically stated in the GBP as well. For a green bond issuance to be included in the green list on the Norwegian stock/securities exchange, they demand a second opinion verification (Oslo Børs, 2014). The CBI also recommends an independent third party verification against the Climate Bond Standards. Approved verifiers for this kind of third party review are audit firms and Environmental Social and Governance (ESG) service providers (CBI, 2015). Third party assurance can provide investors' confidence that the issuer of the bond has processes to track the management of proceeds and that reports on outcomes are robust (KPMG International, 2015). According to Barclays, 60 % of labeled green bonds issuances so far have come with an external review (Preclaw and Bakshi, 2015).

Facing a market with different providers of second opinions gives different methods in practice. CICERO, one of the world's leading providers of second opinions with nearly 60 opinions issued, has invented a methodology called "shades of green". This methodology is developed to reflect the climate and environmental ambition of a bond issue. The different shades are dark green, medium green and light green, which have the following definition:

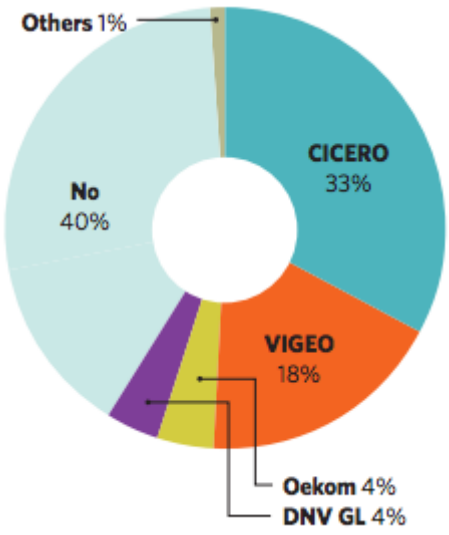
[4] Greenwashing will be further discussed in section 3.7.2.

Dark green: Implementing a 2050 climate solution today. The typical dark green bonds can be investments in renewable energy such as solar or wind power.
Medium green: On the way to a 2050 climate solution. One example is sustainable buildings with good energy efficiency ratings.
Light green: Short-term gains but not a long-term climate solution. Such gains can be for example energy efficiency improvements in an industry that result in short-term reductions of greenhouse gas emissions but do not shift away from a fossil fuel-based economy (CICERO, 2015).

To form their second opinion CICERO looks at information gathered during meetings, e-mail and phone correspondence with the issuer. They also look at documentation of rules and frameworks provided by the issuer as a basis for their opinion.

DNV-GL is another company that provides second opinions for green bond issuers. As a basis of their opinion, they use the GBP framework. They look at the four requirements as earlier presented: Use of proceeds, process for project evaluation and selection, management of proceeds and reporting. To determine if the issue is compliant with the Green Bond Principles they review publicly available documentary evidence, from the web site and reports and drafts provided by the company they are reviewing. In addition, they interview employees and then document their findings in a protocol and make a detailed conclusion (DNV-GL, 2015).

Figure 5: Distribution of companies offering second opinions



Source: Climate Bonds Initiative (2015)

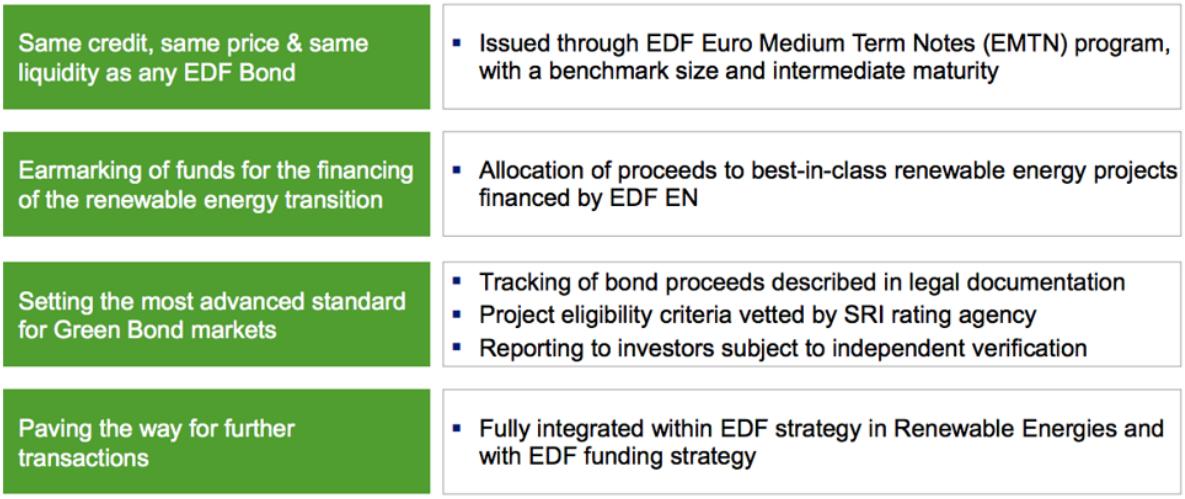
3.4.2 Impact reporting

Impact report is a report conducted by the issuer of the green bond post-issuance, to update investors and stakeholders of the environmental benefits of the use of proceeds. There has currently not been established any standards for impact reporting (ICMA, 2015). This is however changing in this moment. A GBP working group met up in the beginning of March 2016 to begin discussions on how to harmonize impact reporting (Ali, 2016). According to Barclays, the impact reports and the quality of reporting have become a key differentiator for the buyer base for some market participants. The issuers who provide high quality information about environmental benefits of their underwritten projects, are creating more investor demand (Preclaw and Bakshi, 2015). KPMG International recommends bond issuers to report on the environmental benefits that their projects deliver at regular intervals. This should be done during the life of the bond or of the projects invested in, at least annually, which is also in line with the Green Bond Principles. They emphasize that this is to ensure a long term credibility in the market for green bonds. Investors and other stakeholders of the issuance will need evidence that the projects indeed have delivered the intended environmental benefits. The recommendation they give issuers is to design and evaluate processes in advance and implement systems to monitor environmental outcomes over time. They argue that this could contribute to reduce reputational risks and risks of being accused of overstating the environmental benefits of funded projects (KPMG International, 2015).

3.5 The process of issuing green bonds and additional costs

The issuing process for green bonds is similar to the traditional one described in Chapter 2. However, given the Green Bond Principles and expectations from the market and investors, the issuing processes include a few more hurdles for the issuer and the investment banks. In a report conducted by KPMG International (2015), they mention ongoing costs that are associated with the issuance of green bonds as a drawback. The costs associated with issuances of conventional bonds are lower than those of green bonds. Additional tracking, monitoring and reporting process are costs that must be considered, as well as up-front investment to define the bond's green criteria and sustainability objectives (second opinions). In addition, investors may seek penalties for green default if the issuer of the bond breaks agreed-upon green clauses (KPMG International, 2015). The following figure is retrieved from an EDF report after EDF launched their first green bond in 2013. Figure 6 illustrates that the green bonds had the same credit, same price and same liquidity as their other issued bonds, and shows that issuing green bonds is associated with some additional hurdles:

Figure 6: EDF green bond characteristics



Source: EDF, 2013.

The additional hurdles include tracking of green bonds described in legal documentation and reporting to investors subject to independent verification. Adrian King, Global Head of KPMG Sustainability Services, however, claims that the approach to reporting on green bonds should not differ much from reporting on sustainability performance (KPMG International, 2015). This could mean that organizations which already have a mandate of Social Responsible Investment (SRI), could have a lower additional cost from issuing green bonds compared to organizations who do not already report their sustainability performance.

3.6 China and green bonds

China's state council has announced that it wants to establish a market for labeled green bonds, as a part of their shift towards green development. The bond market in China is the world's third largest. The state council has announced that the market for green bonds will be regulated. In April 2015, the Chinese central bank announced ambitious policy proposals. These proposals cover the development of green definitions, an evaluation system for the allocations of funds and the environmental impact of the green bonds. In addition, they are developing tax incentives for green bonds, as well as preferential risk weighting in bank capital requirements and fast track issue for green bonds (CBI and HSBC, 2015). It is worth noticing that both the fact that the government will regulate, and the elements of support and subsidies, distinguish the Chinese green bond market from other markets, with the possible exception of India. Clearly, there can be a link between the wish to support the market and the need to regulate it.

3.7 Criticism of green bonds

In an open letter addressed to the Green Bond Principles executive committee, secretariat and member organizations, signed by BankTrack, Amazon Watch and Friends of the Earth US, among others, they wrote a critical approach to provide input on the principles. In the Green Bond Fact Sheet they write about environmentally harmful activities and green bonds. They called on the Green Bond Principles to: "revise the principles to include real commitments rather than broad recommendations, reference clear and science-based definitions and criteria of what constitutes 'green'; and commit unambiguously to third party, independent verification of sustainability and use of proceeds information reported by bond issuers" (BankTrack, 2015). They worry that the GBP members have grown from 13 financial institutions to over 80 member organizations, emphasizing that this makes an agreement on a satisfactory definition of "green" harder to achieve (BankTrack, 2015). BankTrack is not the only ones with a critical view of the market for green bonds. There has also been raised several other concerns. Some of them are elaborated on in the following sub-sections:

3.7.1 Concerns about additionality

According to the Business Dictionary, additionality can be interpreted as when an input, which can be both an action and an item, or in this case a market, adds to the existing inputs and results in a greater aggregate (Business Dictionary, 2016). For the green bond market to have true value it should ultimately finance investments that are additional, not finance already existing projects or projects that would happen anyway, through the conventional bond market[5].

3.7.2 Greenwashing

The Greenwashing index defines greenwashing as: "when a company or organization spends more time and money claiming to be green rather than actually implementing business practices that minimize their environmental impact" (Greenwashing Index, 2016). The Underwriters Laboratories (UL) Environment defines greenwashing as: "The act of misleading consumers regarding the environmental practices of a company or the environmental benefits of a product or a service" (UL, 2016). The same organization has mapped the extent of greenwashing in the U.S, Canada, England and Australia and they have developed the "seven sins of greenwashing".

In this thesis, the term greenwashing will mean the inappropriate use of green labeling of bonds. It also includes cases where companies through their core operations have a negative environmental impact, and where only a small fraction of the business has a focus on being green. This however, does not necessarily go against the Green Bond Principles if the fraction that has a focus on green actually is green. According to a report by Barclays, the term greenwashing has come to equal issues

[5] The concerns about additionality are further discussed in Chapter 6.

of green bonds that fund projects that lack sufficient environmental benefits, at least in the view of some participants. They emphasize that the required level of greenness of a bond's use of proceeds is a very difficult measure to standardize, particularly because it will differ for each investor and the diversity of project areas (Preclaw and Bakshi, 2015). According to Andrew Mason, responsible investment analyst in Standard Life Investments, greenwashing can contribute to undermining the credibility of the green bond market. He also argues that it can lead to a loss of a green status for a number of bonds when the uses of proceeds become clearer. He points to a lack of consistent mechanisms to credentialize the market and is worried about the many types of green bonds coming to the market, as well as questioning the core operations of some of the issuers (Mason, 2015). Phillip Ludvigsen in Environmental Finance points to the inconsistency in the market and the lack of clear regulation. He argues that there are many definitions of what is green. “One investor's idea of a “dark green” is another's “light green”, “vanilla” or even “brown”” (Ludvigsen, 2015). This lack of clear guidelines in the market for green bonds is clearly a problem, as it opens up for the possibility of greenwashing.

3.7.3 Second opinion risks

Every party offering second opinions have their own way and criteria to conduct them. This can lead to different conclusions from different parties. This lack of a common framework and agreement upon what limitations and rules should apply to green bonds can give different conclusions dependent on the one making the review or verification. CICERO's second opinions are as mentioned based on so-called shades of green, whereas DNV-GL uses the Green Bond Principles as their framework. Other companies engaging in second opinions use their own strategy. In collaboration with CBI and ICMA, many of the firms offering second opinion to issuers of green bonds are also a part of making the green bond framework. Philip Ludvigsen points out that problems can arise when second party review and consultation is presented as an “independent” opinion. It concerns him that these “independent” opinions are published by the same organizations that helped the development of the green bond framework and the project criteria. He emphasizes that a review of your own organization's work can hardly be called independent (Ludvigsen, 2015). Another limitation of a second opinion is that the consultation only addresses a forward looking view, so it can be hard to know if the bond is being managed as intended. In addition, because it is a voluntary action, the result of the opinion is not always reported because it is the bond issuer who decides whether or not to share the opinion with the public (KPMG International, 2015). According to the open letter from BankTrack (2015), they state that after a review of self-labeled green bonds that were issued in 2014, they found that while 57 % of these were accompanied by a second opinion, only 35 % of these were made public. In their analysis of the first quarter issuances of 2015, the proportion of second opinions that were made public dropped to 19 % (BankTrack, 2015). This may be an indication that the encouragement from the

Green Bond Principles is not strong enough for companies to fully commit to the level of transparency that the market aims for.

3.7.4 Delimitation and definitions

As previously mentioned, there is no set of rules that the agents in the market must follow, it is all based on voluntary reporting and delimitation. There are also issues with defining what is green. This second question is what the GBP working group is trying to figure out as this thesis is being handed in. They have organized a working group with the aim of defining "green". The first meeting was in the beginning of March, and the intended plan is to update the taxonomy of which type of projects are suitable for green bonds, before the GBP are being redrafted in June 2016. The working group on impact reporting are also going to submit their findings before the redraft. However, because of the need for market consensus and the controversial nature of these debates, it is unclear if the findings will be adopted in the next version of the GBP (Ali, 2016). So even though there are many people working together to define and create sufficient framework and structure, there is a long way to go. As of today, the market is unorganized and built on self-labeling.

3.8 Towards an explanation of the growth in green bonds

As shown in this chapter, the green bonds market has been growing and is expected to continue growing, despite the above criticism and additional costs of green bonds. As stated in the introductory chapter, an important explanation for the growth in green bonds may be linked to issuers', investors' and regulators' changing preferences. If people's preferences have changed, financial benefits (profit) and risk are not necessarily the only things people or corporations care about when investing, and the green bond market would make more sense. The following chapter, therefore, develops a theoretical model that incorporates preferences for green investment into a household's/investor's maximization problem.

4. Model and Analysis

This chapter develops a theoretical model that incorporates preferences for green investment by using traditional microeconomic theory and incorporating preferences for greenness into an intertemporal maximization problem. It represents the first step in trying to answer the question of whether or not the growth in the green bond market can be explained by changes in preferences.

4.1 Consumer theory

To understand how preferences for "greenness" can affect how investors decide to spend their money, it is useful to understand the standard choices of consumption and saving. In microeconomics, consumer theory explains individual's allocation of income based on their personal preferences and their economic situation. These preferences are subjective and are defined as individuals' ability to assess different combinations of goods, or to allocate their income, in different periods in a consistent way.

4.2 Constructing a micromodel of intertemporal preferences

The aim of the model is to show that the introduction of green saving products can result in an increase in the total savings. Not only will money be transferred from other types of saving/investment, but the total level of saving can increase.

Postulate 1
Some people will accept a lower expected return on green investments because the investment in itself will have an added utility. This implies that investors with preferences for green products will always choose green, if two alternatives have the same economic characteristics apart from greenness.

This also implies that for a given level of investment, some people will have a higher willingness to pay for investments after the introduction of a green market, which in turn will give a higher total level of investment.

4.2.1 Basic assumptions

In the model it will be assumed that there are two types of people: type I and type II. Type I will have a higher utility if the saving products can be classified as green. Type II will be indifferent between "green" and "brown" investment. The terms "green" and "brown" will be used to underline the main point. However, "brown" investments do not necessarily have to be bad for the environment, but it will include investment in fossil fuels and nuclear energy. This being said, the analysis for the type II

investors will not change when a green market is introduced. For type I investors, however, the introduction of green investment products will have consequences.
When green investment is introduced in the model, this will have mainly two consequences for the allocation of resources for type I investors:

1) They will move their saving/investments to green products. Given this, there is the possibility of a corner solution in the model.
2) For any level of investment, the willingness to pay for an increase in investment will now be larger than in the case where only "brown" investment is available. This will lead to a reallocation of resources from consumption to saving. The reallocation will continue until the marginal utility of consumption is equal to the marginal utility of saving.

Seeing as the level of investments for type II investors are not affected, and the type I agents will increase their savings, the result will be a net increase of total savings in the economy.

To keep the model simple, we assume two periods, where investment is only possible in period 1.

We will also assume that types I and II have the same income and that they will save the same amount given that there are only "brown" investment products available.

Further it is assumed that we are facing an open economy and constant prices, so possibilities for consumption are only constrained by the agents' income and the chosen level of investment. The model will also assume an infinite supply of both types of bonds. For simplicity, the model will at the outset exclude borrowing, but a case with borrowing will be presented at the end of the chapter.

The agents' preferences are continuous, but as an alternative, lexicographic preferences will be mentioned at the end.

The utility function of type II is quasi concave with two arguments, the consumption in each period. The function is increasing in each argument. Type I's utility function has an additional term, which is the value of greenness as a function of green savings.

4.3 The basic model

C_t : The agent's consumption during time period t

w_t : The agent's income (other than interest) in time period t

s_G : The agent's savings in "green" in time period 1

s_B: The agent's savings in "brown" in period 1

U: The agent's utility function

r: The rate of interest

Individuals are happier the higher their utility is. We can define utility as: "An economic term referring to the total satisfaction received from consumption" (Kim, 2014, p. 2). Based on this we assume that the agents will maximize their utility given some constraints.

The reference case of the model is a situation where only brown savings opportunities are available. The interest rate r and the incomes w_1 and w_2 are exogenous, so this determines the opportunity set, a straight line going through (w_1, w_2) with slope -(1 + r). The intersect between this budget line and the horizontal axis is the present value of incomes, which is exogenous. This will equal the present value of consumptions.

The model is set up with a time-additive utility function with utility discounting between period 1 and 2, where θ is a number between 0 and 1 to illustrate that an individual has higher utility from consumption today than tomorrow.

$$L = u(C_1) + \theta u(C_2) - \lambda_1(C_1 + s_B - w_1) - \lambda_2(C_2 - (1 + r_B)s_B - w_2)$$

Which gives the first order conditions:

1) $\frac{\partial L}{\partial C_1} = u'(C_1) - \lambda_1 = 0$

2) $\frac{\partial L}{\partial C_2} = \theta u'(C_2) - \lambda_2 = 0$

3) $\frac{\partial L}{\partial s_B} = -\lambda_1 + (1 + r_B)\lambda_2 = 0$

Solving the expressions to find the tangency condition, we get:

$$u'(C_1) = (1 + r_B)\theta u'(C_2)$$

$$\frac{u'(C_1)}{\theta u'(C_2)} = (1 + r_B)$$

The tangency expression determines the optimal choice where the marginal rate of substitution equals the absolute value of the slope of the indifference curve. The marginal rate of substitution (MRS) in the case of intertemporal choice defines the subjective exchange ratio, i.e., how much more consumption the individual must have tomorrow for him to be willing to forgo one unit of consumption today, given a specified level of utility.

While the conditions above determine what point will be chosen along some budget constraint, the budget constraint itself is determined as follows. The budget constraints in the Lagrangian can be expressed as intertemporal budget constraints to express the "lifetime budget constraint", which is the present value of all income equal to the present value of lifetime consumption.

$$w_2 = C_2 - (1 + r_B)s_B$$
$$w_2 = C_2 - (1 + r_B)(w_1 - C_1)$$
$$C_1 + \frac{C_2}{1 + r_B} = w_1 + \frac{w_2}{1 + r_B}$$

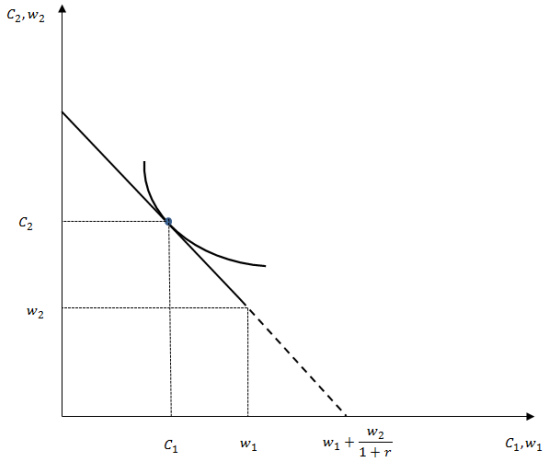


Figure 7: Intertemporal choice of consumption

w_1 and w_2 represent the income in the two periods, and the initial allocation of consumption if they choose to consume all their income in both periods. Given the interest rates on saving, their optimal solution is to save in period one, such that they have a higher consumption in period 2. The tangency point where the indifference curve meets the slope of the budget line is the optimal allocation of consumption between the two periods. The distance $w_1 - C_1$ is the total savings in period 1. Whether the dashed line is part of the opportunity set, depends on whether the individual is allowed to borrow. This is normally the case, but the interest rate is typically a bit higher. The slope of the dashed part should thus be higher in absolute value than the upper part. If people's preferences and pairs of income are spread out continuously, the kink which is caused by borrowing rates being higher than

deposit rates will lead to some bunching at the kink point. This result in a significant number of people having a corner solution instead of the usual tangency solution illustrated in Figure 7. Someone who has a high second-period income, and a low first-period income, will typically want to borrow, i.e., they will have a tangency point at the dashed part. In this analysis, the main focus will be on saving. However, after the remaining part of the model is presented, the issue of borrowing will be discussed in greater detail.

4.4 Introducing a green investment option

A green investment option will now be introduced and it is now assumed that some people will get a higher utility when investing in green. A new term is thus introduced: $\phi(s_G)$, which represents the value of green saving. Following this, $\phi'(s_G)$ is the marginal value of green saving. ϕ is increasing and concave, to express that an agent of type I, will get high utility from the first amount of money invested in green products. ϕ' is positive and decreasing, so the marginal utility will decrease as investments increase. This term is now included in the utility function. In the model it is assumed that $\phi > 0$, for type I investors, and $\phi \equiv 0$ for type II investors. The focus is still on saving and borrowing is thus excluded from the model.

$$L = u(C_1) + \theta u(C_2) + \phi(s_G) - \lambda_1(C_1 + s_G + s_B - w_1) - \lambda_2(C_2 - (1 + r_G)s_G - (1 + r_B)s_B - w_2)$$

Which gives the first order conditions:

4) $\frac{\partial L}{\partial C_1} = u'(C_1) - \lambda_1 = 0 \Rightarrow u'(C_1) = \lambda_1$

5) $\frac{\partial L}{\partial C_2} = \theta u'(C_2) - \lambda_2 = 0 \Rightarrow \theta u'(C_2) = \lambda_2$

6) $\frac{\partial L}{\partial s_G} = \phi'(s_G) - \lambda_1 + (1 + r_G)\lambda_2 = 0 \Rightarrow (1 + r_G)\lambda_2 + \phi'(s_G) = \lambda_1$

7) $\frac{\partial L}{\partial s_B} = -\lambda_1 + (1 + r_B)\lambda_2 = 0 \Rightarrow (1 + r_B)\lambda_2 = \lambda_1$

Case 1: $r_G = r_B$, $\phi'(s_G) > 0$

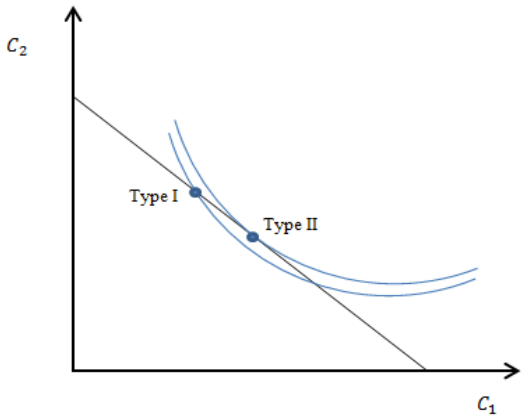
This case occurs when green bonds are priced identically as conventional bonds. As long as $\phi \neq 0$, both equation 6) and 7) cannot be true at the same time, and it is already assumed that type I investors have a positive added value of green. This implies that type I agents who face a positive additional value from $\phi'(s_G)$, will always choose to invest in green. The problem can be solved for the optimal choice of s_G for type I.

$$(1 + r_G)\theta u'(C_2) + \phi'(s_G) = u'(C_1)$$

$$\frac{u'(C_1)}{\theta u'(C_2)} = (1 + r_G) + \frac{\phi'(s_G)}{\theta u'(C_2)}$$

How much the individual is willing to save is based on the subjective size of ϕ. Type II is indifferent and will therefore choose the same point as the optimal point in the model without a green savings option. One could construct indifference curves in the (C_1, C_2) diagram for type I that incorporate not only the MRS between C_1 and C_2, but also the added utility from s_G. This would require a definition that links a unique value of s_G to each point (C_1, C_2) in the diagram. This, again, would rely on the budget constraint, so that a different r_G would imply different indifferent curves. Instead, in Figures 8 and 9, indifference curves for type I that show the trade-off between C_1 and C_2 at each point in the diagram as if s_G is some fixed number will be used. Since $\phi(s_G)$ enters the utility function in an additive way, these indifference curves are the same irrespective of the fixed s_G, and the same as those of type II. It is important to remember that moving to a "lower" indifference curve will be preferred if the move entails a sufficiently high $\phi(s_G)$, which requires a sufficiently high s_G. This may not be achievable if $\phi(s_G)$ adds very moderately to the utility function, but it can be achieved if s_G can be chosen large enough and $\phi(s_G)$ gives a substantial addition in utility.

Figure 8: Introducing a green investment option



When $\phi > 0$, type I will choose a point on the same budget line, but they will be on an indifference curve below that of type II, see Figure 8. The utility level is higher. This allocation of savings and consumption results in a larger share of savings in period 1 for type I investors. Thus the total savings has increased after introducing a green savings product. At the optimum of type I, the absolute value of the slope of the indifference curve, $\frac{u\prime(C_1)}{\theta u\prime(C_2)}$, exceeds $(1 + r_G)$ by the magnitude $\frac{\phi\prime(s_G)}{\theta u\prime(C_2)}$, cf. the f.o.c. above.

A natural extension will be to look at a case where we allow green investment to have a lower return than brown investment. Findings suggest that investment in green bonds in some cases gives a lower

return than investment in conventional bonds (Preclaw and Bakshi, 2015). The model will now present the case where the rate of return on green investment is lower than the rate of return on conventional investment. How strong must the preferences be for type I investors to still invest in green?

Case 2: $r_G < r_B,\ \phi'(s_G) > 0$

This case occurs when the green bond is priced higher than the conventional bond, thus generating lower returns. In this situation, type II will continue to invest in s_B, as is expected. This section will thus focus on the choice of type I. When $C_1 = w_1 - s_B - s_G$ and $C_2 = w_2 + s_B(1 + r_B) + s_G(1 + r_G)$ are substituted into the utility function, the partial effects for type I of changing either s_B or s_G, but keeping the other s constant are:

$\frac{\partial u}{\partial s_B} = -u'(C_1) + \theta(1 + r_B)u'(C_2)$, and $\frac{\partial u}{\partial s_G} = -u'(C_1) + \theta(1 + r_G)u'(C_2) + \phi'(s_G)$

First question: Will s_G be used at all (where to invest the first NOK)? This depends on the values of these two partial derivatives at the "starting point", where $s_B = s_G = 0$. The first NOK should be invested brown if;

$$\frac{\partial u}{\partial s_B}\Big|_{s_B = s_G = 0} > \frac{\partial u}{\partial s_G}\Big|_{s_B = s_G = 0}$$

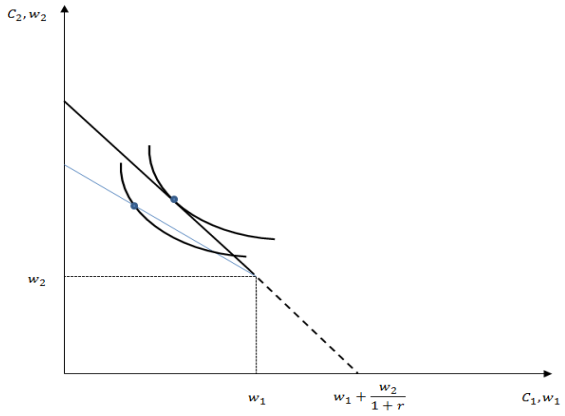
$$\Leftrightarrow (r_B - r_G)\theta u'(C_2) > \phi'(0)$$

The left hand side shows the additional "economic" value of $\Delta s_B = 1$ above $\Delta s_G = 1$, measured in utils. The right hand side is the value of utils if $\Delta s_G = 1$, via greenness. $r_B - r_G$ represents the cost or price of investing in green when the rate of returns are different. The expression will vary in the difference in the returns and in the marginal utility of consumption in the second period.

Assume now that either $\frac{\partial u}{\partial s_B}\Big|_{s_B = s_G = 0}$ or $\frac{\partial u}{\partial s_G}\Big|_{s_B = s_G = 0}$ is positive. If not, they would prefer to borrow. If the first NOK is invested green, then we continue investing more green until one of these two happens:

1) $\frac{\partial u}{\partial s_G} = -u'(C_1) + \theta(1 + r_G)u'(C_2) + \phi'(s_G) = 0$, which is the optimal s_G based on intertemporal tradeoff, as if s_B is impossible. This is illustrated in Figure 9.

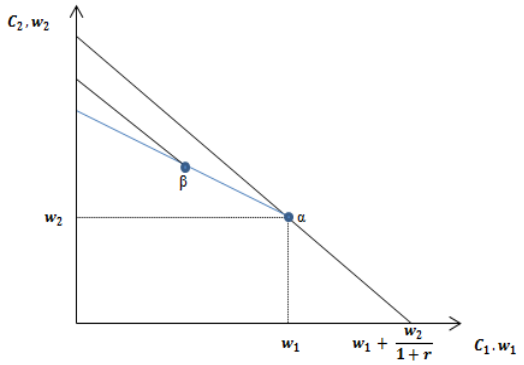
Figure 9: Model of different returns on green and brown investment



The upper budget line has a slope of $-(1 + r_B)$, while the lower budget line has a slope of $-(1 + r_G)$. Where on the budget line the type I investors end up depends on their subjective value ϕ. Since there is no green borrowing option, we do not have to consider the possibility of arbitrage in this scenario. In this case there is an equilibrium where type I investors are willing to give up some return to still have some green saving.

2) We can also think of a situation (see Figure 10) where $\frac{\partial u}{\partial s_B} < \frac{\partial u}{\partial s_G}$. In a point α, it would be optimal to invest the first NOK in s_G, and continue to save in the direction of β. Since $\phi'(s_G)$ is diminishing, type I investors could reach a point β, where $\frac{\partial u}{\partial s_B} = \frac{\partial u}{\partial s_G}$, and any additional saving should be saved in s_B. So, in this case, an interior solution with $s_B > 0$ and $s_G > 0$ for the same household is possible. The optimal s_G in Figure 10 is the horizontal distance between α and β. The optimal (C_1, C_2) will be to the left of β on the budget line with the steeper slope $1 + r_B$, in absolute value.

Figure 10: Alternative model of different returns on green



In the model, continuous preferences were assumed. If the assumption of continuity is broken, and we have a case of lexicographic preferences, the model might not have an equilibrium where $r_G < r_B$. Lexicographic preferences describe comparative, hierarchic preferences. For example, if an agent has preferences where he always prefer more money to less money, independent of the color of the source

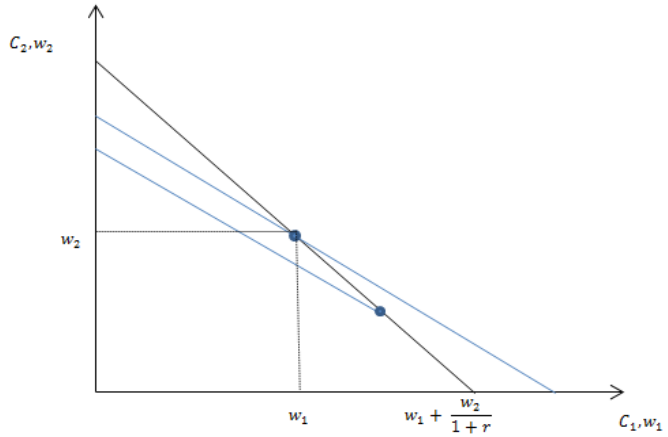
of income for a given level of money. Type I agents would prefer green saving to brown saving only if $r_G = r_B$. This preference ordering would alter the results from the model, because with these kind of preferences type I, with $\phi > 0$, would still not choose any green saving in a situation where $r_G < r_B$. Thus there would not exist an equilibrium in a market where green investment gives lower return. The opposite example can also exist, where some may prefer r_G to r_B, independent of how much larger r_B is.

In the previous representation, $\phi(s_G)$ was assumed to be a concave function. If this is changed to a linear function where the first derivative is constant, it is easy to use the model to discuss the inclusion of borrowing. In a situation where $r_G < r_B$, and borrowing is included, we can get a situation where the agents would like to borrow money to invest.

$$\theta u'(C_2)(r_B - r_G) < \phi$$

If the household has the choice of borrowing at interest r_G or r_B, and $r_G < r_B$, clearly, r_B will be preferred. However, this can hardly be arranged in any other way than a short sale of green bonds. If short sale of green bonds is possible, and $r_G < r_B$, an arbitrage opportunity occurs and there would be problems in connection to keeping an equilibrium where the green bond is priced higher than the conventional bond. People can then short sell a green bond by borrowing it and selling it straight away and buy a brown bond, where the profit is from the differences in price. This would continue to happen until the differences in prices evaporates and $r_G = r_B$. The arbitrage will be close to riskless if the issuer of the two bonds is the same, and other conditions are the same, apart from greenness. Such pairs of green and brown bonds exist, cf. chapter 5. It is unclear whether or not short sale in relations to the green bond market exists, but if it does, it may be beneficial to prohibit short sale of green bonds. This will be further addressed in the discussion in Chapter 6.

Figure 11: Borrowing and short-sale



Assume now instead that borrowing occurs at interest rate r_B. In the case of borrowing, if an investor has very strong preferences for s_G, and in addition is reluctant to give up consumption today, it could be optimal to borrow at rate r_B and invest at rate r_G. In Figure 11 this is illustrated by a movement from the initial allocation with zero savings and no borrowing, downwards along the r_G slope. Following this is a movement upwards along the new r_G slope.

When green bonds and conventional bonds are secured on the balance sheet of the issuing organization, it follows that they carry the exact same risk. If investor demand pushes up the price of green bonds, so that the yield falls, then other investors may see an opportunity of arbitrage and sell their green bonds in order to buy conventional bonds. This would happen until the yield is similar again (McCrone, 2014). It could, however, be a possibility that the owners of the green bonds would be unwilling to sell them because of their strong preferences for green, i.e., a high $\phi(s_G)$, and they would not want to lend them for people to short sell, because this would undermine the $r_G < r_B$equilibrium. The unwillingness to lend for short sale is motivated by a desire to maintain $r_G < r_B$, since these investors want to contribute to cheaper financing of greener investments. To maintain the equilibrium with $r_G < r_B$, the individual investors should also require that institutional investors do not lend their green bonds to short sale, as part of any commitment to green portfolio composition.

4.5 Summary of the model

1) An equilibrium where $r_G = r_B$ is possible. The model predicts that in this case, type I will save in the green option and type II is indifferent between green and brown saving. Type I will save more than they would without the green investment option.
2) An equilibrium where $r_G < r_B$ is achievable if and only if arbitrage can be excluded, more on this in policy recommendations in Chapter 6. In this case, the model predicts that type II saves in the brown option and that type I allocate savings between the brown and green options, dependent on how strong their preferences for green are. Type I may save more than they would without the green option, but also less if r_G is sufficiently lower than r_B. They can also choose to borrow brown and invest in green, given strong enough preferences for the green option.

In the model, all households of type I are the same. In real life however, it is reasonable to assume that there are different degrees of preferences towards green investment.

5. Data Analysis

This chapter presents a limited data analysis of green bonds. Because of lack of data in the market and strict rules from suppliers of the data, only small amounts of data were available for the thesis. The aim of the analysis is to look at differences in yield to maturity between green bonds and conventional bonds, to support the choices made in the theoretical model.

Barclays has created a green bond index where MSCI ESG Research evaluates eligibility and classification. They evaluate the securities independently along four dimensions to determine whether or not a fixed-income security should be classified as a green bond. These criteria reflect the ones stated in the Green Bond Principles:

- Stated use of proceeds
- Process for green project evaluation and selection
- Process for management of proceeds
- Commitment to ongoing reporting of the environmental performance of the use of proceeds

As long as a project falls within an eligible MSCI ESG Research green bond category, a bond can be considered for the index, even though it is not explicitly marketed as green (Upbin et al., 2014). This is a concern that must be addressed in relation to this thesis. As this thesis has its main focus on the labeled green bond market, these data do not provide results exclusively for the labeled market, but for the market for all bonds that is eligible for the green bond label.

In the research by Preclaw and Bakshi (2015), they found that investors are paying a premium for green bonds in the secondary market, as presented earlier in the thesis. Their sample was the Global Credit Index, which includes both corporate and government-related issuers, to offer the best overlap with the Global Green Bond Index. In their research they state that: “It is possible that green bonds are actually less risky or volatile than otherwise similar conventional bonds, making the tighter spreads appropriate to their risk-adjusted return” (Preclaw and Bakshi, 2015, p. 3). On this note, to perform a more comparative analysis, this thesis uses a sample of bond pairings issued by the same issuer in the same currency, with a similar maturity and credit rating.

A dataset provided by Norges Bank Investment Management (NBIM) has been used, containing data on bond issuances, including both green bonds and conventional bonds. From this dataset, it was possible to find 29 pairings of bonds, one green and one conventional, issued by the same issuer, with the same maturity, credit rating and in the same currency. In total there were 24 observations (12 pairs) in EUR and 34 observations (17 pairs) issued in USD. These observations are all from the same

date, 16.03.16. It was considered useful to still look at the data to see if it was possible to find a significant difference between the green bonds and the conventional bonds with respect to yield to maturity. In the analysis, two separate datasets were made, one for the observations in EUR and one for the observations in USD, since the yield curves (yield as a function of time to maturity) may be different. The decision to perform regression analysis instead of looking at the differences in the yield for brown and green issuance in each pair is made primarily because the maturity of the bonds is different. The maturity is similar (same year), but there is still a difference within each year; this can affect the differences in yield to maturity. This is controlled for in the regression.

On each dataset, an OLS regression was performed. Included in these regressions were a dummy variable for green, to distinguish the two types of bonds. Days left until maturity was included, as well as a quadratic term of days left to maturity, to allow for the possibility of a nonlinear yield curve. In addition, the different ratings of the bonds were included. In total, the dataset contained ten different ratings. In the regression the highest rating, AAA=1, AA1=2,...,BAA3=10. Also here a quadratic term was included, to allow for a nonlinear relation between rating and yield. The following equation was formed:

$$1)\ ytm_i = \beta_0 + \beta_1 m_i + \beta_2 m_i^2 + \beta_3 R_i + \beta_4 R_i^2 + \beta_5 G + \varepsilon_i$$

Table 1 shows the results from the first OLS regressions.

Table 1: OLS regression, EUR and USD, 16.03.16.

	(USD) ytm	(EUR) ytm
cons	-0.095 (0.25)	-0.669835 (0.2999)
Maturity	0.0014 (0.00029)***	-0.0000108 (0.0003574)
Rating	0.1376 (0.0668)*	0.35269 (0.117)**
Maturity^2	-2.13e-07 (8.12e-08)*	6.33e-08 (7.18e-08)
Rating^2	0.005 (0.0064)	-0.0305 (0.0155)
Green	-0.04 (0.099)	0.0114 (0.0641)
N	34	24
Adj R^2	0.885	0.88

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The results show that the in the USD dataset, the green dummy variable has a weak negative sign, meaning that the green bonds issuances gives a lower yield to maturity than the brown issuances. This

result however, is not statistically significant. Interestingly enough, the second regression performed on EUR currency had a positive coefficient for green bonds, nor is this statistically significant. The differences may be explained by unobservable characteristics in the companies. The characteristics can bias the regression. An additional fixed-effect regression was performed to control for this. A dummy variable for every company, except one, was included in the OLS regression. In this regression, the credit ratings were omitted, because the credit ratings are based on the characteristics of the different companies. This decision was made to prevent multicollinearity. The companies consist of industrial and utility corporations, financial institutions and government related agencies. The 17 pairs in the USD dataset are issued by 14 different companies and the 12 pairs in EUR dataset are issued by 10 different companies.

$$2)\ ytm_i = \beta_0 + \beta_1 m_i + \beta_2 m_i^2 + \beta_3 G + \gamma_1 D_1 + \gamma_2 D_2 + \ldots\ldots + \gamma_{n-1} D_{n-1} + \varepsilon_i$$

Table 2: Fixed-effect regression, EUR and USD 16.03.16.

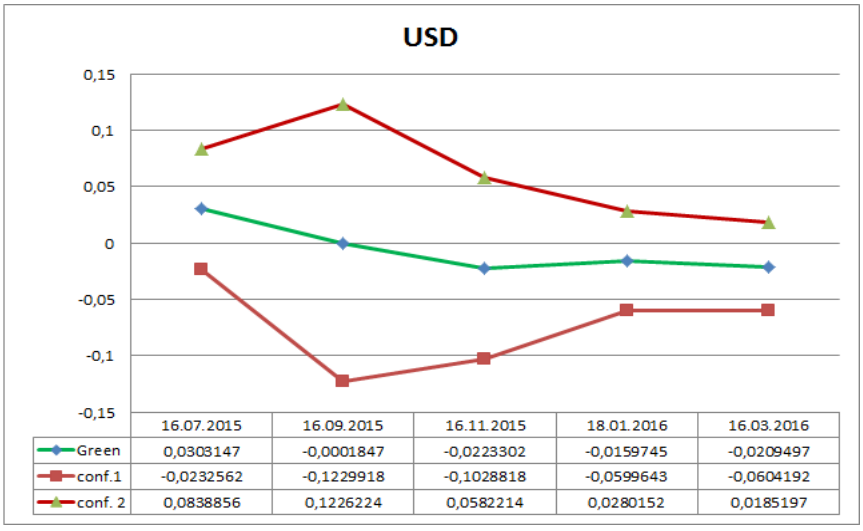
	(USD) ytm	(EUR) ytm
cons	1.808 (0.1178)***	0.1666 (0.1772)
Maturity	0.00036 (0.00017)**	0.000114 (0.000165)
Maturity^2	9.18e-08 (7.23e-08)	6.70e-08 (3.27e-08)
Green	-0.02157 (0.0186)	-0.01327 (0.01886)
D1	-0.8322 (0.15)***	-0.1346 (0.041)**
D2	-0.142 (0.05)**	-0.653 (0.053)***
D3	-0.0025 (0.0722)	0.0367 (0.0518)
D4	0.858 (0.11)***	0.05 (0.044)
D5	-1.1 (0.0665)***	-0.249 (0.0127)***
D6	-0.312 (0.069)***	0.024 (0.0412)
D7	0.294 (0.054)***	0.028 (0.041)
D8	1.475 (0.0538)***	-0.7045 (0.0395)***
D9	-0.2 (0.068)**	-0.54 (0.053)***
D10	-1.737 (0.336)***	
D11	-0.997 (0.049)***	
D12	-0.068 (0.0668)	
D13	-0.247 (0.0775)**	
N	34	24
$Adj\ R^2$	0.99	0.99

Standard errors in parentheses
$^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$

When adding dummies for the companies, the green variable shifted from positive to negative for the EUR dataset. Thus there is a negative sign for green bonds in both currencies, though none of the results are statistically significant. Another point worth mentioning is the very high R-squared. The sample sizes are very small, and including dummies for the companies, most of the variation is explained.

After receiving more data, a possibility of running more regressions opened up. To look at different point estimates across time, five fixed effect regressions were performed on sub-datasets for USD. Not all of the 17 pairs have been in the market since July 2015. The sample sizes ranging from 8 pairs (16 observations), 16.07.15, 11 pairs (22 observations), 16.09.15, 12 pairs (24 observations), 16.11.16, 16 pairs (32 observations), 18.01.16 and 17 pairs (34 observations), 16.03.16. Because 16.01.16 was not a business day, data from 18.01.16 was used instead. It was not possible to perform regressions further back in time due to small samples[6]. In Figure 12, the red lines are representing the 95 % confidence interval from the regressions. Figure 12 shows that for the smaller sample sizes, the point estimate of the green coefficient is positive, but as the sample sizes increase, the point estimate is negative. As seen in Figure 12, as the sample sizes increase, the size of the 95 % confidence interval decrease. However, none of the estimates are significantly different from zero, so it is not possible to draw any conclusions. In the future, if more companies are issuing both green and conventional bonds with the same maturity, significant results may be a possibility with an increase in sample size.

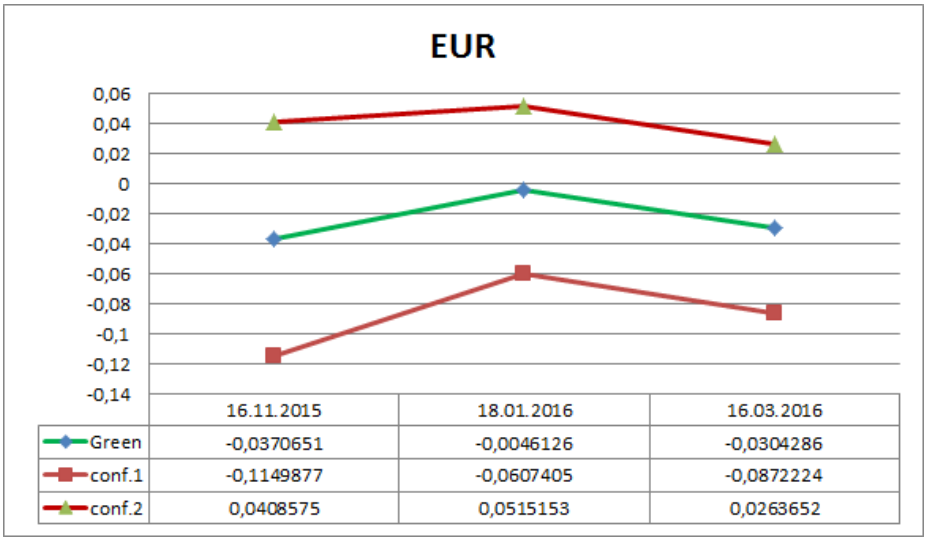
Figure 12: Regressions USD



In Figure 13, there are fewer observations due to small sample sizes in the EUR dataset. Only three regressions were performed. The sample sizes are ranging from 7 pairs (14 observations), 16.11.16,

[6] Regression tables can be found in Appendix 2.

11 pairs (22 observations) 18.01.16, and 11 pairs (22 observations), 16.03.16. All regressions show a negative sign for the green dummy variable, but none of the estimates are significantly different from zero.



	16.11.2015	18.01.2016	16.03.2016
Green	-0,0370651	-0,0046126	-0,0304286
conf.1	-0,1149877	-0,0607405	-0,0872224
conf.2	0,0408575	0,0515153	0,0263652

Figure 13: Regressions EUR

It is hard to make any conclusions based on this data analysis due to few data points, a small sample and insignificant results. However, based on the research by Preclaw and Bakshi (2015), and the weak findings in this thesis, the case where $r_G < r_B$, could be a realistic scenario.

The following chapter will present and discuss different factors and incentives that may influence $\phi(s_G) > 0$.

6. Discussion: Preferences, incentives and potential drivers of growth

This chapter discusses different aspects that may influence preferences for green investments, including green bonds. For the model in chapter 4 to have explanatory value, it requires that preferences actually have changed, i.e., that $\phi(s_G) > 0$. The following sections discuss several factors that may influence preferences. The first section briefly addresses the international processes that encourage green investments. The second section looks at Corporate Social responsibility (CSR), Environmental Social and Governance (ESG) and Social Responsible Investment (SRI) as possible drivers. Section three reflects on the role of institutional investors in the green bond market. Section four addresses the main possible benefits of green bonds, both financial and non-financial. Section five discusses the problem of additionality and implications of a large unlabeled market for climate bonds.

Hence, the first four sections attempt to provide answers to the question of how investments in green bonds may be explained (even in cases with higher investment costs for investors and increased costs for issuer and possibly lower returns on investments) and consequently, the growth in the green bond market. The last section attempts to provide an answer to the question, of whether or not we really need a green bond market.

6.1 International pressure towards green investments

As outlined in the introduction, there are several international processes that all point in the direction of more green investments. The Green Economy advocated by UNEP and others, sustainable development concerns (last expressed by the United Nations adoption of the Sustainable Development Goals (SDGs) in September 2015), and the Paris Agreement are processes that outline a low carbon future and put pressure on the direction of investments. The Paris Agreement includes a number of paragraphs that encourage non-Party stakeholders (among them the private sector and financial institutions), "to mobilize stronger and more ambitious climate action" (United Nations, 2015, p. 2), and "to scale up their climate actions" (United Nations, 2015, p. 17). With the new ambitious targets, climate change introduces a sense of urgency. As a response to the Paris Agreement, KPMG for instance, argues that "The Paris Agreement … sends a clear and unequivocal signal to the private sector: a global political intention to shift to a low carbon, and ultimately zero carbon, future" and argues that it is important for corporations to "protect brand and reputation by developing and communicating a clear and consistent position on the issues of carbon and climate change, and showing what your business is doing to reduce emissions" (KPMG, 2016, p. 2).

Hence, these processes no doubt encourage, but do not demand green investments, including green bonds, but make such investments more likely than if there were no such pressure.

6.2 Corporate Social Responsibility, Environmental Social and Governance, and Social Responsible Investment

Corporate Social Responsibility (CSR), Environmental Social and Governance (ESG) and Social Responsible Investment (SRI) can all be seen both as part of international (and external) processes and as internal processes in business sectors and individual companies. The argument is that these - as the above processes - can be seen as possible drivers of changing preferences. Hjort (2016) gives an overview of CSR/ESG/SRI and its impact on financial returns. This chapter will focus on the environmental aspect of CSR and how CSR and other similar implementations can affect people's preferences and incentives towards green investment and by looking at the link between sustainable investment and financial performance.

6.2.1 Corporate Social Responsibility

There is no unique answer to what CSR actually means and there are a number of definitions of CSR. CSR was earlier seen as primarily a self-regulatory business practice which is voluntarily incorporated into the strategic and operating business model of corporations. The definition of CSR provided by the European Commission reflected such a position: “CSR is a concept whereby companies integrate social and environmental concerns in their business operations and their interactions with stakeholders on a voluntary basis” (Blowfield and Murray, 2014, p. 8).

In the ISO 26000 standard on social responsibility adopted in 2010, however, respect for the rule of law is included as a mandatory part of CSR (Standard Norge, 2010, p. 12). Social responsibility here concerns “the organization’s responsibilities to society and the environment”, where the organization is “accountable for its impact on society, the economy and the environment”, and where the “overarching objective of an organization’s social responsibility should be to contribute to sustainable development” (Standard Norge, 2010, pp. 9-10). The definition of CSR from the Financial Times Lexicon is in accordance with such an understanding of CSR: “Corporate social responsibility (CSR) is a business approach that contributes to sustainable development by delivering economic, social and environmental benefits for all stakeholders” (Financial Times Lexicon, 2016).

Financial Times Lexicon writes that how CSR is implemented and understood, however, can differ greatly between companies and between countries. The concept is very broad and can include topics such as corporate governance, human rights, environmental impacts, health and safety, working conditions and more. The purpose of CSR is to drive change towards sustainability (Financial Times Lexicon, 2016).

The private sector is an important part of the global economy and thus company behavior is a cause for concern. Today firms are subjected to a new level of transparency. Because of this, adverse disclosure can threaten shareholder confidence in a company, brand reputation, production stability trust and other corporate assets. Public opinion today is less tolerant of corporate excess and there is an increasing expectation that business will come up with a solution to environmental challenges (Blowfield and Murray, 2014). The growing importance of CSR can be underlined with an example: In 2005, The Economist published a series of articles that criticized corporate responsibility and the managers that thought it would benefit their businesses. The leaders that were conscious of corporate responsibility were then accused of looking away from shareholder interests. It was The Economist`s view that corporate responsibility was bad governance. In an accompanying survey they found that 35 % of managers prioritized corporate responsibility. In 2008 the Economist ran another feature on corporate responsibility. This time however, the tone had changed dramatically. In this survey, 96 % of managers believed that corporate responsibility offers value for money and also 56 % of managers stated that corporate responsibility was a high priority (Blowfield and Murray, 2014).

6.2.2 CSR and financial performance

Manuela Weber (2008) has reviewed a diverse selection of research that has been conducted regarding the link between CSR and financial performance. She has identified five main business benefits for corporations engaging in CSR:

Positive effects on company image and reputation

A corporation's reputation builds on characteristics and personal experience. This includes the value judgement of the stakeholders of the company. Both image and reputation can influence the competitiveness and performance of a company. An image can change quickly, but a reputation evolves over time and is influenced by communication and consistent performance over several years. However, both the image and reputation can be severely damaged following a scandal. One recent example of this is Volkswagen, who knowingly misled their customers and the world's governments when they illegally manipulated software for exhaust emissions during government testing (Golson, 2015).

Positive effects on employee motivation, retention, and recruitment

This can have an indirect link to a company's reputation. Employees can also be more motivated from working in a better working environment. Motivation can also come from participation in CSR activities that they care about. Through this CSR can both directly and indirectly affect how attractive the company is for new employees.

Cost saving

Cost savings and efficiency gains have been discussed in sustainability research. It is argued that for example substitution of materials during the implementation of a sustainable strategy or that improved contacts to stakeholders such as regulators have cost saving effects. This is however not clear.

Revenue increases from higher sales and market share

It is argued by researchers that CSR can lead to increased revenue. This can happen directly or indirectly. The indirect effect is through an improved brand image. The direct effect can be through product or market development driven by CSR.

CSR-related risk reduction or management

If a company is known to have a poor CSR agenda, the risk of being targeted by NGO driven boycotts and negative press increases. This way, by engaging in CSR, the corporation can mitigate or in some cases offset these risks (Weber, 2008).

There are problems however with measuring the effects of CSR engagement due to reversed causality. A study conducted on the Canadian market that looked at one direction of causality - the causal relationship between Corporate social performance (CSP) and financial return - found no significant relationship between aggregated CSP score and financial performance, except for market return (Makni et al., 2008). According to Luo and Bhattacharya (2006), prior research has shown that there is a concern of reverse causality between financial performance and CSR. This is explained by a firm's CSR affecting its future performance, and that a firm's earlier financial performance contributes to its current involvement in CSR.

6.2.3 The signaling effect

Fundamentally, signaling theory is concerned with reducing information asymmetry between two parties (Connelly et al., 2011). A firm's financial decisions determine the signals the firm sends to its stakeholders. Some firms may want to signal some attributes by undertaking environmental practices or be motivated to green their practices to signal to consumers, other firms and regulatory bodies that the firm is climate friendly (Pavlinovic, 2013). Based on signaling theory, it is argued that the adoption of CSR practices is a way for firms to convey information about their capabilities (Su et al., 2014), and to communicate their characteristics to the competitive market (Matisoff et al., 2014). There are many ways for companies to signal to their investors and stakeholders, e.g., through CSR reports, performance reports or press releases. With the new green bond labeling, the issuance of green bonds can also be thought of as a signaling method. It can signal the investors that a certain project or that the company serves their interest with respect to sustainability and CSR. The green label can also help investors to signal savers and stakeholders that they are making responsible

investments. In addition, the labeling makes it easier for investors with a green mandate to screen potential new projects.

6.2.4 Environmental Social and Governance

"Environmental social and governance factors" is a universal term that is used both in capital markets and by investors to evaluate behavior of corporations and to predict future financial performance of companies. ESG factors are a group of indicators of non-financial performance. These include ethical, sustainable and corporate governance issues, for example managing the corporation's carbon footprint and ensuring that the company has systems in place to ensure accountability (Financial Times lexicon, 2016). The European Federation of Financial Analysts Societies (EFFAS) founded the EFFAS Commission on ESG (CESG) in 2007. Their objective is to integrate ESG aspects of corporate performance into investment processes. In their report of Key Performance Indicators (KPI) for Environmental Social & Governance Issues version 3.0, they have come up with a guideline for the integration of ESGs into financial analysis and corporate valuation. In the report they define topical areas for the reporting of ESGs issues, as well as developed the KPIs. They have defined nine topical areas that applies for all sectors and industries.

1) Energy efficiency
2) Greenhouse gas (GHG) emissions
3) Staff turnover
4) Training & qualification
5) Maturity of workforce
6) Absenteeism rate
7) Litigation risks
8) Corruption
9) Revenues from new products (EFFAS report 3.0, 2010)

These ESGs are factors that more and more investors are applying to their processes. According to Preclaw and Bakshi (2015), the assets under management (AUM) of funds that now incorporate ESG in their decision making have increased eightfold from 2010-2014, to more than $4trn. They underline that the rapid grown in the green bond market has increased as issuers want to promote green initiatives and that this is parallel to an increase in investor mandates with an ESG component (Preclaw and Bakshi, 2015).

6.2.5 Social Responsible Investment

SRI is defined as an investment discipline that considers ESG criteria with a goal of generating long-term competitive returns and positive social impact (US SIF, 2016).

"According to the US SIF Foundation's 2014 Report on Sustainable and Responsible Investing Trends in the United States, as of year-end 2013, more than one out of every six dollars under professional management in the United States—$6.57 trillion or more—was invested according to SRI strategies" (US SIF, 2014).

The Principles for Responsible Investment (PRI) is an investor initiative in partnership with UNEP Finance initiative and the UN Global Compact. They have formed six principles for responsible investment that the signatories will commit to. They state that: "As institutional investors, we have a duty to act in the best long-term interests of our beneficiaries. In this fiduciary role, we believe that environmental, social, and corporate governance (ESG) issues can affect the performance of investment portfolios (to varying degrees across companies, sectors, regions, asset classes and through time). We also recognize that applying these Principles may better align investors with broader objectives of society" (PRI, 2016). Such investments are thus designed to yield the highest possible financial return when risk-adjusted while also taking into account environmental, social or ethical concerns (Døskeland and Pedersen, 2015). In the PRI 2014 annual report, they find that 81 % of asset owners regard climate change as having a material impact on their portfolios (OECD, 2015).

For many financial decisions, however, there will be a balance between considerations concerning short term benefits for the corporation and long term benefits and ESG considerations. In a study conducted by Døskeland and Pedersen (2015), they look at how investors weigh wealth and moral when looking at social responsible investment and how these concerns influence individual investors decisions. They conclude that wealth is more important than morality, but emphasize that moral concerns still remain important and that there are norms for responsible investment that influence investors' behavior (Døskeland and Pedersen, 2015).

Given the above developments, it seems plausible to argue that we are witnessing a change among corporate investors and issuers. Ethical and sustainable business strategies are seemingly becoming more important. These strategies can all be arguments for a larger $\phi(s_G) > 0$ among investors and can thus contribute to explaining the growth and increasing interest in the market for green bonds.

6.3 The role of institutional investors

Institutional investors include pension funds, insurance companies, investment funds, public pension reserve funds, foundations and other forms of institutional savings. Their decision-making processes for allocating capital among different types of instruments and asset-classes are complex and varies significantly across geographies and institutions. When it comes to their asset liability management and asset allocation decisions they generally split asset classes into separate mandates. These mandates are authorizations or instructions to invest a defined proportion of the portfolio in a particular asset sub-category or sub-class. Such mandates can include asset allocation to sustainable energy, and this will rely on investment beliefs about whether the investment will outperform a benchmark or help the institution to meet a risk budget. Institutional investors are increasingly important agents in financial markets. They have traditionally been seen as sources for long-term capital, with an investment horizon tied to a long-term nature of their liabilities. According to OECD, there is a significant potential for institutional investors to expand their investments in sustainable energy. However, their investments to this date in this area have been minimal compared to the scale of their assets (OECD, 2015).

The Norwegian pension fund Storebrand, has integrated climate in their sustainability rating of potential firms to invest in. They argue that their customers are starting to compare quality with sustainability and that their customers are the drivers of their green transition. In addition, they argue that to avoid climate risk is a necessity to protect their customers' savings. They have to this date excluded approximately 60 companies from their investment portfolios based on their criteria of sustainability. Potential companies are analyzed and rated from 0-100, based on sustainability criteria. Storebrand is one of Europe's largest investors when it comes to green bonds. Being on the investor side, they do an independent evaluation of the second opinions provided for the issue of green bonds and once a year they go through their portfolio to make sure that the stated reporting process that is completed by the issuers are up to their standards. In addition, they go through both impact reporting and the financial reporting's (Storebrand, 2016).

Among institutional investors, there are signs of increased investment in sustainable energy. The institutions have an interest in climate change which can have a long-term impact on economic growth and thereby impair on the assets they depend on to generate returns (OECD, 2015). Institutional investors could potentially have an important role for continuous growth in the green bond market. Most pension funds in the OECD countries have bonds as the dominating asset class, which accounts for approximately 50 % of total assets under management on average (Croce et al., 2011).

As the green bond framework is developing and growing stronger, it may be easier for institutional investors to incorporate green bonds in their portfolios. This could in turn generate greater amount of capital into the market for green bonds, using Storebrand's green strategy as an example.

6.4 Possible benefits of green bonds

Ulrik Ross at HSBC asks whether the engine behind the green bond movement is mainly driven by strategic solutions to new types of client demand or by a change in social attitudes, and concludes that both of these drivers are working together (Ross, 2015). In the literature there are no clear distinctions between "pure" environmental benefits (reflecting green preferences) and other moral or political reasons and financial benefits.

Phillip Ludvigsen argues that green bonds offer a unique set of rewards to investors. When an investor looks at possible investment opportunities, he must balance the possible risks and rewards of the decision. When it comes to investments in green bonds, both financial and non-financial benefits must be considered. Ludvigsen points to reputational benefits as one of the main attractions for both investors and issuers. He says that issuers engaging in green bonds can differentiate themselves from competitors (Ludvigsen, 2015). Preclaw and Bakshi point at psychological benefits for investors, brand value and other indirect gains.

In a study conducted by Mirova in 2014, they look at the markets appeal from both investors' and issuers' standpoint. They state that the returns are determined by the overall credit rating of the issuer, thus suggesting that investors receive the same rate of return. They point to this to explain why the issuances have been a success. This way, investors with a green mandate have nothing to lose. On the issuer side they emphasize the strong signal of commitment that a green bond issue sends, which again can be seen as reputational benefits. They also argue that since there are an increasing number of investors committed to SRI, the issuers do not cut themselves off from certain investors. Because of the way green bonds are structured, and the possibility of green project bonds, the issuers can diversify by offering investors to finance only the company's development of renewable energy without having to finance the entire company (Mirova, 2014). KPMG International seconds many of these potential benefits, stating that for some bond issuers green bonds are a win-win situation. They state that green bonds require little additional effort, but can help to improve the issuers' credentials as a responsible and sustainable organization. Another potential benefit they point to includes that the issuer can get access to a broader range of investors and attract new investors that have an ESG focus. In addition they too point to reputational benefit and claim that issuing green bonds is an effective way for a company to show its commitment to environmental causes to demonstrate their green credentials (KPMG International, 2015).

Another potential benefit is the first mover advantage (Ludvigsen, 2015). Ludvigsen argue that as the green market grows, the opportunity lies with the "first movers" to capitalize on customer loyalty and market shares. He states that the first movers have the best condition for long term dominance as the market gradually evolves and innovates.

In the future, green bonds could potentially get special treatment by regulators. The Securities and Exchange Board of India (SEBI), are drafting a framework where they define requirements and that may include incentives for issuing domestic green bonds. As mentioned earlier, the Chinese government is developing their own national green bond standard (Ludvigsen, CBI, 2015). With strong pressure from international agreements on the regulators' side, special treatment for green bonds does not seem far-fetched. In the U.S, the Obama administration has put in place a number of tax credit schemes, to enhance and support green investment (CBI and HSBC, 2015).

As mentioned in the introduction and in chapter 5, there are evidence of growing price premiums in the second hand market. Ludvigsen (2015) offers different possible explanations for the findings. He argues that green bonds may attract a greater diversity of investors who seek an environmental impact and that this in turn can increase demand for green bonds, creating an opportunity for pricing premiums. In addition, shown by earlier examples of oversubscription, there is a limited supply, mainly due to market uncertainties such as evolving standards and related costs for the issuers. Another possible explanation for the growing price premium could be that the labeled green bonds can be regarded as less risky than comparable unlabeled green bonds, leading to higher risk-adjusted returns (Ludvigsen, 2015). Preclaw and Bakshi also argue that the premium may reflect a growing interest in the product and a mismatch between demand and supply. They also point to the possibility of new issuers gravitating to the market if there is an opportunity for cheaper funding. The report argued that the tighter spreads could reflect preferences on the investor side, and this could be the case if the investors experience enough other benefits to offset the lower cash flow (Preclaw and Bakshi, 2015).

In their research, Preclaw and Bakshi have also found that: "they [green-mandate portfolio managers] have a bias toward green issues. But only when they receive risk-adjusted compensation that is equivalent to conventional investments" (Preclaw and Bakshi, 2015 p.3), which is an example of lexicographic preferences. This however raises the question of whether responsible investors can justify paying a premium for green bonds. Or even in the absence of a premium, why would issuers commit to the constraints associated with green bonds in terms of reporting, internal organization and consulting, simply to raise funds they could have obtained through the conventional market, without all the hassle (Mirova, 2014)? This point, however, could be justified by putting together the

arguments above, including reputational benefits, a growing number of investors committed to SRI and the possibility of favoring regulations, which could all have an impact on and push preferences towards green investment, i.e., $\phi(s_G) > 0$.

Lastly, it is argued that green bonds can provide additional value (natural capital) by delivering environmental benefits that can be verified, and that potential benefits could be realized environmental attributes. Even though an environmental attribute is not monetized, it can represent a potential avoided cost of carbon on society, so there may be economic value to the environmental attributes the issuers help finance (Ludvigsen, 2015).

Private provision of public goods?

These last types of arguments as presented by Ludvigsen (2015), represents a dilemma known in economic theory as the "free rider" problem, in connection with public goods. It is known in economics that when it comes to a global negative externality, e.g., global warming, few individuals are willing to pay or contribute. One can argue that climate change is a global negative externality and that goods such as clean air and the absence of global warming can be counted as pure public goods because they are non-excludable, which means you cannot exclude anyone from breathing the clean air. They are also non-rivalrous, because one person's consumption of the good will not reduce availability to others. This presents a dilemma where everyone will benefit from the absence of climate change, but no-one has sufficient incentives to pay for it individually. A "free rider" is thus a person benefitting from others´ investment in clean air, but who is unwilling to contribute. In this sense, investment in green bonds with $r_G < r_B$ can be associated with private provision of public goods as it is financing green projects. The classic reference to private provision of public goods is written by Bergstrom, Blume and Varian (1986). Their main finding is that generally public goods will be under-supplied if based on voluntary contributions (Bergstrom et al.1986). The implication of this argument is that one cannot expect green bonds to solve the problem of climate change. If some binding, collective decision making process had been in place, the outcome would have been stricter regulation and more green investment that can be achieved with green bonds. But a green bond market may channel some willingness to pay toward green investment.

6.5 The problem of additionality

Additionality is an issue that is frequently discussed when it comes to the market for green bonds. If the green bonds have the same yield and risk as non-green bonds, why do we need a green bond market? Cannot these eligible climate friendly projects be funded through the traditional bond market? There are different positions on the issue of additionality. Some argue that the green label does not necessarily bring any new capital into financing green projects. This argument is backed with

the notion that projects that are being financed through the green bond market could, and most likely would be financed through the conventional bond market. Others, however, point to the importance of the green labeled market and argue that the label in itself, contributes to additionality.

In the study conducted at Harvard Kennedy School (duPont et al., 2015) the authors look at green bonds and sustainable land use. They found that the World Bank designated green bonds among projects that they already had decided to fund. In addition, they point to the green bonds issued by the state of Massachusetts, saying they planned to fund their projects regardless of the green labeling of the bond (duPont et al., 2015). However, they did state that when the green bonds were issued by the state of Massachusetts, the issue did attract new investors because of the green label, which can be an argument for additionality in the longer run.

Sophia Grene, writing for the Financial Times raises the question of whether any new money is being channeled into environmental investment. She argues that since the green bonds and conventional bonds have similar yield, it may be a sign that the green bonds are not making any difference. She also states that if the green bonds had a lower yield it would imply that the issuers were getting their capital at a lower cost, and one could infer that projects were being funded that otherwise would not. The lacking difference in yields makes her ask whether the existence of the green bond market adds anything regarding allocation of capital in green projects. In continuation she argues that with no advantage in the cost of capital, the main benefit for the issuer is the PR boost of green bonds. In her point of view, it is not clear that the green bonds represent more than a symbolic gesture (Grene, 2015).

The editor of Guardian Sustainable Business, Marc Gunther also questions the additionality aspect of the green bond market. He exemplifies it by saying that green bonds are primarily being used for refinancing, a core function of the bond market. Refinancing frees up money for other purposes, but it does not necessarily deliver new environmental benefits (Gunther, 2014).

There are however also arguments for relaxing this criterion of additionality. Marcio Viegras argues that it could be beneficial to relax the criteria while the green bond market builds sufficient funds and volume to make it noticeable to mainstream bond investors (Viegras, 2015). The managing director and head of green bonds at JP Morgan, Marilyn Ceci, argues that previous definitions of additionality pre-date the current green bond market. Ceci suggests redefining additionality with respect to green bonds. She defines additionality as incentives or markets that are enabling something to happen, that otherwise would not. In that sense green bonds can offer additionality that differs from traditional definitions. “Green bonds are expanding conversation around important environmental issues and bringing powerful new allies to the table through capital markets in a way that has not happened

before. That, to me, is additionality" (Ceci, 2015). That being said, Ceci, as head of green bonds at JP Morgan, will have a vested interest in promoting green bonds.

In a report by the Climate Bond Initiative and HSBC on the state of the green bond market 2015, they point to the ongoing discussion of additionality. They argue that the definition of additionality is misleading and point to the importance of refinancing projects: "Primarily, bonds are refinancing tools that allow issuers to free up capital from existing assets. This role is crucial in the capital pipeline. ...We need project developers to be confident when investing in the early high-risk stages of projects so that green projects can be refinanced easily and potential at a better price. That is the additionality green bonds can achieve" (CBI and HSBC, 2015 p. 10).

Some of these arguments underline the importance of the existence of a green bond market in terms of momentum, the possibility of cheaper financing and refinancing, and bringing in powerful new allies. However, another related question to the importance of a labeled green bond market and all the possible benefits it can generate is the size of the unlabeled "green" bond market. If the green label brings a whole range of benefits, and if it really is a win-win situation as KPMG International states in their report, how come there is such a large market that is not marketed as green? As mentioned, CBI states that the overall climate bond market has a size of $531.8 bn. The unlabeled green bond market consists primarily of corporates whose businesses are naturally aligned with green projects, such as wind and solar energy companies (Preclaw and Bakshi, 2015). In that sense, companies who are not primarily environmental companies, can draw benefits from issuing green bonds to be associated with green. The importance of labeling could be that it makes it easier for investors to screen projects and for issuers to signal to their stakeholders. The green bond label is more salient than in the conventional bond market. Investors may overlook bonds which finance sustainable projects, when issued by a corporation that is not already associated with environmental projects, if the bond is not labeled as green (Humphreys and Sanders, 2014).

Given the validity of the microeconomic model presented in the thesis, it can be argued that green bonds may contribute to additionality, given strong enough preferences for green investment. This was shown by presenting increased total savings after the introduction of a green market.

6.6 Policy recommendations

This is not a main focus of the thesis, but as revealed from the criticism of green bonds and the above discussions, some policy implications stand out. One of the main concerns presented in the thesis is the issue of lacking transparency in the market. One suggestion would be that CICERO, DNV-GL and the other companies conducting second-party reviews, commit to publish all second opinions they

conduct. This way, it would still be voluntary to seek a second opinion, but it would not be the choice of the issuer to publicly publish it or not, after they have seen the result of the evaluation. This policy recommendation is directed at the GBP, since they are the closest we get to a governance platform that has claimed responsibility for the green bond market.

Another issue that has occurred in the thesis in chapter 4, is the possibility of short sales. One policy recommendation could be an explicit prohibition against short sale of green bonds. This recommendation is aimed at governments. Alternatively, GBP could include in the guidelines that all issuers should make explicit in all contracts that those who invest in green bonds (and subsequent buyers in secondary markets) are prohibited against lending the bonds for short sales.

A third issue can be linked to the discussion about additionality. When some asset or project is financed by green bonds, and then sold to new owners, the bond should be redeemed. Alternatively, the new owners should step in and take over all responsibilities of the original issuer(s) of the bonds. This is to prevent double green bond financing. This recommendation is directed at the GBP to be included in the guidelines, as a required part of issuance conditions.

7. Conclusions

This thesis has aimed to answer several questions concerning green bonds and preferences. The model presented in the thesis shows that changes in preferences may be an important factor in explaining the growth in the market and it shows that with strong preferences for greenness, additionality from green bonds may be achieved because of increased total saving in the capital markets. For the model to have any validity, there must have occurred a change in preferences towards green investment. There are many possible drivers behind changes in preferences, both financial and non-financial, green and non-green. It can be argued that both types are contributing to changing preferences among investors and issuers. Increased focus on climate change and challenges ahead, from regulators, media and through multi-national agreements such as the Paris Agreement, reinforces incentives to incorporate sustainability concerns into investment strategies. For corporations it is becoming more important to show commitment to sustainability and greenness, where green issuances of bonds can reap valuable reputational benefits and send a strong signal to investors with ESG or SRI mandates. Research has shown that investors are paying a premium to obtain green bonds. In the data analysis in the thesis, it can be observed negative point estimates for green bonds in terms of yield to maturity, compared to conventional bonds. These results are not statistically significant, but as the sample size increase, the 95 % confidence interval decrease.

To conclude the thesis, the following presents the answers to the four initial research questions:

Why green bonds instead of conventional bonds?

From the Investor standpoint, investment in green bonds can be strategic and driven by financial incentives. If investors see it as important that that they signal responsible investment, this could be the case for institutional investors or investor funds with a strong mandate for ESG and SRI. Non-financial benefits can also be the main driver, a sense of responsibility and a strong bias towards green investment.

From the issuer's point of view, it can be important for companies to show their commitment to sustainability and to show that they are environmentally friendly. This attitude towards green issuances could be driven by pressure from governments and international agreements, the possibility to reap reputational benefits or because of an underlying expectation of possible cheaper funding for projects in the future. There could also be trend effects where competitors are pressuring each other.

What drives the growth of green bonds?

There is strong evidence of high demand from investors. In the thesis this is shown by a number of examples of oversubscription in the market. Issuers are seemingly willing to go through the hassle of

issuing and investors are willing to go through a screening process to identify green projects. In addition, Barclays has shown that investors are willing to pay up for green bonds in the secondary market, which could also be a driver of growth in the market because issuers see potential for cheaper funding. Strong international pressure and ongoing processes in the direction of green focus can be an additional driver. KPMG argues that the Paris agreement sends a clear signal. Lastly, mobilization of a green bond market in China could contribute to a boost in the green bond market in the future.

What are the main criticism and challenges of green bonds?

There is a lack of monitoring and firm guidelines in the market, which can be a threat to transparency. The market also relies on self-labeling from the issuer and the issuers can choose whether or not to publish their second opinion. This is, however, part of a process that is under development. Today, there is no firm evidence that the green bond market brings additionality when it comes to environmental benefits. Green projects could have, and probably would have been financed without the green bond market. In addition, many green bonds are being used for refinancing. On the other hand, the green label makes the market more salient and causes momentum and interest.

Can the growth of green bonds be explained by the changing of preferences?

Today projects that are being financed through the green bond market could have been financed with conventional bonds, maybe even at a lower cost associated with the issue, less reporting and additional work. This combined with high demand for green bonds and a growing market, is an indication that the changes in preferences discussed in Chapter 6 may be one of the leading causes for the success in the green bond market. There are many drivers behind the changes in preferences, which are all contributing to an increased $\phi(s_G)$.

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9. Appendix 1. The conventional bond market

9.1 A bond's indenture

9.1.1 Interest/coupons

The market interest rate is a key factor when it comes to price and the value of the bond. Hillier and Clacher (2011) emphasize this. The interest rate in the marketplace is changing frequently, but since a bond is a fixed price investment the cash flow from the bond will stay the same, independent of the market interest rate. This means that there will be a fluctuating value of the bond. If the interest rate in the market is rising, this will affect the present value of the remaining cash flow of the bond. Present value can be defined as "the value today of an amount of money in the future", given a specified rate of return. The relevant rate of return is the alternative that may be earned in the market at any time, i.e., the fluctuating market interest rate. The theory is built on the fact that money in the future is of less worth than money today, when factoring in the interest rate. Hence you have to take into account the interest rate when looking at how much something is worth today. This is called discounting. Taking this into account, the present value of the bond will decline in response to an increased interest rate, diminishing the value of the bond. The same procedure is true the other way around. When facing a falling interest rate, the value of the pre-fixed bond will increase.

9.1.2 Maturity date

The maturity date of a bond is the number of years until the face value is repaid or the "length of time the debt remains outstanding with some unpaid balance" (Hillier and Clacher, 2011). Different types of bonds have different maturity dates. The bonds can be short term, which is classified by maturity of one year or less. They can also be long term with maturity exceeding one year. After issuance of the bond, years to maturity start to decline and declines as time passes by. The above, the maturity date, the face value and the interest rate are all a part of a contract between the issuer and the bondholder, also called the bond's indenture (Bodie et al., 2011).

9.1.3 Price in the market

The price and market value of a bond reflects the market's belief of the corporation's ability to pay. If the risk of default is high, the price in the market will fall with the risk. (Bøhren and Michalsen, 2012). Another deciding factor is the difference between the interest rate paid by the issuer to the investor and the interest rate in the market today, meaning the interest rate on newly issued debt with the same risk and maturity. The coupon paid by the issuer is the same independent of the interest rate in the market and it is also separate from what the investor initially paid for the bond.

9.1.4 Value of a bond

When you know the coupon of a bond, the face value and the maturity date (how many periods remain until maturity) you can determine the value of a bond at any point in time. In addition, you need to know what the interest rate is in the market for similar bonds to estimate a bond's' current market value.

The general expression to determine bond value is the following:

$$\text{Bond value} = \Sigma C \left(\frac{1-1(1-r)^t}{r}\right) + \frac{F}{(1+r)^t}$$

C= coupon
r= required yield or discount rate
t= number of periods
F= the face value of the bond

Where the first term of the expression is the present value of the coupon and the second is the present value of the face amount. The summation sign means that we add the present value of each of each coupon payment. This means that every coupon is discounted based on the time remaining until repayment. The present value of the coupon is an annuity and the second term is PV of a single amount (Bodie et al., 2011).

The value of the bond is the same as the face value and so the bond sells for exactly the face value. This is rarely the case though because of a fluctuating interest rate. When you have premium and discount bonds, this is no longer the case. With a premium bond, investors will be willing to pay more for the bond to get the extra coupon amount which is over the market coupon. It is the case that:

Coupon < the return in the market → price < par value
Coupon = the return in the market → price = par value
Coupon > the return in the market → price > par value
(Bøhren and Michalsen, 2012, p. 181).

When a fixed interest bond with a stated maturity is issued, the cash flow from the issuer is defined. After this the price can only vary if the interest rates in the market changes, if the markets perception of the risk associated with the bond changes, or when the time to maturity decreases.

9.1.5 Risk

If interest rates will be fluctuating in the future, this implies risk for bondholders. That being said, the other factors that affect the risk of a bond is the time to maturity and the coupon rate. Generally, if other things are equal, the risk increases in time to maturity. The risk is also increasing the lower the coupon rate is. A bond with 30 years to maturity will be more sensitive to a change in interest rate than a 1-year bond. The 30 year bonds are more sensitive to fluctuations in interest rate because the present value of the face value is much more volatile to small changes in the interest rate. The present value 1-year bond won't be heavily affected by a small change in interest rate (Hillier and Cacher, 2012). If you buy a bond at par with a coupon rate of 6 % and the market rate increases, you will suffer a loss because your money is tied up to 6 %, while you alternatively could have earned more on investments elsewhere. This in turn will cause a drop in the bond price, reflecting the capital loss on the bond. The longer your money is tied up, the greater the loss and the greater the drop in bond prices (Bodie et al., 2011). One can use the same thought process when thinking about why a low coupon rate increases the risk of a bond. If you compare two bonds with same maturity, but have different rates, the bond with the lower rate will be more dependent on the face value. The value of the face amount will fluctuate more when coupon is small. The other bond with a higher coupon will generate a larger cash flow earlier, so it will be less sensitive. (Hillier and Cacher, 2012)

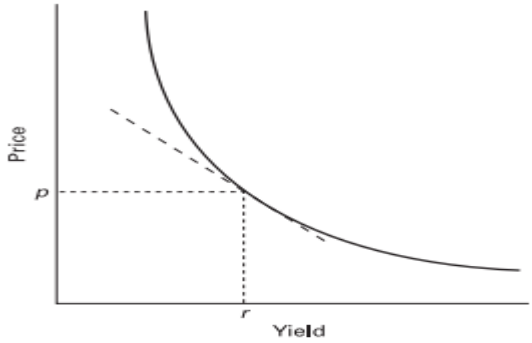
For all bonds that are not issued by stable governments, in the government's own currency, there will also be a risk that the issuer will have troubles paying back the principal or fail to pay coupon payments, these risks are reflected in the credit ratings of the corporation, which were presented in chapter 2.

9.1.6 Yield and yield to maturity

The current yield of a bond is as mentioned a bond's annual coupon payment divided by the price of the bond (Bodie et al., 2011). "The yield on any investment is the discount rate that will make the present value of its cash flows equal to its initial cost or price" (Choudry, 2006 p. 23). From the previous formula of bond prices, it is clear that the price of a bond and the yield are related.

They move in opposite directions of each other. If the yield that investors require, which is the discount rate increase, the net present values of the cash flows decreases. This is represented in the Figure 14 below. This represents the inverse relationship between yield and bond price (Choudry, 2006, p. 22).

Figure 14: Inverse relationship between bond prices and yields



Source: Choudry, 2006, p. 22

When you look at current yield, it ignores any possible capital losses or gains, and takes only into account the cash income provided by the bond as a percentage of the bond price. Nor does the current yield take into account the time value of money. The time value of money concept is based on the idea of present value, that money today is worth more than money in the future. If you want to account for both the current income and increases and decreases in price over the whole lifetime of the bond, the yield to maturity is a standard measure for this total rate of return (Bodie et al., 2011). To calculate the bond's total rate of return you need to know the bond price, the coupon payment and the date of maturity. According to Moorad Choudry (2006), one can interpret this interest rate as the average rate of return an investor will earn given he buys the bond now and holds it until maturity. This is the solution of the bond price equation, for the interest rate given the bond price. In other words, solve for "r" and you get the yield to maturity. Bodie, Kane and Marcus (2011) define the yield to maturity as the internal rate of return over the life of the bond. The calculation of yield to maturity is based on an assumption that the debt service (coupon(s) and principal) is paid as promised. A high yield to maturity typically means that the market believes in a relatively high probability of less than full repayment, which reduces the market price of the bond, which increases the yield to maturity.

9.1.7 Duration

"Duration is a way of measuring *how much* bond prices are likely to change if and when interest rates move" (BlackRock, 2016). The duration is thus a tool that can help investors to gauge price fluctuations that are a result of interest rate risk. Duration determines how a bond's price is affected by changes in interest rates. The concept of duration is similar to yield to maturity. Yield to maturity is as mentioned a calculation used to compare the values of bonds with different coupon rates, maturity, issue and maturity dates. Investors in the bond market are faced with reinvestment. In this there is a threat that when facing falling interest rates, the principal and the interest payments investors receive will have to be invested at a lower rate. The calculations of yield to maturity assume that the money received are reinvested at the exact same rate as the original bonds coupon rate. This is rarely the case in the market. To account for the reinvestment risk, brokers and portfolio managers calculate a bond's duration. The duration is defined as the years that are required to recover the true cost of the bond.

Duration is expressed as a number of years from its purchase date and considers the present value of all principal and coupon payments received in the future (Morningstar, 2015). The general rule is that for every 1 % decrease or increase in interest rate, the price of the bond will change approximately 1 % in the opposite direction, every year of duration. If a bond has a duration of five years and there is an increase in interest rate by 1 %, the price of the bond will decline by approximately 5 % (BlackRock, 2016). This duration can be used to compare bonds with different yield to maturity, coupon rates and issue and maturity. It follows from this that the higher the interest rate of a bond, the shorter duration will be. In other words, the faster money is coming in now, the faster the costs associated with the bond will be recovered. This also means that in general, the bonds with long maturity will have a longer duration since fixed interest payments will be spread over a longer period of time and will be more greatly affected by inflation. When an investor sells a bond, in a situation where the interest rate has risen from 6% - 7 %, he has to discount the bond to raise the yield to 7 %, and sell the bond at a discounted rate (Morningstar, 2015).

9.2 Types of bonds

9.2.1 Government bonds

Governments are the largest borrowers in the world (Hillier and Cacher, 2012). Most governments sell bonds and what is called Treasury notes to the public every month. The US Treasury securities market is the largest bond market in the world (Choudry, 2004). Most of the Treasury securities are ordinary coupon bonds as described above. What separates the Treasury bonds from bonds issued in the private market is that there is no risk of default. Hillier and Cacher (2012) emphasize that this is because governments always can come up with money to make the required payments. In the US this is true because they can always print more money. In the EU on the other hand, the European Central Bank has the final word on money supply, which means that individual countries within the EU can have a risk of default. There are also bonds issued by local governments or states called municipal notes. These issuances can have varying default risk.

9.2.2 Zero-coupon bonds

Zero-coupon bonds are bonds which do not pay coupons. Choudry (2012) explains these bonds as bonds where the only payment or cash flow is the redemption upon maturity. This means that the bonds do not pay any interest, but on the other hand investors can buy them at a discounted price based on the face value. This amount represents the amount the bond will be worth at maturity, assuming that the promised payment will take place. When the bond matures, the investor will be repaid his initial investment plus the imputed interest in one lump sum payment, (SEC, 2016). According to the U.S Securities and and Exchange Commission these bonds usually have a long term

feature with maturity date in ten or more years. Since the zero-coupon bond does not pay any interest, the price will fluctuate more than what is the case with plain vanilla bonds.

9.2.3 Floating-rate bonds

The plain vanilla bonds that have been described have a fixed obligation where interest rates are set as a fixed percentage of the face value of the bond. In that case, the coupon payments are fixed. In the case of the Floating-Rate bonds, they allow adjustment to the coupon payment. These adjustments are tied to an external reference, for example the Treasury bill index (Hillier and Cacher, 2011), or the three/six-month bank lending rate (Choudry, 2012). This external reference should be a measure of current market rates (Bodie et al., 2011). Since the bank interest rates will fluctuate, the cash flow of the bond is not fixed. Usually the coupon will pay out a spread over the reference rate. Since the Floating-Rate bonds are based on the three month or the six-month bank lending rate they can be traded as money market instrument (Choudry, 2012). The money market represents borrowing and lending for periods of a year or less. There is some additional risk for companies who issue “floaters”. The yield spread, which is the difference in yield between two bonds is fixed over the life of the security, which can be a long period. During this period firm's financial strength can change. If a firm experiences deterioration in their financial strength, this will increase the yield demand of the investors. They will want a higher yield premium than what is offered by the security, so the price will fall. So the security adjusts to changes in the market interest rate, but not to the financial condition of the firm (Bodie et al., 2011).

9.2.4 International bonds

There are mainly two types of international bonds, foreign bonds and Eurobonds. The feature of the foreign bonds is that they are issued from another country than the one in which the bond is sold (Bodie et al., 2011). The bond is sold in the currency of the country in which it is marketed. Eurobonds on the other hand, are denominated in one currency. Usually this is the currency of the issuer, but they are sold in other national markets. For example, Euroyen bonds are bonds which are yen-denominated, but sold outside of Japan. There is also a market for Eurodollars sold outside the U.S. In these cases, the Eurodollar bonds are not regulated by the U.S federal agencies.

There are several other types of bonds on the market. Issuers develop innovative bond with different features, so the bond design can be very flexible. That being said, it will not be beneficial to go deeper into other special cases for this thesis.

10. Appendix 2. Regressions

The following regressions are the basis of Figure 12.

Table 3: Regressions, USD.

	(USD 1) ytm	(USD 2) ytm	(USD 3) ytm	(USD 4) ytm	(USD 5) ytm
cons	1.096	1,71	1.22	1.67	0.975
	(0.151)**	(0.438)**	(0.35)**	(0.136)***	(0.152)***
Maturity	0.36	0.204	0.324	0.104	0.132
	(0.08)**	(0.18)	(0.17)	(0712)	(0.062)*
Maturity^2	-0.01	0.011	-0.0019	0.014	0.012
	(0.01)	(0.03)	(0.0228)	(0.01)	(0.0096)
Green	0.03	-0.00018	-0.0223	-0.0159	-0.0209
	(0.02)	(0.05)	(0.036)	(0.02)	(0.018)
D1	0.024	-0.207	0.073	0.023	0.69
	(0.0375)	(0.247)	(0.087)	(0.054)	(0.164)**
D2	0.89	0.48	-0.0436	0.127	0.83
	(0.29)**	(0.52)	(0.137)	(0.078)	(0.178)***
D3	-0.94	-1.235	0.894	0.97	1.69
	(0.054)***	(0.289)**	(0.222)**	(0.12)***	(0.07)***
D4	-0.219	-0.34	-0.837	-0.895	-0.266
	(0.034)**	(0.229)	(0.174)	(0.071)***	(0.172)
D5	0.495	0.247	-0.0545	-0.0035	0.521
	(0.096)**	(0.086)*	(0.129)	(0.075)	(0.179)*
D6	-0.97	1.024	0.42	0.557	1.127
	(0.676)	(0.1)***	(0.0897)**	(0.058)***	(0.158)***
D7	-0.82	-0.316	-1.484	1.55	2.3
	(0.0685)***	(0.265)	(0.733)	(0.057)***	(0.152)***
D8		-2.036	-0.893	-0.09	0.632
		(1.46)	(0.088)***	(0.07)	(0.179)**
D9		-1.17	-0.138	-1.456	-0.9
		(0.099)***	(0.123)	(0.36)**	(0.199)***
D10		-0.25	-0.0446	-0.77	-0.163
		(0.214)	(0.157)	(0.053)***	(0.162)
D11		-0.329		0.027	0.764
		(0.302)		(0.073)	(0.179)**
D12		-0.3028		-0.07	0.585
		(0.103)*		(0.083)	(0.175)**
D13					0.833
					(0.151)***
N	16	22	24	32	34
$Adj\ R^2$	0.99	0.99	0.98	0.99	0.99

The following regressions are the basis of Figure 13.

Table 4: Regressions EUR

	(EUR 1) ytm	(EUR 2) ytm	(EUR 3) ytm
cons	-0.324 (0.248)	0.151 (0.21)	0.254 (0.2)
Maturity	0.029 (0.107)	0.0557 (0.0825)	-0.014 (0.08)
Maturity^2	0.0134 (0.0115)	0.0099 (0.009)	0.017 (0.009)
Green	-0.037 (0.03)	-0.0046 (0.0248)	-0.03 (0.025)
D1	0.556 (0.069)**	0.007 (0.425)	-0.136 (0.043)*
D2	-0.165 (0.262)	-0.556 (0.189)**	-0.854 (0.19)**
D3	0.553 (0.083)**	0.165 (0.085)	-0.037 (0.0479)
D4	0.099 (0.479)	0.278 (0.047)***	0.0348 (0.0479)
D5	-0.105 (0.0469)	-0.131 (0.362)	-0.65 (0.365)
D6		0.085 (0.0421)	0.024 (0.042)
D7		0.072 (0.0422)	0.0265 (0.0428)
D8		-0.615 (0.04)***	-0.698 (0.041)***
D9		-0.523 (0.055)***	-0.531 (0.559)***
N	14	22	22
$Adj\ R^2$	0.99	0.99	0.99

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$