Green Bonds in the Norwegian and Swedish Market

Eline Drage, Vemund Trøan Sundt

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Department of Economics

Norwegian University of Science and Technology

Supervisor: Colin Green

Co-supervisors: Anders Olstad and Tore Lia, Entra ASA

Preface

This Master's thesis has been conducted at the Norwegian University of Science and Technology (NTNU) during the spring semester of 2018. The thesis is part of the programme "Master of Science in Financial Economics". The topic "Green Bonds" was suggested by Entra ASA. Both researchers found this relatively new product interesting and wanted to further explore this topic. The thesis is written in collaboration with Entra ASA, who has provided co-supervisors that have been helpful in discussions about the main content of this thesis. This master thesis is written as a collaboration between Eline Drage and Vemund Trøan Sundt.

Trondheim, 2018-06-01

Eline Drage

Vemund Trøan Sundt

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We would like to express our gratitude to the following persons for their contributions and support in the process of writing this thesis:

To all our respondents, taking their time to talk to us and for being very helpful answering our emails with follow-up questions when needed. Anders Olstad and Tore Lia at Entra ASA, that have been useful discussion partners and has helped us trough long telephone conversations. Thank you for sharing your knowledge and providing valuable insights. Professor Colin Green, who have had an open door policy, and always answered our emails. Thank you for being very helpful with brainstorming ideas and for good support on how to present our thesis.

Abstract

Green bonds are a relatively new financial instrument developed to stimulate sustainable investments. The green bond market has grown exponentially in recent years. There remains lots of potential for further growth as they cover about 1% of the total bond market. The objective of this study is to investigates the benefits associated with green bond issuance, to conclude whether these benefits could justify the extra costs and additional reporting effort that comes from issuing a green bond.

First this study analyzes whether there is a yield difference between green bonds and conventional bonds from the same issuer, in the Norwegian and Swedish market. To investigate this, two approaches are used. A matching method is used to analyze the yield difference between a green bond and an equivalent synthetic conventional bond, in the secondary market. 46 matched pairs are constructed and analyzed, and no significant yield difference is found. Second, interviews are used to analyze the pricing in the primary market, as reported by the issuers themselves. 7/12 issuers report that they experienced a beneficial (lower) yield for green bonds, with an average of 3-4 basis points.

Further, this study investigates other benefits or challenges associated with green bond issuance. For this purpose, semi-structured interviews are used. In total, 26 key stakeholders in the market were interviewed and five main benefits were identified. These include; easier access to capital, stability from a diverse investor base, reputational benefits, enhanced credibility of sustainability commitment, improved internal governance and environmental strategy. The only challenge identified were the extra costs and additional reporting associated with green bond issuance. This study concludes that green bonds provide considerable benefits to issuers, that could justify the extra costs and reporting, regardless of whether a marginal pricing difference exists.

Sammendrag

En grønn obligasjon er et relativt nytt finansielt instrument utviklet for å fremme miljøvennlige investeringer. Markedet for grønne obligasjoner har vokst eksponensielt de siste årene. Potesialet er stort da grønne obligasjoner kun utgjør 1% av det totale obligasjonsmarkedet. Formålet med denne oppgaven er å undersøke fordeler assosiert med utstedelse av grønne obligasjoner, for å undersøke om disse fordelene kan rettferdiggjøre de ekstra kostnadene og arbeid ved utstedelse.

Først vil oppgaven analysere om det finnes en forskjell i avkastning mellom grønne obligasjoner og standard obligasjoner innen samme selskap, i det Norske og Svenske markedet. To metoder blir benyttet for å undersøke dette. En kvantitativ metode blir brukt for å analysere forskjellen i avkastning mellom en grønn obligasjon og en identisk syntetisk standard obligsjon i andrehåndsmarkedet. 46 par bestående av en grønn obligasjon og en syntetisk standard obligasjon blir analysert. Ingen signifikant forskjell i avkastning kan påvises. Deretter benyttes semistrukturerte intervjuer for å analysere prisingen i førstehåndsmarkedet, rapportert av utstederne selv. 7/12 ustdere påstår at de opplevde en bedre pris (lavere rente), tilsvarende 3-4 basispoeng i gjennomsnitt.

Videre undersøkes andre fordeler og ulemper forbundet med utstedelse av grønne obligasjoner. Her blir også semistrukturerte intervjuer benyttet. Totalt 26 aktører i markedet blir intervjuet, og total fem kategorier med fordeler blir identifisert. Disse er; enklere tilgang på kapital, økt stabilitet fra en diversifisert invertorbase, omdømmefordeler, økt kredibilitet for bedriftens miljøengasjement og forbedret miljøstrategi og internt samarbeid i befriten. Kun en ulempe ble identifisert. Dette gjelder ekstra kostnader og rapportering for utstedelse av grønne obligasjoner. Studiet konkluderer med at fordelene er betydelige og kan rettferdiggjøre ekstra kostnader og arbeid knyttet til utstedelse, uavhengig om det finnes en prisingseffekt eller ikke.

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Chapter 1

Introduction

"Green revolution is bigger than industrial revolution and happening at faster pace than digital revolution." - Al Gore (quoted in TheGuardian, 2018)

Climate change is one of the most pervasive and threatening issues of our time, with far-reaching impacts in the twenty-first century (UNEnvironment, 2018). It is widely agreed that global warming is anthropogenic and this issue has become one of the top priorities on the global policy agenda (Stern et al., 2006). In 2015, at the 21st Conference of the Parties (COP21), 195 countries adopted the world's first universal and legally binding global climate agreement, the Paris Agreement. The central aim of this agreement is to strengthen the global response to the threat of climate change by keeping global temperature rise this century well below 2 degrees Celsius, compared to pre-industrial levels (ParisAgreement, 2018).

One of the strategies set out to reach this ambitious goal is making finance flows consistent with a pathway toward low greenhouse gas emissions and climate resilient development (ParisAgreement, 2018), chapter 2.1.c. This suggests that the financial system has a major role in the fight against global warming and in the transition towards sustainable development. Substantial deployment of capital flows towards climate-aligned investments are therefore necessary. According to OECD (2017), the amount of money needed to invest in infrastructures over the next 15 years is approximately $93 USD trillion in a "low-carbon" scenario.

Bonds are one potential financing instrument to fulfill this need. They can leverage a wide in-

vestor base, including institutional investors with more than $100 trillion USD of assets under management (OECD, 2017). Considering the increased attention to climate risk, the appetite for sustainable investments seems to be growing rapidly among investors. This growing interest is indicated by the number of signatories to the UN Principles for Responsible Investments (UN PRI), the world's leading proponent of responsible investments. After these principles were launched in 2006 the number of signatories has grown from 100 to over 1800, representing more than $70 trillion USD of assets under management in 2017 (UNPRI, 2018).

Despite the increasing demand for green investments, investors find there is a lack of definition of what "green finance" actually is. Without generally accepted definitions and standards, mainstream investors face hurdles such as time-consuming due diligence and increased transaction costs during the investment process (Chatterjee et al., 2016). It is therefore crucial to develop channels that could help investors effectively allocate their capital towards sustainable investment projects. Green bonds are one such instrument developed to address this need.

Green bonds are debt instruments used to finance green projects that deliver environmental benefits. These bonds provide greater transparency regarding the use of proceeds and the "green" label which helps investors identify green investment opportunities. Green bonds are self-regulated, but various certification mechanisms have evolved to allow more granularity as well as continuity in assessment. In recent years the green bond market has grown rapidly and reached $154,7 billion USD issued worldwide in 2017. [1]

In April 2017, global climate leaders, including former UN climate chief Christiana Figueres, launched a new global initiative called Mission 2020. Mission 2020 sets out six central calls to action, necessary to meet the Paris Agreement's long-term goals. One of these goals are that investments in climate action is beyond $1 trillion USD per year from 2020. Of the strategies set out to reach this milestone is to multiply the green bond market's issuance of tenfold from 2016 levels of $83,5 billion (Mission2020, 2017). Explosive growth of the green bond market is therefore needed.

According to the OECD (2017), a lack of supply of labelled green bonds is one barrier to scal-

[1] Source: Climate Bonds Initiative; authors' calculation. List of all labelled green bonds complying with the Climate Bonds Taxonomy, provided by Climate Bonds Initiative (CBI) on request. For details about CBI and Climate Bonds Taxonomy, see the Background chapter.

ing up the green bond market. They report that a key lever for market development is effective education on the benefits of green bonds, both for issuers and investors. Issuers may refrain from placing a green label on their bonds because of the additional cost associated with obtaining independent verification, ongoing reporting requirements, and the auditing of the use of proceeds. Given these extra costs, one might expect a lower yield for issuers as an incentive to participate in the market (VanEck, 2017). Anecdotal evidence has emerged that, in some markets at least, green bonds are receiving better pricing than conventional bonds (Boulle et al., 2016).

Considering the lack of supply, it is crucial to understand the incentives and benefits of green bond issuance. This paper therefore aims to provide answer to the following question: *Should pricing be the main incentive for green bond issuance, or are there other benefits that could justify the extra costs?*

To answer this question we first investigate whether there is empirical evidence of a yield difference between green bonds and conventional bonds. For this purpose, two approaches are used. First, a matching method is used to analyze the yield difference in the secondary market after controlling for liquidity. In total 46 matched pairs of bonds are analyzed. The second approach is interviews used to analyze pricing in the primary market, as reported by the issuers themselves. With the objective of investigating other benefits associated with green bond issuance, semi-structured interviews are used. These provides in-depth insight into the market and the market participants experiences. In total 26 interviews were conducted over a two-month period, from January 29 to March 20, 2018.

The main contribution of this study is twofold. It provides in-depth insights into the Swedish and Norwegian Green Bond Market. This information could be useful for participants in these markets and particularly to potential issuers of green bonds. Further, the number of academic studies on the topic of green bonds remain limited. The few academic studies existing seems to focus only on the pricing discussion. Investigating both financial and strategic measures associated with green bond issuance therefore fills a, we believe, gap in the literature.

The rest of this paper is organized as follows. Chapter two provides background information about green bonds and the market development. The third chapter reviews previous literature

of interest. Chapter four covers both empirical approach and data description. In chapter five the results and findings of the study is presented. Chapter 6 discuss these findings. Finally, chapter 7 concludes and outlines recommendations for further research.

Chapter 2

Background

In this chapter we outline the development of the green bond market, and present some definitions and standards of green bonds. We further give an insight to the political interest from central influencer's and organizations. Lastly, we briefly present the green bond market in Norway and Sweden.

2.1 The Development Of The Green Bond Market

The first "Climate Awareness Bond" was issued by the European Investment Bank (EIB) in mid 2007, with the idea of mobilizing capital for green investments (Kreivi, 2016). This bond was listed on the Luxemburg Stock Exchange (LuxSE). In 2008, The World Bank, in close collaboration with Skandinaviska Enskilda Banken (SEB), developed a framework for bonds where proceeds go to green investments. They called such bonds for green bonds (WorldBank, 2018). This marked the beginning of the green bond market.

During the years of the financial crisis of 2007-2008, there was minimal growth in the green bond market. Not until 2013-2014 did the market start to recover, and later experienced exponential growth, as seen in figure 2.1. The first years were categorized by supranational issuance, but soon both corporations and municipalities followed. The first corporate bond was issued by the Swedish property company Vasakronan in November 2013, and the first city bond

by Gothenburg in October 2013 (CBI, 2018b). The main green bond investments in 2017 were within renewable energy, low carbon buildings & energy efficiency, clean transport, sustainable water management, sustainable waste management, sustainable land use & forestry an adaption (Boulle et al., 2017). This also corresponds with the investments in the Nordics (Filkova and Boulle, 2018).

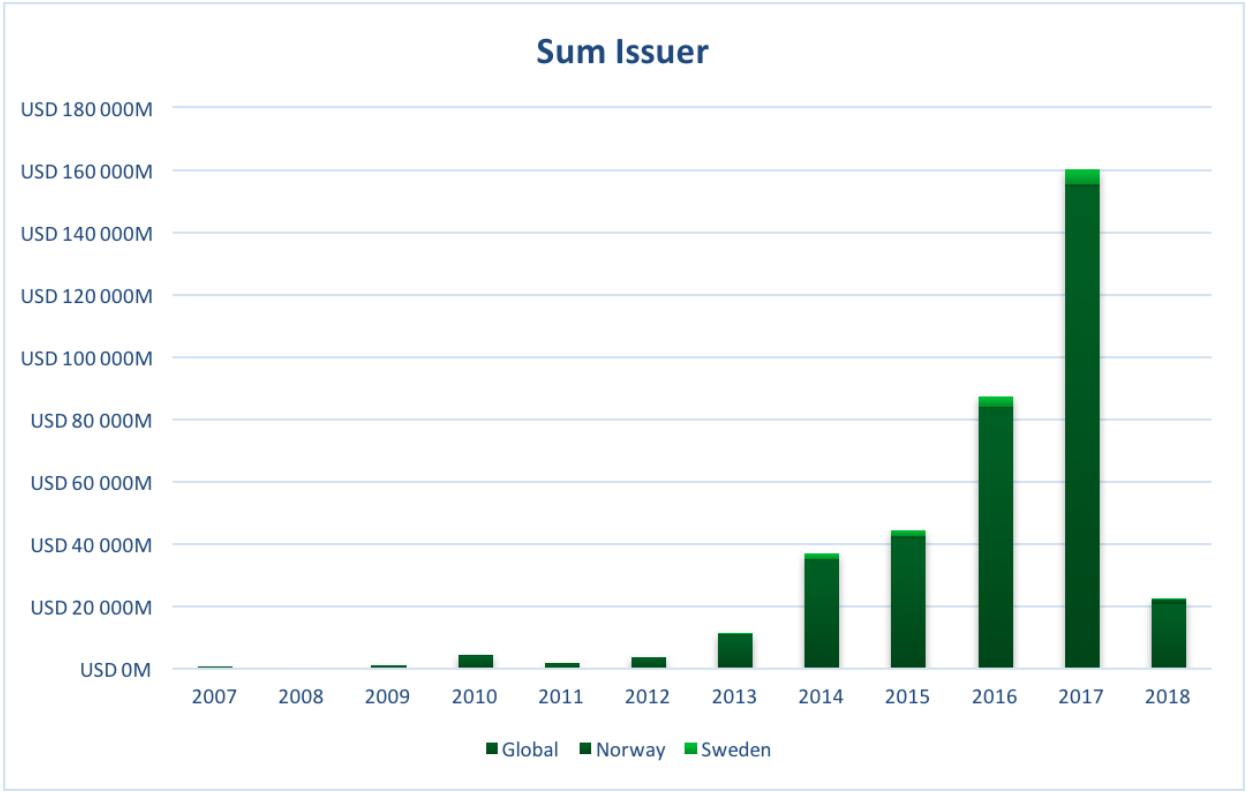

Figure 2.1: **Global Green Bond Issuance**
This figure shows the yearly global green bond issuance from 2007 up until March 15, 2018 in USD. The share of issuance in Norway and Sweden are marked with lighter shades of green. Source: Climate Bonds Initiative; authors' calculations.

Despite the exponential growth in the latest years, there is still a huge potential for green bond issuance. In 2016, it was estimated that green bonds only account for 1% of the total global fixed income market (GlobalCapital, 2015).

Demand is still outpacing supply. This can be indicated by the tendency of green bonds to be more oversubscribed[1] than conventional bonds in the primary market (Harrison et al., 2018).

[1] A bond issue becomes oversubscribed when the demand for shares exceeds the number of shares issued. When a new bond issue is oversubscribed, underwriters or others offering the bond issue can adjust the price or offer more shares to reflect the higher-than-anticipated demand.

Further supply is therefore needed if the sustainable capital market is to gather the traction it needs (Shishlov et al., 2016). The majority of the demand for green bonds comes from investors with ESG-mandates (Andersson et al., 2017). Today a substantial part of these investors are governmental investors, like pension funds etc. (VanEck, 2017). The bottom line is that this is still a relatively new market, and it develops at a high speed both when it comes to supply-demand, but also when it comes to laws and regulations. This will be highlighted more in later sections.

2.2 Definition and Standards

Today, there are no standardized criteria or requirements to determine what makes a bond "green". The market is self-regulated, and follows norms related to the green bonds framework. Nevertheless, there are several different guidelines that green bond issuers are expected to follow. One of these guidelines is called the Green Bond Principles (GBP), and defines green bonds as follows:

"Green Bonds are any type of bond instrument where the proceeds will be exclusively applied to finance or refinance in part or in full new and/or existing eligible Green Projects and which are aligned with the four core components of the GBP" (quoted in ICMA et al., 2017), p 2.

GBP were established by the ICMA together with a consortium of investment banks[2] (Kidney, 2014). These guidelines are meant as a tool to create credibility to green bonds. They are meant to be used broadly in the market to encourage the necessary transparency and disclosure, and to promote integrity in the development of the Green Bond market by clarifying the approach for the issuance of a Green Bond (ICMA et al., 2017). The GBP have four main components:

- Use of proceeds
- Process for project evaluation and selection
- Management of proceeds

[2]Bank of America Merrill Lynch, Citi, Crédit Agricole Corporate and Investment Bank, JPMorgan Chase, BNP Paribas, Daiwa, Deutsche Bank, Goldman Sachs, HSBC, Mizuho Securities, Morgan Stanley, Rabobank and SEB

- Reporting

The main focus in the component is that all Green Project categories should provide clear environmental benefits, which will be assessed and, where feasible, quantified by the issuer. It also lists the most commonly used types of projects supported or expected to be supported by the Green Bond market. The second focus is on the importance of communication towards investors. This includes everything from the issuers strategy to policy of the environmental sustainability objectives. The third objective focuses on the green bonds outstanding balance. This balance of the proceeds should be periodically adjusted to match allocations to eligible Green Projects made during that period. This fourth is related to the last component that is reporting (ICMA et al., 2017).

Under all of these components, the GPB specifies the importance of high levels of transparency and therefore strongly recommends an external review on the project evaluation and selection process. These reviews are conducted by various consulting companies like CICERO, VIGIO, DNV GL, Sustainalytics, among others. The review process is different between the different providers, and their requirements towards the green bond issuer vary to some extent. Some focus on the company as a whole, and some focus directly on the project.The cost of this second opinion ranges between 120 000 - 400 000 SEK according to Andersson et al. (2017).

External review is also a requirement for a green bond to be listed on the Climate Bonds Initiatives (CBI) green bonds list. CBI is a non-profit organization working solely to mobilize the bond market for climate change solutions. They have defined Climate Bonds Standards, that are fully integrated with the GBP and outlines the requirements for a bonds to be Climate Bond Certified (CBI, 2018a). They have further developed guidelines to encourage common definition for the global market. These guidelines are called Climate Bond Taxonomy (CBI, 2018c). CBI's green bond list includes all labelled green bonds complying with the Climate Bonds Taxonomy.

2.3 Political Interest

In line with market growth and the development of new and better definitions, the interest from various political organizations has increased. A range of political organizations want to be involved in the development and contribute to further development.

There has been a number of developments regarding UN engagement towards environment. Some of these developments have formed the background to the Paris Agreement. In 1972, the United Nations Environmental Program (UNEP) was established to provide global leadership and encourage partnerships in caring for the environment. Some years later in 1988 the Intergovernmental Panel on Climate Change (IPCC) was established by UNEP. The same year NASA scientist James Hansen testified to the US Senate that man-made global warming has begun (UNFCCC, 2018). UN Principles for Responsible Investments (UN PRI) was formed in 2006. It is the world's leading proponent of responsible investments, and has more than 1800 signatories. The UN PRI acts in the long-term interests of its signatories, of the financial markets and economies in which they operate and ultimately of the environment and society as a whole (UNPRI, 2018). In September 2015, the Sustainable Development Goals (SGDs) were formed as a extension on the Millenium Development Goals (MGDs) developed in 2000 (IASS, 2018). One of these goals is climate action. For this purpose, later that year, 195 countries adopted the world's first universal and legally binding global climate deal, known as the Paris Agreement.

The Organization for Economic Co-operation and Development (OECD), who have a mission to promote policies that will improve the economic and social well-being of people around the world, have published several reports on green bonds (OECD, 2018). As mentioned in the Introduction, they report that the amount of money needed to invest in infrastructures over the next 15 years is approximately $93trillion USD in a "low-carbon" scenario (OECD, 2017). Substantial deployment of capital flows towards climate-aligned investments are therefore necessary.

The Swedish government decided on December 14, 2016 to designate an investigator with the task of analyzing and proposing how the green bond market can be promoted. The assignment also included issues such as developing examples of project types suitable for this kind of funding, as well as considerations regarding validation and information to investors. The report

came up with many different suggestions that can promote the green bond market. One of the suggestions is that the Swedish government issue a green bond. This would provide a strong signal to other companies, and governments to issue green bonds. Since 20% of the bonds in the world are issued by governments, the potential is huge. Another suggestion is to copy the Singapore model. The government in Singapore has decided to cover the costs for external review, which might be a barrier for some issuers. Further, the report also suggest no Swedish law change with respect to green bonds. The investigation has the mandate to propose the legislative changes deemed necessary, but has come to the conclusion that the self-regulation of the market is functioning well and there is no immediate legislative need to promote green bonds. It is possible that Swedish national law would even act as a barrier to a global market. If a law regulation is to be introduced at all, it should be at EU level at the lowest (Andersson et al., 2017).

2.4 Norway and Sweden

Both Norway and Sweden had early issuers of green bonds. In 2010, Kommunalbanken was the first to issue a green bond in Norway. In 2013, and the City of Gothenburg was the first issuer in Sweden. Later other corporations, municipalities and financial institutions followed. As shown by figure 2.2, the issuance growth of green bonds in Norway and Sweden have been exponential in recent years as compared to the global green bond market.

A total of $16,9 billion USD have been invested through green bonds in Norway and Sweden by March 15, 2018. See the appendix for for full list of Swedish and Norwegian issuance of labelled green bonds complying with the Climate Bonds Taxonomy.

In January 2015, Oslo Børs was also the world's first stock exchange to implement a separate list for labelled Green Bonds. One requirement to be listed is that the bond has an external review. Their intent with the list was to increase the visibility of green investment choices (OsloBors, 2018). In Sweden, SEB have been the main driver of the green bond market. They have put a lot of work into the promotion of green bonds and to increase visibility in the market.

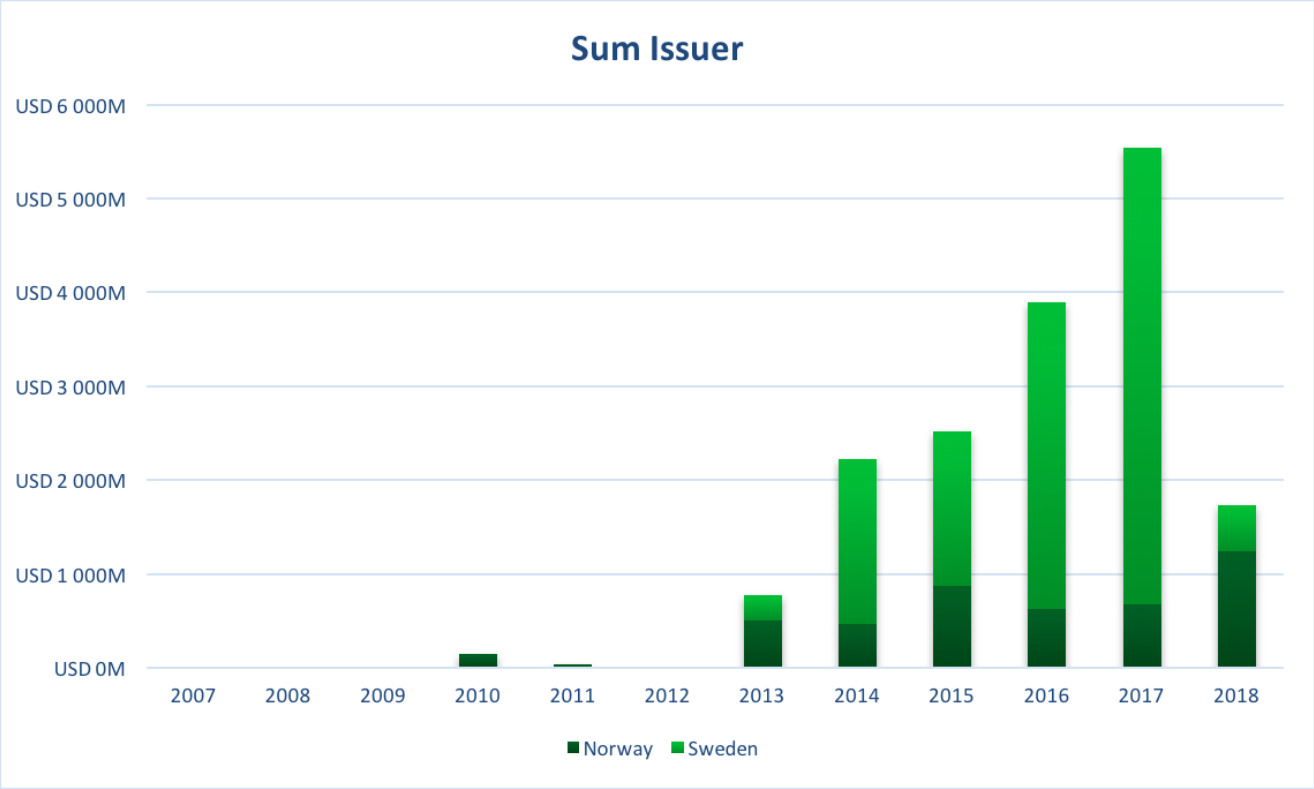

Figure 2.2: **Green Bond Issuance in Norway and Sweden**
This figure shows the yearly green bond issuance in USD for Norway and Sweden from 2007 to March 15, 2018. Source: Climate Bonds Initiative; authors' calculations.

Chapter 3

Literature Review

In recent years several policy papers on green bonds have been published by various actors in the market such as investment advisers, policy makers and sovereign agencies. The number of academic studies, however, remains limited. The few existing academic studies focus mainly on the pricing of green bonds, which is a hot topic of discussion. These studies are discussed below. First, we introduce studies that address the effects of environmental management on the cost of financing on firm level. The last part in this chapter outlines potential benefits and challenges associated with green bond issuance.

3.1 Environmental Management and the Cost of Financing

The effect of environmental management on corporate profitability has been studied thoroughly over the last decades. Considered collectively, this research provides a solid basis for concluding that there is a positive correlation between superior environmental stewardship and strong financial performance (Murphy, 2002).

Various recent studies have focused on examining the effect of environmental management on the cost of financing. Based on information provided by a large cross-industrial sample of US public corporations, Schneider (2011) tests the impact of toxic emission levels on the pricing of bonds for firms in the paper and pulp industry. He reports that higher toxic emissions are

associated with lower bond ratings and a premium on the cost of debt. Chava (2014) investigates the impact of a firm's environmental profile on its cost of equity and debt capital. He reports that firms with more environmental strengths than concerns are charged lower interest rates on their bank loans.

The studies above indicate that investors prefer firms that take responsibility for the environment. These studies compares the cost of financing between firms. It is worth noting that they do not tell us whether investors prefer green bonds over conventional bonds within the same firm.

3.2 Green Bond Pricing

Intuition suggest that a bond being green should not influence its price, as green bonds rank on equal footing with other bonds from the same issuer, having the same characteristics. Hence, there is no credit enhancement to green bonds that can explain a different price. However, anecdotal evidence has emerged that, in some markets at least, green bonds are receiving better pricing than conventional bonds (Boulle et al., 2016). They take the view that pricing will (and should) remain tight, but within limits acceptable to the majority of investors.

As the green bond market grows, the opportunities for research on the subject increases and the pricing discussion has been a hot topic. Preclaw and Bakshi (2015) argues that green bonds have been traded at a premium in the secondary market. They run a regression of operating asset spread (OAS) on common risk factors and a dummy variable for green bonds. Their result shows a significant 16,7 basis points tighter spread for green bonds compared to conventional bonds. However, these results rely heavily on the structural specification of the OAS.

Karpf and Mandel (2017) investigate the differences in the yield term structure between green and non-green callable bonds in the US municipal bonds market. In contrast to Preclaw and Bakshi (2015) they find that green bonds are traded at a 7,8 basis points higher yield than would be expected by their credit profiles and that the "green nature" of the bond therefore seems to be penalized by the market. Both these methods of structural specification provide a framework

to identify determinants of yield differences, but it has been shown that structural bond pricing models lack accuracy Eom et al. (2004) and that there is no real consensus as to how exactly bond yields should be broken down (Bernoth and Erdogan, 2012).

A more recent study by Bos et al. (2018) also investigates green bond pricing in the secondary market, focusing on the full spectrum of global green bonds. They calculate the average difference between an interpolated yield curve and the labeled green bond from the same issuer. This study shows a negative yield premium of 1,1 basis point. Compared to the studies above this method does not rely on a suitable specification of the yield structure. One issue with their methodology though is that they do not control for liquidity, which is agreed upon to be an important determinant of corporate bonds yield (Lin et al., 2010). Due to this the green premium cannot be attributed to the "greenness" of the bond itself.

Zerbib (2017) studied 135 investment grade senior bullet fixed-rate green bonds issued worldwide tackle this issue with controls for the potential differences in liquidity. For each green bond, the author uses a matching method to select the two most similar conventional bonds to construct a synthetic conventional bond (interpolated/extrapolated at the same maturity date) having the same characteristics, expect for the degree of liquidity. The green bond premium is then estimated as the unobserved heterogeneity in a fixed-effects panel regression of the yield difference between the green bond and the synthetic bond on various liquidity controls. His results show an overall average green bond premium of -8 basis points.

All the above studies indicate that there are pricing effects to green bonds compared to conventional bonds and that it varies between markets and the type of issuing entity. Except for the study by Karpf and Mandel (2017) who look at the US Municipal bond market, all studies report a negative green bond premium. Although these vary substantially, ranging from -1,1 to -16,7 basis points. In our view there is clearly room for further research on this topic and as the number of green bonds increases a focus on specific segments could be valuable.

3.3 Matching Method

As mentioned above Zerbib (2017) uses a matching method to investigate the difference in green bond and conventional bond yields. This method can be particularly useful when analyzing the specificity of financial instruments, for instance green bonds. One strength with such approach is that it accounts for unobserved differences between issuers. Another advantage is that there is no need to express the green bond premium in terms of fundamental variables which would inevitably bias the results.

Matched pair studies have for instance been used to investigate differences between sukuk bonds[1] and conventional bonds (Ariff et al., 2017). This study was criticized by Uppal (2015) who argue that matching is difficult as there is a marked difference in the structuring, placement, collateral, issuance cost, liquidity and bankruptcy cost of sukuk and conventional bonds. This criticism does not apply to the same extent to green bonds as they have more similar characteristics to conventional bonds.

Helwege et al. (2014) uses a matching technique to assess the cost of liquidity by matching and comparing pairs of bonds issued by the same firm with the same characteristics except for their degree of liquidity. He reports that liquidity proxies have low explanatory power on the differences in corporate yield spread. These results might have implications for the method used by Zerbib (2017) who uses proxies to control for the difference in liquidity. Helwege et al. (2014) argues that one possible reason for the low explanatory power is that the differences in the spreads of matched bonds are largely due to noise. One reason for this result could be that Helwege et al. (2014) matches pairs of bonds with the closest maturity instead of using interpolation/extrapolation which gives rise to a tiny maturity bias. Based on this and on the results from the studies on green bond pricing above, it could be reasonable to believe that the spread differential between green bonds and conventional bonds is more systematic and that the explanatory power of liquidity proxies would increase.

[1] Sukuk (Islamic bonds) are structured in such a way as to generate returns to investors without infringing Islamic law (that prohibits riba or interest).

3.4 Liquidity Proxies

Liquidity risk has been extensively analyzed and is widely agreed upon to be an important factor for explaining bond returns (Lin et al., 2012). Differences in liquidity must therefore be controlled for or minimized. The term liquidity describes the ease of trading a security and is a rather subjective concept. For corporate bonds, where trading often is limited and most transactions occur over-the-counter market, intraday data on quotes are not available. A lot of measures have therefore been proposed to approximate the extent to which a bond is liquid or illiquid. These measures can be separated into direct and indirect measures. Indirect measures are based on the bonds characteristic such as age, amount issued, currency and coupon type and direct measures are based on transaction data such as bid-ask spread, volume and number of trades.

Bao et al. (2011) and Houweling et al. (2005) establish that the amount issued and age are suitable proxies reflecting the degree of liquidity. These measures can be modelled in the matching procedure and is utilized by Zerbib (2017). The limitation of this approach is that it significantly reduces the number of observations as it hampers the process of finding matched pairs. Zerbib (2017) restricts the eligible conventional bonds to those with an issued amount of less than four times the green bond and greater than one quarter of this amount. The difference in maturity is restricted to be neither two years lower nor two years greater than the green bond's maturity and to those with an issue date which is six years earlier or six years later. These choices are made to get as close as possible without getting a to narrow sample of bonds.

Zerbib (2017) controls for the residual liquidity using either bid-ask spread or zero-trading-days. Bid-ask spread is defined as the difference between the bid price and the ask price at the end of each trading day and is among the most utilized proxies for liquidity (Lin et al., 2012; Chen et al., 2007). The higher the bid-ask spread is the higher is the cost of trading the bond and the lower is the liquidity. Zero-trading-days is measured in percentage of days without any trading during a given period. The greater the percentage of zero-trading days, the more illiquid the bond will be (Chen et al., 2007; Dick-Nielsen et al., 2012). Dick-Nielsen et al. (2012), however, shows that there is no consistent relationship between the number of zero-trading days and yield spreads.

For a more extensive review on liquidity and liquidity proxies see (Zerbib, 2017), pp 8-9.

3.5 Green Bond Issuance: Advantages and Disadvantages

The OECD (2017) reports that a key lever for market development is effective education on the benefits of green bonds. In the same report, advantages and disadvantages associated with green bond issuance as cited by green bonds issuers are outlined. These advantages and disadvantages are presented below. In addition, a variety of other sources are included to support the findings.

3.5.1 Commonly Cited Advantages

- Demonstrating and implementing issuers approach to ESG issues.

An integral part of a green bond is disclosure on the assets it will finance before issuance, and tracking and reporting on the use of proceeds post issuance. The information provided, and the process required to document, report and communicate the environmental impacts bring several positive outputs for both green bond issuers and investors (Shishlov et al., 2016).

- Strong investor demand can lead to over subscription

Strong and increased demand has come from a range of investors including institutional pension and endowment funds with environmental, social, and governance (ESG) mandates to individual investors looking to add a green focus into their fixed income allocations (VanEck, 2017). Several issuers report a benefit in the increased speed of "book building" (Boulle et al., 2017). Strong demand could ultimately lead to a "green premium" as will be discussed later.

- Improving diversification of bond issuer investor base, potentially reducing exposure to bond demand fluctuations

Diversifying the investor base is important for issuers from the financial risk management point of view and was one of the key motivations for the Ile de France region to issue a green bond (Shishlov et al., 2016). Spencer Maclean, head of debt capital markets for Europe at Standard

Chartered, said that the number one attraction of green bonds for issuers is the opportunity it gives them to diversify their investor base (GlobalCapital, 2015).

- Evidence of greater proportion of "buy-and-hold" investors for green bonds which can lead to lower bond volatility in secondary market

In periods of risk aversion, green bonds tend to be more stable, due to more buy-and-hold investors holding bonds in their portfolios. The bond's lower volatility could compensate the investor for a lower yield (Bos et al., 2018). In this context, treasurers consistently mention that they are happy with how their green bonds place. (Boulle et al., 2017)

- Reputational benefits (e.g. marketing can highlight issuer's green credentials and support for green investment

Issuing a green bond companies can get recognition for an innovative approach towards sustainability. Issuing a green bond can be a way for organizations to gain visibility, and thus attract more attention from investors. (Shishlov et al., 2016).

- Articulation and enhanced credibility of sustainability strategy leading to enhanced dialogue with investors

Green bonds can help companies tailor their sustainability strategy and provides an opportunity to highlight their key sustainability goals and objectives to the investor audience. Promotion of sustainability information can be aimed not only at clients, but also at investors in a process of strengthening relationships between issuers and debt providers. (Shishlov et al., 2016)

- Access to "economies to scale" as majority of issuance costs are in setting up the processes

Most of the extra costs associated with a green bond issuance comes from setting up the green bond framework for the first issuance. The same framework can be used for subsequent issues. About half of the Swedish issuers of green bonds have chosen to issue more than one green bond (Andersson et al., 2017).

3.5.2 Infrequently Cited Advantages

- Tracking of use of proceeds and reporting leads to improved internal governance structures, communication and knowledge sharing between project side and treasury side of business

Current research describes the benefits of getting finance and sustainability teams talking to each other (O'Neill, 2016). Not only do finance teams have the opportunity to attract new investors and understand a wider view of business risks and opportunities, but sustainability teams can improve their understanding of investor perspectives to more clearly communicate the financial value of a company's sustainability efforts, and in the case of green bonds, access capital for those efforts.

- For municipalities, a tool to reach constituencies physically located close to the green project they intend to support and provide them with opportunities to invest in programs that have direct proximal impact

Issuers in state and local governments are using green bonds as a tool to reach constituencies physically located close to the green projects they intend to support. The opportunity to invest in a program that improves one's community increases one's sense of connection and social responsibility (WorldBank, 2015).

3.5.3 Commonly Cited Disadvantages

- Up front and ongoing transaction costs from labeling and associated administrative, certification, reporting, verification and monitoring requirements

The additional costs associated with obtaining independent verification, ongoing reporting, and the auditing of the use of proceeds are considered, some issuers may choose to refrain from placing a green label on their bonds. According to Andersson et al. (2017), a Swedish state public report released in 2018, there is a broad perception among issuers that there is an additional work, an extra cost, associated with green bond issuance and that they therefore issue a regular bond without further considerations (Andersson et al., 2017). Considering this, one might

expect that a lower yield for green bonds would significantly increase green bond issuance.

- Reputational risk if a bond's green credentials are challenged

Whilst an enhanced reputation is a significant benefit, issuers need to minimize their reputational risk. The reputational risk for green bond issuers, i.e. when bonds labelled as green issued by others are found not to be "green", remain high and can have an impact on investors' trust (UNDP, 2018). As there are currently no standardized criteria for what makes a bond 'green' and no strict requirements for tracking or reporting on proceeds, it can leave issuers open to criticism and accusations of 'greenwashing'.

3.5.4 Infrequently cited disadvantages

- Investors may seek penalties for a "green default" whereby a bond is paid in full but issuer breaks agreed green clauses

If the use of the proceeds from the bond in the opinion of the auditor or certifier no longer meets the green requirements it will lose its green status. This is sometimes termed "environmental default" as it has failed to meet its obligations. It could be argued that the additional risk of environmental default requires an additional risk premium for investors to compensate for this (Kase, 2015).

Chapter 4

Methodology and Data

This thesis uses both qualitative and quantitative methods. This choice was based on the characteristics of the research question, which has both descriptive and exploratory characteristics. The econometric approach is used to analyze the yield difference between green bonds and conventional bonds in Norway and Sweden. Here both the sign and magnitude of the yield differential is of interest. Further, a survey-based approach is used to identify other potential benefits and challenges associated with green bond issuance. In addition, the survey-based approach is used to validate and complement the results from the econometric approach. In this chapter both methods and the associated data collection procedure is presented.

4.1 Matching Method

The matching procedure starts with a search for two conventional bonds for each green bond having the same characteristics in terms of currency, bond structure, collateral, coupon type and seniority. Maturity and liquidity cannot be matched and need to be addressed with other controls.[1] To control for maturity, we linearly interpolate (or extrapolate) the two conventional bonds to construct a synthetic conventional bond having the same maturity as the green bond. To obtain an accurate approximation without losing too many observations, we restrict the dif-

[1] Matching the maturity date would be impossible without loosing to many observations. Liquidity cannot be matched as it is not an observable variable.

ference in maturity between the green and the conventional bond to be no more than two years. The difference left between the green bond and the synthetic conventional bond are now liquidity and the green label.

As set out in the literature review it is widely agreed that bond yields incorporate a liquidity premium. A substantial difference in liquidity must therefore be controlled for if we want to estimate the effect of the green label in isolation. The liquidity difference can be assessed through amount issued and age (Bao et al., 2011; Houweling et al., 2005). Therefore the conventional bonds issue date is restricted to be no more than three years earlier or three years later than the green bond's issue date. Further, no restrictions are imposed on the amount issued. These restrictions is made in an effort to get as close as possible in terms of date and amount issued, while maintaining a sufficiently large sample size.

The residual difference in liquidity is controlled for with a proxy variable in a regression specification. This allows us to control for liquidity in two ways. First, by constructing the database, we limit the difference in liquidity as described above. Secondly, the residual liquidity bias is controlled for with a proxy variable in the regression specification.

After a synthetic conventional bond is constructed and matched to each green bond in the sample, we calculate the daily ask yield-spread. The absolute yield difference is defined as:

$$\Delta y_{i,t} = y_{i,t}^{GB} - \bar{y}_{i,t}^{CB} \tag{4.1}$$

Where $y_{i,t}^{GB}$ and $\bar{y}_{i,t}^{GB}$ is the green bond and the synthetic conventional bond i ask yield, respectively, on day t.

Similar to Zerbib (2017), the synthetic conventional bond's liquidity proxy (BA^{CB}) is defined as the distance-weighted average of the BA spread of CB1 and CB2. For practical terms we define:

$$d1 = |\text{Green Bond Maturity - CB1 Maturity}|$$

$$d2 = |\text{Green Bond Maturity - CB2 Maturity}|$$

Then the synthetic conventional bonds's BA spread will be:

$$\bar{BA}_{i,t}^{CB} = \frac{d2}{d1+d2} BA_{i,t}^{CB1} + \frac{d1}{d1+d2} BA_{i,t}^{CB2}. \tag{4.2}$$

Finally, we obtain the difference in BA spread between the green and the synthetic conventional bond defined as:

$$\Delta BA_{i,t} = BA_{i,t}^{GB} - \bar{BA}_{i,t}^{CB} \tag{4.3}$$

Where $BA_{i,t}^{GB}$ and $BA_{i,t}^{CB}$ is the green bond and the synthetic conventional bond i bid-ask yield spread, respectively, on day t.

4.1.1 Regression Model

The regression model is specified as:

$$\Delta y_{i,t} = p_i + \beta \Delta BA_{i,t} + u_{i,t} \tag{4.4}$$

Where $u_{i,t}$ is the error term and p_i is the bond specific green bond premium as suggested by Zerbib (2017). To estimate p_i we use a fixed effects estimator. This allows us retrieve the unobserved heterogeneity effect of green bonds on yields, without imposing any distributional restrictions or using other information about the bonds. Under a strict exogeneity assumption regarding the explanatory variable, $\Delta BA_{i,t}$, the FE estimator is unbiased and allows for arbitrary correlation between p_i and the explanatory variables in any time period.

We estimate two different structures of the error term. First, we calculate a fixed effects model without any restrictions on the error term. Furthermore, we use robust standard errors with clusters. This error structure accounts for within-cluster-heteroskedasticity and autocorrelation. For this we used a Huber-White sandwich estimator. This estimator assumes that the disturbances are uncorrelated between clusters.

4.1.2 Data Description

The first step of data collection was to identify all green labelled bonds in Norway and Sweden. For this purpose, all labelled green bonds complying with the Climate Bonds Taxonomy was used. A full list of all bonds issued by Norwegian and Swedish companies can be found in the Appendix. All active bonds issued up until March 15, 2018, are used, corresponding to 111 bonds. To focus on the Norwegian and Swedish market, only bonds issued in NOK or SEK were used. This excluded 9 bonds issued in EUR and/or USD. For further accuracy only ISIN-code with country identification, "SE" or "NO", was used. This excluded 16 bonds with an international "XS" ISIN identification code, which leaves us with 86 green bonds.

The next step was to search for two matching conventional bonds for each green bond as described above. For this purpose, we used Stamdata's database. [2] This database include an overview of all bonds issued in the Nordics. This helped us identify conventional bonds within the same issuer complying with the criterion's described in matching and variable construction above. From this list we also gained access to all bonds ISIN-codes. In this process 40 green bonds, where we could not find two conventional bonds meeting all matching criterion's, were excluded. Our final sample consists of 138 (46 triplets) of bonds across 19 firms.

Each bond's daily bid and ask yield [3] up until March 15, 2018, was downloaded from Thomson Reuters Eikon. For 18 of the 138 bonds there were one or more missing observation. With only one day missing we used linear interpolation to estimate the missing yield for the respective bond. For the sake of accuracy, we also interpolated the other two bonds within the triplet for better comparability. In total, 41 missing observations were estimated, out of 12413 total observations. If yields for two or more consecutive days was missing, these dates was deleted in order to ensure accurate estimation. In total, 32 dates was deleted. The number of observations within each group is determined by the bond having the lowest number of trading days within that group. The lowest number of trading days is 12 and the highest number of trading days is 959, with an average of 269. Hence, the earliest information dates to May 19, 2014. This process leaves us with a unbalanced panel dataset with 12381 observations across 46 groups.

[2] Stamdata delivers detailed information for the Nordic fixed-income market. Access was provided on request.
[3] Yield was used instead of price to have homogeneous variables in the regression.

During the process of data collection, we have considered the trade-off between number of lost observations and number of constraints imposed on the dataset. As a result, we have not imposed any restrictions on floating-rate bonds. Our final sample includes 31 pairs of floating-rate bonds and 15 pairs of fixed-rate bonds. As a robustness check we analyze the distribution of fixed-rate and floating-rate bonds separately.

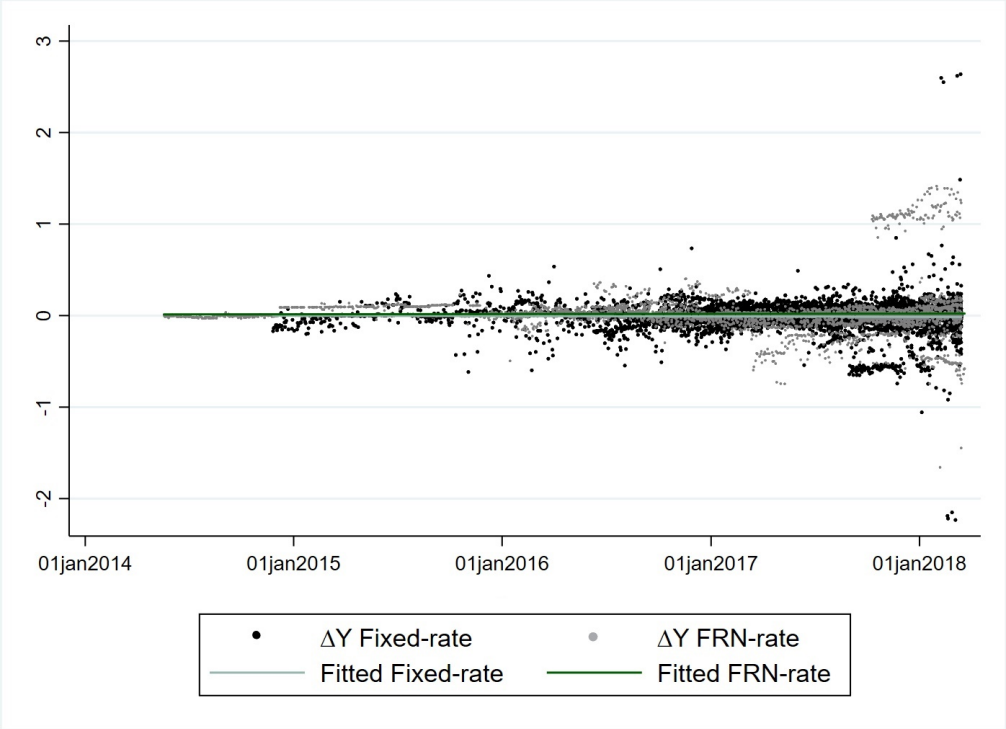

Figure 4.1: **Distribution of Yield Difference**
This figure shows the distribution of absolute yield difference ($\Delta Y_{i,t}$), for fixed-rate and floating-rate bonds plotted separately, over the period May 19, 2014 to March 15, 2018. Yield on the y-axis and date on the x-axis

The plot for fixed-rate and floating-rate bonds shows that the distribution is approximately the same for the two subsets of coupon types. Thus, the overall results should not be affected by the inclusion of floating-rate bonds. Further, the variation in overall yield difference increases over time, which is not unexpected considering the increased number of groups included for later dates. For further investigation of the variables in our dataset, summary statistics for the yield difference and bid-ask difference is presented in table 4.1.

Of particular interest is the mean of the time-demeaned yield difference (ΔY_i). This gives us the yield difference between green bonds and conventional bonds before the last liquidity control is applied.

Table 4.1: **Summary Statistics Final Dataset**
This table contains summary statistics of the variables in the final dataset, including number of trading days covered per group of bonds. $\Delta Y_{i,t}$ is the absolute difference in yield between the green bond and the synthetic conventional bonds ask yield. $\Delta BA_{i,t}$ is the difference in bid-ask (BA) spread between the green bond and the synthetic conventional bond. ΔY_i is the time-demeaned yield difference within each group and ΔBA_i is the time-demeaned BA difference within each group. The statistics considered are: minimum value (min), 25°percentile (p25), mean, median, 75° percentile (p75), maximum value (max) and standard deviation (sd).

	N	min	p25	mean	median	p75	max	sd
Nr. days per bond		12	106	269	261	365	959	208
$\Delta Y_{i,t}$	12,381	-2.233339	-.0386386	-.0014312	-.0007665	.0345819	2.637932	.1718966
$\Delta BA_{i,t}$	12,381	-2.436461	-.001	.0001192	-.0	.0062826	1.622485	.1009387
ΔY_i	46	-.6359345	-.0410208	-.0159582	-.0127939	.020235	1.128262	.2156092
ΔBA_i	46	-.351593	-.0031882	.0082869	.0002949	.0094293	.6495394	.1185095

4.2 Survey-Based Approach

A survey-based approach is used to gain an in-depth insight into the market and the market participants experiences. This is done with the objective of investigating benefits and challenges associated with green bond issuance. This survey-based approach also provides a means of analyzing the importance of pricing in the primary market as reported by the issuers themselves.

The chosen survey method is interviews as it allows us to ask open ended questions and explore individual experiences or opinions regarding the researched phenomenon. Semi-structures interviews are used as it allows for a degree of comparability across the interviews, while it still allows for more ad hoc investigative questions. Considering the exploratory nature of the research question, a more structured interview could have inhibited the possibility to explore important aspects of the topic.

Most of the questions were open-ended, but some were closed-ended and forced the respondent to make a choice. The purpose of this was to gain a mixture of in-depth answers and yes/no answers. To ensure that the same general areas of information were collected from each interviewee, an questionnaire was used. The questionnaire included important questions and was prepared before the first interview was conducted. It formed the basis for all subsequent interviews. Some questions where however added or customized to best fit the specific respondents.

Before each interview we sent out the questionnaire so that respondents could prepare their

answers if necessary. During the interviews the questions were not necessary read verbatim or in order. Thus, extra questions could be asked if an unexpected but relevant area emerged.

After each interview the conversation was transcribed and organized in separate files, including notes taken during the interview. To examine the findings from the interview data we used an inductive strategy inspired by Thomas (2006). This strategy provides a convenient and efficient way of analyzing the large extent of data that was gathered. It helped us to condense the extensive amounts of data into a brief, summarized format and to establish a link between the research objectives and the summary findings derived from the raw data. In this way, the analysis was determined in a deductive manner by the research objectives, and in an inductive manner through several readings and interpretations of the raw data.

The first step in the analysis of raw data was to read the text in detail, followed by categorization into specific segments. Due to the open structure of the interview, a considerable amount of text was not assigned to any category as it was not found relevant to the research topic. In the next step the data was further examined, and some categories were merged to reduce overlap and redundancy among the categories. This resulted in 18 categories for issuers and 18 categories for all other respondents. Some of these categories were identical between the groups. In the next step we merged the categories between the two groups and searched for subtopics, including contradictory points of view and new insights within each category. This whole process resulted in the seven summary categories that are presented in the thesis.

4.2.1 Data Description

In total 26 interviews were conducted over a two-month period, from January 29, 2018, to March 20, 2018. 22 interviews were performed by telephone, three by email, and one through a personal meeting in Trondheim. During all the interviews, except for one, both authors were present. The interview length varied from 25 minutes to 65 minutes, with an average of 41 minutes. All the interviews were audio-taped and later transcribed, which resulted in 207 pages (74 000 words) of transcripts.

When selecting respondents, we had two aims. One was to gain general insights into the green

bond market, the other was to get insight particularly to the experiences of issuers. The various respondents were divided into the following categories; issuers, investors, banks/underwriters and others. Issuers constitute the largest category, with 12 respondents. A detailed list of all respondents can be found in the Appendix.

The first contact with the respondents was through email. Here we described the scope of our thesis, explained why we were interested in interviewing them and asked if they had time for a telephone interview. We contacted 43 people, and 26 of these led to an interview. To those who did not respond to the first email, we sent a reminder, which helped us to gain a few more responses. However, three individuals were difficult to schedule an appointment with, and two did not have the relevant knowledge. Three of the 26 companies did not have time for a telephone interview and answered directly through the questionnaire.

Immediately after each interview we tested the recorder to make sure we recorded the whole interview. We also filled in gaps in the notes taken during the interview. Most of the interviews were conducted in Swedish or Norwegian, therefore some linguistic nuances may have been lost during translation to English.

4.2.2 Verification of Qualitative Approach

The quality of the survey-based approach can be assessed by considering the concepts of reliability, validity and confirmability.

Reliability refers to the question of whether a repetition of the data collection method, by different researchers or by the same researchers at another time and place, would come to the same result (Silverman, 2001). Achieving reliability is especially difficult in qualitative studies. The data yielded under interviews could be a reflection of the circumstances under which the interview is conducted. Reproducing the same interview might lead to different outcomes because of the changing context. The semi-structured format of our interviews also challenges the concept of reliability as both open and improvised questions could be asked.

These reflections do not mean that reliability is neglected. Silverman proposes possible measures to conduct a reliable qualitative research study, which has been followed up in this thesis.

One measure to increase reliability is to document all the steps in a transparent way so that the steps made can be followed, understood and reproduced by others. Furthermore, the readers of the report should be able to access the exact observations made, not only summarizes or generalizations. This was considered in this thesis by voice-recording and transcribing the interviews, as well as including direct quotes from these transcripts into the analyzing part of the thesis.

Validity is another concept to be considered, again this is especially important in qualitative research. The question of validity refers to the integrity of the constructs and conclusions that are generated through the study and whether the study accurately measure what it intended to measure (Silverman, 2001). Hence, for the validity of a qualitative study it is crucial that the observations made, fit to the theories that are developed out of them. We sought to ensure validity through the literature review, which provides other written and publicly available sources of information. Furthermore, to ensure validity with regards to the pricing discussion the results found in the qualitative approach is compared to the results set out in the quantitative approach. If the evidence, drawn from both approaches converge toward the same findings, it strengthens the validity of the study (Silverman, 2001).

Confirmability refers to the quality of the results with respect to the perspectives and biases brought into the study by the researchers. It thus refers to the degree to which the results could be supported by others, being either references to literature or other people involved in the study. Before completion of this thesis, a draft version of the results was sent out to all the respondents with two objectives. One was to secure confirmation of the presentation of data and quotes, the other to ensure that no misunderstanding or interpretation error had occurred during the analysis procedure. Our findings could also widely be supported by other sources of literature set out in the Literature Review chapter. That being said, researcher bias may have been evident during the interviews, in the form of asking leading questions that affected the answers given.

Chapter 5

Results

5.1 Results Matching Method

In this section the results from the matching method are presented. The aim of this analysis is to estimate the daily yield difference between green bonds and conventional bonds, in terms of it's sign and magnitude. A concern with our data is both heteroskedasticity and serial correlation. Both may lead to our standard errors being incorrect and hence may lead to incorrect inference. To test for heteroskedasticity we use a modified Wald test for groupwise heteroskedasticity. [1] This test strongly indicates the presence of heteroskedasticity within groups. Further, to test for the existence of serial correlation within groups we use a Wooldridge test for autocorrelation in panel data. This test indicates serial correlation within groups. The results from these tests are presented in table 5.1.

Table 5.1: **Specification Tests Fixed Effects Regression**
This table summarizes the results of the specification tests, Modified Wald Test and Wooldridge Test.

	Statistic	P-value	Decision
Modified Wald Test	3.3e+05	0.0000	Groupwise heteroskedasticity present
Wooldridge Test	9.649	0.0033	Within serial correlation present

To address the issues of serial correlation and within-heteroskedasticity in our sample, we pro-

[1] This modified Wald test is workable when the assumption of normality is violated, at least in asymptotic terms.

ceed our analysis with a Huber-White sandwich estimator which accounts for both within-heteroskedasticity and autocorrelation. From now we refer to this error structure as clustered errors. The regression results are presented in table 5.2, including both a standard error term and the clustered errors, to compare the results.

Table 5.2: **Regression Results**
This table summarizes the results from the fixed effects regression $\Delta y_{i,t} = p_i + \beta \Delta BA_{i,t} + u_{i,t}$.

Dependent variable $\Delta y_{i,t}$		
	Fixed effects	Fixed effects v/clustered errors
$\Delta BA_{i,t}$	-0.437***	-0.437***
	(0.0117)	(0.0532)
Constant	-0.00138	-0.00138***
	(0.000963)	(6.34e-06)
Observations	12,381	12,381
Adjusted R^2	0.102	0.102
Number of ID	46	46

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Both regressions yield qualitatively similar results. $\Delta BA_{i,t}$ is significant at the 1% level for both error structures. Hence, while the standard errors are larger (as expected), clustering the standard errors does not change the conclusion on the statistical significance of $\Delta BA_{i,t}$. Furthermore, the estimated effect of $\Delta BA_{i,t}$ has the expected negative sign. [2] Our estimates tells us that, holding the BA spread for the synthetic conventional bond constant, a 1 basis point increase in BA spread is expected to reduce $\Delta y_{i,t}$ by 0,437 basis points.

Of particular interest from the above regression is the 46 estimated fixed effects ($\hat{p}_i$). The average of these estimated effects are -0,011 with a standard deviation of 0,222. Hence, the average estimated fixed effect is negative but is essentially 0. With a view of filtering the dataset we try to winsorize our sample at the 1^{th} and 99^{th} percentile, to investigate the effect of some large outliers in our sample , illustrated in figure 4.1. This filtering removes 246 observations and two

[2] A wider BA spread indicates a lower liquidity for the bond.

groups of bonds, which leaves us with 12,135 observations across 44 groups. After winsorizing our sample, the average estimated fixed effect are -0,006 with a standard deviation of 0,055.

The distribution of the fixed effects is investigated below, both for the original sample and the winsorized sample. We also include the distribution of the time-demeaned $\Delta y_{i,t}$, as presented in the Data Description. This is done to illustrate the effect of our last liquidity control.

Table 5.3: **Distribution Fixed Effects**
This table shows the distribution of the estimated fixed effects ($\hat{p}_i$) both for the full sample and the winsorized sample. The table also includes the distribution for the time-demeaned yield difference (Δy_i) from the full sample as presented in table 4.1

	N	min	p25	mean	median	p75	max	std
Fixed-effect ($\hat{p}_i$)	46	-.788268	-.0319416	-.0109563	-.0107136	.0097881	1.143753	.221988
ΔY_i	46	-.6359345	-.0410208	-.0159582	-.0127939	.020235	1.128262	.2156092
Fixed effect ($\hat{p}_i$) (winzorized)	44	-.2244053	-.0245268	-.0054858	-.0069446	.0188651	.1086857	.0548874

The estimated fixed effects ($\hat{p}_i$) and the time-demeaned $\Delta Y_{i,t}$ (ΔY_i), yield comparable results, although the mean and median is marginally closer to 0 for the fixed effects. This shows that the impact of the last liquidity control is small which could indicate that the screening of bonds yields satisfactory results and removes large differences in liquidity.

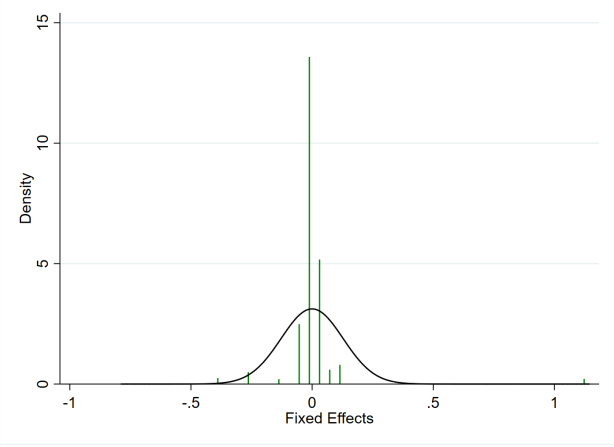

Figure 5.1: **Distribution Fixed Effects ($\hat{p}_i$) Full Sample**
This graph shows the distribution of the estimated fixed effects from the full sample, including the normal distribution for the sample.

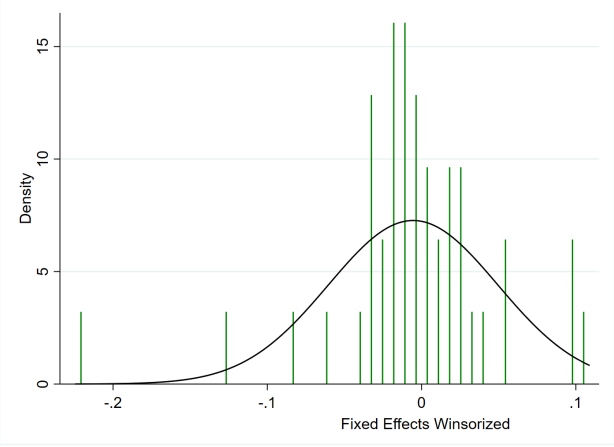

Figure 5.2: **Distribution Fixed Effects ($\hat{p}_i$) Winsorized Sample**
This graph shows the distribution of the estimated fixed effects from the winsorized sample, including the normal distribution for the sample.

5.2 Results Interviews

In the following section we present findings from the interviews. We have identified seven main categories of benefits and challenges associated with green bond issuance. Each of these categories will be presented in separate sections. The extent of which a finding is supported with evidence from the interview data is indicated with numbers assigned to each respondent. A full list of respondents with the assigned number can be found in the Appendix.

Issuers had different expectations before issuing their first green bond. Some issuers had a hope that they would gain increased access to capital or better prices. Some issued green bonds because they wanted to gain increased attention for their green projects and use the green bond as a source of PR. The majority of issuers got the idea of issuing a green bond from banks/underwriters because it suits the company's strategy. This indicates that banks are important drivers of green bond issuance and that effective education on the benefits of green bonds could be a key lever for issuance. Post issuance, 9/12 issuers explicitly say they had a good experience, and want to issue more green bonds. To put the results in a larger context, the view of issuers are complemented with responses from the perspective of investors and underwriters. We also report a selection of comments from other market participants.

5.2.1 Pricing

Out of all the issuers that have issued green bonds, 7/12 indicate that they have seen a positive pricing effect. One issuer did not know, three say they received the same price, and one reported that they got a lower price compared to conventional bonds. Of those who indicated a positive pricing effect, the size of this effects varied from 1-2 up to 10 basis points, with an average of 3-4 basis points. They further emphasize that these stated returns are only indicative. In practice, it is difficult to provide evidence of price effects as they never issue a green bond and a conventional bond at the exact same time.

In contrast, investors report that they will not pay a premium for the green label. Mette Cecilie Skaug, Portfolio Manager at Oslo Pensjonsforsikring AS (OPF) states that she is not certain she

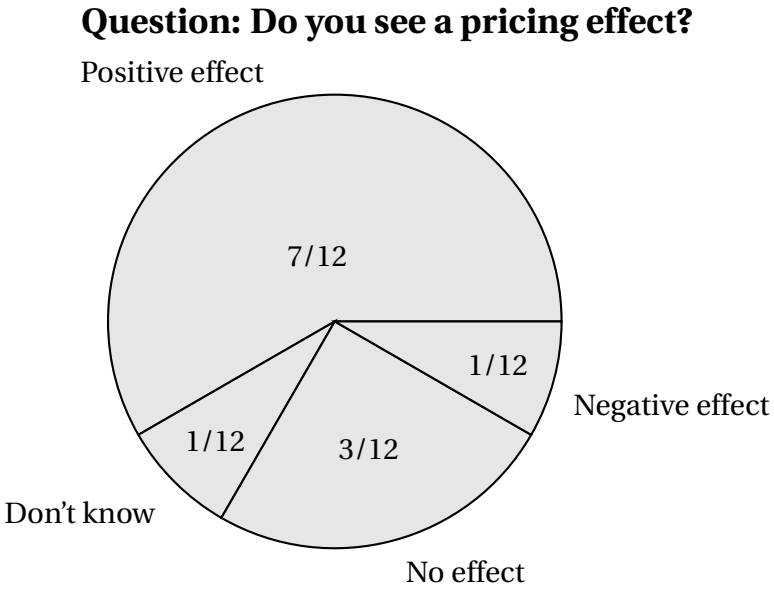

Figure 5.3: **Results Pricing Effect**
This figure shows the pricing effects experienced by the issuers themselves.

would accept a lower return on a green bond as the credit risk is the same as any other bond from the same issuer, but continues *"I tend to turn it around. The issuers that do not have an environmental profile may see a shrinking investor base and therefor face higher credit margins in the future."* Another investor says that *"It is basically the same price on green bonds as for conventional bonds. However, we have seen that demand is sometimes very high for green bonds, which potentially makes the issue more expensive. When the price becomes too high, we do not participate in the issue."* (Peter Lööw, Alecta)

Even though they won't pay extra for the green bond, 3/5 investors explicitly stated that if they have the choice between one green and one conventional, all other things equal, they will choose the green bond every time (14, 16, 17).

Responses from banks with regard to pricing are sometimes contradictory. Three banks explicitly say that the issuers do not get a discount on green bonds. They further emphasize that a pricing effect is hard to prove. On the contrary, they also indicate that they might see a discount, in some cases. In those cases where there has been a pricing effect, it has occurred due to market specific factors and high demand from investors.

"When I talk to issuers, I never promise cheaper financing. Even though we might have seen cases

where high demand have had a small but positive effect on pricing, this should not be seen as the reason to issue green. One should do it because it fits the company strategy and because it provides transparency to investors, hopefully inspiring further investments into sustainable assets. Major investments are needed to live up to the Paris Agreement and the UN's Sustainable Development Goals. Green bonds is just one source of funding for achieving these goals, but still an important one." (Nina Ahlstrand, DNB)

Another bank says: *"No, I would not say you see a difference in pricing. There are many who speculate about this, and there are many who are very wrong. I think it's important to understand the theory behind it. Whether it's a green, blue or red bond does not matter, it's the same asset in the balance of the issuer that are funded."* (Petter Knutzen, Swedbank). He continues: *"Having that said, we have seen a tendency to get more money and that the money might have had a certain tendency to price better on a green bond compared to a normal bond."*

The pricing effect experienced among the majority of issuers seems to be a result of high demand relative to supply (1, 3, 6, 11, 12, 20), leading to better liquidity for holders of green bonds. *"Talking to the investor, it is natural that they do not want to pay more for a green bond, and I can agree with that, but it is more based on supply and demand."* (Pär Lageryd, Skanska). One investor, on the other hand, did not agree that this difference is distinctive enough, to have an effect on pricing: *"Do we see an increased liquidity in the market, as a result of increased demand, and that this is a distinctive feature because it is green, of course we will accept a lower return because of the increased liquidity. At the moment we do not see that this is distinctive enough between green and conventional bonds, in the Nordics."* (Anonymous Investor)

5.2.2 Access to Capital

Nine issuers reported an increased investor base on their green bond, leading to increased access to capital. (1, 3, 4, 5, 6, 8, 10, 11, 12). One issuer stated that they gained 50% more investors on the green bond compared to conventional bonds. Four issuers gained additional investors that invested their money through green mandates. One said that they received more financing as a result of a new international investor participating in the issuance. The rest experienced

a generally higher demand from investors. Some of the issuers did not expect this increased access to capital and found this to be a positive surprise. (10, 11, 12,)

"I've probably had a bit of a cynical approach to the green label, and said that we can do green but it does not matter. This was not the case on the last round we did. However, it is not easy to distinguish between the credit risk, the development of the company and this with the green label. With this said, we did have more investors with a green mandate that were very interested in contributing, with large volumes. This is interesting for us to build on in the future, if we are going back in this market." (Mikkel Tørud, Scatec Solar)

5.2.3 Stability from a Diverse Investor Base

In addition to an increased investor base, there are a high proportion of buy-and-hold investors in green bonds (1, 6, 11,12 ,18, 20), potentially leading to a more diversified investor base. A broader and more diversified investor base reduces fluctuations in investor demand (6, 12). This in turn, reduces the risk of not getting capital in market downturns (6). Due to the higher proportion of buy-and hold investors it reduces the risk and adds stability to the access of capital (12). *"When a bond matures, we tend to make a new one, we extend it can you say. Then we see that those who have bought a green bond, they will always extend it. For us, there is less risk with a green bond."* (Thomas Nystedt, Vasakronan)

5.2.4 Company Reputation

Green bonds tend to attract a lot of attention in the market (1, 2, 3, 4, 6, 8, 11, 18). In addition to increased attention from investors, several issuers report that the issuance received a lot of attention in media (2, 6, 9). This provides an opportunity for the company to highlight and communicate their engagement with sustainability (2, 6, 13, 18, 22). *"We wanted to use this as a marketing tool, to show that BKK is first, and that we are proactive. That's why we traveled to Oslo, calling the media, newspapers etc. and making a point out of it."* (Harald Reikvam, BKK) On the other hand, the term "greenwashing" has come to represent green bond issues that fund projects that lack sufficient environmental benefits, in the view of some market participants. In

such a situation the integrity of green bonds could be reduced and the increased attention could potentially be harmful for such issuers. Even though the majority mention this as a potential risk with green bonds, they do not see it as a problem as of today. *"There are very few cases of greenwashing. I can't think of anyone at the top of my head. I think investors in general are satisfied, and I think they understand that this is a developing market. But because it is kind of a self regulating market, I think issuers also see the risk of not reporting properly. You can spend a lot of time on a green bond framework but it doesn't take long if you are doing things wrong to turn things to dust. So I think that if you want to go down this route you want to do it properly."* (Ben Powell, SEB)

5.2.5 Internal Governance & Environmental Strategy

Four issuers report that issuing a green bond had positive effects within the organisation (4, 6, 11, 12). It provides a way of getting finance teams and sustainability teams to talk to each other (11, 12, 16, 20). Issuing a green bond had positive effects on project management in general, not only with regards to the green aspect (6). The process of setting up a green bond framework and reporting post issuance forces the company to better quantify environmental effects (12). *"It will not only be an extra job and a burden, you will get something out of it. It will be a strategy. It will be a goal."* (Odd Terje Rygh, NTE)

5.2.6 Enhanced Credibility of Sustainability Commitment

Green bonds provides extra transparency which is highly valued from the perspective of an investor (15, 16, 18, 20). The extra transparency is provided through disclosure on the assets it will finance before issuance and tracking and reporting on the use of proceeds post issuance.*"For investors, this is very attractive because they know where the money goes."* (Torunn Bråtå, Kommunalbanken). *"I think the best thing about green bonds is that they increase transparency for investors dramatically. That green bonds offer a transparency level that is more detailed than the usual sustainability reports, and the more transparency, the better!"* (Helena Lindahl, SPP) In addition to extra transparency it is expected that a green bond issuer would have a second opin-

ion. It provides some form of a stamp of approval on how the framework is put together (20). *"If you do a green framework and do everything, define projects and have defined a profile on how you want to facilitate capital, it's much more credible for an investor environment to take the green bond versus a conventional bond. It is very transparent and easy to check."* (Peter Knutzen, Swedbank)

5.2.7 Second Opinion & Reporting

Direct costs for the second opinion is not seen as a problem among issuers (1, 2, 3, 4, 11). In fact, the cost is often covered by the underwriters (22). Indirect costs associated with additional work setting up the green bond framework are more substantial (3, 5, 7, 8, 9, 12). It usually takes around 4 weeks with internal work to get the green framework up and going (22). *"There is not much in terms of an upfront cost but it's more a cost in terms of additional manpower and giving people more work to do that I think is the biggest hurdle."* (Ben Powell, SEB) Companies that have worked with a green strategy for some time, and thus have most of the paperwork available in any event, do not see this additional work as a problem(3, 5, 8, 10, 11, 12).

"Our experience is that many issuers believe that green bond frameworks must heavy, long and complicated documents. However, often the frameworks are only 2-5 pages long, and annual impact reporting can be the same length. It's possible to have simple yet solid routines for reporting." (Kristina Alnes, Senior Advisor, CICERO)

Issuers have contradictory views on whether additional reporting post issuance is a hurdle. Some do not see the reporting as an issue (1, 3, 8, 12), but others see reporting as more time consuming (4, 5).*"Reporting in retrospect, that is where the job is. Setting up the framework can be done once, or at least it can be used for quite long. The big job is to follow up afterwards. In the framework we commit to report on impacts. We report the climate or environmental impact of the financed investments."* (Torunn Bråtå, Kommunalbanken)

Chapter 6

Discussion

As mentioned throughout this thesis, pricing is a hot topic of discussion in the context of green bonds. For issuers, pricing is an important incentive as it could justify the extra costs associated with green bond issuance. The results of our research indicate that there are other considerable benefits, regardless of whether a beneficial pricing exists. These benefits include: easier access to capital, stability from a diverse investor base, reputational benefits, enhanced credibility of sustainability commitment, improved internal governance and environmental strategy.

Our findings show that green bonds could be an effective instrument for companies to show their commitment to sustainability. The potential for both internal and external synergies resulted from a green bond issuance is significant and could justify the extra costs and reporting associated with green bonds. In this chapter our findings will be further discussed to answer the question; *should pricing be the main incentive for green bond issuance, or are there other benefits that could justify the extra costs?*

Our results with regards to pricing shows different, but not necessary conflicting results. The matching method shows that there is no statistically significant yield difference in the secondary market, after controlling for potential differences in liquidity. These results differ from Zerbib (2017), who reports an average green premium of 8 basis points. Zerbib (2017) although reports that the premium vary considerably between currencies, and suggests this can explain the different results. The survey-based approach shows that most issuers experienced a pricing effect,

with an average of 3-4 basis points lower yield for green bonds in the primary market, without liquidity controls. These results are in line with anecdotal evidence reported by (Boulle et al., 2016).

As mentioned in the introduction the investor demand for green bonds is growing rapidly, potentially leading to a mismatch between supply and demand. A current mismatch can be indicated by the strong investor demand experienced among issuers, as set out in the results section. The strong demand relative to supply is positive news for investors with liquidity concerns, as it reduces the risk of holding a green bond in the secondary market, i.e. it would be easy to sell the green bond. On the other hand, a low issuance relative to demand makes it harder to purchase a green bond, potentially reducing the yields at issuance. These current market discrepancies may explain why issuers experience a marginally better pricing at issuance.

As reported by I4CE (2016) a “green” premium is possibly achieved if a sufficiently large "committed demand" from institutional investors develops over time, although this perspective remains largely theoretical due to fiduciary duty limitations. In other words, investors would need to be ready to make their green objectives strong enough to imply discrimination between green and non-green assets. Our interviews have indicated that dedicated green portfolios are emerging, but investors are not willing to pay more for a green bond compared to a conventional bond with identical characteristics within the same company. This result supports the results from the matching method.

A marginally lower yield for green bond issuance could exist as long as the current demand/supply situation continues. Issuers finds this important as it could directly justify additional costs associated with green bond issuance. When we asked one potential issuer what is needed for green bond issuance in the future, he answered *“One expectation is an increased access to investors, which will lead to better pricing, and thus you are willing to take on the extra document work it will involve”* (Peik Nordenberg, Norsk Hydro). Our research, however, shows that there are other significant benefits for issuers that could incentivize green bond issuance, regardless of whether a beneficial price exists. These benefits are in line with those set out by the OECD (2017), and as presented in the literature review. Importantly, green bonds are an effective instrument for companies to show their sustainability commitment. This helps investors effectively allocate

their capital towards sustainable investments which demonstrates the potential green bonds have in the sustainable transition of finance flows.

As indicated by the number of signatories to the UNPRI, the appetite for sustainable investments is growing rapidly among investors. This can explain that green bonds tend to attract more capital, from a wider investor base. While this benefit may not necessarily materialize in the short-term or in unproblematic periods, it can become particularly useful when market conditions deteriorate or when organization's ability to borrow is restricted. In the perspective of an investor the extra transparency is a highly valued feature of green bonds.

Green bonds show characteristics that could significantly benefit issuers. One potential drawback is the extra costs and additional work associated with green bond labeling. In this regard the direct costs for external review are not seen a problem, but indirect costs in form of additional work can be seen as a barrier. As reported by Kristina Alnes in CICERO, many issuers expect the costs and workload to be higher than they actually are. Effective education on the costs and work required could therefore reduce this barrier for potential issuers. In addition, our interviews indicate that issuing a green bond and developing a green bond framework provides positive internal effects in the organization, as better integration between finance and sustainability department.

It should be noted that this barrier could be larger for smaller companies. Both in terms of resources available to develop the framework and for direct costs of external review. The costs and work required are fixed and would therefore be relatively larger for smaller companies. Nevertheless, this is mainly a barrier for first time issuers as the framework can be reused for subsequent issues. Not surprisingly, 9/12 issuers would like to issue more green bonds. Also, companies without an official rating could benefit by reaching investors through their second opinion certified by a credible external reviewer.

Green bonds have characteristics that can prove to be highly beneficial for issuers. Companies with a comprehensive environmental strategy, that confirms this trough green bonds, experience an increased interest among investors. Our hypothesis is that these companies can reduce their overall cost of financing. This hypothesis fits with the stakeholder theory set out in the literature review; there is evidence of a positive correlation between superior environmental

stewardship and strong financial performance. And more specifically, proactive environmental practices are associated with a lower overall cost of debt for the company.

Mette C. Skaug, Portfolio Manager, OPF says the following: *"Green bond issuers tend to have a commitment and anchorage in the organization that is much broader than financing the development of a specific project with an environmental impact. We buy both green and conventional bond from the same issuer because we believe that just the fact that they have a established a green bond program and continue to use it shows that they have the right motivation and commitment in the organization."*

Chapter 7

Conclusion

Major investments into sustainable assets are needed to making financial flows consistent with a pathway toward low greenhouse gas emissions and climate resilient development. Despite a rapidly growing demand for environmentally sustainable investments, it is still unclear to investors what constitutes "green finance". It is therefore crucial to develop channels that could help investors effectively allocate their capital toward sustainable investment projects. Green bonds are one relatively new instrument developed to address this need. Even though the green bond market has seen rapid growth recently, demand still currently outstrips supply.

This thesis has examined benefits and challenges experienced by issuers of green bonds in the Norwegian and Swedish market. The main objective was to investigate if these benefits could justify the extra costs and additional effort associated with green bond issuance. Ultimately, this could incentivize more issuers to choose green bonds rather than conventional bonds.

Pricing has emerged as a hot topic of research in the context of green bonds. This thesis analyzes pricing, in the primary and secondary market, through a survey-based approach and a matching method respectively. The results shows that high buying pressure can reduce the green bond yield at issuance. 7/12 issuers reports that they experienced beneficial pricing for green bonds, with and average of 3-4 basis points. However, the matching method used to analyze pricing in the secondary market shows no evidence of significant yield difference between green bonds and conventional bonds, after controlling for liquidity.

This research has identified other considerable benefits associated with green bond issuance. These benefits could justify the extra costs and additional reporting expected for green bonds, regardless of whether a marginal pricing difference exists. These benefits was identified through interviews with key stakeholders in the market and includes; easier access to capital, stability from a diverse investor base, reputational benefits, enhanced credibility of sustainability commitment, improved internal governance and environmental strategy. Both internal and external synergies resulting from a green bond issuance can be significant and may justify the extra costs and additional reporting effort.

Even though current market discrepancies can lead to a marginal pricing benefit for green bond issuers, this should not be the main incentive for issuance. Green bonds should be part of an overarching strategy and could be an effective instrument for companies to show their commitment with sustainability. This could ultimately reduce the overall cost of financing for the firm. Or to turn it around: those firms that do not have an environmental profile may see a shrinking investor base and therefore face higher credit margins in the future.

The main limitations of this study relate to sample size and data quality. Focusing on the Norwegian and Swedish market limits the number of green bonds available for analysis. Furthermore, most bonds in this market are not frequently traded. Thus, the bond's yield might not reflect it's fair value. Another limitation, due to time restrictions, are the number of respondents. Ideally, the survey could have covered more Swedish issuers considering that there are more issuers in Sweden than in Norway.

Our study raises opportunities for future research. First, we should be careful to draw general conclusions from our study to other countries, due to different characteristics of the markets. In particular, research focusing on developing markets could be interesting. These countries invest tremendous amounts into infrastructure and green bonds could be used to finance climate-resilient infrastructure. Second, one conclusion of our study is that green bonds can generate positive synergy effects for the issuing company. Comparing companies that have issued green bonds to companies that have not issued green bonds, both in terms of financial and strategic measures could be of interest.

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Appendix

Table 1: List of Respondents

Group		Company	Count	ID
Issuer/Potential Issuer	Hydropower	Agder Energi	**12**	1
	Hydropower	BKK		2
	Real Estate	Entra		3
	Real Estate	Fabege		4
	Finance	Kommunalbanken		5
	Hydropower	Lyse Energi		6
	Hydropower	Nord-Trøndelag Elektrisitetsverk (NTE)		7
	Real Estate	OBOS		8
	Municipality	Oslo Kommune		9
	Solar	Scatec Solar		10
	Entrepreneur	Skanska		11
	Real Estate	Vasakronan		12
Investors	Insurance	Alecta	**5**	13
	Insurance	KLP		14
	Insurance	Oslo Pensjonsforsikring (OPF)		15
	Insurance	SPP		16
	Anonymous	Anonymous		17
Bookrunners/Banks	Finance	DNB	**4**	18
	Finance	Nordea		19
	Finance	SEB		20
	Finance	Swedbank		21
Others	Climate foundation	CICERO	**5**	22
	Industry	Norsk Hydro		23
	Stock Exchange	Oslo Stock Exchange		24
	Municipality	Trondhem Kommune		25
	Investment company	UMOE		26
Total number of respondents			**26**	

Table 2: List of Issuers. Source: Climate Bonds Initiative; authors' calculations.

Country/Issuer	Number of green bonds	Amount issued NOK/SEK
Norway		
Agder Energi	1	NOK 750 000 000
BKK	1	NOK 2 000 000 000
City of Oslo	1	NOK 1 500 000 000
DNB Bank	1	NOK 1 000 000 000
Eidsiva Energi	1	NOK 750 000 000
Entra ASA	2	NOK 2 000 000 000
KBN	12	NOK 3 551 280 000
Lyse AS	1	NOK 500 000 000
NTE	2	NOK 750 000 000
OBOS Forretningsbygg	1	NOK 430 000 000
Scatec Solar ASA	2	NOK 1 250 000 000
SpareBank 1 Boligkreditt	1	NOK 1 000 000 000
Vardar AS	1	NOK 300 000 000
Sum Norway	**27**	**NOK 15 781 280 000**
Sweden		
Aligera	1	SEK 600 000 000
Arise	2	SEK 1 450 000 000
Atrium Ljungberg	3	SEK 2 400 000 000
Castellum	1	SEK 1 000 000 000
City of Gothenburg	6	SEK 5 560 000 000
City of Lunds	1	SEK 750 000 000
City of Malmo	1	SEK 1 300 000 000
City of Norrköping	1	SEK 600 000 000
City of Västerås	1	SEK 750 000 000
Fabege AB	8	SEK 3 700 000 000
Fastighets AB Forvaltaren	2	SEK 600 000 000
Fortum Varme	1	SEK 2 500 000 000
Humlegarden Fastigheter AB	1	SEK 1 250 000 000
Kommuninvest	3	SEK 6 100 000 000
Nordea Bank	1	SEK 500 000 000
Orebro Kommun	4	SEK 1 750 000 000
Region Skåne	1	SEK 1 200 000 000
Rikshem	7	SEK 2 750 000 000
SBAB Bank	2	SEK 3 750 000 000
SEB	1	SEK 500 000 000
SFF	8	SEK 5 570 000 000
Skanska	1	SEK 850 000 000
SKB (Stockholms Kooperativa Bostadsförening)	1	SEK 300 000 000
Specialfastigheter	1	SEK 1 250 000 000
Stangastaden	2	SEK 1 075 000 000
Stockholms Lans Landsting	4	SEK 6 400 000 000
Sveaskog	2	SEK 2 000 000 000
Svenska Cellulosa Aktiebolaget	2	SEK 1 500 000 000
Swedbank	1	SEK 500 000 000
Swedish Export Credit	1	SEK 500 000 000
Södra Skogägarna	1	SEK 1 000 000 000
Uppsalahem	1	SEK 500 000 000
Vasakronan	23	SEK 13 606 000 000
Vellinge Municipality	1	SEK 200 000 000
Volvofinans	1	SEK 700 000 000
Wallenstam - Svensk NaturEngeri	2	SEK 900 000 000
Östersund Municipality	1	SEK 800 000 000
Sum Sweden	**101**	**SEK 76 661 000 000**