



Vaasan yliopisto
UNIVERSITY OF VAASA

Kaisa Vanha-Perttula

Impact of green bond issuance on stock prices

Evidence from Nordic markets

School of Accounting and Finance
Master's thesis in Finance
Master's Programme in Finance

Vaasa 2025

UNIVERSITY OF VAASA**School of Accounting and Finance**

Author: Kaisa Vanha-Perttula
Title of the Thesis: Impact of green bond issuance on stock prices: Evidence from Nordic markets
Degree: Master of Science in Economics and Business Administration
Program: Master's Degree Program in Finance
Supervisor: Timo Rothovius
Year of graduation: 2025 **Pages:** 84

ABSTRACT:

Green bonds have become a central instrument in sustainable finance, offering companies a way to raise capital for projects with environmental benefits while signaling long-term responsibility to investors. The Nordic region has established itself as a frontrunner in this field, yet limited evidence exists on whether green bond issuance generates measurable shareholder value. This thesis examines how stock prices react to corporate green bond announcements in Nordic markets and whether firm- and bond-specific factors influence these reactions.

The study applies an event study methodology combined with regression analysis to a dataset of 101 green bond announcements by 47 listed non-financial companies from Finland, Sweden, Norway, and Denmark between 2017 and 2025. Daily stock returns and country-specific benchmark indices are used to calculate abnormal and cumulative abnormal returns (CARs) over multiple event windows. The event study results indicate no statistically significant abnormal returns in the overall sample, suggesting that investors in Nordic markets do not systematically adjust valuations following green bond announcements. However, the analysis reveals a marginally negative reaction to first-time issuances in the longer event window, while repeated issuances are treated as routine financing decisions.

Regression analysis provides further insights into the determinants of short-term reactions. Firm size, leverage, maturity, and issuance history are found to explain variation in CARs within the [-1,1] window. Larger companies and more leveraged firms experience more favorable immediate responses, while longer bond maturities are associated with weaker reactions. First-time issuances also have a significant positive short-term effect, contrasting with their marginally negative longer-horizon impact. Supplementary regressions with country and industry dummies show no systematic differences across geographical or sectoral dimensions, indicating that Nordic markets treat green bond announcements as relatively uniform events across countries and industries.

The findings contribute to the literature on sustainable finance by providing evidence from a mature market with strong ESG integration. For investors and corporate managers, the results highlight that the financial implications of green bond issuance in the Nordics are limited overall, but short-term market responses depend on firm characteristics and bond design. This thesis therefore adds a Nordic perspective to the ongoing debate on whether green bonds deliver value beyond their environmental benefits.

KEYWORDS: green bonds, sustainable finance, market reaction, event study, Nordic markets

VAASAN YLIOPISTO**School of Accounting and Finance**

Tekijä:	Kaisa Vanha-Perttula		
Tutkielman nimi:	Impact of green bond issuance on stock prices: Evidence from Nordic markets		
Tutkinto:	Kauppatieteiden maisteri		
Oppiaine:	Rahoituksen maisteriohjelma		
Työn ohjaaja:	Timo Rothovius		
Valmistumisvuosi:	2025	Sivumäärä:	84

TIIVISTELMÄ:

Vihreistä joukkovelkakirjoista on tullut olennainen osa kestävästä rahoituksesta. Ne tarjoavat yrityksille tavan rahoittaa ympäristöä hyödyttäviä hankkeita ja samalla viestiä sijoittajille vastuullisuudesta. Vaikka Pohjoismaat toimivat kestävästä rahoituksen edelläkävijöinä, tutkimus vihreiden joukkovelkakirjojen vaikutuksista osakkeenomistajien näkökulmasta on yhä vähäistä. Tämä tutkielma tarkastelee, miten osakemarkkinat reagoivat vihreiden joukkovelkakirjojen liikkeeseenlaskuihin Pohjoismaissa ja mitkä tekijät selittävät mahdollisia reaktioita.

Tutkimuksen aineisto koostuu 101 liikkeeseenlaskusta 47 pörssilistatulta, ei-rahoitusalan yhtiöltä vuosina 2017–2025. Tapahtumatutkimuksen ja regressioanalyysin avulla mitataan epänormaalit ja kumulatiiviset epänormaalit tuotot eri tapahtumaikkunoissa. Tulosten mukaan vihreiden joukkovelkakirjojen julkistukset eivät keskimäärin aiheuta tilastollisesti merkitseviä markkinareaktioita. Ensimmäiset liikkeeseenlaskut kuitenkin herättävät pidemmässä tarkastelussa lievästi negatiivisen reaktion, kun taas myöhemmät nähdään rutiininomaisina rahoituspäätöksinä.

Regressioanalyysi tuo esiin lyhyen aikavälin selittäviä tekijöitä. Yrityksen koko, velkaantuneisuus, maturiteetti ja liikkeeseenlaskuhistoria vaikuttavat tuottoihin erityisesti lyhyen aikavälin [-1,1] ikkunassa. Suuret ja velkaisemmat yhtiöt saavat myönteisemmän lyhyen aikavälin markkinareaktion, kun taas pitkät maturiteetit aiheuttavat heikompiä reaktioita. Ensimmäinen liikkeeseenlasku erottuu lisäksi positiivisella lyhyen aikavälin vaikutuksellaan, vaikka pidemmän tarkastelun tulos on lievästi negatiivinen. Lisäksi maita ja toimialoja koskevat lisäregressiot osoittavat, ettei epänormaaleissa tuotoissa ole systemaattisia eroja maiden tai toimialojen välillä, mikä vahvistaa tulkintaa, että markkinareaktiot ovat Pohjoismaissa suhteellisen yhtenäisiä.

Tutkimus täydentää kestävästä rahoituksen tutkimusta pohjoismaisella näkökulmalla, jossa ESG on jo vahvasti integroitunut markkinoihin. Sijoittajien ja yritysjohdon kannalta tulokset osoittavat, että vihreiden joukkovelkakirjalainojen vaikutus osakkeenomistajien näkökulmasta on kokonaisuudessaan rajallinen. Lyhyen aikavälin reaktiot riippuvat kuitenkin selvästi yrityksen ominaisuuksista ja liikkeeseen lasketun lainan rakenteesta. Näin ollen tutkielma tarjoaa lisäymmärrystä siitä, miten vihreät joukkovelkakirjat nähdään Pohjoismaiden kypsillä markkinoilla osana yritysten vastuullista rahoitusta.

AVAINSANAT: vihreät joukkovelkakirjalainat, vastuullinen rahoitus, markkinareaktiot, tapahtumatutkimus, pohjoismaiset markkinat

Contents

1	Introduction	7
1.1	Background and motivation	8
1.2	Purpose of thesis	8
1.3	Research hypothesis	9
1.4	Contribution of thesis	11
1.5	Structure of thesis	12
2	Overview of bonds	13
2.1	Key characteristics of bonds	13
2.2	Risk profiles of bonds	14
2.3	Bond pricing principles	14
2.4	The role of credit rating agencies	16
3	Green bonds	18
3.1	Principles of green bond	18
3.2	Development of the green bond market	20
3.3	Green bonds in the Nordic market	21
3.4	Greenwashing and market credibility	23
4	Stock valuation and market reactions	25
4.1	Measuring stock returns	25
4.2	Stock valuation methods	27
4.3	Modern portfolio theory	28
4.4	Capital asset pricing model	30
4.5	Arbitrage pricing theory	31
4.6	Market efficiency and information asymmetry	32
5	Literature review	34
5.1	Academic perspectives on green bonds	34
5.2	Environmental responsibility and shareholder value	36
5.3	Stock market reactions to green bond announcements	37
6	Data	40

6.1	The green bond data	40
6.2	Data limitations	41
6.3	Final dataset	43
6.4	Variables in the regression model	45
6.4.1	Dependent variables	45
6.4.2	Explanatory variables	47
6.5	Descriptive statistics for model variables	51
7	Methodology	54
7.1	Event study	54
7.1.1	Estimation of expected returns	55
7.1.2	Cumulative abnormal returns	56
7.2	Significance tests	58
7.3	Regression model	58
8	Results	61
8.1	Abnormal returns	61
8.2	Regression results	66
8.3	Country and industry effects	70
8.4	Summary of results	73
9	Conclusions	76
	References	78
	Appendices	83
	Appendix 1. List of issuers in the dataset	83

Figures

Figure 1. Global green bond issuance by year.	20
Figure 2. Nordic green bond issuance by year.	22

Tables

Table 1. Credit ratings for bonds from major rating agencies.	16
Table 2. Number and value of green bond issuances by industry.	43
Table 3. Number and value of green bond issuances by country.	44
Table 4. Annual distribution of green bond issuances.	45
Table 5. Descriptive statistics of cumulative abnormal returns (CARs).	47
Table 6. Explanatory variables used in the regression model.	47
Table 7. Descriptive statistics of green bond characteristics.	52
Table 8. Descriptive statistics of company characteristics.	53
Table 9. Stock market reaction to green bond issuance in the [-10,10] event window.	62
Table 10. Stock market reaction to green bond issuance in the [-5,5] event window.	63
Table 11. Stock market reaction to green bond issuance in the [-1,1] event window.	63
Table 12. Stock market reaction to green bond issuance in the [0,1] event window.	64
Table 13. CARs for first-time and subsequent green bond announcements.	65
Table 14. Regression results for CARs in the [-10,10] event window.	67
Table 15. Regression results for CARs in the [-1,1] event window.	68
Table 16. Regression results for CARs in the [-10,10] event window with country and industry dummies.	71
Table 17. Regression results for CARs in the [-1,1] event window with country and industry dummies.	72

1 Introduction

Climate change has become one of the most pressing global challenges, urging companies and governments to adopt sustainable practices and reduce their carbon footprint (Bracking, 2021). The financial sector plays a pivotal role in supporting this transition, with green finance emerging as a key mechanism to channel capital into environmentally friendly projects. Among these instruments, green bonds enable issuers to raise funds earmarked for sustainability-oriented purposes, such as renewable energy and energy-efficient infrastructure (ICMA, 2021). Since the first issuance by the European Investment Bank in 2007, the market has expanded rapidly. The European Investment Bank (2024) has emphasized the growing importance of climate-related financing, while the Climate Bonds Initiative (2024) shows that green bonds have become firmly established as a mainstream financing tool within global capital markets.

In recent years, the Nordic countries have emerged as leaders in sustainable finance. The Nordic Council (2024) highlights how sustainability has become deeply embedded in corporate and policy agendas across the region. This development has been reinforced by record issuance from Nordic corporates and municipalities, as documented by Nordic Trustee (2024), which demonstrates the region's central role in the global green bond market. Despite this strong momentum, academic research on the financial implications of green bonds remains limited. Much of the existing literature has focused on environmental outcomes, while less attention has been given to whether such instruments influence stock price performance (Tang & Zhang, 2020).

This thesis addresses this gap by investigating the stock price effects of green bond issuance within the Nordic context. By focusing on this specific market, the study contributes to the literature on sustainable finance and provides practical insights for investors and policymakers. The findings are intended to support informed decision-making regarding sustainable investment strategies in the Nordic region.

1.1 Background and motivation

The rapid development of the green bond market reflects the growing demand for financing tools that combine economic growth with environmental responsibility. In the Nordic countries, sustainability is strongly embedded in corporate and governmental strategies, positioning the region as a pioneer in green finance (Nordic Council, 2024). Although the market has expanded rapidly, academic research has only partly addressed the financial implications of green bond issuance. Earlier studies have highlighted environmental and reputational benefits, but evidence on stock market impacts remains limited. Since share prices reflect investor sentiment and expectations, examining whether green bond announcements influence stock performance is essential for understanding the financial relevance of sustainable finance (Tang & Zhang, 2020).

This thesis addresses this gap by analyzing stock price reactions to green bond announcements in the Nordic market. The study contributes to the limited body of research on the financial effects of green bonds in developed economies and aims to provide insights relevant for both investors and corporate managers.

1.2 Purpose of thesis

The purpose of this thesis is to investigate the financial impact of green bond issuance on stock prices in the Nordic market. As green bonds have gained prominence in sustainable finance, understanding their influence on shareholder value is increasingly important for investors, policymakers, and corporate decision-makers (Bracking, 2021). Green bond issuance is often viewed as a signal of a company's commitment to environmental responsibility, potentially enhancing its reputation and attracting ESG-focused investors (Tang & Zhang, 2020). However, while existing research highlights the environmental and reputational benefits of green bonds, few studies have empirically examined their effects on stock price performance, particularly in the Nordic region where ESG standards are highly regarded (Nordic Council, 2024).

To address this gap, this study applies the event study methodology to analyze stock market reactions to green bond announcements, specifically examining abnormal and cumulative abnormal returns (AR, CAR) around issuance dates. The event study method is widely used in finance research to evaluate the impact of specific events on stock prices, allowing for a precise measurement of investor response to green bond issuances (MacKinlay, 1997). By focusing on both initial and subsequent issuances, this thesis also explores whether the frequency or novelty of green bond issuance has differential effects on stock performance.

This research is limited to publicly listed Nordic companies that have issued green bonds in recent years. Previous studies on green bonds have primarily focused on global markets or emerging economies (World Bank, 2024), leaving a gap in understanding the financial implications within mature markets like the Nordics. The findings aim to contribute to the growing body of literature on sustainable finance by offering insights into how green bond issuance impacts corporate value in a region renowned for its sustainability leadership. This study will inform investors, corporate managers, and policymakers about the potential financial outcomes of green finance strategies in the Nordic market.

1.3 Research hypothesis

The purpose of this thesis is to examine how the issuance of green bonds influences the stock prices of publicly traded companies in the Nordic market. Previous research on green bonds has predominantly focused on global markets, European markets, or emerging economies, with limited studies addressing mature markets like the Nordics, where ESG standards are highly integrated into corporate strategies (Nordic Council, 2024). Moreover, findings from prior studies have been inconsistent: some studies report a positive market reaction to green bond issuances, while others find a negative or neutral response (Tang & Zhang, 2020; Flammer, 2021). This thesis seeks to contribute to the existing literature by clarifying these mixed findings within the Nordic context and

exploring the potential impact of green bond issuance on shareholder value. To achieve this, the thesis tests the following research hypotheses:

H₀: The value of the share does not react to the announcement of the green bond issuance in the Nordic market.

If the null hypothesis holds, the issuance of a green bond would have no observable effect on the stock price of the issuing firm. However, based on previous studies that suggest a connection between green bond issuance and stock performance, it is hypothesized that green bond announcements do impact share value. Thus, the main research hypothesis is:

H₁: The value of the share reacts to the announcement of the green bond issuance in the Nordic market.

To further investigate H₁, potential market reactions are divided into the following hypotheses:

H_{2a}: The value of the share reacts positively to the announcement of the green bond issuance in the Nordic market.

H_{2b}: The value of the share reacts negatively to the announcement of the green bond issuance in the Nordic market.

H_{2a} explores whether the announcement of a green bond positively affects shareholder value, measured through cumulative abnormal returns (CARs). This hypothesis is based on the assumption that green bond issuances can enhance corporate reputation and attract ESG-focused investors, potentially driving stock prices higher (Tang & Zhang, 2020). In contrast, *H_{2b}* considers the possibility of a negative reaction, indicating that investors might view green bonds as adding financial constraints or operational commitments, which could lead to a decrease in stock valuations.

In addition to examining the overall reaction, this thesis follows research by Lebellet et al. (2020) and Flammer (2021) in exploring whether market responses differ between first-time green bond issuances and subsequent issuances. This leads to the third hypothesis:

H₃: The reaction differs between the first-time green bond issuance announcement and subsequent announcements.

Based on studies by Lebellet et al. (2020) and Flammer (2021), the assumption is that first-time green bond issuances may generate more significant positive or negative reactions compared to subsequent issuances. First-time issuances may signal a substantial strategic shift toward sustainability, potentially attracting heightened investor attention.

1.4 Contribution of thesis

This thesis provides a focused analysis of the financial impact of green bond issuance on stock prices within the Nordic market, a region recognized for its commitment to sustainable finance and ESG (Environmental, Social, and Governance) practices. While existing literature has explored green bond impacts on stock prices in emerging and global markets, studies specific to the Nordic market remain limited. This thesis addresses this gap by investigating how green bond announcements influence shareholder value in a market with a mature ESG framework (Tang & Zhang, 2020).

Using event study methodology, this research provides a detailed analysis of stock market reactions to green bond issuances. By examining both first-time and repeat issuances, it investigates whether investor reactions differ based on a company's history with sustainable finance. Unlike studies that aggregate data from diverse regions or focus on markets outside the Nordics, this thesis concentrates on the unique characteristics of Nordic investors, who tend to prioritize environmental and social factors in their financial decisions (Flammer, 2021).

The findings from this study are intended to contribute to both academic literature and practical applications. Academically, this research enriches the field of sustainable finance by providing empirical evidence on the relationship between green bond issuance and stock performance in the Nordic market. Practically, it offers insights for investors, corporate managers, and policymakers regarding the potential benefits and limitations of green bonds as a financing tool in sustainability-focused markets. By examining a specific, ESG-forward region, this study complements existing global and emerging market research, providing a valuable perspective on how green financing mechanisms impact corporate value in established sustainable economies.

1.5 Structure of thesis

The structure of the thesis consists of nine chapters. After the introduction, the second chapter presents the theoretical framework of conventional bonds, providing an overview of bond features, risks, pricing, and the role of credit rating agencies. The third chapter focuses exclusively on green bonds, discussing their principles, market development, and specific characteristics within the Nordic market, as well as addressing issues such as greenwashing.

The fourth chapter delves into stock valuation theory, covering key models and concepts relevant to analyzing stock price reactions. Chapter five reviews the existing literature, summarizing previous studies on green bonds, stock valuation, and ecological impacts on stock performance. Chapter six presents the data used in this study, while chapter seven describes the methodology, including the event study approach and regression analysis. Chapter eight contains the main findings, presenting and discussing the results of the analysis. Finally, chapter nine concludes the thesis, summarizing the findings and their implications, and suggesting directions for future research.

2 Overview of bonds

Bonds are fixed-income securities that enable governments, municipalities, and corporations to raise capital from investors. They provide regular interest payments, known as coupons, and repay the principal at maturity, offering issuers a reliable funding source and investors predictable returns (Fabozzi, 2012). Despite their stability, bonds carry risks such as interest rate fluctuations, creditworthiness of issuers, and inflation. Additionally, bonds come in diverse forms, including treasury, municipal, and corporate bonds, to meet varying financial needs, each offering different risk and return profiles (Hull, 2018). This chapter examines the fundamental features of bonds, their risks, pricing mechanisms, and the role of credit rating agencies in evaluating issuers' creditworthiness.

2.1 Key characteristics of bonds

Bonds are financial instruments with specific features that define their structure, valuation, and investor appeal. These features outline the rights and obligations of issuers and bondholders and shape the bond's risk–return profile (Fabozzi, 2012). The face or par value represents the amount repaid at maturity and serves as the basis for calculating interest. The coupon rate specifies the annual interest as a percentage of face value and may be fixed, offering stability, or floating, adjusting periodically to a benchmark such as LIBOR or SOFR (Hull, 2018). The maturity date indicates when the principal is repaid, ranging from short-term (under one year) to long-term (over 10 years). Longer maturities typically involve higher risks, such as interest rate and inflation risk, but also offer higher yields (Bodie et al., 2018).

Additional features include embedded options, such as callable or puttable bonds, which allow early redemption under specified conditions. Callable bonds benefit issuers when interest rates fall, while puttable bonds protect investors by permitting resale to the issuer at a predetermined price (Fabozzi, 2012). Convertible bonds provide bondholders the option to convert holdings into shares, combining fixed-income characteristics with

equity upside. The diversity of bond features caters to different investor preferences and financing needs, making bonds a flexible capital market instrument. These characteristics are central to bond pricing, risk, and marketability, which are discussed further in subsequent sections.

2.2 Risk profiles of bonds

While bonds are often regarded as stable investments, they are subject to several risks that affect their value and appeal. Interest rate risk is particularly significant: as rates rise, bond prices typically fall, with long-maturity bonds most sensitive to these changes (Hull, 2018). Credit risk is another central concern, especially for corporate bonds that depend on issuer stability. Unlike government bonds, corporate bonds carry higher default risk, which investors assess using ratings from agencies such as Moody's and Fitch (Fabozzi, 2012).

Inflation also erodes the purchasing power of fixed coupon payments, a problem especially pronounced for long-term bonds (Tuckman & Serrat, 2011). Inflation-linked bonds such as TIPS mitigate this by adjusting payments in line with inflation. Liquidity risk can emerge in less active markets, forcing investors to accept lower prices if bonds must be sold quickly—a challenge often faced with smaller issuers (Hull, 2018). Finally, callable bonds introduce reinvestment risk, as issuers may redeem debt early when rates fall, leaving investors to reinvest at less favorable levels (Fabozzi, 2012).

2.3 Bond pricing principles

The pricing of bonds is based on the principle of discounted cash flows, which values a bond by summing the present value of its expected future payments. These payments include periodic coupon payments and the repayment of the principal at maturity. The

discount rate applied reflects the bond's yield to maturity (YTM), accounting for the bond's risk, time to maturity, and prevailing market conditions (Bodie et al., 2018).

The formula for bond pricing is expressed as follows in Formula 1 below:

$$P_0 = \sum_{t=1}^T \frac{C_t}{(1+r)^t} + \frac{F}{(1+r)^T}, \quad (1)$$

where:

P_0 = Present value

T = Time to maturity (in years)

t = Number of periods

C_t = Annual coupon rates

r = Required rate of return

F = Face value of the bond

Formula 1 highlights the inverse relationship between the discount rate and the price of a bond. As the discount rate increases, the present value of future cash flows decreases, leading to a lower bond price (Hull, 2018). The discount rate, or yield to maturity (r), represents the compensation investors require for bearing risks associated with the bond. Credit risk is a key factor influencing bond pricing. Bonds with lower credit ratings, reflecting a higher probability of default, offer higher yields to compensate investors for the increased risk. Conversely, highly rated bonds offer lower yields due to their perceived safety (Fabozzi, 2012).

Additionally, bond pricing is sensitive to interest rate changes, as captured by the concept of duration. Longer-duration bonds exhibit greater price volatility, underscoring their higher sensitivity to market fluctuations (Tuckman & Serrat, 2011). Specialized bonds, such as callable and convertible bonds, further complicate pricing. Callable bonds allow issuers to repay early, introducing reinvestment risk for investors, while convertible bonds include an option to convert into equity, requiring more sophisticated valuation models (Choudhry, 2019).

2.4 The role of credit rating agencies

Credit rating agencies (CRAs) play a central role in assessing issuer creditworthiness and supporting transparency in financial markets. The major CRAs include Moody's, Standard & Poor's (S&P), Fitch Ratings, and Kroll, which dominate the industry with globally recognized rating systems (Fabozzi, 2012). Their evaluations help investors gauge default risk and make informed decisions. Bonds are typically classified as investment grade or speculative grade. Investment-grade bonds, rated BBB- or higher by S&P and Fitch and Baa3 or higher by Moody's, are considered lower-risk and attract more risk-averse investors. Speculative-grade, or junk bonds, carry higher risks but compensate with potentially higher returns (Bodie et al., 2018).

Table 1. Credit ratings for bonds from major rating agencies (Jiang, 2021).

Moody's	Standard & Poor's	Fitch Ratings	Kroll	Category
Aaa	AAA	AAA	AAA	Best quality
Aa1	AA+	AA+	AA+	High quality
Aa2	AA	AA	AA	
Aa3	AA-	AA-	AA-	
A1	A+	A+	A+	Upper medium Grade
A2	A	A	A	
A3	A-	A-	A-	
Baa1	BBB+	BBB+	BBB+	Investment Grade
Baa2	BBB	BBB	BBB	
Baa3	BBB-	BBB-	BBB-	
Ba	BB	BB	BB	Speculative
B	B	B	B	
Caa	CCC	CCC	CCC	
Ca	CC	CC	CC	
C	C	C	C	
			D (default)	

Above Table 1 (Jiang, 2021) shows the credit rating scales used by major agencies. The rating system divides bonds into categories that reflect their credit quality. Bonds rated AAA represent the strongest creditworthiness and the lowest risk of default. In contrast, bonds rated Ba3/BB- or below are considered speculative grade and carry a higher risk of default.

CRA use both quantitative and qualitative criteria to assign ratings. Quantitative metrics such as leverage ratios, cash flow stability, and interest coverage offer objective financial insights, while qualitative factors like management quality, market position, and macro-economic conditions provide a broader perspective on creditworthiness (Choudhry, 2019; Fabozzi, 2012). The credibility of CRA has been questioned, particularly due to the issuer-pays model, which critics argue creates conflicts of interest. The 2008 financial crisis highlighted this problem, as several highly rated securities defaulted. Since then, regulatory reforms have aimed to improve transparency and rating quality. Cheng and Neamtiu (2009) find that CRA responded by refining methodologies and increasing accountability, enhancing the reliability of their evaluations.

3 Green bonds

Green bonds have become a central instrument in the field of sustainable finance, offering a way to finance projects that deliver clear environmental benefits, such as renewable energy, energy efficiency, and biodiversity conservation (Tang & Zhang, 2020). While structurally similar to conventional bonds, green bonds differ in that their proceeds must be allocated exclusively to environmentally beneficial projects.

The green bond market has grown rapidly since the first green bond was issued by the European Investment Bank in 2007. This development reflects rising interest from both institutional and retail investors in financial instruments aligned with environmental, social, and governance (ESG) criteria. In addition, frameworks such as the Green Bond Principles (GBP), developed by the International Capital Market Association (ICMA), have contributed to greater transparency and standardization, reinforcing the credibility of the market (ICMA, 2021).

3.1 Principles of green bond

The Green Bond Principles (GBP) are voluntary guidelines developed by the International Capital Market Association (ICMA) to promote integrity, transparency, and consistency in the green bond market. They provide a globally recognized framework to ensure that proceeds are allocated exclusively to projects with environmental benefits (ICMA, 2021). The GBP strengthens investor confidence by helping issuers define, evaluate, and report on green investments, thereby supporting the growth of sustainable finance.

The GBP are built on four core components:

Use of proceeds. Proceeds must be directed to projects that advance environmental objectives, such as renewable energy, clean transportation, sustainable water and wastewater management, biodiversity conservation, and climate change adaptation

(ICMA, 2021). Clear disclosure of how funds are used is essential to avoid greenwashing (Tang & Zhang, 2020).

Process for project evaluation and selection. Issuers should define transparent procedures for selecting projects, often by aligning with international targets such as the UN Sustainable Development Goals (SDGs) or the Paris Agreement (Flammer, 2021). They are encouraged to disclose risk assessments and show how projects support broader sustainability strategies.

Management of proceeds. Issuers must establish formal processes to track allocation of proceeds, typically through dedicated accounts or sub-portfolios. External audits and third-party verification are commonly applied to ensure compliance with the GBP (Choudhry, 2019).

Reporting. Issuers are expected to provide annual updates on allocation and environmental impacts. Reports often include quantitative indicators, such as reductions in greenhouse gas emissions or energy efficiency improvements, which enhance transparency and credibility (ICMA, 2021).

The adoption of the GBP has been central to the rapid expansion of the green bond market. By providing a common language for issuers and investors, they reduce information asymmetry and make issuances easier to compare. This standardization has encouraged institutional participation and improved market integrity (Tang & Zhang, 2020). Adherence to the GBP can also enhance issuers' reputations by signaling a commitment to sustainability (Flammer, 2021). Despite these benefits, the voluntary nature of the GBP creates challenges. Enforcement varies, leading to inconsistencies in reporting and project quality (Choudhry, 2019). To strengthen credibility, additional certification schemes such as the Climate Bonds Standard have emerged, offering independent verification of a bond's environmental credentials and reinforcing trust in green bond issuances (Demski et al., 2025).

3.2 Development of the green bond market

The global green bond market has expanded rapidly since the launch of the first Climate Awareness Bond by the European Investment Bank (EIB) in 2007. This inaugural bond linked proceeds to climate-related disbursements and introduced a financing model that supported the transition toward low-carbon development (European Investment Bank, 2024). A year later, the World Bank issued its first green bond, further contributing to the institutional foundation of sustainable capital markets (World Bank, 2019).

According to the Climate Bonds Initiative (2024), the issuance of sustainable debt instruments reached USD 1.67 trillion in 2024. Green bonds formed the largest category, with annual issuance totaling USD 639.6 billion. Notably, 64 percent of the 2024 volume was aligned with recognized taxonomies, reflecting increasing standardization and market maturity. Regionally, Europe accounted for 55 percent of taxonomy-aligned issuance, followed by Asia-Pacific with 27 percent and North America with 14 percent. The remaining 4 percent came from other regions, including emerging markets, reflecting differences in regulation, investor awareness, and market readiness.

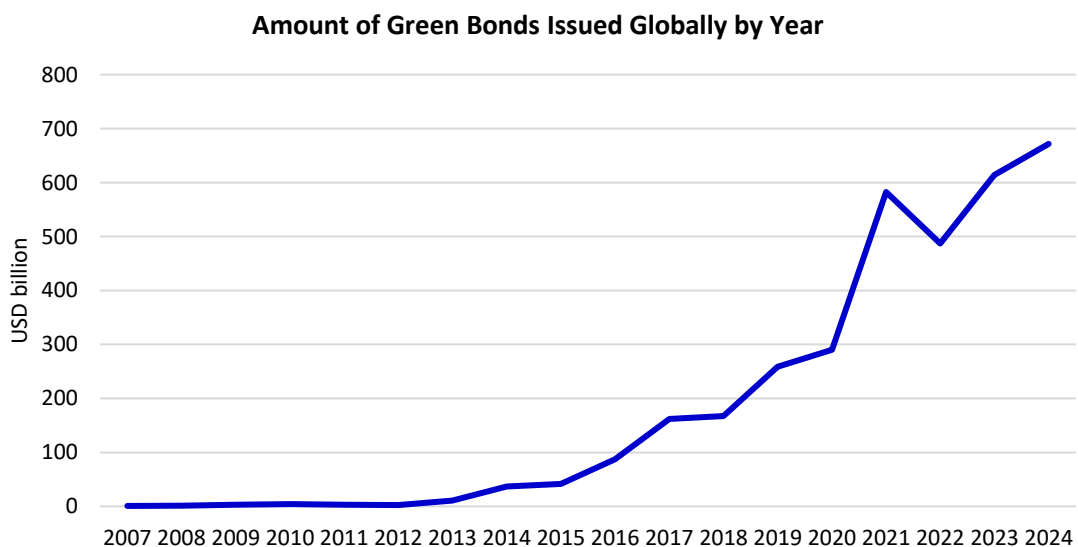


Figure 1. Global green bond issuance by year (Climate Bonds Initiative, 2024).

Figure 1 illustrates the annual growth of global green bond issuance. The market, which began with only a few issuances after 2007, has since grown sharply and reached record levels in recent years. This trend underscores the statistics above and shows how green bonds have evolved from a niche instrument into a significant segment of sustainable debt markets. Institutional issuers have played a central role in this expansion. The EIB, for example, remains one of the most active issuers globally. By the end of 2023, it had issued EUR 93 billion in CABs and Sustainability Awareness Bonds (SABs), with EUR 81 billion still outstanding. These instruments are aligned with the EU Taxonomy and contribute to objectives such as climate mitigation and water resource protection. Issuers like the EIB often provide external verification and detailed impact reporting, which strengthens transparency and investor trust (European Investment Bank, 2024).

Despite this growth, several challenges remain. A key issue is the risk of greenwashing, particularly in jurisdictions with limited regulatory oversight. Without consistent standards, investors may find it difficult to verify the environmental quality of projects financed through green bonds. The absence of harmonized reporting frameworks also complicates comparisons across issuers and regions. As Choudhry (2019) notes, improving disclosure and regulatory alignment is essential to safeguard the credibility of the market and ensure that green bonds deliver measurable environmental benefits.

3.3 Green bonds in the Nordic market

The Nordic countries are recognized for their leadership in sustainable finance and progressive climate policies. The region has been central to the development of the global green bond market, both through innovation and issuance volume relative to population size. Sweden holds a key position: in 2008, Skandinaviska Enskilda Banken (SEB) collaborated with the World Bank to issue its first green bond, helping to establish a globally recognized framework for green finance (World Bank, 2019). Between 2020 and 2024, the outstanding volume of Nordic corporate green bonds more than doubled to EUR 33.1 billion, representing 27 percent of the total corporate bond market (Nordic Trustee,

2024). In 2024 alone, issuance reached EUR 12.5 billion, up from EUR 5.6 billion in 2023, setting a new record. Sweden accounted for 54 percent of issuance, followed by Norway with 34 percent. Figure 2 shows the total outstanding volume of Nordic corporate green bonds by country, highlighting Sweden’s leading role and Norway’s growing contribution.

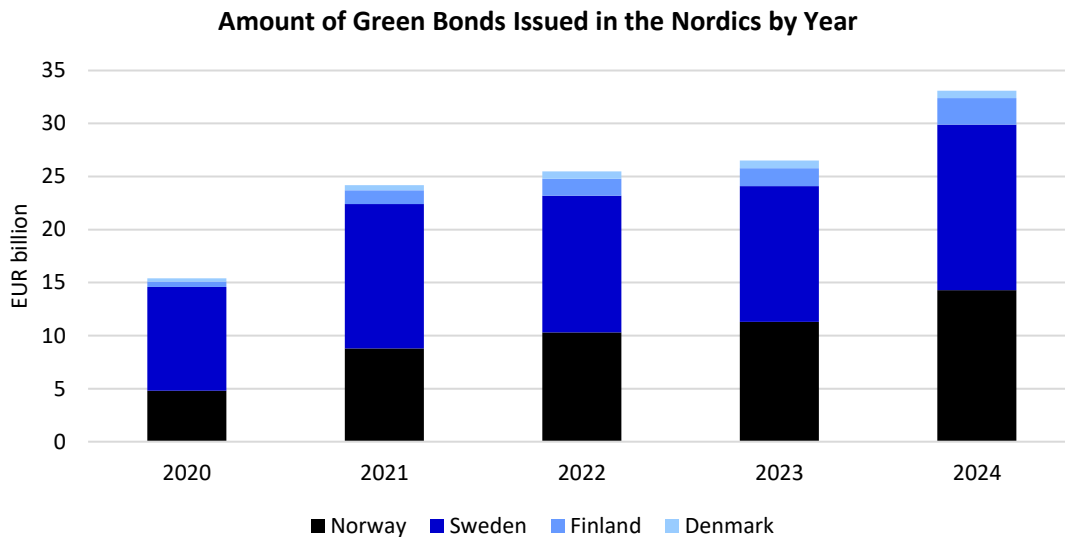


Figure 2. Nordic green bond issuance by year (Nordic Trustee, 2024).

Frequent issuers include municipalities, financial institutions, and companies in the energy and real estate sectors. Issuances are typically aligned with the Green Bond Principles (ICMA, 2021) and the EU Taxonomy, supporting transparency and investor confidence. Real estate led the market in 2024 with 42 percent of outstanding volume, while utilities and industrials also expanded. In the high-yield segment, industrial and real estate issuers together accounted for 92 percent of volumes (Nordic Trustee, 2024).

Innovation has been a hallmark of the Nordic market. Frameworks have been developed to make issuance accessible to smaller municipalities and mid-sized firms, while institutional investors such as pension funds are required to integrate sustainability considerations into their portfolios. Proceeds primarily finance renewable energy, green buildings, and sustainable transport, with newer themes such as the circular economy, biodiversity, and climate adaptation gaining ground. Despite its strengths, the Nordic market faces

challenges. The relatively small size can limit liquidity, and concerns about greenwashing persist, although strong regulation and transparency help mitigate these risks. Ongoing initiatives, including the EU Green Bond Standard and broader ESG reporting, aim to enhance credibility and support further growth (European Union, 2022). Looking ahead, the Nordic region is well positioned to remain a global leader, offering a model for scaling sustainable finance worldwide.

3.4 Greenwashing and market credibility

As the green bond market expands, concerns about greenwashing have become increasingly prominent in academic and policy discussions. Greenwashing refers to situations where issuers overstate or misrepresent the environmental benefits of projects financed through green bonds. It may involve weak project selection criteria, vague reporting, or limited evidence of actual environmental impact. These risks threaten the credibility of the market and can reduce investor trust in sustainable finance as a whole (Choudhry, 2019; Healy & Palepu, 2001). Although voluntary frameworks such as the Green Bond Principles (GBP) encourage transparency and accountability, the absence of binding rules allows variation in how issuers apply them. As noted by Choudhry (2019), issuers may selectively disclose information or adopt broad eligibility definitions without clear measurement of impact. Demski et al. (2025) also highlight that some bonds are marketed under sustainability labels without rigorous validation, increasing the risk of misleading investors. These issues are particularly concerning in jurisdictions where regulatory oversight is still developing.

The problem of greenwashing is closely tied to information asymmetry between issuers and investors. When investors cannot verify how proceeds are used or what outcomes are achieved, they face higher uncertainty and perceive greater reputational or financial risk. This may lead to pricing inefficiencies or reduced participation, especially among institutional investors with strict ESG mandates (Healy & Palepu, 2001). To mitigate these risks, the market has developed voluntary and regulatory mechanisms aimed at

improving credibility. Certification schemes such as the Climate Bonds Standard provide third-party verification of frameworks, while ongoing use-of-proceeds reporting strengthens post-issuance accountability. On the regulatory side, the EU Green Bond Standard introduces stricter criteria and alignment with the EU Taxonomy, aiming to create a more consistent definition of environmentally sustainable investments (European Union, 2022). These tools reduce information gaps, discourage opportunistic behavior, and support a more trustworthy green bond market.

In the Nordic region, issuers commonly align with international verification schemes and employ external reviewers to reinforce environmental integrity. They also complement frameworks with detailed impact reporting and alignment with national and EU-level policy goals, further reducing the risk of greenwashing (European Investment Bank, 2024; Climate Bonds Initiative, 2024). These practices are essential to maintaining the credibility of green finance and ensuring that environmental goals linked to green bond issuance are genuinely achieved.

4 Stock valuation and market reactions

This chapter presents the key theoretical frameworks related to stock valuation. The aim is to provide a foundation for understanding how stock prices are formed and how different risk and return components influence valuation. The discussion begins with the basic concepts of stock returns and pricing mechanisms. It then introduces four central models in financial theory: Modern Portfolio Theory (Markowitz, 1952), the Capital Asset Pricing Model (Sharpe, 1964; Bodie et al., 2018), the Arbitrage Pricing Theory (Ross, 1976; Nikkinen et al., 2002), and the Efficient Market Hypothesis (Fama, 1970). Together, these models form the theoretical background for analyzing market behavior in the context of green bond announcements.

A common approach to stock valuation is based on dividend discount models, where the value of a stock is defined as the present value of expected future dividends (Nikkinen et al., 2002, pp. 149–150). However, this process is rarely straightforward. As noted by Knüpfer and Puttonen (2018, p. 93), forecasting future dividend payments is challenging due to uncertainty in corporate earnings and the absence of legal obligations to distribute dividends. As a result, stock pricing often involves significant assumptions about a firm's profitability, future cash flows, and market expectations.

4.1 Measuring stock returns

Return on stock refers to the income an investor earns from holding a stock over a period, which typically includes both capital gains and dividends. It is a fundamental concept in finance and a key metric for evaluating investment performance (Bodie et al., 2018, p. 400). The total return is used to assess whether a stock has created value and how it has responded to market events (Nikkinen et al., pp. 150–151). In the context of this thesis, return measurement is essential for identifying market reactions to green bond announcements, where short-term abnormal returns are observed using event study methodology (Campbell et al., 1997, p. 10).

The total return of a stock over a single period is typically expressed as:

$$R_t = \frac{P_t - P_{t-1} + D_t}{P_{t-1}}, \quad (2)$$

where,

R_t = Total return at time t

P_t = Stock price at the end of the period

P_{t-1} = Stock price at the beginning of the period

D_t = Dividend paid during the period (Bodie et al., 2018, p. 401).

This formula 2 captures the combined effect of capital appreciation and income from dividends. Dividend income is especially relevant when analyzing companies with stable payout policies, and the dividend yield can be used to compare the income return across different stocks (Brealey et al., 2020, p. 88).

In financial econometrics and academic studies, particularly those involving short-term price movements, logarithmic returns are often preferred due to their statistical properties. The continuously compounded return is defined as:

$$r_t = \ln \left(\frac{P_t}{P_{t-1}} \right), \quad (3)$$

where,

r_t = Logarithmic return

P_t = Stock price at the end of the period

P_{t-1} = Stock price at the beginning of the period (Brooks, 2019, p. 67).

Log returns are time-additive and normally distributed under standard market assumptions, which makes them particularly suitable for modeling purposes. According to Strong (2003, p. 4), using log returns also facilitates more accurate aggregation over multiple periods, which is often needed in event studies.

This thesis applies daily log returns when analyzing short-term market responses to green bond issuance announcements. Using daily data allows for capturing immediate market reactions and detecting abnormal returns around event dates (MacKinlay, 1997, p. 13). This is consistent with the efficient market hypothesis, which assumes that stock prices adjust quickly to new information (Fama, 1970).

4.2 Stock valuation methods

The price of a stock reflects the present value of its expected future cash flows, most commonly in the form of dividends. Stock valuation models provide a theoretical framework for determining whether a stock is fairly priced in relation to its expected profitability and risk. In fundamental analysis, the most widely used valuation approach is the dividend discount model, which assumes that investors base their valuation on anticipated future dividend payments (Nikkinen et al., 2002, p. 150).

The most common framework for valuing dividend-paying stocks is the Dividend Discount Model (DDM). It assumes that the current stock price equals the sum of all future dividends, discounted at the investor's required rate of return. The general form of the DDM is (Nikkinen et al., 2002, p. 150):

$$P_0 = \sum_{t=1}^{\infty} \frac{D_t}{(1+r)^t} \quad (4)$$

where,

P_0 = Current stock price

r = Required rate of return

D_t = Future dividends

t = Time in years (Nikkinen et al., 2002, p. 150).

In cases where dividends are assumed to remain constant, the model simplifies into a zero-growth dividend model (Knüpfer & Puttonen, 2018, pp. 96–97):

$$P_0 = \frac{D_1}{r}. \quad (5)$$

If dividends are expected to grow at a constant rate, the model further simplifies into the Gordon Growth Model (GGM):

$$P_0 = \frac{D_1}{r-g}, \quad (6)$$

where,

g = Constant dividend growth rate (Knüpfer & Puttonen, 2018, pp. 96–97).

Dividend-based models are particularly useful for valuing stable, dividend-paying firms. However, they are less effective when applied to companies that do not distribute dividends or have irregular payout policies. In such cases, models based on free cash flows, such as the Discounted Cash Flow (DCF) approach, are more appropriate (Brealey et al., 2020, pp. 104–106). Stock prices are sensitive to changes in growth expectations, interest rates, and perceived risk. As such, even small changes in projected cash flows or required returns can significantly impact the theoretical valuation. This is particularly important in event studies, where investor reactions to new information such as a green bond issuance may quickly alter market expectations (Campbell et al., 1997, p. 12).

4.3 Modern portfolio theory

Modern Portfolio Theory (MPT), developed by Harry Markowitz in 1952, is one of the cornerstones of modern financial thought. The theory introduced a systematic approach to portfolio construction based on the idea that risk can be reduced through diversification. According to Markowitz (1952), investors can improve their risk-return trade-off by combining assets that do not move perfectly in tandem. This insight challenged the earlier focus on selecting individual securities in isolation and shifted attention toward optimizing the performance of the portfolio as a whole.

The central objective of MPT is to help investors construct portfolios that maximize expected return for a given level of risk or, alternatively, minimize risk for a given level of return. This trade-off is visually represented by the efficient frontier, which defines the set of portfolios that offer the highest possible return at each risk level. Portfolios lying below the efficient frontier are considered suboptimal because they deliver lower returns for the same amount of risk. The final portfolio choice depends on the investor's risk tolerance, which is often represented using utility functions or indifference curves (Bodie et al., 2018, pp. 208–210).

A key contribution of MPT is the understanding that portfolio risk is not simply the sum of individual asset volatilities. Instead, it depends on how asset returns move in relation to each other. If the returns of different assets are imperfectly correlated, the overall portfolio volatility can be reduced, even if the individual assets are risky. This principle forms the basis of diversification and remains highly relevant in both academic research and practical investment strategies (Elton et al., 2014, pp. 136–137).

While MPT has been highly influential, it also has its limitations. The model assumes that investors behave rationally, asset returns are normally distributed, and parameters such as expected returns, variances, and covariances are known and stable. These assumptions may not hold in real-world markets, where investor behavior can be affected by emotions, and returns can exhibit skewness or fat tails (Elton et al., 2014, pp. 145–146). In addition, estimating future return distributions with accuracy is inherently difficult, which can affect the practical applicability of the model.

Despite these challenges, MPT continues to provide a fundamental framework for portfolio management. It also serves as the theoretical foundation for later models, most notably the Capital Asset Pricing Model (CAPM), which builds on MPT's risk-return logic but incorporates market-wide factors and equilibrium pricing. As such, MPT remains an essential part of financial theory and a relevant reference point for understanding investor behavior and asset allocation.

4.4 Capital asset pricing model

The Capital Asset Pricing Model (CAPM) is a widely used model for estimating the expected return of a financial asset based on its exposure to market risk. The model was developed by Sharpe (1964), Lintner (1965), and Mossin (1966), and it builds on Modern Portfolio Theory by formalizing the relationship between systematic risk and expected return. CAPM assumes that investors are rational, risk-averse, and operate in a frictionless market with homogeneous expectations. According to the model, the return on an asset depends on the time value of money and the compensation for taking on additional risk. This relationship is illustrated by the Security Market Line (SML), which describes the expected return of a security as a function of its sensitivity to market movements, measured by beta (Bodie et al., p. 280–282).

Beta (β) represents the responsiveness of an individual asset's returns to changes in the market portfolio. A beta greater than one indicates higher volatility than the market, while a beta less than one implies lower sensitivity. This measure is central to CAPM's role in asset pricing, as it quantifies systematic risk that cannot be eliminated through diversification (Elton et al., 2014, p. 287).

The expected return of a security in the CAPM framework is given by:

$$E(R_i) = R_f + \beta_i [E(R_m) - R_f], \quad (7)$$

where,

$E(R_i)$ = Expected return of the asset

R_f = Risk-free rate

β_i = Beta of the asset

$E(R_m)$ = Expected return of the market portfolio (Bodie et al., 2018, p. 282).

While CAPM has become a standard tool for estimating the cost of equity and evaluating risk-adjusted returns, empirical studies have raised concerns about its assumptions and explanatory power. Fama and French (2004) argue that the model's reliance on a single

market factor is insufficient to capture the full variation in asset returns. They propose additional factors, such as company size and book-to-market value, to improve return predictions. Despite its limitations, CAPM continues to serve as a useful benchmark in financial analysis, capital budgeting, and event studies. It offers a straightforward way to quantify the trade-off between risk and return using a market-based approach.

4.5 Arbitrage pricing theory

The Arbitrage Pricing Theory (APT) was introduced by Stephen Ross in 1976 as a more flexible alternative to the Capital Asset Pricing Model (CAPM). While CAPM assumes that a single market risk factor explains the variation in asset returns, APT allows for multiple sources of systematic risk to influence expected returns (Ross, 1976). This multifactor structure makes the model especially useful in explaining asset pricing in complex or volatile environments.

APT assumes that the return on a financial asset can be modeled as a linear function of several macroeconomic or firm-specific risk factors. These can include variables such as interest rate movements, inflation, GDP growth, exchange rates, or industrial production. Each factor contributes to the expected return through a sensitivity coefficient known as a factor loading, and each has its own risk premium (Elton et al., 2014, pp. 311–313). The idea is that investors should be compensated for exposure to each of these systematic risks, depending on how sensitive the asset is to changes in those factors.

The core logic of APT relies on the absence of arbitrage in efficient markets. If two assets or portfolios are expected to deliver the same future payoffs but are priced differently, arbitrageurs would exploit this price difference by buying the underpriced asset and selling the overpriced one. Their actions would continue until the price discrepancy disappears, thereby restoring market equilibrium. This principle allows APT to generate asset pricing predictions without relying on the assumption of a well-defined market portfolio, which is a key limitation of CAPM in real-world applications (Bodie et al., 2018, p. 308).

One of the main strengths of APT is its flexibility. Since it does not require a specific benchmark portfolio, the model can be adapted to different investment contexts by selecting appropriate risk factors. This flexibility has made APT particularly useful in empirical finance, where researchers often tailor the factor set based on the market being studied or the assets being analyzed. In practice, APT has influenced the development of widely used multifactor models, including the Fama–French three- and five-factor models, which aim to improve the explanatory power of traditional asset pricing tools.

Despite these strengths, APT also has its limitations. The theory does not specify which risk factors should be included in the model or how many are relevant. This creates challenges in empirical testing, as different studies may use different factor sets and produce inconsistent results (Strong, 2003, p. 358). Additionally, identifying and measuring the correct factors often depends on data availability and economic assumptions, which can limit the model's practical reliability across time and market environments.

In the context of this thesis, APT is relevant because it provides a framework for understanding how multiple sources of risk, including environmental and regulatory factors, may influence stock returns. While not often applied directly in green bond event studies, the theory supports the idea that markets may react to complex information beyond just market-wide risk, such as a firm's sustainability profile or its exposure to green finance trends.

4.6 Market efficiency and information asymmetry

Market efficiency describes how well asset prices reflect available information. According to the Efficient Market Hypothesis (EMH), introduced by Fama (1970), markets are efficient when securities trade at prices that fully incorporate known information. EMH is commonly divided into three forms: weak, semi-strong, and strong. The weak form suggests that past price movements cannot be used to predict future performance. The semi-strong form assumes that all publicly available information is already reflected in

stock prices, while the strong form states that prices incorporate all information, including both public and private (Bodie et al., 2018, pp. 360–362).

In an efficient market, investors should not earn consistently abnormal returns using publicly available information. This principle is especially relevant in event studies, which seek to isolate how new information affects stock prices. If markets are semi-strong form efficient, the stock price should adjust quickly to announcements such as the issuance of a green bond (Campbell et al., 1997, p. 10). Information asymmetry arises when one party has access to more or better information than the other. In capital markets, this usually refers to the advantage that corporate insiders may hold over external investors. When information is unevenly distributed, it can lead to suboptimal pricing, volatility, or misallocation of capital. In the case of green bonds, asymmetry may occur if issuers fail to disclose sufficient details about how the proceeds will be used, raising concerns about greenwashing and reducing investor trust (Healy & Palepu, 2001).

To address this issue, companies often adopt transparency measures such as third-party verification, impact reporting, and adherence to frameworks like the Green Bond Principles. These actions help reduce uncertainty, improve information flow, and increase the credibility of the bond offering. In event studies, minimizing information asymmetry is important to ensure that observed price movements reflect genuine investor reactions rather than speculation or confusion (Elton et al., 2014, pp. 476–477).

5 Literature review

This chapter reviews existing academic literature on green bonds and their relationship with firm value and investor behavior. The aim is to establish a foundation for understanding how financial markets interpret environmental financing instruments and how such interpretations may influence stock prices. The review is organized into three themes: general research on green bonds and their market role, the connection between corporate environmental performance and firm value, and finally, empirical studies focused specifically on stock price reactions to green bond announcements.

5.1 Academic perspectives on green bonds

Green bonds have attracted growing academic attention as financial instruments that aim to connect capital markets with environmental objectives. The literature has evolved rapidly, examining green bonds from multiple angles, including market development, pricing behavior, investor preferences, and associated risks such as greenwashing. These perspectives offer a valuable foundation for analyzing how green bonds are perceived by financial markets and how they may affect firm value.

One area of focus in the literature is the structure and development of green bond markets. Li et al. (2022) present a comparative study of the Chinese and U.S. markets, highlighting how policy environments shape the growth trajectory of green finance. In the United States, private sector initiatives have played a central role, whereas in China, the market has expanded through strong government involvement and regulation. The study underscores the importance of institutional support, as well as the challenges in ensuring cross-border consistency in standards and definitions. Bhutta et al. (2022) add a broader policy perspective by examining how green bonds can finance projects aligned with the UN Sustainable Development Goals. They emphasize that successful market development depends on both credibility and global coordination.

Another frequently discussed topic is the pricing behavior of green bonds. Many studies point to a so-called “greenium,” or green bond premium, meaning that green bonds often carry lower yields compared to similar conventional bonds. MacAskill et al. (2021), in a comprehensive literature review, find that a premium typically exists in both primary and secondary markets, although its size varies by issuer and region. The authors identify issuer reputation, third-party verification, and environmental reporting transparency as key drivers behind this effect. Zerbib (2019) supports these findings with empirical evidence, reporting a small but statistically significant yield advantage for green bonds, which may reflect investors' growing interest in sustainability-oriented assets.

In addition to pricing, the literature discusses the signaling function of green bonds. Tang and Zhang (2020) investigate market reactions to green bond announcements across 28 countries. They find positive abnormal stock returns, especially for firms with strong ESG performance. The authors interpret green bond issuance as a corporate signal that enhances firm reputation and attracts investors with sustainability mandates. Flammer (2021) contributes to this discussion by showing that certified green bonds elicit stronger market responses than uncertified ones, reinforcing the importance of external validation in establishing credibility.

Despite these positive trends, the rapid growth of the green bond market has raised concerns about greenwashing. Some issuers may exaggerate the environmental benefits of their projects to gain investor attention or meet regulatory expectations. Xu et al. (2022) examine this issue in the Chinese market and find that investors respond to weak or questionable environmental claims by demanding higher yields. However, they also show that third-party certification can reduce credit spreads and restore investor confidence, underlining the role of external assurance in mitigating greenwashing risk.

5.2 Environmental responsibility and shareholder value

The relationship between a company's environmental performance and its market valuation has been a subject of extensive academic research. While earlier views often framed environmental actions and financial performance as opposing objectives, more recent studies argue that corporate responsibility can support shareholder value. This shift reflects a growing understanding that environmental factors are embedded in firm-level risk assessments, operational efficiency, and investor expectations.

One of the earliest empirical contributions in this area comes from Shane and Spicer (1983), who analyzed how financial markets reacted to firms' pollution control performance. Their findings revealed a negative relationship between stock prices and pollution intensity, especially for companies with inadequate environmental controls. In contrast, firms that had stronger environmental systems experienced less severe valuation penalties. These results suggest that investors may interpret poor environmental performance as a risk factor that undermines long-term value. Hamilton (1995) further developed this idea by focusing on how public visibility influences market reactions to environmental disclosures. His analysis of stock price movements following the U.S. Environmental Protection Agency's Toxics Release Inventory found that firms suffered significant valuation declines when pollution data became public, particularly if the events attracted media coverage. The study highlighted the amplifying effect of transparency and public awareness on the financial consequences of environmental misconduct.

Later research emphasized that capital markets respond to both negative and positive environmental news. Klassen and McLaughlin (1996) examined how firms were affected by environmental awards and crises. Their study showed that firms announcing environmental achievements experienced positive abnormal stock returns, while those associated with environmental accidents saw a decline in market value. This dual effect suggests that markets reward firms that demonstrate credible environmental leadership and penalize those that damage their environmental reputation. Flammer (2013) expanded the scope by exploring investor reactions to a wide range of environmentally

relevant corporate events. She found that financial markets consistently responded positively to initiatives promoting sustainability, especially when these efforts were made public. Harmful environmental behavior, on the other hand, resulted in swift and negative stock price adjustments. These findings point to a growing integration of environmental concerns in investor decision-making.

Krüger (2015) added nuance by showing that capital markets react more strongly to negative environmental events than to positive ones. His research demonstrated that environmental controversies, particularly those involving regulatory violations or unmet stakeholder expectations, led to a more pronounced decline in stock prices. This asymmetrical pattern implies that environmental irresponsibility poses both reputational and financial risk. A broader economic perspective is offered by Weidenbaum et al. (1997), who challenged the idea that environmental responsibility is a trade-off with profitability. Instead, they argued that ecological behavior can align with financial goals by improving internal efficiency, reducing regulatory pressure, and building investor confidence. This argument supports the idea that sustainability efforts are not only ethically motivated but also strategically valuable.

5.3 Stock market reactions to green bond announcements

In recent years, a growing body of empirical research has examined the relationship between green bond announcements and stock market performance. These studies have primarily used event study methodology to isolate the effect of such announcements on firm value, measured through cumulative abnormal returns (CARs). The results generally suggest that green bond issuance is positively received by investors, although outcomes vary depending on certification status, firm characteristics, and regional factors.

Flammer (2021) presents one of the most comprehensive global studies on this topic. Her dataset includes nearly 1,200 green bond issuances by 400 firms worldwide. The results show a statistically significant CAR of 0.49 percent in the [-5, +10] day event

window. Notably, the study finds that certified green bonds lead to stronger positive market reactions compared to non-certified ones. According to Flammer (2021), this highlights how external validation strengthens the credibility of green bond announcements and signals a firm's genuine commitment to environmental goals. In addition, she observes long-term benefits such as improved environmental performance and a shift in equity ownership toward sustainability-focused investors.

Tang and Zhang (2020) also contribute to the global evidence, analyzing 1,510 green bond announcements across multiple countries. Using the Capital Asset Pricing Model (CAPM), they estimate a significant CAR of 1.4 percent over a [-10, +10] day window. The effect is particularly strong for firms with high environmental performance, first-time issuers, and companies based in countries with more stringent environmental regulations. Their findings support the idea that green bond issuance acts as a strategic signal of environmental responsibility, especially when backed by regulatory frameworks and credible corporate behavior.

Region-specific studies offer additional insights into investor reactions. Wang et al. (2020) focus on the Chinese market and find significant positive CARs in the [-3, +3] and [-10, +10] windows for 159 green bond announcements. The study highlights corporate social responsibility (CSR) as a moderating factor, showing that firms with stronger CSR profiles enjoy more favorable market responses. This indicates that green bond announcements are more effective when they align with an established track record of environmental responsibility. Baulkaran (2019) narrows the focus to Europe and reports statistically significant abnormal returns following green bond announcements among publicly listed companies. The peak CAR of 1.48 percent is observed in the [-10, +10] window. The study suggests that investors interpret green bond issuance not only as a financing decision but also as a strategic move to reduce climate-related risks and appeal to long-term investors.

While the majority of studies point to a positive market reaction, some offer a more cautious view. Lebellet et al. (2020) analyze 475 international green bond announcements and find negative CARs in narrower windows such as $[0, +1]$ and $[-1, +1]$. Their results suggest that investors in developed markets may react skeptically, particularly when the bonds lack transparency or third-party certification. Interestingly, they find that green bond announcements in emerging markets lead to more favorable responses, possibly due to the stronger signaling effect in less mature regulatory environments. Xi and Jing (2022) further explore the Chinese market using both CAPM and the Fama–French five-factor model. Their findings show that while the short-term reaction to first-time green bond announcements is modest, subsequent issuances produce more substantial positive effects. The authors argue that investors gain confidence as firms build a consistent record of engagement in green finance, which reinforces the signaling value of each new issuance.

6 Data

In this chapter, the data used in the study is presented. First, the green bond data collection process is described, including the filtering criteria and final sample formation. Second, the data limitations encountered during the data collection process are discussed. Third, the final dataset is summarized with descriptive statistics related to the green bond issuances and issuing firms. Then, the variables used in the regression model are introduced, and finally, descriptive statistics of the selected variables are presented.

6.1 The green bond data

This section presents the dataset used in the thesis, including origin, scope, and the main variables collected. The green bond data used in this study has been collected from the Bloomberg database and includes green bonds issued by publicly listed non-financial corporate entities incorporated in the Nordic countries: Finland, Sweden, Norway, Denmark, and Iceland. The dataset covers the period from November 2017 to June 2025, which reflects the active years of corporate green bond issuance in the region. The initial dataset includes all instruments classified as green bonds by Bloomberg. To ensure comparability, only bonds denominated in Nordic currencies (EUR, SEK, NOK, DKK, and ISK) were retained. The sample covers both first-time and subsequent green bond announcements, which allows testing whether the market reaction differs between initial and repeated issuances.

From Bloomberg, detailed information was collected on both bonds and their issues. For each green bond, the dataset includes the issuer name and ticker, announcement date, issue date, amount issued, maturity, coupon rate, callable feature, and whether the bond was the firm's first green bond. Issuer-level information covers country of incorporation, industry classification based on Bloomberg Industry Classification Standard (BICS), credit ratings from S&P, ESG disclosure scores, and selected accounting variables such as total assets, liabilities and return on assets (ROA). Financial variables are drawn from the fiscal

year preceding the bond issuance to ensure consistency in measurement. In addition to bond and firm-level data, stock return data and relevant market indices were obtained from Bloomberg. Daily stock price data was retrieved for each issuer to compute abnormal returns around the announcement dates. Country-specific stock indices were used as benchmarks to control market-wide movements.

6.2 Data limitations

This study focuses on green bond announcements by publicly listed non-financial companies in the Nordic countries. The aim was to include all five Nordic countries—Finland, Sweden, Norway, Denmark and Iceland. However, the final dataset includes companies from four countries, as no eligible corporate green bonds issued in Iceland could be identified within the sample period. This reflects the relatively limited development of Iceland's corporate bond market in comparison to the more active green financing environments in the other Nordic countries.

The sample includes green bonds announced between November 2017 and June 2025. Although Bloomberg records green bond activity from earlier years, the first corporate green bond issued by a listed Nordic firm did not appear until late 2017. Therefore, this starting point reflects the actual beginning of green bond issuance activity within the defined scope. The end of the sample period is determined by the date of data collection. Some of the most recent announcements from 2025 were included to provide as comprehensive a view as possible of recent market activity. To ensure consistency and comparability, only green bonds issued by non-financial corporates were included. Financial institutions were excluded because their green bond proceeds are often used to finance external lending portfolios rather than internal sustainability investments. This structural difference in how proceeds are applied could affect investor responses and reduce the interpretability of the results. The exclusion of financials is also supported by previous research on corporate green bonds (Fatica et al., 2021; Gilchrist et al., 2021).

Only companies with publicly listed equity were included, as the event study method requires access to reliable and complete stock price data. Furthermore, firms were only retained in the sample if they had at least 252 trading days of return data prior to the green bond announcement. This allows for the use of a 200-day estimation window, which is commonly applied in financial event studies (Flammer, 2021). In addition, the availability of market index data for the country of incorporation was required for all firms to calculate abnormal returns. To minimize potential confounding effects, all green bond announcements were manually reviewed for overlapping major corporate events around the announcement date. If significant events such as earnings releases, mergers and acquisitions, or CEO changes occurred within the [-10, 10] or [-5, 10] event windows, the observations were excluded from the final dataset (Tang & Zhang, 2020).

Both first-time and subsequent green bond announcements were retained in the sample to allow for comparison between initial issuances and follow-up announcements. This design supports the testing of differences in market reactions between the two, as highlighted in earlier literature (Flammer, 2021; Lebellet et al., 2020). In cases where multiple green bonds were issued by the same firm on the same day, they were treated as one announcement. If the same firm issued green bonds on different dates, each was included as a separate event.

Some limitations relate to data availability. Although the data was primarily retrieved from Bloomberg, firm-level information such as credit ratings and ESG disclosure scores was not available for every issuer. Consequently, the number of usable observations in the regression analysis is lower for these variables, with 70 observations for credit ratings and 97 for ESG scores. This does not, however, affect the event study sample or the descriptive analysis. Private placements were not excluded, since the main interest of this study is on the market's reaction to the announcement of a green bond. As all firms in the sample are publicly listed, their announcements are expected to be visible to investors and thus meaningful from a market signaling perspective.

6.3 Final dataset

The final dataset includes 101 green bond announcements issued by 47 publicly listed non-financial companies in the Nordic region, with a total issuance volume of 26 billion euros. The sample covers both first-time and subsequent issuances. No qualifying green bond issuance by listed non-financial companies was identified from Iceland within the sample period.

Green bond issuance is distributed across multiple industries, with the industrials sector being the most active. A total of 52 green bonds (51.5%) were issued by companies in this sector, amounting to 9.01 billion euros, or 35.3% of the total volume. This result is in line with expectations, as industrial firms typically engage in large-scale projects such as infrastructure, logistics, and manufacturing upgrades, many of which are eligible for green financing. The materials sector accounts for 15 bonds (14.9%) and 4.13 billion euros (16.2%), while consumer discretionary follows with 14 bonds (13.9%) and 2.67 billion euros (10.5%). Although the energy sector accounts for only 14 bonds (13.9%), it represents the second-largest issuance amount of 7.72 billion euros, or 30.2% of the total. This is consistent with the capital-intensive nature of energy transition projects. Smaller volumes and lower activity were observed in the technology, communications, and utilities sectors. Table 2 shows the number of green bond issuances and the corresponding total issued amount for each industry.

Table 2. Number and value of green bond issuances by industry, including percentage shares.

Industry	Amount of GB	Percent	Total issued amount (bn€)	Percent
Industrials	52	51.5%	9.01	35.3%
Materials	15	14.9%	4.13	16.2%
Consumer Discretionary	14	13.9%	2.67	10.5%
Energy	14	13.9%	7.72	30.2%
Communications	4	4.0%	1.47	5.8%
Technology	1	1.0%	0.50	2.0%

Utilities	1	1.0%	0.05	0.2%
Total	101	100%	25.56	100%

Table 3 presents the distribution of green bond issuances by country, based on the number of announcements and the total volume issued. From a geographical perspective, Sweden leads in terms of the number of green bond announcements, with 45 issuances (44.6%), representing 7.31 billion euros or 28.6% of the total volume. Finland, on the other hand, has the highest total issued amount, reaching 8.47 billion euros (33.1%) from 21 bonds (20.8%). This indicates that Finnish firms tend to issue larger-sized green bonds compared to their Swedish counterparts. Denmark issued 12 bonds (11.9%) with a total volume of 6.55 billion euros (25.6%), while Norway issued 23 bonds (22.8%) totaling 3.23 billion euros, or 12.6% of the dataset's volume. These figures highlight that while Sweden is the most active in terms of issuance count, Finland dominates in total capital raised through green bonds.

Table 3. Number and value of green bond issuances by country, including percentage shares.

Country	Amount of GB	Percent	Total issued amount (bn€)	Percent
Sweden	45	44.6%	7.31	28.6%
Norway	23	22.8%	3.23	12.6%
Finland	21	20.8%	8.47	33.1%
Denmark	12	11.9%	6.55	25.6%
Total	101	100%	25.56	100%

Issuance activity has also increased significantly over time. While only one bond was issued in 2017, volumes and announcements have grown steadily since. The most active year was 2023, with 40 green bonds issued (27.8%) amounting to 8.95 billion euros (28.0%). 2022 followed with 24 issuances and the largest total volume of 6.59 billion euros, corresponding to 20.6% of the sample's issuance amount. This development reflects broader regulatory trends, such as the adoption of the EU Taxonomy and Green

Bond Standards, as well as increased investor demand for ESG-aligned instruments. Table 4 provides an overview of the development of green bond issuance by year.

Table 4. Annual distribution of green bond issuances, including number of bonds and total issued amount (bn€).

Year	Amount of GB	Total issued amount (bn€)
2017	1	0.75
2018	0	0.00
2019	3	0.92
2020	10	2.98
2021	13	3.27
2022	15	4.70
2023	21	4.65
2024	24	4.75
2025	14	3.54
Total	101	25.56

6.4 Variables in the regression model

This study applies a regression framework to analyze the determinants of stock market reactions to green bond announcements. In the model, cumulative abnormal returns (CARs) are used as the dependent variable, while the explanatory variables are divided into two categories: characteristics of the issued green bonds and company-specific characteristics of the issuing firms. This structure allows the analysis to capture both bond-level and firm-level factors that may influence investor reactions.

6.4.1 Dependent variables

The dependent variable in this study is the cumulative abnormal return (CAR), which measures the stock market reaction to the announcement of a green bond issuance.

CARs are obtained by aggregating abnormal returns (ARs) across different event windows around the announcement date. The event study methodology follows earlier literature, where the announcement effect of green bond issuances is captured within short-term and medium-term windows (Flammer, 2021; Tang & Zhang, 2020; Wang et al., 2020).

To examine the robustness of market reactions, four event windows are applied: [-10,10], [-5,5], [-1,1], and [0,1]. These windows are commonly used in prior studies on green bond issuances and conventional bond offerings, as they allow detection of both immediate and slightly delayed stock price responses (Flammer, 2021; Tang & Zhang, 2020; Lebellet et al., 2020). The [-10,10] and [-5,5] windows capture broader investor reactions and potential information leakage prior to the announcement, while the shorter [-1,1] and [0,1] windows focus on the immediate market response.

Descriptive statistics of the CARs are presented in Table 5. The mean CARs are close to zero for all windows, ranging from -0.6% in the [-10,10] window to $+0.1\%$ in the [0,1] window. This indicates that, on average, stock price reactions to green bond announcements are modest. The largest variation appears in the [-10,10] window, where CARs range from -33.1% to $+24.9\%$, reflecting that individual firms may experience substantial differences in market responses. In comparison, the [0,1] window shows a much narrower range of -8.9% to $+6.8\%$, suggesting more concentrated movements around the actual announcement date.

The distributional characteristics also differ between windows. For instance, the [-1,1] window exhibits a negative skewness of -0.9 , implying that negative reactions are more common than positive ones in the immediate days surrounding the announcement. Furthermore, the Jarque-Bera test statistics are significant at the 1% level for all windows, which indicates that the CAR distributions deviate from normality. This observation is consistent with prior event study findings where stock price reactions often display non-normal characteristics (Campbell et al., 1997).

Table 5. Descriptive statistics of cumulative abnormal returns (CARs) across four event windows.

	CAR [-10,10]	CAR [-5,5]	CAR [-1,1]	CAR [0,1]
Mean	-0.006	0.000	-0.002	0.001
Median	-0.005	0.003	0.001	0.005
Maximum	0.249	0.199	0.073	0.068
Minimum	-0.331	-0.180	-0.119	-0.089
Std. Dev.	0.081	0.062	0.029	0.022
Skewness	-0.310	0.205	-0.917	-0.635
Kurtosis	3.060	1.485	3.165	2.424
Jarque-Bera Probability	41.025 0.000000	9.990 0.006771	56.304 0.000000	31.513 0.000000
Sum	-0.627	-0.019	-0.207	0.061
Sum Sq. Dev.	0.660	0.388	0.082	0.049
Observations	101	101	101	101

6.4.2 Explanatory variables

The explanatory variables included in the regression model are divided into two categories: green bond characteristics and company characteristics. This division allows the analysis to account for both the features of the issued bonds and the underlying attributes of the issuing firms. All variables are defined in line with earlier empirical research on green bond announcements and corporate bond event studies. The 10 explanatory variables used in the regression model are presented in table 6. For each variable, a short definition is provided along with the data source.

Table 6. Explanatory variables used in the regression model, including definitions and data sources.

Variable name	Definition	Source
Amount_issued	Natural logarithm of the green bond issue size (in million euros).	Bloomberg
Coupon	Fixed coupon rate of the green bond.	Bloomberg

D_First_GB	Dummy variable which equals to 1 if the bond is the issuer's first green bond, otherwise equal 0.	Bloomberg
Maturity_years	Time to maturity of the bond in years.	Bloomberg
D_Callable	Dummy variable which equals to 1 if the bond is callable, otherwise equal 0.	Bloomberg
Firm_size	Natural logarithm of the total assets of the company (in million euros).	Bloomberg
Leverage	The company's total debt divided by total assets	Bloomberg
ROA	The company's net income divided by total assets	Bloomberg
S&P_Rating	S&P credit bond rating (20 for AAA, 19 for AA+, ... 2 for CC and 1 for C).	Bloomberg
ESG_Score	Company's ESG disclosure score from Bloomberg (scale 0-100)	Bloomberg

When selecting the explanatory variables for the regression model, a bottom-up approach was used. Starting with two variables, explain the characteristics of the green bond. The starting variables were: "issued amount" and the "first green bond" to determine if the two factors have a strong effect on the cumulative abnormal returns when not considering any other variables. In the final regression, all 10 variables are included in the model. The following subchapters present the included explanatory variables in more detail. The result of the regression model is presented in chapter 8.2.

Amount_issued

The variable *Amount_issued* measures the size of the green bond issue, expressed as the natural logarithm of the amount in million euros to reduce skewness and account for outliers. Larger issues may carry stronger signaling value and visibility. Flammer (2021) finds that bond size can influence investor reactions around announcements, while Wang et al. (2020) show that issue size enhances credibility in environmental finance contexts.

D_First_GB

The dummy variable *D_First_GB* equals one if the bond is the first green bond issued by a company and zero otherwise. Flammer (2021) shows that first-time issuances can act as a strong signal of a firm's sustainability commitment, which may strengthen investor confidence. Accordingly, this variable is expected to be positively related to CARs.

Coupon

The variable *Coupon* represents the fixed interest rate attached to the green bond. Coupon levels reflect both the issuer's risk profile and the market conditions at issuance (Fabozzi, 2012). Higher coupon rates generally signal greater perceived credit risk, which may lead to more cautious investor reactions (Hull, 2018).

Maturity_years

The variable *Maturity_years* measures the length of the bond in years. Longer maturities generally imply higher uncertainty and greater risk exposure, while shorter maturities are associated with lower risk (Bodie et al., 2018). Prior literature finds mixed evidence on how bond maturity influences stock market reactions (Tang & Zhang, 2020).

D_Callable

The dummy variable *D_Callable* equals one if the bond is callable and zero otherwise. Callable bonds provide issuers with flexibility to redeem debt before maturity but may increase reinvestment risk for investors (Fabozzi, 2012). Prior studies suggest that the market reaction to callable bonds depends on the broader market environment and investor expectations (Wang et al., 2020).

Firm_size

Firm_size is measured as the natural logarithm of the company's total assets in million euros from the fiscal year prior to the bond issuance (Bodie et al., 2018). Larger companies often benefit from greater visibility and financial stability, which can enhance

investor confidence (Choudhry, 2019). Previous studies show that firm size is positively associated with market reactions to financing decisions (Flammer, 2021; Wang et al., 2020).

Leverage

Leverage is calculated as the ratio of total debt to total assets (Bodie et al., 2018). A higher leverage ratio implies greater financial risk and higher obligations, which may negatively affect investor perceptions. Prior research shows that leverage can influence stock market reactions to bond issuances (Lebelle et al., 2020).

ROA

ROA (Return on Assets) measures company profitability, defined as net income divided by total assets from the year prior to issuance (Bodie et al., 2018). ROA is a widely used indicator of performance and efficiency, and prior studies find that profitability is often positively related to market valuation effects (Flammer, 2021).

S&P_Rating

The S&P_Rating variable reflects the long-term issuer credit rating, transformed into a numeric scale from 1 (lowest) to 20 (highest). Credit ratings convey information on a company's creditworthiness and capacity to meet financial obligations (Fabozzi, 2012). A higher rating is therefore expected to generate a more favorable investor reaction (Tang & Zhang, 2020).

ESG_Score

The ESG_Score is taken from Bloomberg and measures company performance across environmental, social, and governance dimensions on a scale from 0 to 100. A higher ESG score reflects stronger sustainability practices, which can enhance investor trust. Prior studies show that firms with higher ESG ratings tend to receive more favorable market responses when issuing green bonds (Flammer, 2021).

In addition to these variables, the analysis also considers whether abnormal returns differ systematically across countries or industries. For this purpose, dummy variables were created for each country (Finland, Norway, Denmark) and for each industry sector (Materials, Consumer Discretionary, Energy, Communications, Technology, and Utilities), with Sweden and Industrials serving as the baseline categories. These variables are included in supplementary regressions presented in Chapter 8.3.

6.5 Descriptive statistics for model variables

This section provides an overview of the explanatory variables included in the regression analysis. The variables are grouped into two categories: green bond characteristics and company characteristics. For each variable, descriptive statistics such as the mean, median, standard deviation, minimum, maximum, skewness, and kurtosis are reported. Amount issued is expressed as the natural logarithm of millions of euros, firm size as the natural logarithm of the company's total assets, leverage as the debt-to-assets ratio, ROA in percent, issuer rating as a rank from 1 to 20 where AAA corresponds to 20 and C to 1, and ESG score as a value between 0 and 100.

Table 7 summarizes the descriptive statistics for the green bond characteristics. The average issuance size, measured as the natural logarithm of the issue amount, is 5.02, with values ranging between 2.94 and 6.80. This reflects that the sample includes both relatively small green bond issues and significantly larger ones. The natural logarithm is applied to compress outliers and reduce skewness in the variable distribution. The mean coupon rate is 4.65 %, but the maximum of 13.0% indicates that some issues were priced at relatively high interest levels, reflecting either higher risk or market conditions at the time of issuance. Of the total sample, 47 issuances (46.5%) were first-time green bonds, highlighting that a substantial portion of the dataset captures firms entering the green bond market for the first time.

The maturity of the bonds averages 8.9 years, but the wide standard deviation shows that the sample includes both very short- and very long-term issuances, with the longest exceeding 61 years. Callable bonds are also common in the sample, with 62 issues (61.4%) containing a call option. The Jarque-Bera statistics indicate that several variables depart from normality, consistent with skewed distributions typical in financial datasets.

Table 7. Descriptive statistics of green bond characteristics, including number of issuances, bond features, and distribution measures.

	Amount_issued (m€)	Coupon	D_First_GB	Maturity_years	D_Callable
Mean	5.023	4.646	0.465	8.900	0.614
Median	4.929	4.403	0.000	5.001	1.000
Maximum	6.802	13.000	1.000	61.25	1.000
Minimum	2.936	0.125	0.000	2.189	0.000
Std. Dev.	1.082	2.276	0.501	12.408	0.489
Skewness	-0.038	0.701	0.141	3.350	-0.475
Kurtosis	-1.350	1.417	-2.021	10.044	-1.811
Jarque-Bera Probability	7.695 0.021329	16.724 0.000234	17.515 0.000157	613.461 0.000000	17.594 0.000151
Sum	507.308	469.229	47.000	898.880	62.000
Sum Sq. Dev.	117.069	518.067	25.129	15394.912	23.941
Observations	101	101	101	101	101

Table 8 reports the descriptive statistics for the company-level variables. The average firm size, measured as the natural logarithm of total assets, is 8.59, ranging from 3.04 to 11.22. This indicates that the sample covers both relatively small firms and very large Nordic corporations. The leverage ratio has a mean of 26.4%, with values ranging from 7.7% to 61.1%. The distribution is relatively narrow compared to other variables but still displays non-normal characteristics. Profitability, measured as return on assets (ROA), averages 4.7%, with a minimum of -20.1% and a maximum of 24.0%, highlighting that the dataset includes firms both negative and strongly positive profitability prior to issuance.

The S&P long-term issuer rating variable has a mean of 7.84 on the applied 1-20 scale. However, not all companies in the dataset had credit ratings, resulting in 70 observations for this variable. The ratings range from B+ (the lowest) to A- (the highest), while the average rating corresponds to BBB. Around half of the rated companies fall within the medium investment-grade category between BBB+ and BBB-, reflecting a typical level of credit quality among Nordic corporate bond issuers. The ESG score has a mean of 54.87 on a 0-100 scale, with values ranging between 22.46 and 78.31. Not all companies reported ESG scores, which reduces the number of observations to 97. The range of ESG scores illustrates notable differences in sustainability practices and reporting across Nordic issues.

Table 8. Descriptive statistics of company characteristics, including firm size, leverage, profitability, credit rating, and ESG score.

	Firm_size (m€)	Leverage	ROA	S&P_Rating (1-20)	ESG_Score (1-100)
Mean	8.589	0.264	0.047	7.843	54.870
Median	8.619	0.248	0.047	8.000	56.020
Maximum	11.220	0.611	0.240	11.000	78.310
Minimum	3.035	0.077	-0.201	4.000	22.460
Std. Dev.	1.519	0.127	0.059	2.424	13.541
Skewness	-0.989	0.669	-0.339	-0.031	-0.393
Kurtosis	1.486	-0.315	3.495	-1.681	-0.368
Jarque-Bera Probability	25.743 0.000003	7.959 0.018696	53.353 0.000000	8.255 0.016122	3.049 0.217686
Sum	867.530	26.630	4.780	549.000	5322.400
Sum Sq. Dev.	230.742	1.608	0.349	405.271	17602.580
Observations	101	101	101	70	97

7 Methodology

This chapter presents the empirical methods used in the analysis. First, an event study framework is applied to measure whether green bond announcements generate abnormal stock market reactions. The approach begins with the estimation of expected returns and the calculation of cumulative abnormal returns across different event windows. Second, statistical significance tests are conducted to evaluate whether the observed market reactions differ from zero. Finally, an ordinary least squares (OLS) regression is used to examine how bond- and firm-specific characteristics explain the variation in cumulative abnormal returns.

7.1 Event study

The event study methodology is widely applied in financial research to examine how specific events affect the value of a firm. The method is based on the idea that financial markets react quickly and efficiently to new information, and that the impact of an event can therefore be measured through abnormal stock price movements around the announcement date (MacKinlay, 1997; Campbell et al., 1997). By isolating the stock market reaction to an event from overall market fluctuations, the event study provides an effective tool for analyzing the information content of corporate decisions.

In the context of this thesis, the event of interest is the announcement of a green bond issuance. The event study approach makes it possible to evaluate whether such announcements generate abnormal returns for the issuing firms. Previous studies have applied this methodology to green bonds and other financing decisions to capture short-term changes in firm value (Flammer, 2021; Tang & Zhang, 2020).

The following subsections present the methodological steps in more detail. Section 7.1.1 describes how expected returns are estimated using the market model, while section

7.1.2 explains how abnormal returns are aggregated into cumulative abnormal returns (CARs).

7.1.1 Estimation of expected returns

To analyze the influence of green bond announcements on the stock prices of issuing companies, it is necessary to first determine what the normal return of the stock would have been in the absence of the event. The difference between this expected return and the actual realized return is defined as the abnormal return. Abnormal returns provide a measure of the firm-specific effect of an event after controlling general market movements. This approach has been widely used in financial research and builds on the framework established by early event study literature (Sharpe, 1964; MacKinlay, 1997; Campbell et al., 1997).

The expected returns are estimated using the market model, which assumes a linear relationship between the return of a company's stock and the return of the overall market. The model is expressed as follows (Flammer, 2021):

$$\hat{R}_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_i, \quad (8)$$

where \hat{R}_{it} is the expected return of stock i at time t . R_{mt} is the return of the country-specific market index at time t . α_i is the stock-specific intercept, and β_i measures the sensitivity of the stock return to market movements. The error term ε_i captures unsystematic factors not explained by the model. Both α_i and β_i are estimated individually for each stock using ordinary least squares (OLS).

The abnormal return (AR) is defined as the deviation of the actual observed return from its expected value (MacKinlay, 1997):

$$AR_{it} = R_{it} - \hat{R}_{it}, \quad (9)$$

where R_{it} represents the actual return and \hat{R}_{it} is the expected return of the stock i at time t . The abnormal return therefore reflects the part of the return that cannot be explained by normal market variation and thus represents the stock price reaction to new information (MacKinlay, 1997; Tang & Zhang, 2020).

In line with prior event study research, the model parameters are estimated over an estimation window that precedes the event window. MacKinlay (1997) notes that the estimation period should be long enough to provide reliable parameter estimates but should not overlap with the event itself. Following this guideline, a 200-day estimation window is applied in this thesis, covering the period from $t = -210$ to $t = -11$ relative to the announcement. This length is consistent with recent green bond studies, such as Flammer (2021) and Wang et al. (2020), and ensures sufficient observation while avoiding potential information leakage in the days leading up to the announcement.

The choice of the market index is central to the reliability of the results. Following MacKinlay (1997), the benchmark index should represent the overall market in which the firm operates. Therefore, each company is matched with its domestic index: OMXH Helsinki for Finland, OMX Stockholm for Sweden, Oslo Børs Benchmark Index for Norway, and OMX Copenhagen for Denmark. Using country-specific indices ensures that the estimated abnormal returns reflect firm-specific reactions to the announcement, rather than being influenced by broader international market movements. A similar approach has been applied in recent green bond event studies by Flammer (2021) and Tang and Zhang (2020).

7.1.2 Cumulative abnormal returns

Once the abnormal returns are calculated, they are aggregated over a chosen time window to capture the total market reaction to the announcement. This measure is referred to as the cumulative abnormal return (CAR). The model is following (MacKinlay, 1997):

$$CAR_{i(T_1 T_2)} = \sum_{T_1}^{T_2} AR_{it}, \quad (10)$$

where T_1 and T_2 represent the start and end date of the event window for the stock i . The use of cumulative abnormal returns allows for an assessment of whether the stock market response occurs primarily on the announcement day or whether it is spread across several days, which can capture effects of information leakage or delayed investor reactions (Campbell et al., 1997; Flammer, 2021).

To generalize results across firms, the individual CARs are averaged over the sample. The average CAR provides a measure of whether green bond announcements are, on average, associated with abnormal stock market reactions, rather than firm-specific noise. This aggregation is standard practice in event studies (MacKinlay, 1997) and has also been applied in recent green bond research (Flammer, 2021). The average CAR for an event window $[T_1, T_2]$ is calculated as follows:

$$\overline{CAR}_{i(T_1 T_2)} = \frac{1}{N} \sum_{T_1}^{T_2} CAR_i, \quad (11)$$

where CAR_i represents the average abnormal return at the time t and N is the number of events in the sample.

This thesis employs four different event windows to capture both short- and medium-term effects: $[-10,10]$, $[-5,5]$, $[-1,1]$, and $[0,1]$. The wider windows, such as $[-10,10]$, allow for the detection of potential information leakage or gradual adjustments, while shorter windows focus on the immediate market response surrounding the announcement. The selection of these windows follows prior studies on green bond announcements, including Flammer (2021) and Tang and Zhang (2020).

7.2 Significance tests

After calculating cumulative abnormal returns, statistical testing is required to determine whether the observed stock market reactions differ significantly from zero. Event studies typically employ both parametric and non-parametric tests to evaluate significance. The parametric approach assumes that abnormal returns are normally distributed, while non-parametric tests provide robustness when this assumption does not hold (Campbell et al., 1997).

In this thesis, the primary test is the conventional t-test, which evaluates whether the average CAR differs significantly from zero. The test statistic is calculated as follows (MacKinlay, 1997):

$$t = \frac{\overline{CAR}_{T_1 T_2}}{S(\overline{CAR}_{T_1 T_2})}, \quad (12)$$

where $\overline{CAR}_{T_1 T_2}$ is the average cumulative abnormal return across firms for the event window $[T_1, T_2]$, and $S(\overline{CAR}_{T_1 T_2})$ is the standard deviation of the average CAR. The t-test provides an intuitive measure of whether the abnormal returns are statistically significant (MacKinlay, 1997). Although the assumption of normality may not always hold for financial return distributions, previous studies on green bond announcements have also relied on this test to evaluate significance (Flammer, 2021; Tang & Zhang, 2020).

7.3 Regression model

To complement the event study results, a regression analysis is conducted to examine which factors explain variation in cumulative abnormal returns (CARs). The purpose is to test whether bond-specific and company-specific characteristics have a significant impact on stock price reactions following green bond announcements. Ordinary least squares (OLS) regression is applied, which is widely used method in financial event

studies for estimating the relationship between a dependent variable and several independent variables (Brooks, 2019; Lebellet et al., 2020).

The general form of the OLS regression model is:

$$Y_i = \alpha + \beta_1 X_{1i} + \beta_2 X_{2i} + \dots + \beta_k X_{ki} + \varepsilon_i, \quad (13)$$

where Y_i is the dependent variable, α is the intercept, β_k are the estimated coefficients measuring the marginal effect of the explanatory variables X_{ki} , and ε_i is the error term (Lebellet et al, 2020).

The OLS regressions are applied to test how cumulative abnormal returns (CARs) can be explained by the set of explanatory variables. The analysis is conducted both by including all variables in one model and by grouping them into green bond characteristics and company characteristics to examine their separate effects. The regression specification using all variables is presented as follows:

$$\begin{aligned} \overline{CAR}_{it} = & \alpha + \beta_1 Amount_issued_i + \beta_2 Coupon_i + \beta_3 D_First_GB_i \\ & + \beta_4 Maturity_years_i + \beta_5 D_Callable_i + \beta_6 Firm_size_i \\ & + \beta_7 Leverage_i + \beta_8 ROA_i + \beta_9 S\&P_Rating_i + \beta_{10} ESG_Score_i + \varepsilon_i \end{aligned}$$

where,

\overline{CAR}_{it}	The event window.
α	The intercept term.
$Amount_issued$	Natural logarithm of the amount issued given in million euros.
$Coupon$	Coupon rate of the green bond expressed in percentage form.

<i>D_First_GB</i>	Dummy variable where 1 if the issue of the firm's first green bond and 0 otherwise.
<i>Maturity_years</i>	Bond maturity expressed in years.
<i>D_Callable</i>	Dummy variable where 1 if the bond includes a call option and 0 otherwise.
<i>Firm_size</i>	Natural logarithm of the issuer's total assets given in million euros.
<i>Leverage</i>	Ratio between the total debt and total assets of the issuer from the fiscal year prior to the announcement.
<i>ROA</i>	Ratio between net income and total assets of the issuer from the fiscal year prior to the announcement.
<i>S&P_Rating</i>	Issuer's long-term credit rating ranked from 1 (lowest) to 20 (highest).
<i>ESG_Score</i>	ESG disclosure score from Bloomberg ranging from 1 to 100.
ε	The error term.

In addition to the baseline specification, supplementary regressions with country and industry dummies were estimated. These are reported in Chapter 8.3 and provide evidence on whether cumulative abnormal returns differ systematically across geographical or sectoral dimensions.

8 Results

This chapter presents the empirical findings of the study. The results are reported in three parts. First, the outcomes of the event study are presented, focusing on cumulative abnormal returns (CARs) around green bond announcements. The analysis is conducted for four event windows and includes non-parametric significance tests. In addition, the sample is divided into first-time and subsequent announcements to investigate whether market reactions differ between these groups. Second, the regression results are reported to examine whether bond- and firm-specific characteristics explain variation in CARs. Finally, a brief summary of the results is provided to highlight the main findings before moving on to the interpretation and discussion in chapter 9.

8.1 Abnormal returns

To determine whether the announcement of a green bond issuance generates a stock market reaction in the Nordic region, cumulative abnormal returns (CARs) were calculated across four different event windows. As indicated by the descriptive statistics in Chapter 6, the distributions of CARs deviate from normality according to the Jarque–Bera test statistics. Consequently, the Wilcoxon signed-rank test is applied to assess statistical significance, as it does not rely on the assumption of normally distributed data (Lu & White, 2014).

The results for the [-10,10] event window are reported in Table 9. The mean CAR is -0.6 percent, while the median is -0.5 percent. The Wilcoxon signed-rank test shows no statistical significance ($p = 0.48$). This finding indicates that, over a 21-day horizon surrounding the announcement, green bond issuances by Nordic firms do not systematically influence stock prices. The outcome differs from Flammer (2021), who finds significantly positive abnormal returns in a global sample, and from Tang and Zhang (2020), who also report a positive market response. Instead, the Nordic evidence aligns more closely with

the view that developed markets may react less favorably to green bond announcements (Lebelle et al., 2020).

Table 9. Stock market reaction to green bond issuance in the [-10,10] event window, including CARs, Wilcoxon signed-rank test, and median test results.

		CAR [-10,10]
Mean		-0.006
Median		-0.005
Std. Dev.		0.081
Method	Value	Probability
Wilcoxon signed rank	2365.0	0.4758
Median test summary		
Category	Count	Mean rank
Obs. > 0.000000	49	48.2653
Obs. < 0.000000	52	53.5769
Obs. = 0.000000	0	
Observations	101	

For the [-5,5] event window, the results are presented in Table 10. The mean CAR is close to zero, with a median of 0.3 percent. The Wilcoxon signed-rank test again indicates no significance ($p = 0.89$). This suggests that in the shorter horizon surrounding the announcement, investors in Nordic markets neither reward nor penalize issues. Previous studies provide more mixed evidence: Tang and Zhang (2020) and Wang et al. (2020) report significantly positive CARs in similar windows, while other research emphasizes that market reactions can vary depending on certification, issuer characteristics, and market maturity (Baulkaran, 2019).

Table 10. Stock market reaction to green bond issuance in the [-5,5] event window, including CARs, Wilcoxon signed-rank test, and median test results.

		CAR [-5,5]
Mean		0.000
Median		0.003
Std. Dev.		0.062
Method	Value	Probability
Wilcoxon signed rank	2535.0	0.8909
Median test summary		
Category	Count	Mean rank
Obs. > 0.000000	52	48.7500
Obs. < 0.000000	49	53.3878
Obs. = 0.000000	0	
Observations	101	

The results for the [-1,1] event window are displayed in Table 11. The mean CAR is -0.2 percent, with a median of 0.1 percent. The result suggests a slightly negative response, but the Wilcoxon signed-rank test shows no statistical significance ($p = 0.95$). This finding contrasts with studies such as Flammer (2021), who documents a significant short-term positive effect, and Wang et al. (2020), who also observe strong positive reactions in Chinese issuances. Instead, the absence of significance in Nordic markets suggests that announcements may be anticipated or interpreted as routine financial decisions rather than new information.

Table 11. Stock market reaction to green bond issuance in the [-1,1] event window, including CARs, Wilcoxon signed-rank test, and median test results.

		CAR [-1,1]
Mean		-0.002
Median		0.001
Std. Dev.		0.029
Method	Value	Probability
Wilcoxon signed rank	2557.0	0.9500
Median test summary		

Category	Count	Mean rank
Obs. > 0.000000	52	49.1731
Obs. < 0.000000	49	52.9388
Obs. = 0.000000 0	0	
Observations	101	

Finally, the [0,1] event window is examined in Table 12. The mean CAR is 0.1 percent and the median 0.5 percent. The Wilcoxon signed-rank test again provides no evidence of significance ($p = 0.54$). This very short window captures the most immediate reaction, yet the findings remain consistent with the broader results of this study: investors in Nordic markets do not appear to systematically adjust their valuations in response to green bond announcements. While earlier research has highlighted positive market effects in similar windows (Tang & Zhang, 2020; Baulkaran, 2019), the Nordic results suggest a neutral stance.

Table 12. Stock market reaction to green bond issuance in the [0,1] event window, including CARs, Wilcoxon signed-rank test, and median test results.

		CAR [0,1]
Mean		0.001
Median		0.005
Std. Dev.		0.022
Method	Value	Probability
Wilcoxon signed rank	2395.0	0.5409
Median test summary		
Category	Count	Mean rank
Obs. > 0.000000	59	46.7119
Obs. < 0.000000	42	57.0238
Obs. = 0.000000 0	0	
Observations	101	

To further examine market reactions, the sample was divided into first-time green bond announcements and subsequent issuances. The results are reported in Table 13. For first-time issuances, the mean CAR is -2.0 percent in the [-10,10] window, with a Wilcoxon p -

value of 0.080. This indicates a marginally significant negative reaction at the 10 percent level, suggesting that investors may initially perceive the introduction of green bonds as value-reducing, possibly due to concerns about issuance costs or uncertainty about the credibility of the instrument. In contrast, the shorter windows of [-5,5], [-1,1], and [0,1] produce mean CARs close to zero and are not statistically significant (p-values of 0.797, 0.341, and 0.641, respectively). This implies that the immediate market response to the first announcement is muted, and that the observed reaction develops only over a longer horizon.

For subsequent announcements, the mean CARs are close to zero in all event windows (0.6 percent in [-10,10], 0.1 percent in [-5,5], -0.5 percent in [-1,1], and 0.0 percent in [0,1]). None of the Wilcoxon tests show significance (p-values of 0.544, 0.942, 0.210, and 0.773), indicating that repeated issuances are largely anticipated and do not alter investor valuations in a systematic way. Overall, the evidence suggests that only the first announcement of a green bond has the potential to influence stock prices, and even then, the reaction is negative and limited to the longer event window. Subsequent issuances appear to be regarded as routine financing decisions without meaningful informational content for shareholders.

Table 13. CARs for first-time and subsequent green bond announcements across four event windows.

Event Window	First Announcement				Subsequent Announcement			
	[-10,10]	[-5,5]	[-1,1]	[0,1]	[-10,10]	[-5,5]	[-1,1]	[0,1]
<i>Mean CAR</i>	-0.020	-0.002	0.001	0.001	0.006	0.001	-0.005	0.000
<i>Median CAR</i>	-0.018	-0.002	0.006	0.006	0.008	0.004	-0.003	0.003
<i>Wilcoxon (prob.)</i>	0.080	0.797	0.341	0.641	0.544	0.942	0.210	0.773
<i>Skewness</i>	-0.67	0.07	-0.54	-0.09	0.11	0.31	-2.06	-1.60
<i>Kurtosis</i>	4.72	1.15	0.93	0.33	1.33	1.96	8.39	6.44
N	47	47	47	47	54	54	54	54

Taken together, the evidence from Nordic markets suggests that green bond announcements do not produce statistically significant abnormal stock returns in the overall

sample. Based on these findings, the null hypothesis (H_0) — that the value of the share does not react to the announcement of a green bond issuance — cannot be rejected. The results also do not provide support for the hypothesis (H_{1a}) that share prices react positively to green bond announcements, nor for the hypothesis (H_{1b}) that they react negatively. However, the subsample analysis offers partial support for the hypothesis (H_2) that the reaction differs between first-time and subsequent announcements, as the results indicate a marginally significant negative effect for the first announcement in the longer event window, while subsequent announcements do not show a systematic reaction. Overall, these findings imply that in the Nordic context, green bond announcements are not perceived as value-enhancing events but may, in some cases, be interpreted as neutral or even slightly costly financing decisions. To further investigate whether firm- and bond-specific factors explain variation in abnormal returns, regression analyses are conducted and presented in the following section.

8.2 Regression results

The purpose of the regression analysis is to investigate which independent variables can explain the cumulative abnormal returns (CARs) observed around the announcement of green bond issuances. The dependent variables analyzed are CAR [-10,10] and CAR [-1,1], as these event windows were the most relevant in the earlier event study. The regressions are performed as ordinary least squares (OLS) models using Python in Google Colab. For each explanatory variable, the coefficient is reported, and the t-statistic is shown in parentheses. Three regression models are estimated for each event window: Regression 1 includes all explanatory variables, Regression 2 is restricted to firm-specific characteristics, and Regression 3 is limited to bond-specific characteristics.

The results for CAR [-10,10] are reported in Table 14. Across all three regression specifications, no independent variable is statistically significant at conventional levels. For example, firm size, leverage, and return on assets (ROA) do not show explanatory power, and bond-specific factors such as coupon rate, maturity, callable structure, or first-time

issuance also remain insignificant. The adjusted R-squared values are close to zero, indicating that the explanatory variables account for only a very limited share of the variation in long-window abnormal returns. These findings suggest that, in the Nordic context, longer-horizon reactions to green bond announcements are not systematically related to observable issuer or bond characteristics. This result contrasts with prior studies such as Lebellet et al. (2020), who report that leverage is an important driver of market reactions, and Baulkaran (2019), who finds that profitability can positively affect CARs. One possible explanation for the absence of significance is that longer event windows may capture confounding events unrelated to the bond issuance, which weakens the explanatory power of the regressions.

Table 14. Regression results for CARs in the [-10,10] event window with firm- and bond-specific variables.

	Regression 1	Regression 2	Regression 3
Amount_issued	0.0046 (0.340)		0.0021 (0.195)
Coupon	0.0042 (0.752)		0.0045 (1.007)
D_First_GB	-0.0270 (-1.514)		-0.0253 (-1.558)
Maturity_years	-0.0004 (-0.579)		-0.0003 (-0.448)
D_Callable	0.0336 (1.718)		0.0319 (1.670)
Firm_size	0.0044 (0.387)	0.0072 (0.875)	
Leverage	-0.0295 (-0.340)	-0.0011 (-0.013)	
ROA	0.1657 (0.962)	0.1010 (0.595)	
S&P_Rating	0.0021 (0.816)	0.0024 (0.990)	
ESG_Score	-0.0013 (-1.609)	-0.0013 (-1.589)	
Constant	-0.0326 (-0.296)	-0.0168 (-0.253)	-0.431 (-0.652)
Observations	101	101	101
R-squared	0.111	0.035	0.071

Adjusted R-squared	0.012	-0.016	0.022
F-statistic	1.119	0.6928	1.447
Prob (F-statistic)	0.357	0.630	0.215

Turning to the short event window, the regression results for CAR [-1,1] are presented in Table 15. In contrast to the [-10,10] regressions, several variables are statistically significant. In Regression 1, which includes all variables, firm size is positive and significant at the 1 percent level, indicating that larger firms experience more favorable immediate stock market reactions. This finding is consistent with Wang et al. (2020), who show that larger issuers may attract more investor attention and credibility in the green bond market. Leverage is also positive and significant at the 5 percent level, suggesting that more leveraged firms obtain stronger short-term reactions. While this result differs from Lebellet et al. (2020), who associate higher leverage with risk and negative abnormal returns, it may reflect investor expectations that additional debt financing through green bonds supports growth opportunities and sustainable investments.

Table 15. Regression results for CARs in the [-1,1] event window with firm- and bond-specific variables.

	Regression 1	Regression 2	Regression 3
Amount_issued	0.0004 (0.085)		0.0056 (1.465)
Coupon	0.0008 (0.432)		-0.0010 (-0.630)
D_First_GB	0.0152 (2.578)		0.0071 (1.257)
Maturity_years	-0.0006 (-2.459)		-0.0005 (-2.021)
D_Callable	-0.0065 (-1.009)		-0.0072 (-1.078)
Firm_size	0.0112 (2.967)	0.0063 (2.243)	
Leverage	0.0756 (2.638)	0.0592 (2.003)	
ROA	0.0069 (0.121)	0.0238 (0.409)	
S&P_Rating	0.0002 (0.182)	-0.0001 (-0.148)	

ESG_Score	-0.0002 (-0.610)	-0.0001 (-0.429)	
Constant	-0.1140 (-3.133)	-0.0662 (-2.920)	-0.0202 (-0.874)
Observations	101	101	101
R-squared	0.220	0.090	0.089
Adjusted R-squared	0.133	0.042	0.041
F-statistic	2.539	1.876	1.856
Prob (F-statistic)	0.00959	0.106	0.109

Another noteworthy finding is the negative and significant coefficient for maturity in both Regression 1 and Regression 2. The results imply that bonds with longer maturities are associated with weaker immediate market responses. This could reflect investor preference for shorter-dated securities, which involve less uncertainty and are easier to evaluate in terms of expected cash flows and environmental impact. Furthermore, the dummy for first-time issuance (D_First_GB) is positive and significant in Regression 1, indicating that initial entry into the green bond market generates favorable investor reactions within the $[-1,1]$ window. This is consistent with Flammer (2021), who finds that first-time green bond issuances act as a strong signal of a firm's commitment to sustainability, leading to positive abnormal returns.

Regression 2, which isolates firm-specific variables, reinforces these findings. Firm size remains positive and significant, while leverage retains a positive coefficient, although its significance level is slightly reduced. Regression 3, focusing solely on bond-specific factors, highlights the continued importance of maturity, which remains negatively associated with short-term CARs. Taken together, the adjusted R-squared values are higher for CAR $[-1,1]$ (up to 0.133) compared to CAR $[-10,10]$, suggesting that short-term market reactions are more systematically linked to observable characteristics of the issuer and the bond.

Overall, the regression analysis indicates that Nordic stock market reactions to green bond announcements are better explained in the immediate short term than over longer

horizons. Specifically, larger firm size, higher leverage, shorter bond maturity, and first-time issuance are associated with stronger positive reactions in the $[-1,1]$ window. In contrast, the $[-10,10]$ regressions do not reveal any systematic explanatory factors. These findings suggest that investors respond to clear and credible signals—such as the scale of the issuer or the novelty of the green bond—within a narrow time frame, while longer event windows dilute these effects. In line with the earlier hypotheses, the results support the idea that first-time issuances (hypothesis on differential reactions) are perceived differently from subsequent announcements, and that firm- and bond-specific characteristics matter more for immediate reactions than for longer-term performance. In addition to firm- and bond-specific factors, the analysis was extended to test whether abnormal returns differ across countries or industries.

8.3 Country and industry effects

In addition to firm- and bond-specific factors, the analysis was extended to examine whether abnormal returns differ systematically across countries or industries. This was motivated by earlier research, which has reported mixed evidence on the market impact of green bond announcements, and by the possibility that geographical or sectoral differences could explain variation in results. To test this, separate regressions were estimated using country and industry dummies as explanatory variables. Sweden and Industrials were chosen as the baseline categories due to their largest representation in the dataset.

The regression results are reported in Table 16 for the $[-10,10]$ window and in Table 17 for the $[-1,1]$ window. For the longer window, all country coefficients were small and negative, and none were statistically significant suggesting that issuers from Finland, Norway, and Denmark did not experience different abnormal returns compared with Swedish firms. Similarly, the industry dummies produced coefficients close to zero, with Consumer Discretionary positive and Utilities negative, but none were statistically significant. The very low explanatory power of the models confirms that neither country nor

industry differences account for variation in cumulative abnormal returns over this horizon.

Table 16. Regression results for CARs in the [-10,10] event window with country and industry dummies.

	Regression 4	Regression 5
D_Finland	-0.0076 (-0.350)	
D_Norway	-0.0054 (-0.255)	
D_Denmark	-0.0062 (-0.230)	
Constant (Sweden)	-0.0027 (-0.217)	
D_Materials		-0.0052 (-0.218)
D_Consumer_Discretionary		0.0350 (-1.420)
D_Energy		0.0098 (0.399)
D_Communications		0.0357 (0.841)
D_Technology		0.0549 (0.664)
D_Utilities		-0.0792 (-0.958)
Constant (Industrials)		-0.0128 (-1.129)
Observations	101	101
R-squared	0.002	0.044
Adjusted R-squared	-0.029	-0.017
F-statistic	0.0528	0.7183
Prob (F-statistic)	0.984	0.636

For the shorter window, the findings were consistent. Coefficients for Finland, Norway, and Denmark were close to zero, indicating no systematic differences in market reactions between countries. Likewise, none of the industry coefficients differed significantly from Industrials. Energy and Communications displayed marginally positive coefficients, while

Utilities was slightly negative, but these effects were not significant. Again, the models explained little variation, as reflected in the very low R^2 values.

Table 17. Regression results for CARs in the [-1,1] event window with country and industry dummies.

	Regression 4	Regression 5
D_Finland	0.0005 (0.069)	
D_Norway	0.0005 (0.070)	
D_Denmark	0.0044 (0.496)	
Constant (Sweden)	-0.0001 (-0.035)	
D_Materials		-0.0055 (-0.681)
D_Consumer_Discretionary		0.0015 (0.186)
D_Energy		0.0101 (1.223)
D_Communications		0.0058 (0.407)
D_Technology		-0.0017 (-0.063)
D_Utilities		0.0090 (0.324)
Constant (Industrials)		-0.0005 (-0.132)
Observations	101	101
R-squared	0.003	0.028
Adjusted R-squared	-0.028	-0.034
F-statistic	0.0841	0.4445
Prob (F-statistic)	0.969	0.847

Overall, the country and industry regressions demonstrate that abnormal returns in the Nordic region do not vary systematically across geographical or sectoral dimensions. This suggests that the absence of strong market reactions cannot be explained by differences between countries or industries. Instead, the findings reinforce the earlier conclusion that short-term reactions are driven primarily by firm- and bond-specific features, such

as size, leverage, maturity, and issuance history. The results also underline the distinctiveness of the Nordic market context, where a high degree of ESG integration may contribute to more uniform investor responses compared to the mixed evidence reported in global or emerging market studies.

8.4 Summary of results

This subchapter summarizes and discusses the main findings from both the event study and the regression analyses, with the focus on addressing the hypotheses formulated in Chapter 1. The results are also reflected against earlier studies on green bonds to position the Nordic evidence in a wider academic context.

The first hypothesis tested was the null hypothesis (H_0), which states that share value does not react to the announcement of a green bond issuance. The event study results across four event windows confirm that abnormal returns did not differ significantly from zero in the overall sample. Mean and median CARs were close to zero in each case, and the Wilcoxon signed-rank tests indicated no statistical significance. These findings support H_0 and suggest that investors in the Nordic region do not perceive green bond announcements as events that systematically change firm value. This result contrasts with studies in global and emerging market settings, such as Tang and Zhang (2020) and Flammer (2021), who report positive reactions, as well as Lebellet et al. (2020), who document negative abnormal returns in developed markets. Instead, the Nordic evidence is more neutral, likely reflecting the maturity of local capital markets and the integration of sustainability considerations into existing investment practices.

The second set of hypotheses concerned the direction of possible reactions. H_{1a} proposed that announcements would be associated with positive abnormal returns, while H_{1b} suggested a negative effect. The absence of statistical significance across all four windows means that neither H_{1a} nor H_{1b} can be supported. Compared with prior research, this neutrality is noteworthy. In markets where sustainability is newer or less

embedded, announcements may act as signals of credibility or strategic change and thus generate measurable reactions. In the Nordic context, however, issuances appear to be viewed as standard financing decisions without strong informational content for shareholders.

The third hypothesis (H₂) addressed whether reactions differ between first-time and subsequent issuances. The results provide partial support. First-time issuances were associated with a marginally significant negative CAR in the longer [-10,10] window, whereas subsequent announcements had no effect. This outcome indicates that the novelty of entering the green bond market may trigger initial caution, possibly linked to issuance costs or uncertainty about the credibility of projects. Over shorter horizons, however, the first-time effect disappears. These findings differ from Flammer (2021), who finds positive abnormal returns for first-time announcements, but they align more closely with Lebellet et al. (2020), who argue that in developed markets the signaling value of green bonds weakens as they become mainstream.

The regression analysis provides further insights into these findings. For the longer event window of [-10,10], none of the explanatory variables reached statistical significance. Both firm-specific factors, such as leverage, profitability, and size, and bond-specific variables, such as maturity or coupon, failed to explain variation in abnormal returns. This suggests that over longer horizons, share price movements are more likely to be influenced by other corporate or market events that dilute the effect of bond announcements. In contrast, the regressions for the short window of [-1,1] revealed several significant explanatory factors. Firm size was consistently positive and significant, indicating that larger companies experienced more favorable immediate reactions. This result is in line with Wang et al. (2020), who suggest that larger issuers are perceived as more credible and attract greater investor attention. Leverage was also positively associated with CARs, which contrasts with Lebellet et al. (2020), but may reflect expectations that debt-financed green investments create growth opportunities. Bond maturity was negatively significant, supporting the interpretation that investors prefer shorter-dated instruments

that involve less uncertainty. Finally, the first-time issuance dummy was positive and significant, suggesting that market entry can serve as a favorable short-term signal, consistent with the argument in Flammer (2021) that initial announcements carry symbolic value.

To test the robustness of these findings, supplementary regressions were conducted with country and industry dummies. These models tested whether abnormal returns differ systematically across Nordic countries or sectors. The results show that none of the coefficients were statistically significant, and the explanatory power of the models was negligible. This indicates that market reactions do not vary across geographical or sectoral dimensions, reinforcing the conclusion that investors in the Nordic region treat green bond announcements in a relatively uniform manner.

Taken together, the evidence shows that the Nordic equity market does not exhibit a uniform positive or negative reaction to green bond announcements. Instead, the market response depends on the characteristics of the issuer and the bond, with significant effects concentrated in the immediate short term. For issuers, this implies that the announcement of a green bond alone is unlikely to affect share value, although large firms and credible first-time issuances may benefit in the short run. For investors, the findings highlight the importance of analyzing issuer fundamentals and bond features rather than assuming that all announcements convey the same signal.

9 Conclusions

This thesis examines the stock market reaction to green bond announcements in the Nordic region between 2017 and 2025. The focus is on publicly listed non-financial companies in Denmark, Finland, Norway, and Sweden that issued green bonds during this period. The analysis has assessed how these announcements affect firm value by applying a theoretical framework on bonds and stock valuation. The empirical study employed event study methodology to calculate cumulative abnormal returns, the Wilcoxon signed-rank test to assess significance, and regression models to examine the role of firm- and bond-specific characteristics. In addition, supplementary regressions with country and industry dummies were estimated to evaluate whether abnormal returns differ systematically across geographical or sectoral dimensions.

The findings show that green bond announcements do not generate statistically significant abnormal returns in the Nordic market. Across all four event windows, no systematic reaction was detected, suggesting that investors in the region treat issuance as routine financing rather than as new information. Compared with studies that report significant reactions in emerging or global markets, the results highlight the more neutral stance of a mature market with strong ESG integration. Possible explanations include the transparency of Nordic capital markets, the integration of sustainability into existing investment practices, and the reduced novelty of the instrument.

An integral part of this study was to test whether market reactions differ between first-time and subsequent issuances. The results show marginally significant negative abnormal returns for first-time announcements in the longer $[-10,10]$ window, while subsequent issuances produced no systematic effect. This suggests that novelty may trigger initial caution, while repeated issuances are anticipated and generally perceived as routine. The regression analysis further highlights that in the short-term window of $[-1,1]$, larger firm size and higher leverage were positively associated with abnormal returns, whereas longer maturity was negatively associated. The first-time issuance dummy was also positive and significant, implying that entering the market for the first time can

provide a favorable short-term signal. The supplementary country and industry regressions confirmed these findings, showing no systematic variation across Nordic countries or industries. This supports the conclusion that investor responses are uniform across the region, with short-term effects driven primarily by firm- and bond-specific characteristics. These findings are partly in line with previous academic research, while also leaving room for further studies to explore how firm- and bond-level features shape investor responses in developed markets.

Future research could expand on this study by examining the long-term effects of green bond issuance, such as changes in firm value, ownership structure, or environmental performance. Another avenue would be to include financial institutions, which are among the most active issuers in the Nordic region but were excluded from this analysis due to differences in how proceeds are applied. Extending the scope to the wider European market could also provide valuable insights, particularly as the EU Green Bond Standard becomes more established. Comparative studies between Nordic and non-Nordic countries, or between developed and emerging markets in Europe, could highlight how institutional and regulatory contexts shape reactions. Further research might also explore the role of certification, ESG profiles, or sectoral differences in shaping investor interpretations.

References

- Baulkaran, V. (2019). Stock market reaction to green bond issuance. *Journal of Asset Management*, 20(5), 331-340. <https://doi.org/10.1057/s41260-018-00105-1>
- Bhutta, U. S., Tariq, A., Farrukh, M., Raza, A., & Iqbal, M. K. (2022). Green bonds for sustainable development: Review of literature on development and impact of green bonds. *Technological Forecasting and Social Change*, 175, 121378. <https://doi.org/10.1016/j.techfore.2021.121378>
- Bracking, S. (2021). Climate finance and the promise of fake solutions to climate change. In S. Böhm & S. Sullivan (Eds.), *Negotiating climate change in crisis* (pp. 255–272). Open Book Publishers. <http://dx.doi.org/10.11647/obp.0265.20>
- Bodie, Z., Kane, A., & Marcus, A. J. (2018). *Investments* (11th ed.). New York: McGraw-Hill Education.
- Brooks, C. (2019). *Introductory Econometrics for Finance* (4th ed.). Cambridge: Cambridge University Press.
- Brealey, R. A., Myers, S. C., & Allen, F. (2020). *Principles of corporate finance* (13th ed.). New York: McGraw-Hill Education.
- Campbell, J. Y., Lo, A. W., & MacKinlay, A. C. (1997). *The Econometrics of Financial Markets*. Princeton: Princeton University Press.
- Cheng, M., & Neamtiu, M. (2009). An empirical analysis of changes in credit rating properties: Timeliness, accuracy and volatility. *Journal of Financial Economics*, 47(1–2), 108–130.
- Choudhry, M. (2019). *Fixed income securities and derivatives handbook* (3rd ed.). Hoboken: Wiley.
- Climate Bonds Initiative. (2024). *Global State of the Market 2024*. Climate Bonds Initiative. Retrieved 2025-06-24 from <https://www.climatebonds.net/data-insights/publications/https-www.climatebonds.net-data-insights-publications-global-state-market>
- Demski, J., Dong, Y., McGuire, P., & Mojon, B. (2025, 11. March). Growth of the green bond market and greenhouse gas emissions. *BIS Quarterly Review*. Retrieved 2025-06-24 from https://www.bis.org/publ/qtrpdf/r_qt2503d.htm

- Elton, E. J., Gruber, M. J., Brown, S. J., & Goetzmann, W. N. (2014). *Modern portfolio theory and investment analysis* (9th ed.). Wiley.
- European Union. (2022). *Regulation of the European Parliament and of the council on European green bonds*. Retrieved 2025-06-24 from <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52021PC0391>
- European Investment Bank. (2024). *Climate Awareness Bonds and Sustainability Awareness Bonds in the context of evolving EU legislation on sustainable finance*. Retrieved 2025-06-24 from <https://www.eib.org/en/investor-relations/publications/all/eib-cab-sab-presentation>
- Fabozzi, F. J. (2012). *Bond markets, analysis, and strategies* (8th ed.). Boston: Pearson.
- Fama, E. F., & French, K. R. (2004). The Capital Asset Pricing Model: Theory and evidence. *Journal of Economic Perspectives*, 18(3), 25–46. <https://doi.org/10.1257/0895330042162430>
- Fama, E. F. (1970). Efficient capital markets: A review of theory and empirical work. *The Journal of Finance*, 25(2), 383–417. <https://doi.org/10.2307/2325486>
- Flammer, C. (2013). Corporate social responsibility and shareholder reaction: The environmental awareness of investors. *Academy of Management Journal*, 56(3), 758–781. <https://doi.org/10.5465/amj.2011.0744>
- Flammer, C. (2021). Corporate green bonds. *Journal of Financial Economics*, 142(2), 499–516. <https://doi.org/10.1016/j.jfineco.2021.01.010>
- Hamilton, J. T. (1995). Pollution as news: Media and stock market reactions to the Toxics Release Inventory data. *Journal of Environmental Economics and Management*, 28(1), 98–113. <https://doi.org/10.1006/jeem.1995.1007>
- Healy, P. M., & Palepu, K. G. (2001). Information asymmetry, corporate disclosure, and the capital markets: A review of the empirical disclosure literature. *Journal of Accounting and Economics*, 31(1–3), 405–440. [https://doi.org/10.1016/S0165-4101\(01\)00018-0](https://doi.org/10.1016/S0165-4101(01)00018-0)
- Hull, J. C. (2018). *Options, futures, and other derivatives* (10th ed.). Harlow: Pearson.

- ICMA. (2021). Green bond principles. *International Capital Market Association*. Retrieved 2025-06-24 from <https://www.icmagroup.org/sustainable-finance/the-principles-guidelines-and-handbooks/green-bond-principles-gbp/>
- Jiang, S. (2021). *Ba3/BB-: Definition, How Bond Ratings Work, Yields & Risks*. Retrieved 2025-06-24 from <https://www.investopedia.com/terms/b/ba3-bb.asp>
- Klassen, R. D., & McLaughlin, C. P. (1996). The Impact of Environmental Management on Firm Performance. *Management Science*, 42(8), 1199–1214. <https://doi.org/10.1287/mnsc.42.8.1199>
- Krüger, P. (2015). Corporate goodness and shareholder wealth. *Journal of Financial Economics*, 115(2), 304–329. <https://doi.org/10.1016/j.jfineco.2014.09.008>
- Knüpfer, S., & Puttonen, V. (2018). *Moderni rahoitus*. Alma Talent.
- Lebelle, M., Lajili Jarjir, S. & Sassi, S. (2020). Corporate Green Bond Issuances: An International Evidence. *Journal of risk and financial management*, 13(2), 25. <https://doi.org/10.3390/jrfm13020025>
- Li, H., He, T., Liao, X., & Tong, W. (2022). China's Green Bond Market: Structural Characteristics, Formation Factors, and Development Suggestions—Based on the Comparison of the Chinese and the US Green Bond Markets Structure. *International journal of antennas and propagation*, 2022, 1-15. <https://doi.org/10.1155/2022/1890029>
- Lintner, J. (1965). The valuation of risk assets and the selection of risky investments in stock portfolios and capital budgets. *The Review of Economics and Statistics*, 47(1), 13–37.
- MacAskill, S., Roca, E., Liu, B., & Stewart, R. A. (2021). Is there a green premium in the green bond market? Systematic literature review revealing premium determinants. *Journal of Cleaner Production*, 280, 124491. <https://doi.org/10.1016/j.jclepro.2020.124491>
- MacKinlay, A. C. (1997). Event studies in economics and finance. *Journal of Economic Literature*, 35(1), 13–39.
- Markowitz, H. (1952). Portfolio selection. *The Journal of Finance*, 7(1), 77–91. <https://doi.org/10.2307/2975974>

- Mossin, J. (1966). Equilibrium in a capital asset market. *Econometrica*, 34(4), 768–783.
- Nikkinen, J., Rothovius, T., & Sahlström, P. (2002). *Finanssianalyysi*. Kirjayhtymä.
- Nordic Council. (2024). *Nordic Co-operation Programme for Economic and Fiscal Policy 2025–2030*. Nordic Council of Ministers. Retrieved 2025-06-23 from <https://www.norden.org/en/publication/nordic-co-operation-programme-economic-and-fiscal-policy-2025-2030>
- Nordic Trustee. (2024). *Nordic Corporate Bond Market Report 2024*. Nordic Trustee. Retrieved 2025-06-23 from <https://nordictrustee.com/nordic-corporate-bond-market-report-2024/>
- Ross, S. A. (1976). The arbitrage theory of capital asset pricing. *Journal of Economic Theory*, 13(3), 341–360. [https://doi.org/10.1016/0022-0531\(76\)90046-6](https://doi.org/10.1016/0022-0531(76)90046-6)
- Shane, P. B., & Spicer, B. H. (1983). Market response to environmental Information Produced Outside the Firm. *The Accounting Review*, 58(3), 521-538.
- Sharpe, W. F. (1964). Capital asset prices: A theory of market equilibrium under conditions of risk. *The Journal of Finance*, 19(3), 425–442. <https://doi.org/10.2307/2977928>
- Strong, R. A. (2003). *Practical investment management* (3rd ed.). South-Western College Pub.
- Tang, D. Y., & Zhang, Y. (2020). Do shareholders benefit from green bonds? *Journal of Corporate Finance*, 61, 101427. <https://doi.org/10.1016/j.icorpf.2018.12.001>
- Tuckman, B., & Serrat, A. (2011). *Fixed income securities: Tools for today's markets* (3rd ed.). Hoboken: Wiley.
- Wang, J., Chen, X., Li, X., Yu, J. and Zhong, R., (2020). The market reaction to green bond issuance: Evidence from China. *Pacific-Basin Finance Journal*, 60, 60, 101294. <https://doi.org/10.1016/j.pacfin.2020.101294>
- Weidenbaum, M., Douglass, C., & Orlando, F. (1997). How to achieve a healthier environment and stronger economy. *Business Horizons*, 40(1), 9-16. [https://doi.org/10.1016/S0007-6813\(97\)90020-3](https://doi.org/10.1016/S0007-6813(97)90020-3)

- World Bank. (2024). *The World Bank Impact Report: Sustainable Development Bonds & Green Bonds*. World Bank. Retrieved 2025-06-23 from <https://treasury.worldbank.org/en/about/unit/treasury/impact/impact-report>
- World Bank. (2019). *10 years of green bonds: Creating the blueprint for sustainability across capital markets*. Retrieved 2025-06-24 from <https://www.worldbank.org/en/news/immersive-story/2019/03/18/10-years-of-green-bonds-creating-the-blueprint-for-sustainability-across-capital-markets>
- Zerbib, O. D. (2019). The effect of pro-environmental preferences on bond prices: Evidence from green bonds. *Journal of Banking & Finance*, 98, 39–60. <https://doi.org/10.1016/j.jbankfin.2018.10.012>
- Xi, B. & Jing, H. (2022). Research on the impact of green bond issuance on the stock price of listed companies. *Kybernetes*, 51(4), 1478-1497. <https://doi.org/10.1108/K-12-2020-0900>
- Xu, G., Lu, N., & Tong, Y. (2022). Greenwashing and credit spread: Evidence from the Chinese green bond market. *Finance research letters*, 48, 102927. <https://doi.org/10.1016/j.frl.2022.102927>

Appendices

Appendix 1. List of issuers in the dataset

Issuer Name	Ticker
A.P. Møller - Mærsk A/S	MAERSK
Arendals Fossekompani ASA	AREFOS
Boliden AB	BOLSS
Bonava AB	BONAVA
Bonheur ASA	BONNO
Borregaard ASA	BRGNO
Cinis Fertilizer AB	CINISS
Citycon Oyj	CITCON
Electrolux AB	ELTLX
Elisa Oyj	ELIAV
Elkem ASA	ORKNO
Elopak ASA	ELONO
Epiroc AB	EPIBSS
Granges AB	GRNGSS
Grieg Seafood ASA	GSFNO
H & M Hennes & Mauritz AB	HMBSS
Husqvarna AB	HUSQB
Kesko Oyj	KESBV
Lamor Corp Oyj	LAMOR
Leroy Seafood Group ASA	LSGNO
Logistea AB	LOGISS
Metsä Board Oyj	METSA
Midsummer AB	MIDAB
Mowi ASA	MOWINO
Munters Group AB	MTRSSS
NCC AB	NCCAB
Neste Oyj	NESVFH

Issuer Name	Ticker
NKT A/S	NKTDC
Norsk Hydro ASA	NHYNO
NRC Group ASA	NRCNO
Orkla ASA	ORKBNO
Orsted AS	ORSTED
Peab AB	PEABSS
Salmar ASA	SALMNO
Skanska AB	SKABSS
SKF AB	SKFBSS
Stendorren Fastigheter AB	STEFBS
Stora Enso Oyj	STERV
Svenska Cellulosa AB	SCABSS
Telefonaktiebolaget LM Ericsson	ERICB
Telia Co AB	TELIAS
Tomra Systems ASA	TOMNO
Trelleborg AB	TRELB
UPM-Kymmene Oyj	UPMFH
Valmet Oyj	VALMTF
Volvo Car AB	VOVCAB
Wästbygg Gruppen AB	WBGRB