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Does it pay to be greener?
Exploring certification and scoring in the green bond market

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Abstract

The green bond market is new and exciting, but is the regulation, in the form of certificates and the green bond score, proving its value? I show, using a sample of 602 corporate bonds from 214 companies, that abnormal returns when issuing a green bond are based on irrational motives and not driven by certified products. However, when liquidity of a certified and scored issuers increases over a longer period of time it becomes apparent that future returns could be present. This prediction is confirmed when long-term improvements of ASSET4 scores are higher for certified bonds. This signals to investors they own shares of a future-proof company. Institutional owners already take certification, monitoring and scoring into account when they buy a stock in light of a green bond issue. Their role in the pre-issuance phase is measured using probit models and it shows that specific institutional owners improve the probability of having certificates and scores.

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1 Introduction

The first green bonds appeared over a decade ago and since 2013 the market has taken off. A green bond is defined as a fixed income product with the proceeds being used on a sustainability goal, which usually relates to a decrease in carbon emissions, a decrease in the use of fossil fuels or a decrease in the use of water. For instance, Apple Inc. used their $1.5 billion green bond to improve its current buildings and improve energy storage in its data centres. All green bonds proceeds tie into one of the fifteen sustainability goals outlined in the treaty of Paris. In order to ensure the correct usage of bonds' proceeds the Climate Bond Initiative (CBI) and many outside verifiers (i.e. Bureau Veritas, Sustainalytics) have created stringent guidelines. The verifiers test these guidelines and ensure the proceeds are used in the correct way, as an issuer you pay the verifiers. Furthermore, as an issuer you can also receive a green bond score (GBS) from Moody's or S&P, who will also monitor the promised environmental performance of the bond.

The paper by Ehlers and Packer (2017) highlights these features amongst other general trends based on an early green bond sample. The most important finding they present is the comparison between the GBS methodology of Moody's and S&P. In this thesis the S&P score will primarily be used and if necessary supplemented by the Moody's score. The S&P method is most in line with the conventions of the CBI and is preferred for this reason. With issuers spending large amounts on verification and certification a potential conflict of interest arises. Nevertheless, when the market starts to show a rational reaction to certification the conflict of interest is mitigated by possible damage of the issuer' reputation. Moreover, with the green bond market enjoying a great deal of media attention the risks of green washing seems to fade away. Ehlers and Packer (2017) also showed in their early sample that a green bond issues results in abnormal stock return. This indicates that not only fixed income buyers are flocking to these products, but also equity investors want to buy stock of those companies.

In their papers Flammer (2018) and Tang and Zhang (2018) provide further detail on this effect using much larger samples. They supplement the outlook on abnormal returns by looking at liquidity and long-term environmental performance and institutional ownership changes. These two papers are the benchmark papers for this thesis. Flammer (2018) shows that the abnormal returns are robust and appear to be driven by certified green bonds. Moreover, green bond issuers appear to do somewhat better on ASSET4 items compared to matched grey bond issuers in the years post-issuance. Finally, there appears to be a positive long-term impact on the company performance when a green bond issue is announced. The allusion that green bond issuers are innovative provides the explanation for the abnormal return. Because investors believe these companies will outperform the market in the future. Tang and Zhang (2018) also find the abnormal return for green bond issuers around the announcement date. They have more robust results than Flammer (2018) and also include the Fama-French 3 and 5 factor models and find statistically significant results.

The primary purpose of this thesis is to uncover if the abnormal returns, increased liquidity and changes in institutional ownership are driven by rational motives, proxied by certification and scoring. I employ a short- and long-term point of view to provide a complete overview. Noting that earlier research shows that certification appears to be important to investors the first signs for a rational reaction are present.

However, in this thesis the abnormal returns are much smaller, but remain statistically significant. More-over, the impact of the certificates is smaller compared to earlier research. The larger sample size of green bonds from a longer sample period indicate more robust results. The GBS was looked at for the first time and in a small sample it was a predictor of higher abnormal return. The key difference between my work and earlier papers is the focus on certification and GBS, an entirely new concept. The contributions to the

research field are the first assessment of the GBS and its impact on the market. It is paramount to notice that investors believe greener investments will provide them with both higher real and latent returns in the future.

The two benchmark papers also look at increased attention for green bond issuing companies in the form of liquidity. Again their results are positive and significant indicating that green bond issuers experience higher liquidity in the post-issuance period. They employ two measures and both show higher liquidity. In this thesis the same effects and conclusions are found using the same methods. It is concluded that certification and scoring increases liquidity.

Finally, Flammer (2018) and Tang and Zhang (2018) look at the institutional ownership (IO) structure of green bond issuers. The results show higher IO in the post-issuance period. The same results, supplemented by more characteristics of institutional owners, are displayed in later sections.

A new field of research I explore is the role of IO in the pre-issuance period. It is important to notice if the probability of having a certificate or GBS is also impacted by IO. This shows that institutions have an important role in both the pre- and post-issuance period. I use probit models to find out how IO impacts the probability of a company getting a certificate or score. There appears to be a weak negative relationship, this does show that companies are internally motivated to get certified or scored. In contrast, the institutional owners who push for certification appear to be from the home country of the issuer. I also employ probit models in order to asses what sort of companies have there bonds certified. Innovative companies are less likely to get a certificate, but do have higher GBS.

In separate sections tests based on earlier research will be supplemented by new models. As some of the coefficients for the certificates and GBS are significant and positive it suggests the market is truly shifting towards sustainable investing. Nevertheless, it is also puts forwards that investor value the scores, but do not consider them the most important metric yet. The short-term reactions seem opportunistic, but if investors are familiar the long-term impact the reaction is fully rational.

The results highlight the key aspects of the green bond market. First of all, investors on both the fixed income and equity side are very interested in the issuers. The companies are investing in innovation and sustainability, two aspects that are becoming more important to investors. On the fixed income side the yields are some basis points lower than on grey bonds as described by Zerbib (2019) and the savings are used to pay for the monitoring and certification cost. However, not all issuers have the certificates so it could be a cheaper way to finance the same project.

Finally, I will focus on what drives the decision to acquire certificates for sustainable investments. Moreover, I will again asses what the long-term impact is of employing a sustainable strategy. As stipulated by Tang and Zhang (2018) when companies indicate they are investing in innovation there is increased media attention. However, investors can know about the abnormal returns at announcement and exhibit return chasing behaviour. Consequently, the issue of greenwashing can be present. Since going green is popular the question arises whether companies are really going green or merely trying to look green. In the last models the impact of a green bond issue on the environmental performance is measured. It results in a large and continuous increase in the environmental performance. Suggesting the green bonds are making their proposed impact. Furthermore, the IO component is looked at in the years after a green bond issue. IO is influenced by green bonds, but other indicators offer better explanations.

2 Literature review

Building upon the existing literature on green bonds as well as the extensive work on sustainability this thesis will provide a robust overview of the sustainable investment market. Finally, studies on the implication of investor attention will be used. The combination of these fields will provide a broad basis for the proposed hypotheses regarding green bond issues.

Conventional economic and corporate finance theory is very much concerned with the leverage structure of a company. Holding theories, stretching as far back as Modigliani and Miller (1958) and Majluf and Myers (1984) would argue that, while there is a balance to be found, an equity investor on aggregate would not be content with additional debt issuance. However, in the green bond market abnormal returns for the issuing company are present, the literature review looks into the current research relating to the paradox. Furthermore, it serves as the basis for the hypotheses and methodology. This literature will first look at the short-term impact of a green bond issuance, focusing on the abnormal return and the increased liquidity. A distinction will be made between the rational and behavioural literature. Afterwards the long-term perspective is taken on how companies develop after their green bond issue. Finally, the hypotheses tested in this thesis will be stated and outlined.

2.1 Short-term reaction after a green bond issue

2.1.1 Rational approach

Tang and Zhang (2018) find that green bond issuance offer abnormal return, increased liquidity and increased institutional ownership to investors. Flammer (2018) also looked at abnormal returns after a green bond issue and she finds very robust abnormal returns for corporate green bonds. Moreover, she notes that green bond that have been certified have a higher abnormal return than non-certified green bonds. Her findings provide substantial evidence that the market very much values the certification of green bonds. Baker et al. (2018) seek to explain what drives the so-called green bond premium in the US municipal bond market. They find that certification causes green bonds to be more closely held and that green bonds are issued at a yield premium. Moreover, they show using the Herfindahl-Hirschman Index that concentration of green bond ownership increases further when issued with a certification.

The green bond premium puzzle was first looked at by Zerbib (2019) he finds substantial differences in the premium when he segments the market based on credit rating and currency. Gianfrate and Peri (2019) find similar results when focusing on Euro denominated corporate bonds. These corporate bonds appear to hold their green premium in the secondary market as well. This premium can offset the substantial cost of certification and monitoring of the bonds. These findings are based on characteristics inherent to bond issues (industry, rating, size) and offer some normative predictions yet fail to include what drives these premiums. The five papers are the first to explain what makes the green bond market tick. Especially seeking to explain why investors on both the equity and fixed income side are willing to invest in these bonds, issued with lower coupons, and the issuers' stocks.

The puzzle is mainly explained by institutional investors who have a shifting preference for more sustainable products. Renneboog et al. (2008) survey the existing literature and find that most investors are willing to accept a decrease in returns for sustainability benefits. What is remarkable is the fact that investors on both sides of the table appear to be taking penalties. Furthermore, the five papers on green bonds primarily list liquidity, increased investments in innovation and increased institutional ownership as a reason for the

abnormal returns. With firms displaying their willingness to innovate and invest in the future the abnormal returns are a revealing sign of the market believing this rationale. Nevertheless, it is not clear if a bond that is certified or has a GBS will yield a higher abnormal return.

A potential benefit for investors could be increased liquidity of their portfolio. In his seminal paper Amihud (2002) explains why a decrease in liquidity can explain some premium in the stock market. Investors are taking more risk by holding less liquid stocks, thus demand some compensation. Therefore, it would appear that when stock turnover, as a proxy for liquidity, increases after a green bond issuance it cannot fully explain the abnormal return. However, when we take into account the fact increased liquidity is better for investors a long-term increase in liquidity could be paired with a short-term abnormal return.

One of the more comprehensive studies on liquidity and stock returns is the paper by Pástor and Stambaugh (2003) using a 34-year decile based sample. They show that stocks with a higher liquidity beta enjoy higher returns at up to 11.39% per year. On the other hand Baker and Stein (2004) find increased liquidity decreases expected return, but they primarily link it to sentiment using cross sectional data. The extensive literature is unable to provide a consensus, but in the case of green bonds the abnormal return and increased liquidity can both have rational and behavioural motives. Also when taking into account the willingness of investors to own part of a company investing in sustainability by participating in the green bond market the rational motives prevail. As a green bond is an open indicator of investing in innovation and sustainable development.

If investors take into account the paper by Eberhart et al. (2004) who show that innovative companies, proxied by R&D expenditure have abnormal returns, they should invest in green bond issuers. While in their sample substantial differences exist between high-tech and low-tech companies, the overall pattern holds. Rational investors buying the green bonds issuers' stock can expect to see an increase in stock prices, an increase in stock liquidity and a long-run increase in Tobin's Q, as a proxy for innovation. A higher GBS can be used as an indicator that the company is investing more in sustainability than other green bond issuers and a higher NPV of this venture can increase future returns.

2.1.2 Behavioural approach

The foundation of behavioural finance as laid out by Barberis and Thaler (2003) focuses on investors making irrational choices. One of the more pronounced behavioural finance phenomena is return chasing behaviour of investors. This has been well researched both in equities by Jagadeesh and Titman (1993), in mutual funds by Gruber (1996). The behavioural explanation underpinning this the momentum effect that is incorporated in the French-Fama-Carhart (FFC) four factor model. Rationally speaking momentum can never explain stock increases, since according to the efficient market hypothesis (EMH) all information is already incorporated. Therefore, momentum can only be present when additional positive news appears.

In contrast, when we look at a green bond announcement the momentum factor in the FFC model can explain the abnormal return. Because it is a signal to the market that the firm is investing in innovation and sustainability. Since some media outlets provide a constant information flow about the same green bond issue there is no new news, but there is coverage and thus momentum. Considering Fang and Peress (2009) show that news coverage can explain abnormal returns on a short-term basis. The behavioural factor that is very important is the media coverage effect. Once a stock is covered in the media it is on the irrational investors' radar and he is more likely to buy it.

The papers by Tetlock (2007) and Fang and Peress (2009) provide a great deal of evidence why this happens and what it brings investors in terms of return. Since green bond issues are well covered in the

media and is increasingly searched for by individuals (Appendix 1 and Appendix 2) this could be a factor that explains the abnormal return.

Every investor type appears to be influenced by media coverage as Fang et al. (2014) show that also mutual funds are subject to this bias. Especially high media coverage has a very pronounced effects on buying. The media coverage for mutual funds can either be positive or negative since this a more advanced investor class and they can make their own predictions. In relation to green bonds it can be argued that the issuing companies are put back on the radar. The principle explaining why coverage is so important is the limited attention bias. While the universe of possible equities is immense even portfolio managers must first know about a company. Therefore, this can be of explanatory power. Concluding, irrational investors could be the driver of the abnormal return since they would be heavily influenced by the coverage in the media. However, with the lack of knowledge on the entire taxonomy of green bonds these buyers are less likely to know about the certification and GBS. Therefore, as the market matures the focus should be on the certified products.

Nevertheless, as this is a sentiment driven choice without a great amount of knowledge on green bonds and certification returns should be roughly the same for all green bonds. As Tang and Zhang (2018) indicate institutional ownership is increasing and these investor class is less susceptible to behavioural biases. On the other hand private investors maintain a bad reputation in the academic world. Their buying is often attributed to irrational motives and they are highly subject to the most of the biases discovered since prospect theory (Kahneman and Tversky (1979)). Moreover, they are especially prone to buying in the face of news stories as Engelberg and Parsons (2011) showed. Relating this to green bonds issuance it can be expected to see local buying to increase after issuance.

When looking at private investors that are classified as excessive traders, the excessive trading as shown by Flammer (2018) could explain the relatively short CAR of one day. The paper by Barber and Odean (2007) showed that especially individuals are buying based on news stories. These papers also showed that trading on news has a no positive impact on returns. Concluding, while a behavioural reaction to green bonds could be present, based on earlier research it seems unlikely. However, testing again for the effect is necessary, especially since the GBS were not included in earlier research.

2.2 Long-term impact of a green bond issue

2.2.1 Rational reasons for being sustainable

Irregardless of green bond characteristics the market will always respond in a certain manner to sustainability. In recent years there the focus has shifted and sustainability has become embedded in corporate policies across the world. Partly because of investor demand, but also because of appeal to investors. Many studies cover environmental, sustainability and governance (ESG) factors. Konar and Cohen (2002) report that market value is positively related to environmental performance. They use lawsuits and toxic chemical releases as proxies for environmental performance. More lawsuits and more toxic release lead to lower Tobin's Q and lower market value, they value the loss at $380 billion in intangible assets for manufacturing companies in the S&P 500. The papers by Capelle-Blanchard and Laguna (2010) underpins this by showing negative reaction to chemical disasters.

Nevertheless, these papers indicate negative reaction to bad events, while the reverse is not always true, it is a strong indication that investors value ESG factors. A relatively new phenomena is ESG focused mutual funds and ETFs. Bialkowski and Stark (2016) look at fund flows and returns of US Socially Responsible

investing (SRI) mutual funds compared to normal domestic equity funds. After matching it to normal mutual funds they find higher inflows for the SRI funds, yet while having non-distinguishable four factor alphas. Moreover, what is most striking is the fact that more strict funds in terms of scanning criteria outperform the other SRI funds. Henke (2016) specifically looks into bond mutual funds. He concludes that SRI bond funds outperform conventional funds from 2001 to 2014 by about 1.5%. Showing that a more sustainable approach to investing can yield higher returns even in bond funds.

The question why companies invest in corporate social responsibility (CSR), as it is seemingly not optimising current shareholder value, is partly answered by the future value of a company. CSR can boost future performance, therefore it is rational to invest in. Furthermore, also agency problems exist between investment in CSR and investor value maximisation. Ferell et al. (2012) use a very large sample and find that CSR has a positive impact on firm value. Yet it is only present in well governed firms. They suggest good governance causes more CSR, which further increases firm value. The causes of good governance are often attributed to the legal system in the home country or the strength of institutional investors. There is a great amount of papers on the relation between institutional ownership and corporate governance (i.e. Chung and Zhang (2011), McCahery et al. (2016), Shleifer and Vishny (1997)) they all report better governance when institutional owners own a larger part of the shares outstanding.

Relating this to green bonds, taking into account that better governance drives CSR and that institutional ownership drives better governance, the paper by Dyck et al. (2019) bridges these drivers. They find that higher institutional ownership causes better ESG performance. While there are some caveats the main conclusion stands firmly. The relation between investors, ESG performance and financial performance is becoming clear. It can be established that institutional investors are pushing for more sustainable investing. Moreover, the benefits of being sustainable are numerous. From an investor' perspective a company with a higher GBS is investing greener and it can serve as a predictor of higher future returns. The primary buyers of sustainable companies can also be large institutions. As institutions hold a greater amount of buying power their trades have bigger impact. Ofek and Richardson (2003) and Griffin et al. (2011) provided a great amount of work on this. Both papers look at the buying of institutions and individuals in relation to the internet bubble. Both conclude institutional buying caused the bubble to form. Therefore, it is meaningful to notice who is buying the green bond issuers stocks before and after the issuance.

In order to judge why companies issue green bonds with certificates the role of institutional investor on corporate governance must be taken into account. The following papers look at IO in relation to the strenghth of corporate governance from a global perspective (Aggarwal et al. (2011), Ferreira and Matos (2008)). Both find that independent firms from countries with strong corporate governance codes are more active. Another aspect considered is the impact of domestic institutional ownership, some advantages and disadvantages exists for domestic institutional ownership. A final metric that has to be considered is which institutional investors are vocal for reforms and changes. Most of the research is based on the US, but the results show trends across institutional investor classes. Relating this back to green bond issuers, it is important to note who are their shareholder, where are they from and what type of investor class do they represent.

Very often pension funds are described as more active shareholders. First of all, Gillan and Starks (2000) show in their paper that pension funds are very active in terms of shareholder proposals. Moreover, they show that the voting outcome is much higher when the plan is sponsored by an institution. However, the institution sponsored proposals also cause a negative CAR, which is not present for green bonds. The role of pension funds as the active shareholder is also described and outlined by Del Guercio and Hawkins (1999),

they find that pension funds are more successful in their efforts than previously assumed. The interesting aspect is that the motivation is always fund value maximisation. The paper by Renneboog et al. (2008) reveals the shift to inclusion of SRI in the investment policy. Therefore, it is meaningful to see if this implies that pension funds are also using their voting power to push for the green bond issuance. In order to evaluate how effective the efforts from IO were it is paramount to reassess the conclusions of Flammer (2018). In her sample the green bond issuers improved their entire ASSET4 scores in the years after. A higher GBS signals greener investment so the companies should improve more on their ASSET4 scores. The large change can be endogenous because of better governance caused by higher IO.

2.2.2 Behavioural reasons for being sustainable

With many rational reasons for being sustainable it would appear for all companies to invest at least some of their funds into sustainability. Yet this is exactly the problem, investing in sustainability and innovation is very costly. Furthermore, for some companies in very polluting industries the efforts could outstrip their competitive advantage. However, in the past we have seen examples of making very little effort yet attracting significant capital. The most blatant example is the paper by Cooper et al. (2001) (A Rose.com by any other name). They looked at the effect of adding dotcom to a companies name and its stock performance. They found a cumulative abnormal return of 74% in the ten days after the name change. None of the companies made fundamental changes they merely changed their names. The study by Peng and Ziong (2006) provide some clarification. They find that investors are not very sophisticated, can be overconfident and often look at industries as a whole when making investment decisions. If investors made such irrational responses to name changes during the dotcom bubble the question becomes, do they act the same in relation to sustainability?

The process of companies changing their identities, names or products to appear more green is called greenwashing. A problem extensively researched in the field of behavioural environmental economics. Among the first were Delmas and Burbano (2011) who look at what drives greenwashing efforts. They find a number of external and internal drivers including: managerial compensation, (investor) marketing pressure, media pressure and regulatory reasons. From an investors point of view the marketing is most important. They find that by greenwashing performance indicators (ASSET4, ESG scores) the company can appear more appealing to investors. This has numerous negative consequences first of all the value of green products diminishes. As with many premium products you pay more for a green product. However, should the premium disappear, because you cannot be certain of the green value the willingness to pay the premium disappears as well.

The role of certification and the GBS can start to play a more important role in order to kerb scepticism of the market. In their paper Leondiou and Skarmeas (2017) find that green scepticism has a negative impact on the buying of green products. Especially in a market where trust plays a large role green bonds need to be truly green and not greenwashed. However, this is only from the investor perspective, an issuer might still be inclined to use greenwashing. Academic literature does not stretch far when it comes to the negative consequences for companies caught greenwashing. Even though scandals on environmental disasters (i.e. Brumadinho dam disaster and Deep Water Horizon) are often written about these are not related to direct greenwashing. The disasters do have a negative impact on the entire industry thus the green bond market should be cautious when it comes to greenwashing. The papers by Lyon and Maxwell (2011) and Parguel et al. (2011) provide some clarification by showing that disclosure, monitoring and rating can improve the credibility of firms and reduce the risk of greenwashing. Nevertheless, the reverse is not outlined in much detail. However, most of the literature finds a positive relation being green and any measure of firm value.

Combining this with the knowledge on correct reporting the chances for firms to engage in active green-washing appear slim. Moreover, with a higher level of scrutiny by NGOs the higher probability of being caught increases the possible negative impact. Finally, with more ratings of green products coming into existence the level of independent screening rises. Ensuring that rating agencies and NGOs stay independent seems vital for the future and could provide the many rational benefits to the green bond market. While the greenwashing of green bonds might not have much effect it would appear possible that if non-certified green bonds also earn the abnormal returns irrational investor are buying the stocks.

2.3 Hypothesis formulation

The literature has shown that the market for investing in popular products can be very behavioural (i.e. Cooper et al. (2001), Ofek and Richardson (2003)). With companies that are frequently named in the news being bought more (i.e. Barber and Odean (2007), Peng and Xiong (2006), Tetlock (2007)). Moreover, the limited attention of some investors can explain part of the puzzle. Nevertheless, for the green bond market and sustainability as a whole, hopefully it is not the reason why the abnormal returns are present. As this would indicate that the market has little interest in the future and is only focused on short-term returns. Therefore, the certification and a higher GBS would have to predict higher returns. I will test these predictions based on hypotheses 1a and 1b. Furthermore, I expect that institutions are the net-buyer in the announcement year. Most indicators are that institutions value more sustainable products. In hypotheses 5, 6a and 6b this is tested. Moreover, as laid out in previous sections local and time effects are very important. I would expect that companies from countries that are more on the forefront of sustainability to have higher abnormal returns. In the robustness section this is assessed further. When this is shown the rational hypothesis for the abnormal returns will gain the upper hand and it will place green bond issuance in line with more conventional economic theory.

The rest of the this thesis will focus on the aspects described above. First of all the short-term impact will be evaluated. The research will focus on explaining the abnormal returns and increased liquidity. Hypotheses 2a and 2b take further look at liquidity. Also what are the predictors of the abnormal return focusing on the certificates, first issues and GBS. Also it will be assessed what type of company decides on certification. I will use probit models based on hypotheses 3b and 3c. However, first hypothesis 3a will be looked at in more detail using multiple tests. Finally, it will be identified who is the buyer of green bond stock, as this will play an important role in deciding whether it is a rational or behavioural phenomena. Furthermore, I will assess how institutional owners are impacting the probability of certificates and scores in hypotheses 4a and 4b. The research is very important since green bond certification and ratings are a costly affair for issuers. If it is a rational decision to buy the stocks companies will make rational choices as it delivers value for their shareholders. In case it is a behavioural phenomenon there are no added benefits and the cost might not outweigh the benefits.

Afterwards the long-term perspective will be taken. First, the ESG performance in the post-issuance years will be measured and tested based on hypothesis 7. Not only can the market take this into account when making investment decisions, but also is a testimony to the successful taxonomy of the CBI and the methods of the rating agencies. Finally, in hypothesis 8 the changes in IO will be looked at and related to the green bond issue. All hypotheses are listed on the following page.

Hypotheses

$H1a=$ A green bond certificate has a positive impact on return

$H1b=$ A higher green bond score has a positive impact on return

$H2a=$ A green bond certificate increases liquidity

$H2b=$ A higher green bond score increases liquidity

$H3a=$ Innovative companies have a higher abnormal return at a green bond issue

$H3b=$ Companies that invest in innovation have a higher probability of having certificates

$H3c=$ Companies that invest in innovation will have a higher GBS

$H4a=$ Certification of a green bond is driven by institutional ownership

$H4b=$ A green bond score is driven by institutional ownership

$H5=$ Institutions are the buyers of green bond issuer stock

$H6a=$ A green bond certificate will have a positive impact on institutional buying

$H6b=$ A higher green bond score will have a positive impact on institutional buying

$H7=$ A certified green bond will have a positive impact on ASSET4 scores

$H8=$ Certification of green bonds will lead to higher long-term institutional holdings

3 Methodology

3.1 Issuer and issue characteristics

3.1.1 Issuer

The issuers of green bonds are very diverse, including, amongst others, supranational organisation, municipalities and banks. This thesis primarily looks at the market reaction from an equities perspective. Therefore, I will use a sample of listed companies. The issuer will have a number of figures publicly available and another that will have to be constructed. The publicly available accounting information includes: assets, ASSET4, cash, home country, leverage, liquidity, market to book, net profit, proxies for innovation (Tobin's Q and patents by company), ROA, R&D expenses, shares outstanding, tangibility and finally volatility. All of these are needed for all years in the sample period as it will allow me to test changes in them pre- and post-issuance. I will also need to inspect the ownership structure of the companies pre- and post-issuance.

3.1.2 Issue

The issue specific information will have an effect since a higher credit quality alludes to a safer company. Furthermore, many issue specific causes will underpin the equity reaction I am researching. I will look at the common bond issue characteristics: coupon, credit quality, issuance year, maturity and size. Additionally I will look at the green bonds certification, first and later issues, the GBS and what use of purpose the bond covers. These facets will serve the purpose of uncovering what investors are looking for when buying the stock of the companies.

3.2 Abnormal returns

In order to assess the impact of a green bond issue on stock performance the abnormal return will be calculated based on a reference index. The focus will be the replication of the method as detailed in Flammer (2018) and Tang and Zhang (2018). First of all the expected return will be calculated based on the estimation window of [-150,-15] and [15,150]. This is displayed in formulas (1 and 2). Afterwards, the abnormal return will be calculated as the difference between the expected return and the real return in four event windows as shown in formula (3). The cumulative abnormal return (CAR) is calculated will serve as a central variable in this thesis. Multiple regression models will be employed in order to note differences in terms of CAR in comparison to different types of indices.

$$R_{i,t} = \alpha_i + \beta_i \times R_{mt} + \epsilon_{i,t} \tag{1}$$

$$\hat{R}_{i,t} = \hat{\alpha}_{i,t} + \hat{\beta}_i \times R_{mt} \tag{2}$$

$$AR_{i,t} = R_{i,t} - \hat{R}_{i,t} \tag{3}$$

In formulas (1, 2 and 3) R is the return specified by either the issuer or the market at time t. The expected return is denoted as $\hat{R}$ and the abnormal return (AR) is taken as the difference between the expected and actual return.

In order to ensure robustness multiple reference indices will be chosen. Where Flammer (2018) was already very careful to events and industries I will take a more critical approach and will focus on beating the world wide market. I will use a global and diversified control index. Moreover, in order to see how pro-

nounced the announcement effect is different time intervals will be employed. The focus will be on [0,1] as it it important to exclude conflicting events. After the conclusions and the robustness following the abnormal returns the regressions models to decide on what explains the abnormal return will be completed based on the [-10,10] event window. The focus of the regression will be on the certification and the green bond scores. The use regressions will help to explain whether regulation of green bonds matters.

Formula (4) indicates the most relevant variables considered. It will focus on the certification dummy, first dummy and the green bond score (GBS). Moreover, a set of the issue controls and of issuer controls will be used as well as fixed effects.

$$
\begin{aligned}
CAR_i = \alpha_i &+ \beta_1 \times GBS_i + \delta_1 \times CERTIFICATE_i + \delta_2 \times FIRST_i + \gamma_i \times ISSUE + \gamma_i \times ISSUER \\
&+ TIMEFE + INDUSTRYFE + \epsilon_i
\end{aligned}
\tag{4}
$$

In the formula GBS represents the green bond score of the specific bond. A certification dummy will be given if the bond has been certified according to CBI principles. The first dummy signifies it was the first green bond the company issued. The issue controls include: coupon, credit quality and size. The issuer controls include: assets, ASSET4, cash, leverage, market to book and ROA. By capturing the industry and time fixed effects I hope to avoid overestimating outlying industries or years.

If the main variables are positive and significant it can be inferred that the market sees a certified or scored as a more promising issue. All the control variables are used to take out possible mediating influence on abnormal return. Namely a less liquid stock can have higher return because it needs fewer trades to increase.

Moreover, strong industry and time effect can be present. Therefore, more test will be done based on industry. The industry fixed effects are included because banks will can use the proceeds for lending to third parties, thus not making them necessarily more sustainable. On the contrary green lending is supported by the market. Meanwhile industrial companies will use the proceeds to fund their own projects. Finally, because of the economic cycle, time fixed effects are included. This mitigates the problem of higher abnormal return based on positive news during a downward trend.

The model will allow me to test hypotheses 1a and 1b. The certificate dummy should have a positive coefficient. The GBS variable should also have a positive coefficient. The expectations are in line with earlier research. However, hypothesis 1b has not been researched before and I will attempt to also confirm this finding. For abnormal returns the certificate and GBS should have an effect, since both indicate a great deal on potential stronger future returns of the issuer.

3.3   Liquidity

The illiquidity measures of Amihud and a pre- and post-issuance turnover analysis will be used to see what the impact of a green bond issue is on liquidity. In his paper Amihud (2002) introduced his proxy for illiquidity according to the specification in formula (5).

$$
ILLIQUID = \frac{1}{Days} \sum_{t=1}^{DAYS_t} \frac{|RETURN_{i,t}|}{VOLUME_{i,t}}
\tag{5}
$$

The sum of the absolute value of the returns is divided by the dollar volume of shares outstanding. The

first term then multiplies that value with the reciprocal of the number of days. A higher value would indicate a more illiquid stock. It will then be transformed to a monthly measure, based on the monthly sum. In addition to the Amihud measure the turnover ratio can also be taken as a proxy for increased or decreased liquidity. The turnover ratio is specified according to formula (6).

$$TURNOVER = \frac{\sum_{AD+1}^{t=x} \frac{T_{i,t}}{T_{m,t}}}{\sum_{t=-x}^{AD-1} \frac{T_{i,t}}{T_{m,t}}}$$

(6)

In terms of the above equation, the $T_{i,t}$ refers to the turnover of firm i at time t and the $T_{m,t}$ refers to the turnover of a reference index at time t. Lastly, AD refers to the announcement day, which represents the first trading day after the announcement has been made. When shown that the turnover ratio is statistically different from one the stock becomes more liquid. Once these measures have been created the main analysis on what increases the liquidity will be performed according to the model of Tang and Zhang (2018).

In formula (7) country fixed effects are also used since liquidity is heavily influenced by the location of the listing. In formula (7) firm fixed effects are also implemented since turnover already takes into account the size of the company. Furthermore, inter firm differences can be of influence. In formula (8) time fixed effects are used to correct for years with higher trading volume. According to the paper by Lesmond (2005) the Amihud measure is the preferred for the emerging world. The paper by Fong, Holden, and Trzcinka (2017) conclude the same, but for global research. Therefore, it will be the focus in this thesis.

$$
\begin{aligned}
ILLIQUIDITY_{i,t} = {} & \alpha_{i,t} + \beta_1 \times POST_{i,t} + \beta_2 \times (POST \times CERTIFICATE)_{i,t} \\
& + \beta_2 \times (POST \times FIRST)_{i,t} + \gamma_{i,t} \times ISSUE \\
& + \gamma_{i,t} \times ISSUER + COUNTRYFE + FIRMFE + \epsilon_{i,t}
\end{aligned}
$$

(7)

$$
\begin{aligned}
TURNOVER_i = {} & \alpha_i + \beta_1 \times GBS_i + \delta_1 \times CERTIFICATE_i + \delta_2 \times FIRST_i + \gamma_i \times ISSUER \\
& + TIMEFE + \epsilon_i
\end{aligned}
$$

(8)

Formulas (7 and 8) will allow me to test hypotheses 2a and 2b. I particularly expect that hypothesis 2a is correct since this shows that the proceeds will be spent correctly. Hypothesis 2b is more difficult to prove since there are a great number of other variable that could explain more liquidity. Rather than just a higher GBS, especially when we look at the rational reasons for investors buying a stock. Sometimes it is more rational to buy a green, yet lesser green company based on more important fundamentals such as profitability. The coefficient for the research variables have to be negative in formula (7) as this indicates less illiquidity, and positive in (8), this indicates higher turnover.

3.4 Investments in innovation

In order to identify investor' beliefs with regards to the future of the firm a number of proxies will be used. Tobin's Q is the most common measure of future expectations. Furthermore, environmental performance based on ASSET4 and profitability based on ROA are used. In addition to Tobin's Q, patents are another proxy for innovation. The annual change in patents is scaled over R&D to ensure large companies are not given an unfair weight. Two different approaches will be taken to see what the effect of the GBS is on innovation and company success. First of all I will establish if the innovation measures provide reasons as

to why the abnormal return is present. The following formula will be used:

$$CAR_i = \alpha_i + \beta_1 \times TOBINSQ_i + \beta_2 \times ROA_i + \beta_3 \times ASSET4_i$$
$$+ \beta_4 \times \frac{log(1 + PATENTS)_i}{R\&D_i} + FIRMFE + TIMEFE + \epsilon_i \qquad (9)$$

In formula (9) the expectations for Tobin's Q and ROA are to be robust and positive. ASSET4 covers more factors on corporate governance than just environmental performance and since improved governance is also important the entire ASSET4 score is employed. However, it is not expected for it to play a role.

Formula (9) will test hypothesis 3a and offer some explanation on the reliability of company policy. Dealing with endogeniety with Tobin's Q is difficult, but issuing a bond signifies investing in a new or expanding a current project. Therefore, in the pre-period it should not have been reflected in Tobin's Q. Firm fixed effects are used to eliminate the unobserved effect from innovative and non-innovative firms. Finally, time fixed effects are included this will correct for changes in the economic cycle.

In the second model I want to address what are the predictors of a higher GBS. Based on the literature it is expected that more innovative companies would benefit from a higher GBS as this signals they are innovating more. Therefore, I will use the same set of variables yet this time see if they can function as predictors of the GBS according to formula (10). Furthermore I will use probit regression models to measure whether the variables can explain a higher probability of certification. In formula (11) the CDF of the normal distribution is used. Finally, the variables use the average of the pre-issuance year and issuance year. Since it is expected that the issuers' financial position in the previous year is the indicator of its financial health in the year after. However, for bond issues in December the financial position is impacted much more by the results of that year. Additional testing will deal with this measurement problem.

$$GBS_i = \alpha_i + \beta_1 \times TOBINSQ_i + \beta_2 \times ROA_i + \beta_2 \times ASSET4_i + \epsilon_i \qquad (10)$$

$$Pr[CER_i = 1 | X_{1,2,3}] = F(\beta_0 + \beta_1 \times X_1 + \beta_2 \times X_2 + \beta_3 \times X_3)$$
where
$$X_1 = TOBINSQ_i$$
$$X_2 = ROA_i$$
$$X_3 = ASSET4_i \qquad (11)$$
and
$$F(x) = \int_{-\infty}^{x'\beta} \phi(z)dz$$

These methods will allow me to test hypotheses 3b and 3c. I particularly expect that hypothesis 3b is true since this shows that the company is seeking validation for its innovative efforts. Hypothesis 3c is more difficult to establish since there innovation and business sense do not always go hand in hand. When focusing on green products I expect that the conscious decision to go green could be overpowered by a business rationale to not only be green, but also be profitable. This would result in a certificate, but not necessarily induce the need for a higher GBS.

3.5 Institutional ownership

The most interesting aspect in order to see what drives green bond issuance is the institutional ownership component. Since this thesis only covers the green bond universe I will look use probit regressions to find out if institutional ownership matters for certification and scoring. Moreover, different regressions will be used to test what the role of the different types of institutions are.

The role of institutions and sustainability is complex and especially puzzling in the green bond market. The two aspects I will focus on are does higher institutional ownership increase the probability of certification and a GBS. As mentioned by Dyck et al. (2019) institutions push companies to be more sustainable. Is this also the case for green bonds? Furthermore, who is buying the stocks after the issuance will provide information on the rational or behavioural reaction. Finally, once this effect has been established I will look if certification and GBS drives institutional buying.

3.5.1 Institutional ownership as the driver

It has been established that green bonds enjoy a great deal of popularity in the market. The bonds indicate companies are willing to combat climate change and pollution. Furthermore, it will allow for companies to promote themselves as green and this attracts a great deal of attention from investors and the media. Nevertheless, not all companies would use this method to promote innovation. It can also be done through other investment vehicles, which lack the certification and monitoring costs of green bonds. Therefore, the question arises why would a company decide to issue a green bond. The potential role of institutional owners is further explored in this thesis. First of all, large pension and insurance funds are becoming more vocal when it comes to sustainability. A green bond issue is an easy and opportunistic manner to show that the companies you invest in are becoming greener. Moreover, as it is a given that green bond issuance creates abnormal return, increases liquidity and boost innovative investment from a current shareholder perspective it is very sensible to push for green bonds issuance and certify it. Formula (12) will allow me to test if institutional ownership improves the chances of having a certificate. Furthermore, as noted large country and regional differences exist in addition to the type of institutional owner. Since green bonds are issued during many moments in the year it is difficult to classify what measurement year for IO to select. In the formulas the IO value of the issue year is used. To correct for endogeniety multiple additional tests have to be completed including the IO value of the year prior and the moving average of the prior and post year.

Formulas (12 and 13) tests if higher Institutional Ownership (IO) increases the probability of having a certificate in an issue. Both use the CDF of the normal distribution. Furthermore, the set of issuer controls such as cash and ROA will allow me to see what other factors from the issuer perspective push the certification process. A company limited in its cash position might not want to spent it on certification as this impedes its business practice. A dummy for pension funds (PF) as the primary institutional owner will be employed when PF are as an industry own the largest share of an issuer' shares. Furthermore, a home country (HC) dummy will be employed when the country based sum of institutional ownership majority is from the issuers' home country. Finally, a common law (CL) dummy will be used when the largest country based sum of shareholders is from a common law country. The paper by La Porta et al. (1997) stipulated that the legal origins of a country can have significant impact on the ease of finance. In addition to the certification the GBS will also be evaluated. The greenwashing problem arises here, is certification enough or are institutions pushing for greener projects? Formula (13) will provide more detail on this.

$$Pr[CER_i = 1|X_{1,2,3,4,5}] = F(\beta_0 + \beta_1 \times X_1 + \beta_2 \times X_2 + \beta_3 \times X_3 + \beta_4 \times X_4 + \gamma \times X_5)$$

where
$X_1 = IO_i$
$X_2 = PF_i$
$X_3 = HC_i$ (12)
$X_4 = CL_i$
$X_5 = ISSUERCONTROLS_i$
and

$$F(x) = \int_{-\infty}^{x'\beta} \phi(z)dz$$

The formulas (12 and 13) provide the evidence for hypothesis 4a and 4b. The combination of evidence will help to establish if institutional owners are using their voting power to push for certificates and a GBS. Moreover, it allows for discussion on what sort of institutional owners are most vocal.

$$Pr[GBS_i = 1|X_{1,2,3,4,5}] = F(\beta_0 + \beta_1 \times X_1 + \beta_2 \times X_2 + \beta_3 \times X_3 + \beta_4 \times X_4 + \gamma \times X_5)$$

where
$X_1 = IO_i$
$X_2 = PF_i$
$X_3 = HC_i$ (13)
$X_4 = CL_i$
$X_5 = ISSUERCONTROLS_i$
and

$$F(x) = \int_{-\infty}^{x'\beta} \phi(z)dz$$

When shown that shareholders are pushing for certification and GBS the market paradigm is shifting towards sustainability rather than providing nudges in that direction. The testing of hypothesis 4a and 4b have not been completed in depth in earlier research.

3.5.2 Who is buying?

Relating back to the two competing hypotheses for abnormal return is the question which investor class is buying the green bond issuer stock post-issuance. While it is not entirely true that institutions are rational and all retail investors are responding to noise this is the common distinction between the two. In order to test this I will look at the change in institutional ownership in the years post-issuance. When this increases it can be deduced that institutions are also the class who is buying the stock.

$$\Delta IO_{i,t+1} = \alpha_{i,t} + \beta_1 \times GBS_i + \delta_1 \times CERTIFCATEi + \gamma \times ISSUER_i + INDUSTRYFE$$
$$+ TIMEFE + \epsilon_i \tag{14}$$

According to formula (14) the change in ownership could be caused by a green bond issuance in the

year prior. However, I will also consider issuer specific controls such as leverage and profitability. Since most of the time this would also make a very probable case as to why institutions would buy this company. Furthermore, I will test if certification and a higher GBS affects the change in ownership. Industry fixed effects are used to correct for differences in holding patterns between industries. As Ferreira and Matos (2008) also included to correct for these effects. Time fixed effects are also used to correct for potential buying and selling of institutions during various years.

By testing hypotheses 5, 6a and 6b conjointly the picture becomes clear who is the cause of the increased liquidity. I expect all to be true with 6a and 6b having higher positive coefficients than 5. This could be changed by switching to smaller time intervals i.e. [AD,180] instead of the year after issuance. However, semi-annual holdings are not commonly available.

3.6 Long-term impact

In order to measure if the green bonds actually improve a companies green efforts I will employ similar methods as Flammer (2018). The first is the measure the long-term change in ASSET4 score year by year. In order to judge if the green bond has effect the change in ASSET4 will be taken and regressed against the control variables. Time fixed effects are used to ensure the results are robust across the sample period.

$$\Delta ASSET4_{i,t+1,2} = \alpha_i + \delta_1 \times CERTIFICATE_i + \gamma \times ISSUER_i + TIMEFE + \epsilon_i \tag{15}$$

As outlined in formula (15) the GBS and certification could have effect, but a more profitable year can also play a large role for changes in ASSET4. It is important to look at what has the explanatory power. Furthermore, to test when the green bond has an effect the ASSET4 score one and two year later will be looked at. First of all, not all bonds are issued at the same date of the year. Therefore, the impact of some will not be reflected in the score one year later. Second, it is assumed that there is a significant gap between raising the bond and creating the projected impact.

$$\Delta IO_{i,t+2,3} = \alpha_i + \beta_1 \times GBS_i + \delta_1 \times CERTIFICATE_i + \gamma \times ISSUER_i + \epsilon_i \tag{16}$$

In formula 16 the change in the share of institutional owners is regressed against the GBS, the certificates and a set of issuer controls. Since IO is expected to increase after a green bond issue it is also important to notice if it has a long-term impact. However, it is important to include the controls on the issuer level since an high market to book ratio can still have trouble attracting the additional investors. In additional tests the home country IO characteristics will be evaluated.

Formula (15) will allow me to test hypotheses 7. The expectations are for the change in ASSET4 score to be positively related to the variables and as the time interval becomes larger for more robust results to show.

Hypothesis 8 will be tested using formula (16). I expect there to be some correlation, but cannot imply causation yet.

4 Data

4.1 Data Collection

The green bond issuance data is obtained from Bloomberg, the announcement date is also provided by Bloomberg. The announcement dates are checked using Bloomberg, The Financial Times, Reuters, The Wall Street Journal and various national newspapers. The bond ISIN codes are matched to the company ISIN using Bloomberg. All the company specific accounting information is obtained using Thomson Datastream. Most information in Datastream is reliable and trustworthy, but sometimes it is inconsistent with previous years. Because of this many measures in this thesis are constructed based on the availability of consistent data.

Ownership data is obtained using Bureau van Dijk and Orbis. Because of big inconsistencies in the Orbis data a great deal of work was done manually in order to ensure consistent names and identification numbers. The ownership classification based on SIC codes was also completed using the Orbis data. The latest SIC code was used if it changed in the sample period.

Finally, Orbis also provided the patent data. Orbis has some limitations in terms of data sizes. Therefore, only the total number of patents per year can be used. Since patents expire the difference between the years is tainted by expiring patens. However, the measurement error is constant for all companies.

The Climate Bond Initiative shared their certified bond datafile, which allowed for rapid processing of the certificates. The CBI has a great deal of data on green bonds and I thank them for sharing this with me. The file contains all information needed with regards to the certificates. Furthermore, the use of purpose of the bonds can also be found using their file. The various goals are in line with the Paris 2015 sustainability goals.

The GBS had to be looked up manually on the Moody's and S&P websites as there is no current database in Bloomberg or Datastream. Furthermore, since the methods of rating and scoring are somewhat different a conversion model was used. Moody's use a quintile based rating. All the S&P scores were also separated into quintiles and the median of the S&P quintiles was used as the score for the Moody's bonds.

A combination of Excel and STATA are used to merge the data from the various sources. Most of the preparatory work was done in Excel. Afterwards STATA was used to combine the individual files. For the analytical analysis and statistical tests STATA was used.

4.2 Summary statistics

4.2.1 Issue Characteristics

Table 1: Green Bond issues by country per year

Country	2013	2014	2015	2016	2017	2018	2019	Total	Average Size in $m
AE	0	0	0	0	1	0	0	1	548
AT	0	1	0	0	0	1	0	2	500
AU	0	2	1	1	3	4	1	12	367
BE	0	0	0	0	0	1	0	1	500
BM	0	0	0	2	1	2	0	5	224
BR	0	0	2	2	2	0	0	6	516
CA	0	0	0	0	2	1	2	5	402
CH	0	0	0	0	0	0	2	2	89
CN	0	0	1	25	31	30	8	95	562
CO	0	0	0	0	1	0	0	1	57
DE	1	1	2	2	5	6	5	22	338
DK	0	0	1	0	2	0	4	7	474
ES	0	3	0	3	5	5	2	18	644
FI	0	0	0	0	1	0	5	6	386
FR	1	3	6	4	6	11	5	36	620
GB	0	2	1	0	2	3	1	9	465
HK	0	0	0	2	6	5	4	17	159
ID	0	0	0	0	0	5	0	5	15
IN	0	0	3	6	3	2	1	15	229
IT	0	2	0	0	2	2	4	10	500
JP	0	0	1	2	4	29	10	46	152
KR	0	0	0	0	1	3	6	10	362
KY	0	0	0	1	1	3	2	7	284
LU	0	0	0	0	2	0	0	2	400
MU	0	0	0	0	2	0	0	2	421
MY	0	0	0	0	0	26	0	26	5
NL	0	0	3	1	1	6	3	14	575
NO	0	0	1	1	2	0	3	7	84
NZ	1	0	0	0	1	0	2	4	55
PH	0	0	0	0	0	0	2	2	180
PT	0	0	0	0	0	0	1	1	1000
SE	0	0	1	2	14	24	15	56	91
SG	0	0	0	0	2	0	1	3	323
TH	0	0	0	0	0	0	5	5	73
TW	0	0	0	0	6	10	2	18	58
US	0	1	85	10	7	7	10	120	159
XS	0	0	0	0	0	0	1	1	568
ZA	0	0	0	0	0	3	0	3	25
Total	3	15	108	64	116	189	107	602	300

Note: Appendix 3 contains a list of Country Codes and Country Names

In total 602 corporate green bonds are used in the thesis issued by 214 companies. Table 1 shows how the corporate green bond market takes of in 2015 and does not lose momentum afterwards. Moreover, a small number of countries are offering many bonds. In addition to larger economies of China and the United States, smaller countries that have a stronger sustainability drive such as Australia and Sweden offer many green bonds. Table 1 indicates that green bonds are issued on a global scale and it is not dominated a small number of countries. The average issue size is $300 million, but significant differences between countries exist.

Table 2: Green bonds by industry and certification

Industry	Non-Certified	Certified	Total	Median Coupon(%)
Bank	127	15	142	2.8
Financial	30	7	37	0.91
Industrial	318	27	345	3.60
Insurance	1	1	2	3.16
REIT	62	1	63	1.54
Utility	13	0	13	3.65
Total	551	51	602	3.25

Since many industrial companies offer green bonds it is a strong signal to the market that these companies also are acquiring most certificates. The risk of green washing is highest in the industrial sector. Furthermore, banks have been offering many non-certified green bonds, but their internal scrutiny should prevent negative usage. However, they are also aligning their policies more with the CBI and start to acquire more certificates.

Finally, the coupons for most bonds seem to hover around the overall median. Notable exceptions are the financial and REIT industries, these lower numbers are driven by the issues in 2018 and 2019.

4.2.2   Issuer Characteristics

Table 3: Green bond issuer characteristics in the issue year

Variables	N	Mean	Standard Deviation	Median
Assets (ln)	306	18.33	2.776	17.65
ASSET4	211	58.57	25.21	41.36
Cash (ln)	277	14.38	2.74	14.01
Leverage	306	0.348	0.150	0.336
Liquidity	277	0.089	0.072	0.077
MTB	202	1.539	0.991	1.220
ROA	306	0.002	0.055	0.011

The companies that issue green bonds have about 100 million in assets. The standard deviation is large suggesting the sample contains both large and small cap companies. It appears that some companies have very low ASSET4 scores due to the large differences between median and the mean, this is also indicated by the large standard deviation. The cash position of most companies is between 2.5 and 3 million on average, with large differences. Leverage, defined as total debt over total assets, hovers around 35% of the companies. Some industry differences exist, but apart from financial institutions who have a leverage of 53% most are near the mean and median. Liquidity is defined as cash/assets and most companies have between 8% and 9% of the assets as cash positions. The market to book ratio, after trimming for economic unrealistic values, has a much higher mean than median suggesting some companies are really expensive. Finally, the return on assets defined as operating income over assets at a median of 1%, caused by loss making companies. These figures is somewhat inline with expectations and earlier papers on green bonds.

5 Results

5.1 Abnormal Returns

5.1.1 Cumulative Abnormal Returns

Table 4: Cumulative Abnormal Returns for different event windows

For 514 different green bond issues the cumulative abnormal returns were calculated based on the predicted return of a reference index. The different event windows are based on the commonly employed event windows for event studies. The estimation window was [-150,-15] and [15,150]. A total of 11 companies and 88 bonds did not qualify for these tests the abnormal returns could not be calculated, since the companies were not listed during the estimation period. Two companies issued a very high number of bonds and caused this discrepancy. (Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1)

Event Window	(1) [0,1]	(2) [-2,2]	(3) [-5,5]	(4) [-10,10]
Coefficient	0.00395***	0.00445***	0.00515***	0.00833***
	(0.00102)	(0.00119)	(0.00147)	(0.00199)
Observations	514	514	514	514

Formulas (1, 2 and 3) serve as the basis for the calculation of the abnormal return. Table 4 displays the results are based on four event periods and one reference index. Column (1) shows an abnormal return of 0.395% at a 1% significance level for the [0,1] event window. Column (2) shows an abnormal return of 0.445% at a 1% significance level. Column (3) shows an abnormal return of 0.515% at a 1% significance level. Finally, column (4) shows an abnormal return of 0.833% at a 1% significance level for the [-10,10] event window. The MSCI ACWI index was used as a reference index because of the global diversified constituents. As green bonds are also issued in the emerging world it is the chosen index.

The results imply the following: first of all a very robust cumulative abnormal return is present. Furthermore, the small increases after the first day suggests that the a green bond issue can be the only cause of the return. Nevertheless, with it only being 0.395% the interpretation has to be cautious, it is too small to be truly linked to the announcement. Even when including firm fixed effects the results do not change much in terms of economic significance. Finally, is noteworthy that the CARs keep increasing. Suggesting that pre and post-announcement these stocks are also being acquired by investors. This can also be due to information leakage about the bond issuance. Acharya and Johnson (2007) report on insider trading in the CDS market, this can also be the case in the normal bond market.

5.1.2 Predictors of abnormal return

Table 5 shows the predictors of the abnormal returns based on formula (4). Column (1) reports only on the GBS and because of the lacking of observations it is very insignificant also noting the very low R-Squared. In columns (2 and 3) by including the fixed effects the coefficients become significant at a 5% level and show an increase in abnormal return with a higher GBS. The small sample size is a problem at this stage since some observations can play a large role. The additional clustering of other variables helps for significance, yet fails to explain the role of the GBS. The Moody's quintile based scores showed the same pattern

Columns (4 till 8) report on the certification and first dummies. In contrast to initial expectations the certificates do not increase the abnormal return but rather decrease it. This remains significant in at a 10% level even in columns (7 and 8). The first issues do not appear to make a significant effect. The issue control

variables do not have an impact as would be expected. On the other hand, assets and Tobin's Q have a positive effect and significant effect in column (8). Assets remain significant and positive when including firm fixed effects, thus it can be concluded that larger companies have higher returns. In order to correct for endogeniety Tobin's Q of the year after was also included and the coefficient became higher and remained significant. In further tests based on the interaction between certificates and the industry classification it appears the decrease is caused by some industrial companies. The F-Test and the Hausman test were completed as a check for the need of fixed effects. Both confirmed the correct use of the industry and time fixed effects. Overall, it is surprising to note the negative effect of the certificate on abnormal returns. The results allow me to reject hypothesis 1a certificates do not increase the CAR. I accept hypothesis 1b a higher GBS increases the CAR.

Table 5: Predicting variables for a CAR post green bond issuance

For 514 different green bond issues the cumulative abnormal returns were predicted using various other variables. The cumulative abnormal return with the event window [-10,10] was used. The GBS, certificate dummy (1=Certifcate) and first dummy (1=First issue) are the focus with all others serving as controls. The controls are split into issue controls (Coupon, Credit Rating and Issue Amount) and issuer controls (Assets, Cash, Leverage, Liquidity, Return on Assets and Tobin's Q). Credit quality is based on the Moody's credit ratings with Aaa being the highest. Leverage is defined as debt over assets. Liquidity is defined as cash over assets. Industry fixed effect based on the industries listed in table 2 were employed. Time fixed effect are based on annual differences. (Robust standard errors in parentheses *** $p<0.01$, ** $p<0.05$, * $p<0.1$)

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
GBS	9.52e-05	0.0110***	0.00944**					
	(0.00265)	(0.00175)	(0.00174)					
Certificate				-0.0126**	-0.0127**	-0.0136	-0.0131*	-0.0208**
				(0.00637)	(0.00631)	(0.00827)	(0.0070)	(0.0094)
First				-0.000268	0.000446	0.000508	0.0005	0.0032
				(0.00401)	(0.00452)	(0.00127)	(0.0041)	(0.0054)
Issue Amount							-4.53e-06	
							(1.79e-05)	
Coupon							-2.96e-05	
							(2.85e-05)	
Credit Quality							-3.77e-05	
							(4.19e-05)	
Assets (ln)								0.0043*
								(0.0024)
Cash (ln)								-0.0013
								(0.0018)
Leverage								-0.0045
								(0.0191)
Liquidity								-0.085
								(0.0572)
ROA								0.1192
								(0.1101)
Tobins Q								0.0121**
								(0.0053)
Constant	0.0169	-0.920***	-0.782**	0.00968***	-0.0144	-0.0148**	-0.0177	-0.0602*
	(0.225)	(0.149)	(0.146)	(0.00256)	(0.0421)	(0.00551)	(0.0205)	(0.0324)
Observations	11	11	11	513	513	509	505	304
R-Squared	0.000	0.708	0.728	0.007	0.018	0.019	0.011	0.077
Industry FE	No	No	Yes	No	No	Yes	No	No
Time FE	No	Yes	Yes	No	Yes	Yes	No	No
Issue Controls	No	No	No	No	No	No	Yes	No
Issuer Controls	No	No	No	No	No	No	No	Yes

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5.2 Liquidity Effects

5.2.1 Amihud Illiquidity

Following the examples of Tang and Zhang (2018) the Amihud Illiquidity measure is month based it has been multiplied by one million to create more sensible numbers. Furthermore, the log of measure was taken after in order to have a deal with substantial differences between companies. Finally, it was trimmed at a 5% level in order to exclude unrealistically high (low) values. The Amihud illiquidity measure was taken on a 3 month pre- and 3 month post-issuance basis in order to align it with the turnover measure. Table 6 allows me to interpret the coefficients and see if they are significant when test using various controls and fixed effects. However, because of the monthly aggregation it is not possible to conclude on daily effects.

Table 6: Amihud illiquidity analysis

The Amihud illiquidity measure as specified in formula (5) is regressed against a number of factors that influence liquidity. The event window is [-60,60] In the post dummy is defined as the post-issuance period. The post×certified and post×first are dummy variables are based on the two dummy variables for certified and first issues. It is expected that a post-period would be more liquid. Finally, the volume and volatility values are used to check this model is coherent with economic theory. Volume is the currency volume of trades. Volatility is a daily volatility measure. Because of possible significant differences between large and small firms and calm and turbulent years the fixed effects are employed. (Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1)

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
Post	0.256***	0.0606***	0.273***	0.0389***	-0.0114	0.0508***
	(0.0445)	(0.0125)	(0.0442)	(0.0123)	(0.00739)	(0.00734)
Post × Certfied	-0.756***	0.0114	-0.687***	0.000814	-0.0362*	-0.0227
	(0.0665)	(0.0175)	(0.0663)	(0.0173)	(0.0185)	(0.0157)
Post × First	-0.175***	-0.0463***	-0.208***	-0.0258**	-0.0384***	-0.0863***
	(0.0451)	(0.0127)	(0.0448)	(0.0124)	(0.00789)	(0.00784)
Volume (ln)		-0.973***		-0.976***		-0.252***
		(0.00210)		(0.00209)		(0.00535)
Volatility		0.0305***		0.0300***		0.0313***
		(0.000682)		(0.000689)		(0.00363)
Constant	-1.997***	8.132***	-0.234	8.446***	-2.002***	-0.117
	(0.0276)	(0.0299)	(0.223)	(0.0561)	(0.00461)	(0.110)
Observations	20,899	13,660	20,899	13,660	20,899	13,660
R-Squared	0.008	0.942	0.028	0.944	0.003	0.159
Firm FE	No	No	No	No	Yes	Yes
Time FE	No	No	Yes	Yes	No	No

Column (1) shows that illiquidity overall decreases in the post-issuance period. This appears to be driven be certified and later issues. In column (3) it becomes apparent that across the years the same conclusions hold. However, in column (5) it becomes clear that the results are caused by some companies as the overall post coefficient is negative while insignificant. The post×certified and post×first coefficients are negative and significant in most models. In column (2) the control variables of volume and volatility are behaving as expected and significant. They remain significant when including annual and firm fixed effects. The Hausman test showed the firm fixed effects had no influence on this model. The F-test showed there was enough evidence to infer the annual fixed effects were useful. A higher currency volume of trade will decrease illiquidity and higher volatility will increase illiquidity. In additional test based on one and five month pre- and post-issuance periods the conclusions are the same. This is in inline with holding economic principles. It can thus be inferred that stocks become more liquid after a green bond issue. Moreover, the stock become even more liquid when it is a certified or first issue.

5.2.2 Turnover Ratio

The turnover measure was trimmed at the 5% level after it has a mean of 1.14 and is highly significant with a t-value of 3.03 compared to no change in turnover. Only 239 bonds can be used for this test. Since the rest of the sample was issued to closely to each other to get correct ratios. This suggests that in the post-issuance period the stock of the company is involved in 14% more trades.

Table 7: Turnover ratio analysis

The turnover measure is based on the paper by Chen et al. (2003) and taken as the ratio of volume based turnover in the pre [-60,AD-1] and post period [AD+1,60]. GBS is the score on a scale from 1 to 100. Certificate and first are dummies taking on 1 when they are certified or the first issue. All other variables are issuer controls. Leverage is defined as debt over assets. Liquidity is defined as cash over assets. Firm and Time fixed effects are used in order to compensate for differences. (Standard errors in parentheses *** $p<0.01$, ** $p<0.05$, * $p<0.1$)

VARIABLES	(1)	(2)	(3)	(4)	(5)
GBS	-0.0575	0.112*			
	(0.0366)	(0.0447)			
Certificate			-0.190**	-0.105	-0.422**
			(0.0941)	(0.0863)	(0.177)
First			-0.115	-0.103	0.206
			(0.115)	(0.125)	(0.150)
Assets (ln)					0.0420
					(0.0838)
ASSET4					0.00177
					(0.00246)
Leverage					1.243***
					(0.348)
Liquidity					1.478
					(1.420)
ROA					10.53***
					(2.162)
Cash (ln)					-0.0835
					(0.0687)
MTB					-0.0497
					(0.0698)
Tobins Q					-0.708***
					(0.228)
Constant	5.832	-8.810	1.257***	0.737***	0.239
	(3.041)	(3.801)	(0.107)	(0.172)	(0.703)
Observations	8	8	237	237	53
R-Squared	0.292	0.972	0.013	0.120	0.538
Time FE	No	Yes	No	Yes	Yes
Issuer Controls	No	No	No	No	Yes

Table 7 shows that the results of the regression model specified in formula (8). In columns (1 and 2) the GBS is looked at. In column (2) it is listed that a higher GBS increase the turnover ratio, while only significant at a 10% level. The differences in R-Squared show that much of the variation is absorbed by the annual fixed effects. In columns (3, 4 and 5) the certification and first issues are highlighted. A certificate appears to decrease turnover ratio by -0.19, but with a constant of 1.257 thus remaining above 1 and showing a higher post-issuance turnover. In column (5) many issuer controls are included. First of all, higher leverage increases turnover. It is significant at the 1% level and positive. Potentially because the float is smaller. Tobin's Q appears to decrease turnover, this could be linked to the company being overvalued according to some investors. ROA increases turnover, as a more profitable company is more likely to be bought by investors. The F-test showed the time fixed effects were useful.

The results of tables 6 and 7 show ambiguous results. The Amihud illiquidity decreases in the post period with a certificate and with a first issue. However, the turnover ratio appears to decrease. Because of the literature claiming the Amihud measure is preferred I hesitantly accept hypothesis 2a. With the GBS in a very small sample being I do not accept nor reject hypothesis 2b, but noting the impact of certificates I believe future research can provide more substantial evidence on the GBS and liquidity.

5.3 Investing in Innovation

Since it has been established that a green bond issue is a sign of investing in innovative and sustainable projects it is important find out how the market views these new ventures. Furthermore, this section will show what sort of companies get their green bonds certified or score. Formulas (8, 9 and 10) highlight the details of the models, also testing for other indications of investing in innovation would help to explain how the market assess a green bond issue. Tables 8 and 9 shows the results for the tests.

5.3.1 Innovative companies and abnormal returns

As the main indicator of innovation Tobin's Q has a positive effect on abnormal return. The Tobin's Q score used was of the year prior to issuance. This indicates that when an innovative company issues a green bond the market believes it will bring additional benefits. the coefficient is always positive and significant in three models. Investors of more profitable companies also enjoy a higher abnormal returns. In column (3) the coefficient is high and significant at a 5% level, but it is only a very small sample dominated by a small number of companies.

Table 8: Abnormal returns for innovative companies

The CAR based on the [-10, 10] event window are used to measure if innovative companies have a higher abnormal return when issuing a green bond. It is based on the notion that being green is an investment in the future. Tobin's Q as a measure of innovation and future returns is used. ROA and ASSET4 serve as controls. A scaled measure of patents per year is used as another proxy for innovation. The delta patents measure was capped at zero, although patents expire it distorts the measure. To correct for industrial and non-industrial firms the fixed effects are used.(Standard errors in parentheses *** $p<0.01$, ** $p<0.05$, * $p<0.1$)

VARIABLES	(1)	(2)	(3)	(4)	(5)
Tobin's Q	0.00685***	0.000743	0.0189	0.00825***	0.0470**
	(0.00240)	(0.00326)	(0.0139)	(0.00302)	(0.0237)
ROA	0.154**	-0.0431	-0.3707**	0.141**	1.265*
	(0.0597)	(0.0786)	(0.1715)	(0.0676)	(0.764)
ASSET4		9.29e-05			
		(0.000131)			
Patents			8.12e-05		
			(1.93e-04)		
Constant	-0.00149	-0.00160	0.0560	-0.0298	-0.0583*
	(0.00391)	(0.0113)	(0.0102)	(0.0299)	(0.0337)
Observations	420	250	54	420	420
R-Squared	0.020	0.005	0.343	0.039	0.016
Time FE	No	No	No	Yes	No
Firm FE	No	No	No	No	Yes

The two other indicators of innovation and sustainable practises do not offer useful results. Column (2) has a very low R-Squared and ASSET4 is not significant. In column (3) the patents measure is not

significant. Companies that are innovative and profitable see higher abnormal returns when a green bond is issued. If the Tobin's Q of the post-issuance year is chosen the coefficient is lower, for the ROA the coefficient is much higher. This confirms the key notion of table 8, innovative companies have higher abnormal returns, and supports the assertion that investors also take into account the previous years financial performance. Lastly a split sample between profitable and non-profitable companies was created. The differences are small for Tobin's Q and mirrored in the for ROA with more profitable and less profitable non-profitable companies having less abnormal return. The Hausman test indicates firm fixed effects are not necessary, while there is are firm effects they are not strong enough. Annual effects are weakly significant at a 10% level. It shows that Tobin's Q is an important indicator of abnormal return as table 5 already alluded to. Based on these findings I accept hypothesis 3a.

5.3.2 Innovative companies, certification and GBS

Showing that innovative companies enjoy higher abnormal returns indicates the market believes their efforts will generate future returns. Therefore, will these companies also have a higher probability of having their bond issues certified or have higher scores? Formulas (9 and 10) serve as the base for the regression models.

Table 9: Height of GBS and probability of certification based on issuer characteristics

The regression model seeks to explain what causes a higher GBS. The probit regression models are employed to check if the probability of having a certificate is impacted by other issuer dependent variables. Tobin's Q as a measure of innovation ROA as profitability and ASSET4 as a measure of sustainability are used. Time fixed effects are also used to ensure robustness based on the different years. (Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1)

VARIABLES	(1) GBS	(2) Certificate	(3) Certificate	(4) Certificate
Tobin's Q	3.2287	-0.702***	-0.922**	-0.942*
	(2.955)	(0.242)	(0.440)	(0.498)
ROA	-27.53	0.671	-1.021	-5.620
	(31.79)	(4.217)	(6.850)	(8.714)
ASSET4			0.00147	0.00298
			(0.00544)	(0.00587)
Constant	83.56***	-0.684***	-0.575	0.490
	(1.167)	(0.162)	(0.499)	(1.006)
Observations	8	430	256	250
Chi-squared		29.34	29.95	34.79
(Pseudo) R2	0.205	0.102	0.178	0.214
Time Fe	No	No	No	Yes

In column (1) the GBS is regressed against other variables. The results are not significant and do not explain why companies would have a higher GBS. While it are isolated projects there still can be correlation. Furthermore, columns (2, 3 and 4) show clearly that Tobin's Q as a measure of innovation decreases the probability of having either a certificate . It is robust in all columns, in addition all Chi-Squareds and Pseudo R-Squareds, indicating that the models have merit. It can be explained by the fact that either the companies rather use their funds elsewhere, or their reputation ensures a credibility. The test was also performed with an average Tobin's Q of the year before and the issue year. The conclusions are the same since the coefficient is similar and significant. Furthermore, the same test were also completed based on a logit model and the sign or the significance of the results are the same. The marginal effects test and Wald showed the model was correct in terms of signs and the variables were independent. The other explanatory variables do not offer clear indications or significant results. I reject hypothesis 3b and 3c, innovative companies are not more

probable to have a certificate or a higher GBS.

5.4 Ownership of green bond issuing companies

Identifying why companies decide to issue a green bond over a grey bond is complex. However, noting earlier research the institutional ownership (IO) structure of companies can provide some guidance. The following sections look if higher IO pushes for more green bonds scores and certificates. Furthermore, it could also be linked to classification of a type of owner. In the following section both the pre- and post-issuance period will be evaluated.

5.4.1 Institutional ownership pushing for green bond certification

Following formulas (11 and 12) the regression model is based on the IO of a company during its issue year. Second, the issuer specific control variables are used. Finally, three dummy variables regarding the type of the largest owner are employed. The PF dummy was based on the SIC code for pension funds (PF=1 if a pension fund is the largest institutional owner). The HC dummy was created if the company and owner are from the same country (HC=1 if the largest institutional owner is from the home country). The CL dummy was based on the eight countries in the sample that use common law namely: Australia, Canada, Great Britain, Hong Kong, India, New Zealand, Singapore and the United States (CL=1 if the largest institutional owner is from a common law country).

Table 10: Probability of a GBS or certificate based on ownership characteristics

Probit regression models are used to asses whether certain owners of company stock are making a push for the company to go green and have their green bonds rated or scored. Both the GBS and Certificates are dichotomous variables in this model. Institutional ownership is defined as the shares of stock held by a institution in a given year. The pension fund, home country and common law variables are all dummies based on established literature regarding active institutional owners and their wishes. Liquidity is defined as cash over assets. Furthermore, three control variables regarding availability of assets and profitability are used. (standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1)

VARIABLES	(1) GBS	(2) GBS	(3) GBS	(4) Certificate	(5) Certificate	(6) Certificate	(7) Certificate
Institutional Ownership	0.00698	0.00793	0.00421	-0.0460	-0.0516*	-0.0530	-0.0380
	(0.0118)	(0.0138)	(0.0176)	(0.0281)	(0.0295)	(0.0346)	(0.0285)
Pension Fund					0.279		0.424
					(0.598)		(0.596)
Home Country		0.461	0.570		0.703***	0.842**	0.633**
		(0.412)	(0.688)		(0.224)	(0.336)	(0.247)
Common Law					0.580**	0.719**	0.534**
					(0.247)	(0.352)	(0.263)
Liquidity			8.432**			-3.016	
			(3.977)			(2.278)	
MTB			-0.638			-0.274	
			(0.499)			(0.218)	
ROA			2.681			0.499	
			(14.57)			(6.337)	
Constant	-2.287***	-2.368***	-2.315***	-1.090***	-1.429***	-0.760*	-1.221***
	(0.222)	(0.293)	(0.833)	(0.152)	(0.187)	(0.401)	(0.235)
Observations	311	250	106	303	303	132	291
Chi-squared	0.287	1.560	6.783	4.773	20.64	19.79	29.85
Pseudo R2	0.00671	0.0380	0.248	0.0250	0.108	0.188	0.162
Time FE	No	No	No	No	No	No	Yes
Issuer Controls	No	No	Yes	No	No	Yes	No

Table 10 presents the results for the probit regressions. Columns (1, 2 and 3) present the probit models for having a green bond scored. The very small Chi-Squared and Pseudo R-Squared show the columns (1

and 2) are lacking validity. However, noting the direction of the coefficients it can be said that institutional owners from the home country value ratings. In column (3) the coefficient for IO and home country remains positive, furthermore liquidity has a positive impact on the GBS rating. Using a margins test it became apparent that clear that liquidity indeed positive impact. A company with more cash can spent more on the issuance. In additional tests using the pre-issuance year value of IO the coefficient was higher also when the two year average is used, but both are not significant.

Probability of certification is tested in columns (4 till 7). The first notable result is the negative coefficient in all columns for institutional ownership. In column (5) it is significant at a 10% level as well. This shows that not necessarily see need for the certification process. As insiders they could also use other powers to check the use of the proceeds. Moreover, when looking at columns (5 and 7) it becomes clear that the dummies all have a positive impact. The common law and home country are significant at a 5% level in all models. In test using the two year average IO value the coefficient became significant and remained negative. Furthermore, when taking the previous year the common law dummy becomes insignificant. Finally, using a three year moving average the coefficients remain negative. Based on margins tests the effects reported have sufficient impact on the probability to interpret the sign of the coefficients. The Wald test also showed that the variables predict the probability independently. Finally, the same tests were performed based on a logit regression formula and the signs of significance of the results did not change. Overall, by employing so many additional tests and statistical checks the table displayed shows the correct conclusions.

Table 10 shows that certain types of investors are noting the importance of certification and scoring. As expected it are investors from the issuers' home country and mostly from common law country. The results allow me to accept hypothesis 4a and 4b. Certain institutional owners push for certification and scoring.

5.4.2 Institutional ownership buying stock post-issuance

Outlined in earlier section and based on earlier research it is expected that IO will rise in the years post-issue. Year one is seen as the first year after the issuance year. This section shows the results, first of all the one-year delta is between -9.23% and +14.91%, this is a reasonable spread. Table 11 presents the results for the models according to formula (13).

In column (1) the GBS is regressed against the change in IO, it has a negative and insignificant coefficient. In column (2) the certificate dummy is regressed. It has a negative and significant at a 5% level coefficient, but looking at the coefficient it becomes clear that green bond issuers get a higher share of IO. However, the non-certified issuers experience a larger change in IO.

Columns (3 till 6) test for various control variables and fixed effects. Return on Assets seems to explain a great deal of why a company is hold less by an institutional owner. 1% higher ROA corresponds to a decrease of 0.35% in IO. Private investors could be the buyer of popular profitable companies. Finally, the various fixed effects show that significant industry differences exist. The begin of the economic boom period in 2015 and 2016 correspond to higher IO in the models. With the large differences across industries and years it is difficult to conclude. The firm differences also explain a great deal on the holdings. In additional non-reported tests the coefficient for the certificates becomes positive yet insignificant. Finally, the F-test confirmed industry effects are present, yet the Hausman test revealed there is no difference between random and fixed effects. The F-test revealed the annual variances are different from zero. That annual difference explain a great deal of change is also reflected in the R-Squared of column (5) compared to column (4).

Table 11: Immediate change in institutional ownership after a green bond issue

The change in institutional holdings in the year after a green bond issue are regressed based on the GBS and the certificates. In the year after the green bond issue the change in IO was calculated and trimmed at a 5% level in order to deal with outlier that seem unrealistic in relation to a green bond issue. For instance, a company could be acquired by another company, but this is mostly likely due to other variables. Moreover, some company specific control variables are used to see if other factors play a larger role. Liquidity is defined as cash over assets. Finally, the differences cause by industry and year of issuance are taken into account.(Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1)

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
GBS	-3.880					
	(1.476)					
Certificate		-1.779**	-0.0997	-2.384***	-0.399	-1.187
		(0.846)	(0.980)	(0.893)	(0.801)	(0.816)
Assets (ln)			-0.229			
			(0.596)			
Cash (ln)			0.658			
			(0.540)			
ROA			-35.99***			
			(5.092)			
Liquidity			0.240			
			(8.318)			
Constant	329.9	1.848***	-4.037	1.100*	0.239	1.769
	(123.6)	(0.270)	(3.878)	(0.596)	(3.921)	(3.816)
Observations	4	275	214	268	275	268
R-Squared	0.776	0.016	0.301	0.041	0.210	0.273
Industry FE	No	No	No	Yes	No	Yes
Time FE	No	No	No	No	Yes	Yes

Therefore, I accept hypothesis 5, a green bond issue has a positive impact on institutional buying. I reject hypothesis 6a, the GBS sample is too small. Finally, I neither accept nor reject hypothesis 6b. There is no clear conclusion regarding the certificates. Many other variables offer better explanations.

5.5 Long-term impact

5.5.1 Improvements of environmental performance

The ultimate goal of a green bond is to improve the environmental performance of a company. Not only is it paramount for the credibility of the issuer, but also for the green bond market as a whole. Moreover, with the GBS rating agencies also monitoring environmental performance the improvements should be clear. Recently, a green bond score got downgraded by Moody's (Mexico City New Airport), thus it appears the monitoring is effective.

The regression models are based on formula (14) and takes a one and two year post-issuance outlook. The change between one and two years later is also considered. Since continuous improvement would show that the bonds continue to make its impact.

Table 12 displays the results for the test on improvements of environmental performance. Columns (1 and 2) test the difference a year after issuance. After introducing time fixed effects the certificates are still a negative significant impact on ASSET4 scores. However, because of the difference in constant between the two models it is difficult to asses whether the performance is statistically different from zero. In non-reported tests using firm fixed effects it became apparent that a small number of firms cause a large part of the negative coefficient. Nevertheless, because t=1 is too early to show the real impact the other columns are preferred.

In columns (3 and 4) the certificates have a positive and in column (3) significant at the 1% level impact. The lower R-Squared and insignificant constant do cause doubt whether green bonds themselves make impact.

Table 12: Continuous improvements in environmental performance

The ASSET4 environmental performance score is taken one and two years after a green bond issue, also the change after one and two years is looked at. The two year time window is preferred to ensure bonds issued in the fourth quarter also can make their impact. All control variables are also taken from the t=1, t=2-1 or t=2 year. Liquidity is defined as cash over assets. Time fixed effects are introduced as well as a set of issuer related control variables. (standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1)

VARIABLES	(1) t=1	(2) t=1	(3) t=2	(4) t=2-1	(5) t=2	(6) t=2
Certificate	-6.992***	-6.491***	5.791***	2.017	15.51***	11.82***
	(1.425)	(1.431)	(2.101)	(1.968)	(3.999)	(3.960)
Liquidity					0.157	-27.96**
					(5.351)	(11.08)
ROA					-10.31*	8.488
					(5.321)	(6.965)
Assets (ln)						-2.846***
						(0.824)
Cash (ln)						1.312*
						(0.731)
Constant	-0.0406	7.771	-0.169	-0.112	-0.532	32.24***
	(0.423)	(4.965)	(0.362)	(0.259)	(0.734)	(8.520)
Observations	170	170	135	115	125	125
R-Squared	0.125	0.309	0.054	0.009	0.127	0.228
Time FE	No	Yes	No	No	No	No

In non-reported additional tests the annual differences do not make a large impact, but strong industrial differences exists.

Finally, columns (5 and 6) show that large companies have more difficulty improving their environmental performance. A larger company would have to expand more resources to create the same impact thus has intuitive appeal. However, the other variables all make weak impact in one of the models. Therefore, no comment on their further impact is made. The certificates remain highly significant at a 1% level and make very strong positive contribution to the performance. This allows me to accept hypothesis 7, certified green bonds are improving ASSET4 performance.

5.5.2 Changes in institutional ownership

As it has been shown that the improvement of the ASSET4 score is continuous the increases in IO could also be increasing in the second and third year post-issuance. In order to see what is the long-term impact of a green bond issue the two and three year post-issuance changes in IO are regressed following the same principles as in table (11). The changes have also been trimmed at the 5% level and have higher positive means and higher standard deviation than the IO variable at (t+1). The regression follow the model described in formula (15).

Table 13 shows the results and repeat the conclusions made after reviewing table 11. Many characteristics other than a green bond issue make a company attractive for institutional holding. All columns have a very low R-Squared so they lack validity. Finally, it it surprising that the certificates fail to make additional impact. In non-reported random effects test after a Hausman test the coefficient was still negative. Based on the Hausman and F-test the random effects model suits the data the best. Suggesting it was not due to particular companies.

Table 13: Long-term changes in institutional ownership

The institutional holdings of green bond issuers are looked at in the years (t=2, t=3) after an issue. A set of control variables are used that also offer predictive power for institutional holdings. The controls are also from the t=2 or t=3 years. Liquidity is defined as cash over assets. Finally, time fixed effects are introduced to correct for some diversity in economic conditions. (standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1)

VARIABLES	(1) t=2	(2) t=3	(3) t=2	(4) t=3	(5) t=2	(6) t=3
Certificate	-1.579*	-0.826	-1.566	-0.142	-0.800	-0.109
	(0.877)	(0.893)	(1.206)	(1.235)	(0.875)	(0.890)
Assets (ln)			-0.192	0.951**		
			(0.419)	(0.412)		
Cash (ln)			0.383	-0.814**		
			(0.345)	(0.337)		
ROA			-8.389	-18.29***		
			(5.855)	(5.739)		
Liquidity			2.082	14.76**		
			(6.913)	(6.802)		
Constant	0.807***	1.535***	-1.724	-4.764	-0.293	-1.953
	(0.272)	(0.270)	(3.784)	(3.753)	(1.265)	(2.391)
Observations	280	274	214	208	280	274
R-Squared	0.012	0.003	0.052	0.078	0.086	0.070
Time FE	No	No	No	No	Yes	Yes

Based on the results of table 13 I reject hypothesis 8, no change in long-term IO can be attributed to a green bond issue.

6 Discussion and Robustness

6.1 Discussion and future research

The largest drawback of this thesis is the lack of GBS at this moment. While both certification and GBS are gaining momentum the number of green bonds that are scored and monitored remains small. Especially the monitoring aspect is vital for the growth of the market. A prospectus can make many promises, but the proceeds from the bond still ends up on the cash balance of the company. Therefore, it remains unclear if it is used in the promised manner. While the ASSET4 scores and IO increase in the years after issuance, an independent monitor is still preferred. In addition to the monitoring, the other effects tested in this thesis will also become more robust with a higher number of GBS. In many sections comments were made on the lack of observations and this is indeed the largest drawback. Hopefully future research will have access to more observations and also focus on cases were the score changes during the monitoring period. Especially the market reaction in light of an upgrade or downgrade of a GBS would be interesting. Not only is it a test for investor awareness, but also a test for the systems developed by Moody's and S&P. It will allow for full judgement whether the systems are important or just a gimmick.

The second major drawback are the inconsistencies in worldwide accounting information standards. In the US and parts of Europe ownership data is much more accessible than in the developing world. The difference is amplified by the inconsistency in databases. This thesis uses a relatively small number of companies (214) and years (7), but larger studies will have more trouble working with the data. Because of this issue it is possible certain data points are incorrect. It is regrettable since the models and ideas have intuitive appeal. Similarly the ASSET4 model needs a great deal of accounting information from the listed companies. However, in many nations this is either not available or not fully reliable. Also the reliability of accounting information in some cases was a drawback. Especially since it often was inconsistent across years. Some measures in this thesis were altered (i.e. leverage) to correct for inconsistency and unreliablity. In addition, sometimes it can be very difficult choosing the correct value based on endogeniety. Since this thesis is concerned with bond issues throughout the year the issuer data is never fully correct. In this thesis is was mitigated by using averages and pre-issuance years as robustness checks. However, in future research it would be better to use a more consistent methodology. If the bond issue is in the first half use the data of the previous year and if it is in second half use that year' data.

In this thesis there has been little focus on individual topics. As the green bond market is still so new general trends had to be established and hypothesised first. There is little literature on this specific market so information has to be drawn from resources that looked at other markets. The hypotheses stated were often deduced from non-related information. Synthesising information from green bond focused research in relation to the minor topics, for instance environmental performance changes, will create a more robust picture of the full market.

Finally, the differences in the green bond market based on country, industry and year factors show it is difficult to stipulate common and robust trends. Every hypothesis tested in this thesis can be altered when the focus would be on one country or industry across an earlier or later sample. Because of this it is important for research in the forthcoming years to remain focused on the full market and not one aspect. Once the market matures more the attention should shift towards the individual elements of the green bond market specifically.

6.2 Additional robustness

As described in the sections above a number of other factors will be looked at in regards to green bond issues and the market surrounding it. The seven topics looked at are: annual differences, other references indices, use of purpose of the bonds, differences because of HDI-level, excluding banks, change in IO for repeated issuers and change in home country holdings.

6.2.1 Yearly differences

In earlier sections it was noted how much excitement surrounded the green bond market. Having order books six times the value of the bond was not uncommon. However, as the market matures and investors become more aware of the certificates and scores how will the abnormal return change. Also noting the liquidity question, are there trends that the underlying tests have not shown yet. It can be expected that the highest abnormal returns are before 2018 with it diminishing in 2019. For liquidity the reverse is expected to be present. Where the later period is associated with more liquidity.

In table 14 the results are displayed per year for the CAR with a [0,1] event window and for the turnover ratio. Furthermore, additional non-reported test were performed on the impact of the certificates. The first thing that are the highest CARs in 2015 and 2018. Suggesting that taking a different sample period would have impacted the results of chapter five. However, other than the higher numbers in 2018 it is not possible to see a trend.

The same holds when looking at the turnover analysis. Apart from an outlying value in 2018 higher turnovers are present post-issuance in 2016 till 2019. There appears to be even more interest in these companies in 2019 than initially assumed.

The certificates have a positive impact on the CAR in three of the seven years and a negative impact in the other. Again it is difficult to define a trend. For turnover, the certificates do not have a positive impact until 2018. In 2019 their effect is almost zero. It really shows how little impact the certificates have on the equity side of the market.

Table 14: Annual differences in CAR and turnover

For 514 different green bond issues the cumulative abnormal returns were calculated based on the predicted return of a reference index. The estimation window was [-150,-15] and [15,150]. The displayed event window is [0,1]. The turnover measure is based on the paper by Chen et al. (2003) and taken as the ratio of volume based turnover in the pre [-60,AD-1] and post period [AD+1,60]. The sample is split across the individual years in the sample period. (standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1)

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
VARIABLES	2013	2014	2015	2016	2017	2018	2019
CAR [0,1]	-0.00987	-0.0138**	0.00685***	0.00386*	-0.00193	0.00745***	0.00334*
	(0.0151)	(0.00597)	(0.00193)	(0.00215)	(0.00202)	(0.00252)	(0.00178)
Turnover	0.581	0.764***	0.944***	1.230***	1.213***	0.884***	1.482***
	(0.194)	(0.117)	(0.111)	(0.119)	(0.124)	(0.0444)	(0.111)

6.2.2 Different references indices

As the abnormal returns are such an important part of this thesis two other indices are also used as references. These are both focused on environmental and SRI performance. The first is the Dow Jones Sustainability World Enlarged Index ex Alcohol, Tobacco, Gambling, Armaments & Firearms and Adult Entertainment index (DJ SWE), which can be classified as virtuous. The second is the S&P Global Clean Energy Index

(S&P GCEI). As green bond issuing companies want to have appeal to conscious investors according to Renneboog et al. (2009), it is also interesting to see if they are able to generate abnormal returns compared to these indices. Moreover, I want to note if there are differences between the MSCI ACWI and these indices. First of all, the two additional control indices are more focused on sustainability and virtuous industries. However, both failed to beat the MSCI ACWI over the last five years. Thus it can be expected that the CARs will be higher.

After using the same methodology as for the MSCI ACWI the CARs across the four event windows were unrealistically high. Even trimming the data did not yield usable numbers. Therefore, the regression models were based on the median rather than the mean. For full comparison the median of the MSCI ACWI is also listed in table 15.

Table 15: Median CAR for different reference indices

For 514 different green bond issues the cumulative abnormal returns were calculated based on the predicted return of a reference index. The different event windows are based on the commonly employed event windows for event studies. The estimation window was [-150,-15] and [15,150]. A total of 11 companies and 88 bonds did not qualify for these tests the abnormal returns could not be calculated, since the companies were not listed during the estimation period. Two companies issued a very high number of bonds and caused this discrepancy. The median abnormal returns are displayed. (standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1)

	(1)	(2)	(3)	(4)
Control Index	CAR [0,1]	CAR [-2,2]	CAR [-5,5]	CAR [-10,10]
S&P GCEI	0.00997***	0.00773***	0.00837***	0.0159***
	(0.00191)	(0.00128)	(0.00108)	(0.00115)
DJ SWE	0.00984***	0.0109***	0.00949***	0.0147***
	(0.00151)	(0.00106)	(0.000741)	(0.00149)
MSCI ACWI	0.000839	0.00327***	0.00400***	0.00499***
	(0.000585)	(0.000871)	(0.001052)	(0.001561)

The median abnormal returns across the two new indices are significant and much higher than compared to the MSCI ACWI. It clearly shows that the companies are performing better than a sample of their peers. However, what it also shows is that the earlier research is very robust because the MSCI ACWI was used as the reference index. Not only are the results much lower, which suggests that it is not entirely certain that there is abnormal returns at a green bond issuance. Moreover, the CARs do not become much higher in column (4) compared to column (1) suggesting if the abnormal return is mostly related to the announcement.

Adding two other indices focused on sustainability and virtuous industries has proven that abnormal returns are present, but not as large as earlier research had suggested. In addition, the announcement effect is strongest on the announcement date. It confirms the conclusions of chapter 5 and suggests that the announcement effect is present. On the other hand it also shows how subjective abnormal returns are when a different index is chosen.

6.2.3 Use of Purpose

Since each green bond is linked to a goal as explained in the 2015 Paris agreement. Will the market react differently to the various uses of purpose? There can be an effect for example CO_2 reduction leading to a higher abnormal return than less water pollution. In individual cases the appeal is there, but on an aggregate scale the effect will probably disappear. The file by the CBI lists the use of purpose for all green bonds that are certified. After testing for in group differences it appears that on the short-term there are very little differences in terms of abnormal return (in group F-statistic of 0.47) or increased turnover (in group F-statistic of 0.7). This links to earlier findings that there is little attention to the actual goals of the green

bonds from equity investors.

In retrospect the only plausible correlation will be on individual bond levels. Since some investors who dedicate themselves to water investments or solar investments would be very interested in the bond themselves. However, as the research is focused on the entire company the relation cannot be found. When the fixed income perspective is taken the use of purpose could have an impact, but not in the equities market.

6.2.4 Differences due to HDI-level

As noted earlier are there strong regional differences based on how developed a nation is? Countries with a higher Human Development Index (HDI) score could be more involved in going green and improving sustainability. On the other hand developing nations could leapfrog certain industrial development cycles. For instance, China is already the largest producer of solar panels in the world. Will their efforts to become more sustainable cause better performance? The ranking is according to the HDI deciles with the highest HDI scores being awarded a 1 and the second highest a 2. It is based on the 2018 HDI ranking as to not create confusing situations. The result are displayed in table 16.

For the abnormal returns strong differences exist between groups. After testing for firm fixed effects, clustering by year the direction of the coefficient remains positive suggesting that companies from lesser developed countries have higher abnormal returns. The turnover ratios are subject to significant differences as well. Again when including more control variables the effect becomes stronger, but not significant. A possible explanation is the developing world having more media attention for these bonds. Therefore, on a short-term basis the companies from lesser developed countries seem to be helped more by green bond issues. Furthermore, as expected the credit quality is lower and issues are smaller.

Table 16: Short- and long-term effect of HDI levels of home countries

Two variables for short-term reaction to a green bond issuance: CAR and Turnover are used. For For long-term reaction: change in ASSET4 and change in IO are used. These are regressed against a HDI-score decile based variable. A higher HDI score indicates a lesser developed country. The model tests for short- and long-term green bond impact differences. Because the issuers home country is more developed further and has better access to information. (standard errors in parentheses *** $p<0.01$, ** $p<0.05$, * $p<0.1$)

VARIABLES	(1) CAR [0,1]	(2) Turnover	(3) Δ ASSET4 (t+2)	(4) Δ IO (t+1)
HDI	0.00403**	0.0874*	-0.984*	-0.975***
	(0.00183)	(0.0504)	(0.563)	(0.222)
Constant	-0.00246	1.015***	0.539	2.988***
	(0.00255)	(0.0945)	(0.830)	(0.405)
Observations	502	232	166	355
R-Squared	0.026	0.013	0.018	0.052

In the long-term the HDI levels have a negative impact when it comes to change in environmental performance. However, it is difficult to establish what causes this negative coefficient. When clustering, involving fixed effects amongst other statistical methods no significant evidence emerges. For changes in IO the companies from more developed countries are held more closely. It is robust across firms, industries and years. I suggest the green bond market in the emerging world becomes a focus area for studies once the market has matured

6.2.5 Excluding banks

Following the examples of earlier research banks are excluded. As their green bond issues will most likely be used for lending to third parties. First of all, the abnormal returns and turnover analysis will be completed again. Furthermore, because of the lending to third parties it is unlikely that their environmental performance will improve. When taking into account IO it is not clear how the market reacts. Since some institutions would prefer a bank that is attempting to stimulate sustainability in their portfolio of holdings, but it will not be the only decision point. On the other hand, noting the popularity of ethical banks in the consumer market, the appeal of these banks can also be large on the stock market.

Table 17: Short-term effects post green bond issuance excluding banks

For 514 different green bond issues the cumulative abnormal returns were calculated based on the predicted return of a reference index. The estimation window was [-150,-15] and [15,150]. The displayed event window is [0,1]. The turnover measure is based on the paper by Chen et al. (2003) and taken as the ratio of volume based turnover in the pre [-60,AD-1] and post period [AD+1,60]. The sample is split including and excluding banks. (standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1)

VARIABLES	Excl. CAR [0,1]	Incl. CAR [0,1]	Excl. Turnover	Incl. Turnover
Constant	0.00472***	0.00395***	1.072***	1.151***
	(0.00124)	(0.00104)	(0.0454)	(0.0480)
Observations	372	514	167	237
R-Squared	0.000	0.000	0.000	0.000

These results are displayed in Table 17 and described here. The short-term effects are an increased abnormal return when excluding banks. This is similar to earlier research and is not surprising also taking into account the different metrics used to assess a bank compared to a company. On the other hand, a decrease in turnover. Insurance and utility companies see a decrease in turnover post-issuance. In earlier models this did not become clear because the represent a smaller part of the companies.

Table 18: Long-term effects post green bond issuance excluding banks

The sample is split including and excluding banks. The change in two-year ASSET4 and IO across the entire sample period is taken when the sample is split. The entire period is used to notice general trends and not relate it directly to green bond issues. (standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1)

VARIABLES	Excl. Δ ASSET4 (t+2)	Incl. Δ ASSET4 (t+2)	Excl. Δ IO (t+1)	Incl. Δ IO (t+1)
Constant	3.902***	3.718***	0.917***	0.912***
	(0.459)	(0.451)	(0.103)	(0.0991)
Observations	685	705	1,223	1,296
R-Squared	0.000	0.000	0.000	0.000

The long-term effect on the other hand do not change significantly when excluding banks. The change in ASSET4 is slightly higher, but the small number of companies in the sample can also be the cause. Furthermore, there is a minute difference in change in IO, which cannot be attributed to the different remaining industries. Table 18 displays these results.

6.2.6 Change in IO for repeated issuers

Because table 11 shows Institutional owners are interested in the companies they fund going green. However, do repeated issuers enjoy the same benefits as when a new company issues a green bond?

The focus of these test is on the difference between the change in IO after a first issue and the change after subsequent issues. The relation between subsequent issuer and IO is difficult to hypothesise since subsequent issues show a commitment to sustainable investments. Therefore, their appeal can be larger to institutions. On the other hand there can also a spike of interest after the first issue and no reaction after the subsequent issue. The first is a more rational long-term outlook on the company. The second is a behavioural reaction to a one-time event.

Table 19: Change in institutional ownership after multiple green bond issues

The one year change in IO is regressed against the first dummy. This tests if there is a larger change in institutional buying after multiple issues or merely the first. Various control variables are used that played a role in earlier tests. The first dummy is one if the bond was the first issue of the company. (standard errors in parentheses *** $p<0.01$, ** $p<0.05$, * $p<0.1$)

VARIABLES	(1)	(2)	(3)	(4)	(5)
First	-2.761***	-2.653***	-0.540	1.810*	1.180
	(0.489)	(0.502)	(0.674)	(0.961)	(0.773)
Certificate		-0.815			
		(0.828)			
Assets (ln)			-0.241	0.290	
			(0.271)	(0.385)	
Cash (ln)			0.660***	-0.0778	
			(0.251)	(0.351)	
ROA			-33.44***	-4.336	
			(5.826)	(13.39)	
MTB				-0.586	-0.614
				(0.421)	(0.497)
Constant	3.133***	3.158***	-3.545	-3.608	0.733
	(0.356)	(0.357)	(2.392)	(3.562)	(0.978)
Observations	275	275	214	121	172
R-Squared	0.105	0.108	0.303	0.079	0.039

After testing for the first dummy it appears that there is a much stronger increase in IO after subsequent issues. In a model with the certificates the first variable is a much stronger predictor of change in IO and again the negative coefficient shows the subsequent issues have a larger impact on IO. Finally, when taking into account the issuer specific profitability and size characteristics the negative coefficient remains. Suggesting there is a strong correlation. Only when including MTB-ratio the coefficient becomes positive. However, these columns (4 and 5) have a low R-Squared and little observations. Therefore, the results are less convincing than the results reported before.

This evidently shows that companies committed to remain sustainable see a stronger increase in IO than first time issuers. It is a testimony of the shift of IO to more sustainable companies. Also it alludes to the rational elements of investments. Table 19 displays the results. I suggest this becomes a key area of focus in future research on corporate governance, green bonds and institutional ownership.

6.2.7 Change in home country holdings

Since the home country dummy had a significant effect in earlier models. Is it also possible that institutional investors from the issuer' home country are the net-buyer? It is a key concept in behavioural economics known as the home country effect and linked to naive under-diversification of investors. Because the investor knows these companies better they often buy there stocks. In the case of a green bond issue it is already the case that home country investors push for certification. Therefore, it can be the case that they are also the net-buyer post-issuance. With earlier indications pointing towards this fact I hope to establish if this is the case.

I use the same regression model as listed in formula (14). It is expected that the same patterns hold, yet with smaller coefficients. Furthermore, I will describe to see what part of the change in overall IO is caused by HC investors. After multiple tests based on formula (14) there appears to be no additional affect. Many changes in HC holdings were tested and none of the variables were robust or significant.

It shows that the home country bias is not present in the green bond issuer market. It underpins the idea that institutions play a role in the pre-issuance phase, but have other interests on a long-term basis.

7 Conclusion

The main question this thesis attempts to answer is why would a green bond issuance cause an abnormal return for shareholders. The simple rational answer is it improves future earnings based on investing in innovation and sustainability. The second question looked at is how are certificates and GBS impacting the market. In the literature review the focus was on the market reaction being rational or behavioural. If investors know about long-term changes in environmental performance it is a rational reaction. Otherwise, it is based on behavioural motives.

The abnormal returns are robust across companies and time, but with some annual differences. However, in a larger sample than earlier research the abnormal return is much smaller compared to the results of those articles. The GBS improves the abnormal return and surprisingly certification has a negative impact on the abnormal return. Furthermore, the impact of first or a subsequent issue is very small. However, this is only looking at it from a short-term perspective.

The second element looked at was the effect on liquidity of a stock post-issuance using the Amihud illiquidity and the turnover ratio. The Amihud illiquidity decreases further post-issuance when a bond is certified or the first. Moreover, the effect of certified products is much stronger than the first placement effect. The turnover ratio increases post-issuance, yet the certificates, a first issue or a GBS have little effect. With other variables appear to be playing a more important role. It can be concluded that investors have rational reasons for the decreased illiquidity and increased turnover.

Afterwards the abnormal return was predicted by looking at other factors. While faced with endogeniety issues it can be concluded that innovative companies, proxied by higher Tobin's Q, have higher abnormal returns. This can be classified as a rational reaction since it is a sign the company is investing in innovation. A great part of the value of these companies can be based on this.

Finally, probit models were used to predict what type of companies would have their bond issues scored. Three proxies based on innovation, profitability and environmental performance were used. It showed that innovative companies were less likely to have their products certified. The overall short-term conclusion has rational and behavioural elements to it. Since it is unknown if investors would know about future changes in company performance after a green bond issue.

For the long-term perspective the pre- and post-issuance period were assessed from a environmental performance and institutional ownership perspective. In the pre-issuance period it the became clear that the certain types of owners push for certification and scoring. Especially the role of investors from the home country is important. Pension funds and shareholders from common law countries also play a minor role.

In the post-issuance period the environmental performance improves and the IO increases. Certificates are a key indicator that the environmental performance will improve significantly. In contrast, the long-term change in IO decreases when a bond is issued with a certificate. After two or three years post-issuance a green bond issue plays no role in IO.

Seven additional robustness tests were completed. These underpinned earlier conclusions that there is a high number of unobserved variables in the green bond market. A company from a lesser developed country will have a higher abnormal return. Also different control indices predict higher abnormal returns. Across the seven years that were looked at few trends can be observed. Institutions are very interested in companies who commit to the green bond market. However, it is likely that the market is through its infancy and sufficient knowledge about the products will rationalise the market in the forthcoming years.
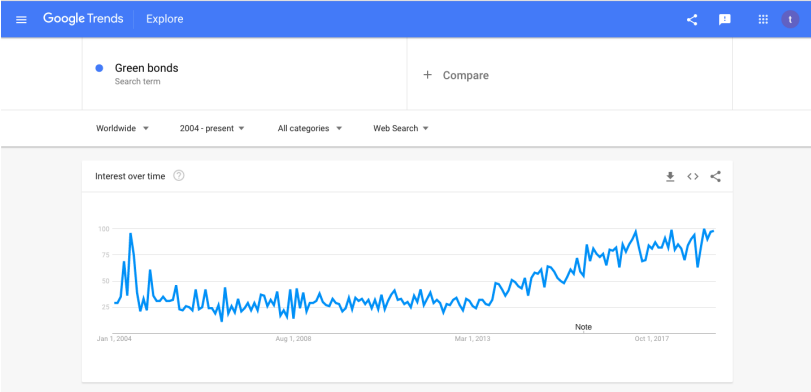
Appendices

Appendix 1

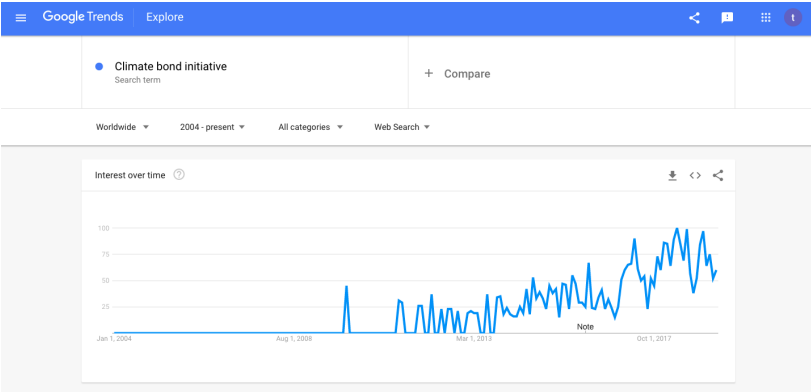
Figure 1: Search frequency Green Bonds
Source: Google Trends

Figure 2: Search frequency CBI
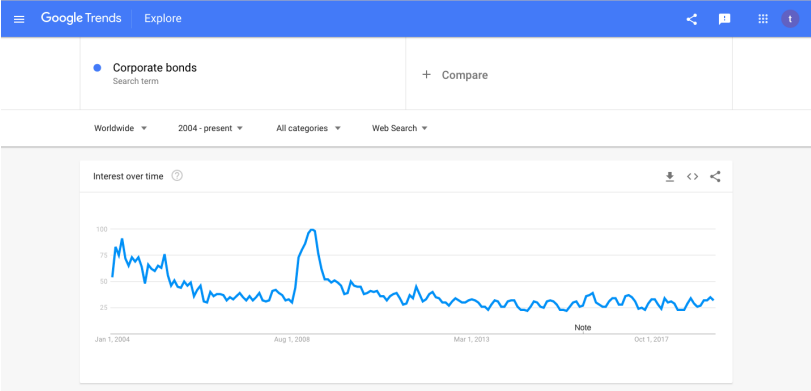Source: Google Trends

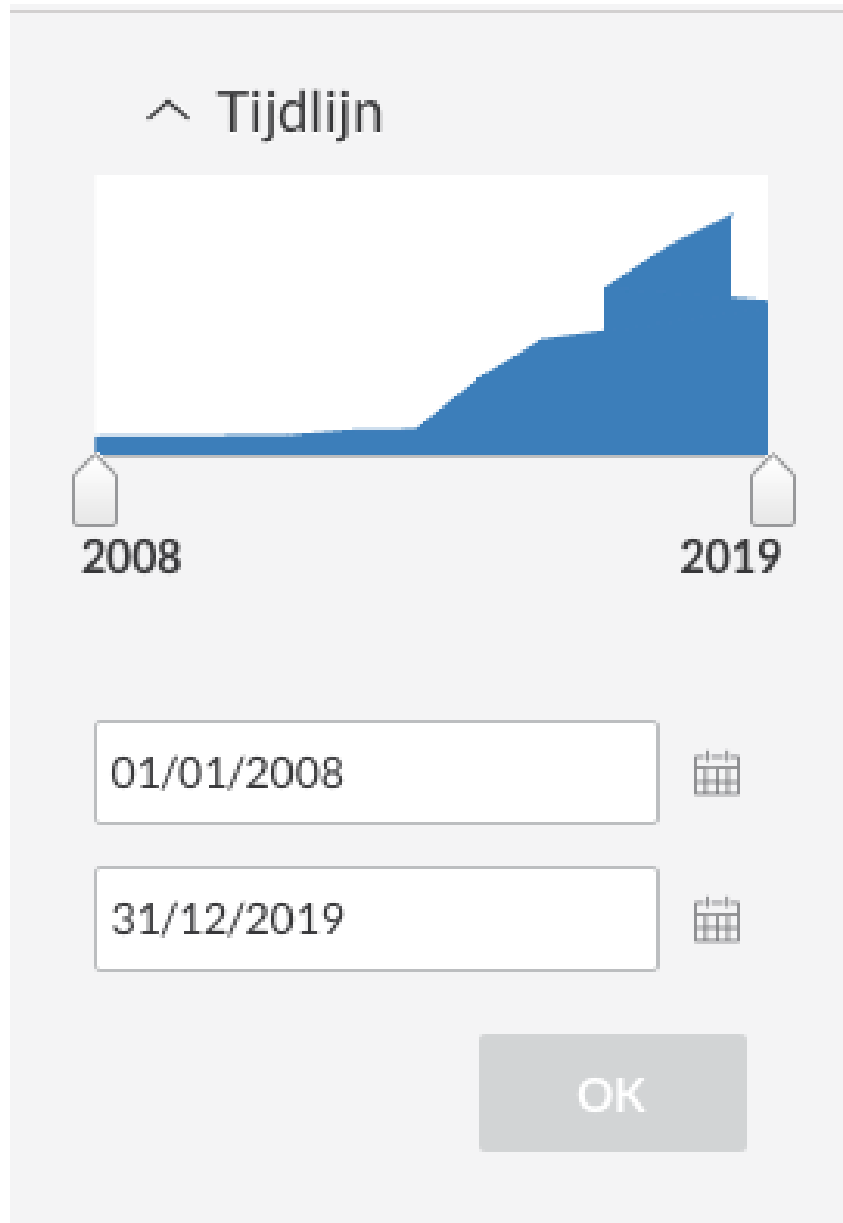**Figure 3:** Search frequency conventional bonds
Source: Google Trends

Appendix 2

Figure 4: Article frequency on Green Bonds
Source: Nexis Online

Appendix 3

Country Code	Country Name
AE	UNITED ARAB EMIRATES
AT	AUSTRIA
AU	AUSTRALIA
BE	BELGIUM
BM	BERMUDA
BR	BRAZIL
CA	CANADA
CH	SWITZERLAND
CN	CHINA
CO	COLOMBIA
DE	GERMANY
DK	DENMARK
ES	SPAIN
FI	FINLAND
FR	FRANCE
GB	UNITED KINGDOM
HK	HONG KONG
ID	INDONESIA
IN	INDIA
IT	ITALY
JP	JAPAN
KR	REPUBLIC OF KOREA
KY	CAYMAN ISLANDS
LU	LUXEMBOURG
MU	MAURITIUS
MY	MALAYSIA
NL	NETHERLANDS
NO	NORWAY
NZ	NEW ZEALAND
PH	PHILIPPINES
PT	PORTUGAL
SE	SWEDEN
SG	SINGAPORE
TH	THAILAND
TW	TAIWAN
US	UNITED STATES
XS	INTERNATIONAL SECURITY
ZA	SOUTH AFRICA

Figure 5: ISIN Country abbreviations
Source: ISIN

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