
MASTER THESIS

MSc Financial Economics

# Green bonds, cost of equity, and corporate financial performance: A Difference-in-Differences analysis

**M.J. Blauw**

**537377**

Thesis supervisor: A. Yang

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# PREFACE AND ACKNOWLEDGEMENTS

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# ABSTRACT

The green bond market has grown rapidly over the recent years and has not reached its peak yet. This study contributes to an improved understanding of green bonds and their impact on the cost of equity and financial performance of firms. The data sample consists of 28 listed firms from the U.S. and 19 listed firms from Europe that issued green bonds in a time period between 2016 and 2019. Using a Difference-in-Differences (DiD) approach, the effect of green bond issuance on the cost of equity and corporate financial performance is tested and discussed. The cost of equity is calculated using analyst forecast earnings in an abnormal revenue model as Easton (2004) and Ohlson and Jeuttner-Nauroth (2005). The main results show that green bond issuance negatively affects the cost of equity, but with low significance. In the U.S. green bond financing has a positive effect on the cost of equity and in Europe the effect is negative. Moreover, this paper shows that firms that score low on Corporate Social Responsibility (CSR) do not experience a lower cost of equity after green bonds are issued. Lastly, this study has not found evidence about the effect of green bond financing on the financial performance of firms.



Keywords: Green bonds, green bond issuance, cost of equity, corporate social responsibility, corporate financial performance

# Table of Contents

# List of Tables



# List of Figures

# 1. Introduction

Climate change is a problem of global proportions. To mitigate the effects of climate change and to finance green initiatives, that are needed to prevent climate change, an enormous amount of investment is necessary. Research shows these investments could amount up to US$1,000 billion a year. However, the government does not have enough resources to solve this problem on its own, particularly in developing countries, Therefore, private investment is needed to replenish scarce public resources and credit. In large, this can only be realised through global financial markets, with innovative solutions across asset classes. Green bonds have recently developed as one of the best candidates to acquire financial resources towards sustainable and clean investments (Reichelt, 2010).

Green bonds are a fixed income product, where proceeds connected to the bond are used for projects that benefit the environmental sustainability. In addition, it offers investors the opportunity to participate in the financing of green projects that help mitigate climate change (Reichelt, 2010). Green bonds have similar characteristics to conventional bonds by the issuing entity, including size and credit risk. Several papers and practical experiences show that investors have interest in funding green projects (Amel-Zadeh and Serafeim, 2018; Crehalet, et al., 2020). A practical example is the issuance of green bonds by DC Water, where on the day of issuing they increased the initial offering size of $300 million with $50 million due to strong demand (DC Water, 2014). Regarding to the possible drivers of this growing demand, it is clear that green bonds allow investment firms to fulfil the request of investors sensitive to environment-related issues.

There are also firm specific benefits. For example, green bonds can be used to promote a firm's environmental performance as well as to create an opportunity to increase their pipeline of green assets. Another benefit that could result from firms issuing green bonds is investor diversification, where firms attract socially responsible investors in addition to their usual clientele (Shishlov et al., 2016). Overall, we can state that green bonds stimulate investments in CSR-activities and in particular the environmental performance of firms. The future size of these activities will be an important factor in the impact on mitigation of climate change and this emphasizes the relevance of this thesis.

In addition to these environmental aspects, previous studies show that green bond issuance has a positive effect on the corporate financial performance of firms (Alonso-Conde & Rojo-Suárez, 2020; Zhou & Cui, 2020). Furthermore, Zhang et al. (2020) argue that green

projects can help lower the cost of equity of Chinese firms. The Climate Bond Initiative (CBI) stated in their summary of 2019 that the U.S. became the biggest issuing country of green bonds and that Europe represents 45% of the global green bond issuances. Therefore, this study examines the impact of green bond financing on the cost of equity and financial performance of firms from the U.S. and Europe. To examine this impact the following questions need to be answered:

- Does green bond financing lower the cost of equity of firms?
- Does green bond financing improve the financial performance of firms?

To answer these questions multiple DiD analyses are done. I have also conducted three regressions to examine the size, industry and CSR-effects on the cost of equity after green bond issuance. In advance, two groups are individually matched based on similar size and industry. The treated group are firms that issued green bonds and the control group are firms that never issued green bonds but issued conventional bonds instead. The cost of equity is calculated using analyst forecast earnings in an 'abnormal revenue model' as used by Easton (2004) and Ohlson and Jeuttner-Nauroth (2005). The results show that green bond financing negatively affects cost of equity, but with a low significance. The effects are also estimated for the U.S. and Europe individually and the regressions show different outcomes. Firms from the U.S. experience an increase in their cost of equity after green bond issuance, while firms from Europe experience a reduction in their cost of equity after issuance. Moreover, this thesis shows that firms with a CSR score below 70.0 experience a higher cost of equity after green bond issuance. Lastly, this study did not find evidence about the effect of green bond financing on the financial performance of firms.

The remainder of this paper is organized in four parts. First, a review on recent developments in the green bond market and previous research on the relationship between green bond financing, cost of equity and CSR are presented. Second, hypotheses development, sample selection, methodology used for this study and descriptive statistics are discussed. Third, an overview of the empirical results is presented and discussed. In the end a conclusion is given along with limitations and insights for future research.

# 2. Literature

The literature review is divided in three parts. First, the development of the global green bond market is discussed. Next, an overview of existing literature on green bonds, cost of equity and CSR is given. The last part focuses on previous research about green bonds and corporate financial performance.

## 2.1 Development of the green bond market

The world's first green bond was successfully issued by the World Bank and the European Investment Bank (EIB) in 2008 to fund renewable energy projects. The issue amount was €600 million. The initiation for this issuance came from a Swedish pension fund in the late 2007, which wanted to invest in projects that mitigate the effects of climate change. By financing climate-related projects at an early stage, the World Bank became a global leader in green bond issuing. With this, they increased awareness for the challenges of climate change and showed the potential for investors to support climate solutions through safe investments without sacrificing financial returns (Shishlov et al., 2016).

Although the first green bonds were issued in 2007 the market did not expand until 2013, when the green bond market developed rapidly as many firms entered the market by issuing green bonds. According to the Climate Bonds Initiative (CBI), the volume of global green bond issuances increased from $13 billion in 2013 to approximately $250 billion in 2019. This increase in volume shows the rapid development of the green bond market and the expansion of this market with new types of issuers and geographies. It also contributed to the emergence of new green initiatives such as green mortgages, green derivatives, and green loans. In the past few years, an increase in interest for green bonds amongst investors and regulators is seen, since more and more countries have joined the green bond market. In 2019, there were up to 436 green bond issuers spread over more than 40 countries around the world. The issuers included financial institutions, government support agencies, multilateral development banks, non-financial enterprises, sovereign countries, and various types of local governments (CBI, 2019).

The type of issuers and their issue amount are depicted in figure 1. The largest category of green bonds issued are corporate bonds, either financial corporate or non-financial corporate, and represent 44% of the market. Government bonds cover 38% of the market and can be either issued by development banks, large sovereigns, local governments and

government-backed entities. The remaining shares of issued green bonds are asset-backed bonds (ABS) and loans, which contain the last 18% of the market. Despite the continuous growth, green bond issuances made up only 0.2% of all bond issuances in 2018 (CBI, 2019). This small percentage demonstrates that the green bond market is still relatively small and that there is still much to be gained.

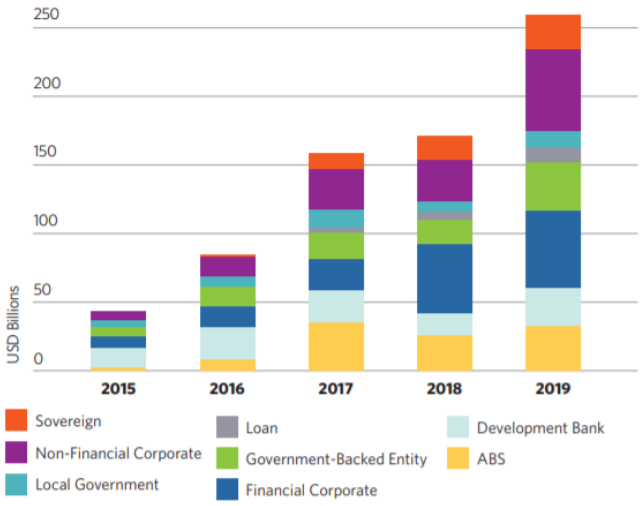


Figure 1 – Green bonds and type of issuers (CBI, 2019)

Figure 2 shows the pattern of green bond issuance across different countries. From this figure, I observe that the U.S., China and France are leading in the field of green bond financing. In 2019, they accounted together for 44% of global issuance. The U.S. became the biggest issuing country of green bonds with a contribution of $51.3 billion and China holding a second place with $31.3 billion. Followed by France, Germany and the Netherlands who brought $30.1 billion, $18.7 billion and $15.1 billion to the green bond market respectively. These high volumes are supported by figure 3, where can be seen that Europe represents the largest part (45%) of green bond issuances in 2019 (CBI, 2019). Additionally, the figure demonstrates that the volume of green bond issuances has grown every year since 2015.

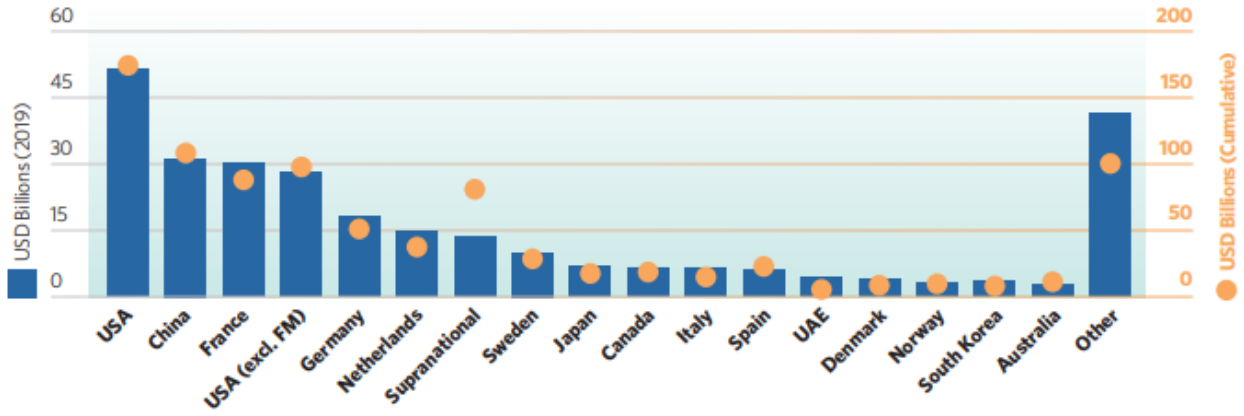


Figure 2 - Green bond issuance in 2019 and cumulative per country (CBI, 2019)

The capital raised through the issuance of green bonds has various use of proceeds, which are shown in figure 4. The building and energy sector have dominated the market with approximately 30%. The market share of the transport sector has grown over the years and the market share of the waste and water sector has declined. However, the changes in market share are relatively small, which means that the volume growth is proportionately distributed across all sectors.

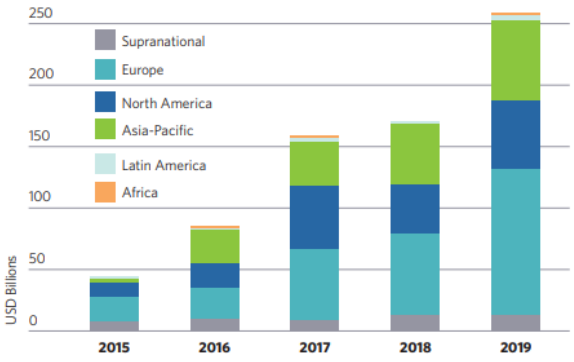


Figure 3 – Green bond issuance per region (CBI, 2019)

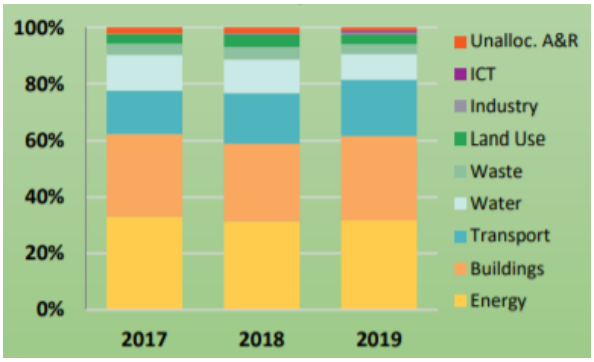


Figure 4 - Green bond issuance and use of proceeds (CBI, 2019)

At the end of 2019, green bond issuance amounted for $790.15 billion worldwide. The latest green bond market summary of Q3 2020 shows that growth in this market continues since it reached a new record and peaked at $64.9 billion in the third quarter of 2020, the

second highest amount in any individual quarter. The cumulative issuance volume since inception is now $948 billion (CBI, 2020).

## 2.2 Green bonds, cost of equity and CSR

Currently, there is little empirical work about the relationship between green bond financing and the cost of equity capital. The purpose of this study is to discuss the impact of green bond issuance by listed firms on their cost of equity and their financial corporate performance. In addition, this study contributes to a better understanding of the preferences of investors. This paper assumes that the issuance of green bonds has a positive effect on the cost of equity of listed firms in the U.S. and Europe.

Some researchers have undertaken quantitative studies verifying that there is a negative relationship between green bond issuance and cost of equity. For instance, Ng nd Rezaee (2015) investigated whether and how economic sustainability disclosure (ECON) and Environmental, Social and Governance (ESG) interactively affect the cost of equity of a firm. They found that economic sustainability disclosure has a negative relationship with the cost of equity, especially when ESG performance is strong. These results indicate that a negative relationship between green bond issuance and the cost of equity can exist. Moreover, Humphrey et al. (2012) examined the effect of corporate social performance on the performance and risk of a sample of firms from the United Kingdom. They investigated environmental, social and governance separately to understand the relationship of each factor with performance. Their conclusion is that there is no difference in performance between firms with high or low ESG-ratings. Thus, managers and investors can integrate a ESG-business strategy or investment without experiencing any significant financial costs in terms of return or risk.

In addition, Zhang et al. (2020) found empirical evidence that green financing strategies can help lower cost of equity in three ways: improving stock liquidity, lowering issuers' perceived risk and reducing information asymmetry. These findings imply that environmental risk management create corporate value. Based on previous studies, I conclude that green bond financing has certain impact on the firm's cost of equity. Furthermore, stock financing and bond financing are both forms of direct financing and are the main sources for firms to fund capital. Both forms have the same issuer and are therefore

affected by the same fundamentals of a firm. In other words, a firm's performance on the stock market and bond market are related (Gebhardt et al., 2005).

In this study the relationship between green bond financing, cost of equity capital and CSR will be further investigated. Kruger (2015) studied the stock markets' reaction to positive and negative announcements related with a firm's CSR. The results show that investors value compensation of previous corporate social irresponsibility, because investors tend to react more favourably after positive news about CSR concerned firms is published. Although, these results are based on a short-run event study and provide no evidence about the long-term effects of CSR activities. The capital that is raised through green bond issuance gives firms the opportunity to spread CSR related projects and activities over a longer time horizon. Therefore, it is interesting to examine the long-term effects of green bond issuance on corporate performance.

In addition, Cho et al. examined whether CSR performance affects information asymmetry. Their research offers direct evidence that both positive and negative CSR performance reduce information asymmetry. More specifically, they found that the influence of negative CSR performance reduces information asymmetry more than positive CSR performance. Firms can positively influence investor perception by reducing information asymmetry. That is to say, firms with high CSR may take advantages in terms of their perception by society and achieve a win-win outcome. Firms with a low CSR could reduce information asymmetry by the issuance of green bonds and affect the perception by society in a positive way. Additionally, Cui et al. (2018) investigated the empirical relationship between CSR and information asymmetry and found that CSR activities can be used as a resource to achieve and maintain the reputation of a firm and improve the information environment. Since high CSR firms already have a reasonable perception by society and low CSR firms can use green bonds to offset prior corporate social irresponsibility, it could be expected that the effect of green bond issuance by low CSR firms is stronger than that of high CSR firms.

The improvement of a firm's reputation due to CSR activities depends on the quality of reporting. Reverte (2011) examined the effect of the quality of CSR reporting on the cost of equity for a sample of Spanish listed firms. He found a significant negative relationship between CSR disclosure scores and cost of equity, especially for firms that operate in environmentally sensitive industries. His results indicate that improved CSR can enhance firm value by reducing the firm's cost of equity. Specifically, firms can reduce information

asymmetries between managers and investor through improvements in CSR reporting. Green bond issuers have to report the flow of funds from the moment green bonds are issued until funds are reconciled against expenditures of the eligible green projects. Thus, green bonds are useful instruments to improve CSR reporting.

Furthermore, Bongaerts and Schoenmaker (2020) argue that green bonds contributed significantly towards the transparency of green investments. However, green bonds are not undisputed for several reasons. Firstly, most of the time green bonds are used to refinance existing green projects that were previously financed with conventional bonds. Therefore, green bonds do not directly increase the volume of environmentally friendly projects. Secondly, the reduction in financing costs due to green bond financing is small and largely offset by other costs such as issuing costs and costs associated to low bond liquidity as a result of fragmentation. Lastly, the product structure and market of green bonds is currently not suitable enough to collect information in order to measure the environmental performance of projects financed with green bonds.

## 2.3 Green bonds and corporate financial performance

Several existing studies have focused on pricing and differences in the rate of return of green bonds, whereas the aim of this thesis is to examine the impact of green bond issuance on corporate economic and financial performance. Previous empirical research suggests that firms with high environmental performance tend to be profitable. The first research about the relationship between corporate financial performance (CFP) and ESG can be traced back to the beginning of the 1970s (Friedman, 1970). Friede et al. (2015) integrates the findings of 2,200 individual studies and found that circa 90% of the studies found a non-negative relationship. Even more interesting is that the large majority of studies demonstrate a positive relation between CFP and ESG.

However, after more than three decades of theoretical as well as empirical studies, there are still persisting questions about the nature of the relationship. Some studies have found that in some cases financing- and investment decisions can achieve win-win results for both the firm and the environment. For example, King and Lenox (2001) examined 652 U.S. manufacturing firms and found a relationship between lower pollution and higher financial valuation. Hart and Ahuja (1996) have done research to the impact of reduction in polluting emissions to a minimum within one or two years of the project's beginning and found that

the effects were positively related to the benefits of firms. Based on these previous studies, we can state that a firms' effort to improve their environmental performance can definitely improve their financial performance.

This study on green bonds and corporate financial performance closely relates to the study of Zhou and Cui (2019). Their sample included 70 listed Chinese firms that issued green bonds. They examined the effect of green bond issuance announcement on corporate stock prices using an event study approach. A DiD method was used to investigate the effect of green bond issuance on firms' financial performance and CSR. They found that announcements of green bond issuance have a positive effect on firms' share prices and that green bond financing improves the financial performance and CSR of firms. These results suggest that green bond financing can contribute to environmental improvement and that firms can use it as a tool to create value and increase profitability. Green bond issuances can also help firms to attract investors to some extent. The study of Zhou and Cui (2019) is supported by the study of Aguilera-Caracuel and Ortiz-De-Mandojana (2013), which explored a sample of 88 green innovative firms and 70 matched non-green innovative firms and found a positive correlation between profitability and the level of green innovation.

Alonso-Conde and Rojo-Suárez (2020) also examined the effects of green bonds from a firm's perspective and focused specifically on the profitability of certain green projects. They conducted a base case that allowed them to study the effect of green financing on the profitability and solvency of sustainable investments in comparison to other financial structures generally used in project finance. Their results show that the internal rate of return for shareholders is higher when firms use green bonds to finance projects compared to bank loans. Thereby, they found that green bond financing leads to higher average debt service coverage ratios. These results support the view that green bonds can potentially play an important role in greening the economy without any disadvantages for the issuers.

In this study, it is assumed that the issuance of green bonds ensures a positive effect on the firm's financial performance. As mentioned before, the U.S. and Europe represent the largest part of the green bond issuance market globally, therefore further research on the effect of green bond financing on the financial performance of firms in the U.S. and Europe will contribute to the understandings of economic benefits of green bonds.

# 3. Hypothesis Analysis

The aim of this thesis is to extend the literature on green bond financing. I have studied this particular asset class by doing research on the effect of green bond issuance on the cost of equity and corporate financial performance. In their research, El Ghoul et al. (2011) examine the impact of CSR on the cost of equity capital and their findings suggest that the environmental performance proxy is negative and highly significant related to cost of equity capital. Based on these results, they argue that it is interesting to extend the research on cost of equity and CSR, since it may alter the behaviour of firms. Empirical results that prove a significant reduction in cost of equity after green bond issuance can stimulate firms to upsize their green investments and CSR activities. Focusing on green bond issuance and cost of equity, hypothesis 1 is proposed:

*H1. Green bond issuance has a negative effect on the cost of equity of firms.*

Since investors are willing to accept lower yields in order to mitigate climate change, green bonds will be priced at a premium in comparison to non-green bonds. However, Flammer (2020) did not find evidence that corporate green bonds trade at a premium compared to non-green bonds, which implies that green bonds are not a cheaper source of debt financing. These findings suggest that a possible negative relationship between green bond financing and the cost of capital is due to other reasons than the premium on green bonds. One of these reasons could be that firms with more social responsibility concerns pay higher interest on loans than firms that act more responsibly. This argument is supported by the study done by Goss & Roberts (2011). Another argument could be that firms attract more investors after they have issued green bonds, which can lead to a lower cost of equity (Shishlov et al., 2016).

In a working paper of Rotterdam School of Management several studies regarding environmental performance and cost of equity are discussed and judge that prior empirical results are inconclusive (Gianfrate et al., 2015). The purpose of this thesis is to find significant evidence that provides a negative relationship between these variables and in particular green bond financing and corporate cost of capital. Hence, it examines the effect of green bond financing on cost of equity of firms with a low- and high CSR score. Cui et al. (2018) argue that CSR activities can be used as an instrument to improve and maintain the reputation of a firm and reduce information asymmetry, which is aligned to other studies

(Reverte, 2011; Krüger, 2015). These results indicate that green bond financing should have more impact on the cost of equity of firms with low CSR, leading to hypothesis 2:

*H2. Green bond issuance has more impact on the cost of equity of firms with low CSR compared to firms with high CSR.*

Green bond financing could be an effective resource to compensate previous corporate social irresponsibility. From a more financial perspective, it could serve as an effective way to broaden financing channels. Thereby, it may reduce financing costs. Zhou & Cui (2019) conducted research on the Chinese green bond market and found that green bond financing positively affects corporate performance of firms. This study expects that these results will be in line with the green bond market of Europe and U.S., leading to hypothesis 3:

*H3. Green bond issuance has a positive effect on corporate financial performance.*

# 4. Empirical Research

## 4.1 Dataset

Before being able to evaluate the changes in cost of equity and financial performance between firms that have issued green bonds and firms that not have issued green bonds, a database needs to be constructed. Bloomberg's fixed income database is used to verify which firms have issued green bonds in the past. All corporate bonds with a fixed coupon and that are labelled as "green bonds" were selected. Subsequently, I filtered on country of corporation and other countries than the U.S. or European countries were excluded from the file. Due to limited data availability, the remaining data sample consists of 28 listed firms from the U.S. and 19 listed firms from Europe that issued green bonds between January 1st 2016 and June 30th 2019. Basic information about the sample firms can be seen in Table 1. Based on the Bloomberg Industry Classification Level I (BICS Level 1), 52% of the firms in this sample were from the financial industry, and 48% were from non-financial industry.

**Table 1 - Basic information about the 94 sample firms**

| Classification | Type | Indicator | Treated group | Matched control group |
|---|---|---|---|---|
| BICS Level 1 | Financials | 1 | 26 | 23 |
| | Utilities | 2 | 14 | 6 |
| | Energy | 3 | 2 | 4 |
| | Technology | 4 | 1 | 2 |
| | Communications | 5 | 1 | 2 |
| | Industrials | 6 | 2 | 4 |
| | Consumer Staples | 7 | 1 | 5 |
| | Health Care | 8 | 0 | 1 |
| Country of corporation | U.S. | 1 | 28 | 28 |
| | Europe | 2 | 19 | 19 |

To examine the relation between green bond financing and cost of equity, I used implied cost of capital estimates (ICC) to test hypothesis 1 and 2. The calculations mainly depend on firms' future performance and therefore analyst forecast data is obtained from Thompson Institutional Brokers Earnings Services (I/B/E/S). Financial and industry affiliation data are consulted from Compustat North America and Compustat Global.

ASSET4 provides CSR data that is used to examine the relationship between green bond issuance, cost of equity and CSR. All amounts are converted into US dollars to facilitate comparisons.

## 4.2 Measures cost of equity capital

Financial researchers testing international asset pricing models experience that realized returns are extremely noisy proxies of expected returns. Several studies about ICC have provided evidence on the relationship between risk and return and found that this cost of equity proxy is more intuitive and more consistent with theoretical predictions than those computed using ex post realized returns (Lee et al., 2009; Daske et al., 2010; Lee at al., 2010). Additionally, Zhang et al. (2020) used the implied cost of capital to test the impact of green bond issuance on the cost of equity. Therefore, I also calculated three cost of equity proxies based on the implied cost of capital. The estimation is related to two models: the Easton model (2004) and the Ohlson and Juettner-Nauroth model (2005).

The following definitions are similar in all three models. Specific assumptions and adjustments to these variables are described with the model.

$EPS_1$ = forecasted average future earnings per share of next quarter,

$EPS_2$ = forecasted average future earnings per share of next second quarter,

$DPS_1$ = forecasted average future dividend per share of next quarter,

$P_0$ = price per share of common stock in the current quarter,

g = short-term growth rate.

**Model 1: Easton (2004)**

The first proxy for the cost of equity is developed by Easton (2004) and is a variation of the abnormal growth valuation model constructed by Ohlson and Juettener-Nauroth (2005). This model includes the following parameters: one-year ahead and two-year ahead earnings per share forecasts, as well as expected dividends per share in period t + 1. It also known as the MPEG ratio[1]. Thereby, the model assumes that the expected dividends are a constant fraction of forecasted earnings and growth in abnormal earnings is infinitely after the initial period.

[1] MPEG: A valuation model to determine the relative trade-off between the price of a stock, the earnings per share (EPS), and the expected growth of a firm (Easton, 2004).

Due to the nature of the model, it requires positive changes in forecasted earnings to hold a solution. The abnormal earnings growth model takes the form:

$$AGR_2 = EPS_2 + ICC_{MPEG} * DPS_1 - (1 + ICC_{MPEG}) * EPS_1$$

When AGR = 0, the standard abnormal growth model reduces down to the MPEG ratio:

$$ICC_{MPEG} = \sqrt{\frac{EPS_2 + ICC_{MPEG} * DPS_1 - EPS_1}{P_0}}$$

Under the additional assumption that $DPS_1 = 0$, the following equation can be derived.

$$ICC_{PEG} = [(EPS_2 - EPS_1)/P_0]^{1/2} \quad (1)$$

This ICC estimate is second cost of equity proxy and also known as the PEG ratio.

**Model 2: Earnings-price (EP) ratio**

This is a special case of the Easton (2004) model assuming that abnormal earnings growth is set to zero. The EP ratio takes the form:

$$ICC_{PE} = \frac{EPS_1}{P_0} \quad (2)$$

**Model 3: Ohlson and Juettner-Nauroth (2005)**

The third proxy is also a special form of the abnormal earnings growth valuation model and is developed by Ohlson and Juettner-Nauroth (2005). The input parameters for this model are one-year ahead forecasted dividends and earnings per share, as well as forecasts of short-term and long-term abnormal earnings growth. The short-term growth rate g is measured as the average of forecasted percentage change in earnings from year t + 1 to t + 2. This measurement is based on the study of Gode and Mohanram (2003). Thereby, I assume that the rate of infinite growth in abnormal earnings beyond forecast horizon ($\gamma$ - 1) equals 2%.

The model is a generalization of Gordon constant growth model. ICC can be derived from the following equation.

$$ICC_{OJ} = A + \sqrt{A^2 + \frac{EPS_1}{P_0} * [g - (\gamma - 1)]} \quad (3)$$

where,

$$A = \frac{1}{2}\left[(\gamma - 1) + \frac{DPS_1}{P_0}\right]$$

$$g = \frac{EPS_2 - EPS_1}{EPS_1}$$

## 4.3 Methodology

DiD approach have been generally used in many areas, such as medical research, environmental governance, investment performance studies, and policy impact evaluation. In this research, DiD method is used to estimate the effect of issuing green bonds on the cost of equity and corporate performance of firms. DiD approach is based on the fundamental that changes in observed factors are estimated in the case of the occurrence and non-occurrence of an event (counterfactual thinking framework). In practice, perfect treatment and control groups in relation to the occurrence of particular events are uncommon (Zhang et al., 2020). This paper examines the impact of green bond issuance on the economic benefits of firms. Generally, if the issuance of green bonds can be seen as natural or quasi-experimental, the effect of green bond issuance can be evaluated by comparing firms that have issued green bonds (treated group) and firms that have not issued green bonds (control group).

However, comparing firms that issued green bonds and firms that not issued green bonds could lead to sample selectivity bias or heterogeneity bias, which in turn can lead to inaccurate results. Therefore, each firm in the experimental group is individually matched to a firm in the control group based on same industry and size. The treated group is a list of firms that have issued green bonds in the period from January 1st 2016 to June 30th 2019. The control sample is constructed in two steps. First, I have collected all firms that issued conventional bonds and never issued green bonds in the period from January 1st 2016 to June 30th 2019. Then, I selected 28 firms from the 101-listed-firm candidate pool as the matching samples of the treated group. This matching procedure is also executed for the treated group with firms from Europe, where the candidate pool included 96 listed firms.

Afterwards, the DiD approach is used to estimate the causal effects of green bond issuance. Zhou and Cui (2020) and Zhang et al. (2020) also applied the DiD method to examine the impact of green bond financing. The analytic window consists of 17 quarters, 8 pre-event quarters, 8 post-event quarters and the quarter in which the first green bond was issued. For those less than two years from the first green bond issuance to June 30th 2020, I have set the window from their 8 pre-event quarters to June 30th 2020. Resulting in unbalanced panel data including 1,326 quarterly observations of firms from the U.S. and Europe, 663 among them in the treated group and 663 observations in the control group. The time interval of the control group is the same as that of the corresponding treated group. The regression equation for model 1 is as follows:

Model 1:

$$ICC_{it} = \beta_0 + \beta_1 Green_{it} Issue_{it} + \beta_2 Green_{it} + \beta_3 Issue_{it} + \beta_4 X_{it} + a_l + \delta_t + u_{it} \quad (1)$$

Here, the dependent variable, ICC is implied cost of capital calculated as in Appendix A. Issue is a dummy variable and the value of 1 implies the time after the first green bonds are issued, while the value of 0 implies the time before the first green bonds are issued. Green is dummy variable represents whether a firm has issued green bonds. The value of Green is 1 if a firm has ever issued green bonds at least one time. Otherwise, it is 0. The cross term represents the treatment effect and a significantly negative cross-term coefficient shows that there is a significant reduction in the cost of equity. X is vector of control variables that may have a significant impact on cost of equity, including ROA, size, and leverage.

Several prior studies found evidence that these variables affect cost of equity (Gebhardt et al., 2001; Dhaliwal et al., 2006; Hail and Leuz, 2006). *ROA* is the ratio of net income after tax to total assets. *Size* is the natural logarithm of total assets and *Leverage* is the ratio of total liabilities to total assets. As cost of equity can differ between firms and over years due to different economic conditions, all regressions have been controlled for industry and year fixed effects. In the regression model, $\alpha_l$ represents industry fixed effects and $\delta_t$ represents year fixed effects. The variance in the dependent variable that cannot be explained by the independent variables is captured in the error term. $i$ and $t$ are indicators for the specific firm and time.

To examine whether the effect of green bond issuance is higher or lower for firms with low CSR, a triple interaction variable is added to the model. After adding the new variable, the regression equation for Model 2 is as follows:

Model 2:

$$ICC_{it} = \beta_0 + \beta_1 Green_{it} Issue_{it} Low_{it} + \beta_2 Green_{it} Issue_{it} + \beta_3 Issue_{it} Low_{it} + \beta_4 Green_{it} Low_{it} + \beta_5 Green_{it} + \beta_6 Issue_{it} + \beta_7 Low_{it} + \beta_8 X_{it} + a_l + \delta_t + u_{it} \quad (2)$$

Low is dummy variable and has the value 1 if the firm has a CSR rating below 70.0 in the quarter the green bonds are issued. Otherwise, it is 0. Regression 2 is also used to estimate size and industry effects. I expect that green bond issuance has a larger negative impact on the cost of equity of large firms compared to small firms, since they reach a larger group of investors through different communication channels. Furthermore, the Paris Agreement stimulates countries and firms to scale up renewable energy initiatives and reduce $CO_2$, therefore my expectation is that firms operating in utility and energy sector face a greater change in their cost of equity compared to firms operating in other sectors.

In order to test the impact of green bond financing on corporate performance, two aspects of corporate performance are measured in this study: profitability and operational performance. Profitability can be described as the financial success achieved by a company in relation to the capital invested in it. Therefore, this study uses ROA and ROE to analyse profitability. Gross profit margin (GPM) reflects the current profitability and potential profitability of a firm, so this ratio is a good indicator to measure the operational performance. GPM is the gross profit (net sales minus cost of goods sold) as a percentage of net sales. Regression analyses are done with the same samples as used in the first two regressions. Three DiD regressions are executed to examine each corporate performance aspect. The regression equation for model 3 as follows:

Model 3:

$$ROA_{it} = \beta_0 + \beta_1 Green * Issue_{it} + \beta_2 Green_{it} + \beta_3 Issue_{it} + \beta_4 X_{it} + a_l + \delta_t + u_{it} \quad (3)$$

where, dependent variable, ROA is return on total assets. The definition of the cross term is similar to Model 1. X is vector of control variables that may influence the corporate

performance, including corporate size, leverage, and total asset turnover ratio (ATO). ATO is the net sales or turnover as a percentage of total assets. The same regression model is used to estimate the changes in ROE and GPM after green bond issuance.

### 4.4 Descriptive statistics

In order to verify the similarity between treated and control firms, the descriptive statistics are measured and presented in Table 2. The mean size in the treated group is 11.425 compared to 11.260 in the control group. Also, the median of the treated and control group is relatively close after matching. In contrast, the mean industry of the treated group is 0.809 lower than the mean industry of the control group. This difference is mainly due to the higher number of utility firms in the treated group. According to the summary of the Climate Bonds Initiatives (2019), the capital raised through green bond issuances is mainly used for energy allocations and investments in renewable energy. In other words, most listed utility firms have already issued green bonds and therefore the number of utility firms in the candidate pool was limited. Overall, the differences between the treatment group and the control group are relatively small, so the matching was successful.

**Table 2 – Descriptive statistics of the treated and control groups after matching**

This table presents descriptive statistics comparing treated and matched control firms. Industry is a dummy variable and size is a natural logarithm of total assets.

| | | MEAN | MEDIAN | MIN | MAX | SD |
|---|---|---|---|---|---|---|
| Industry | Treated | 1.872 | 1 | 1 | 7 | 1.454 |
| | Control | 2.681 | 1 | 1 | 8 | 2.247 |
| Size | Treated | 11.425 | 11.271 | 7.778 | 14.770 | 1.919 |
| | Control | 11.260 | 11.198 | 7.451 | 14.804 | 1.853 |

Table 3 shows the summary statistics of all variables used in Model 1. Three different cost of equity proxies are calculated to assess the impact of green bond issuance on the cost of equity. On average the cost of equity of green bond issuers before issuance is lower than the cost of equity of conventional issuers. In addition, there is small increase in the average cost of equity of green bond issuers after issuance. As for the control variables, we see that the mean size is consistent with the descriptive statistics in Table 2. The mean of *ROE* and

*Leverage* of green bond issuers is similar to the means of conventional bond issuers. This observation confirms once more that the matching procedure was successful.

### Table 3 - Issuer characteristics

These tables display summary statistics of main variables calculated based on quarterly data, which is used in regression 1. Panel A represents the treated group, firms that have issued green bonds. The firms that have never issued green bonds are reported in Panel B.

**Panel A: Green bond issuers**

| | Issue = 0 (Before) | | | | | Issue = 1 (After) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Variable | MEAN | SD | MIN | MAX | N | MEAN | SD | MIN | MAX | N |
| $ICC_{PEG}$ | 0.060 | 0.049 | 0 | 0.434 | 373 | 0.067 | 0.042 | 0 | 0.260 | 295 |
| $ICC_{PE}$ | 0.015 | 0.013 | -0.087 | 0.129 | 373 | 0.015 | 0.013 | -0.062 | 0.054 | 295 |
| $ICC_{OJN}$ | 0.123 | 0.045 | 0.011 | 0.390 | 373 | 0.124 | 0.043 | 0.017 | 0.256 | 295 |
| ROA | 0.010 | 0.017 | -0.057 | 0.165 | 373 | 0.008 | 0.014 | -0.032 | 0.086 | 295 |
| Size | 11.195 | 2.053 | 7.347 | 14.870 | 373 | 11.459 | 2.013 | 7.732 | 14.885 | 295 |
| Leverage | 0.725 | 0.178 | 0.349 | 0.980 | 373 | 0.737 | 0.178 | 0.392 | 0.963 | 295 |

**Panel B: Conventional bond issuers**

| | Issue = 0 (Before) | | | | | Issue = 1 (After) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Variable | MEAN | SD | MIN | MAX | N | MEAN | SD | MIN | MAX | N |
| $ICC_{PEG}$ | 0.081 | 0.165 | 0 | 1.689 | 371 | 0.110 | 0.241 | 0 | 1.798 | 287 |
| $ICC_{PE}$ | 0.081 | 0.350 | -0.341 | 2.977 | 371 | 0.072 | 0.337 | -0.895 | 2.941 | 287 |
| $ICC_{OJN}$ | 0.191 | 0.300 | 0.035 | 2.773 | 371 | 0.193 | 0.286 | 0.030 | 2.353 | 287 |
| ROA | 0.009 | 0.018 | -0.127 | 0.115 | 371 | 0.009 | 0.017 | -0.091 | 0.085 | 287 |
| Size | 11.060 | 1.931 | 7.396 | 15.126 | 371 | 11.312 | 1.868 | 7.382 | 15.192 | 287 |
| Leverage | 0.713 | 0.218 | 0.032 | 1.120 | 371 | 0.712 | 0.206 | 0.068 | 1.173 | 287 |

# 5. Results

In this section, I empirically explore firm's financial benefits from green bond issuance by first testing whether there is a significant change in cost of equity after firm issuing green bonds. The results based on the total sample and two sub-samples (U.S. and Europe) are discussed in the first section. Next, the second hypothesis is tested to evaluate whether firms with low CSR benefit more from green bond financing than firms with high CSR. I also conducted three regressions to test size and industry effects. In the last section, the relationship between green bond financing and corporate performance is discussed.

## 5.1 Changes in cost of equity after green bond issuance

Three different measures of implied cost of capital are calculated in order to examine the impact of green bond financing on the cost of equity. Table 4 shows that firms that issued green bonds have a lower cost of equity than firms that not issued green bonds. According to the cross term, only the first proxy ($ICC_{PEG}$) has a negative coefficient at 10% significant level. This outcome indicates that the cost of equity significantly decreases with -0.026 after the issuance of green bonds in 8-quarter event window. This decrease shows that there is some evidence that green bond financing reduces cost of equity of firms in the U.S. and Europe.

The same DiD regression is done for two subsamples and the estimation results are also reported in Table 4. According to the U.S. sample, the first implied cost of capital proxy ($ICC_{PEG}$) is significant at a level of 10%. The interpretation of this coefficient suggests that green bond issuance increases the implied cost of capital with 0.007. Thus, green bond financing rather has a positive than negative effect on the cost of equity. Thereafter, a regression is executed using the sample with only firms from Europe. Table 4 reports that the cross-term of $ICC_{PEG}$ is significantly negative at a level of 10%, which indicate that there is some evidence that green bond issuance has a negative effect on the cost of equity firms from Europe. The difference in results between the two subsamples could be explained by the fact that investors trading in EU-stocks attach more value to sustainability and are willing to sacrifice a part of their return. In addition, Amel-Zadeh & Serafeim (2018) found that European investors are more likely to use ESG information to engage with firms than investors from the U.S. Overall, we can conclude that the results are inconsistent and therefore $H_1$ is not supported.

## Table 4 - Changes in cost of equity after green bond issuance

This table presents the results of the DiD model that estimates the changes of cost of equity after green bond issuance. The dataset includes 1,326 quarterly observations of firms from United States and Europe, 663 among them in the experimental group and 663 observations in the control group. The cost of equity proxies are calculated as in Appendix A.

| | $ICC_{PEG}$ (1) | | | $ICC_{PE}$ (2) | | | $ICC_{OJN}$ (3) | | |
|---|---|---|---|---|---|---|---|---|---|
| | ALL | US | EU | ALL | US | EU | ALL | US | EU |
| Green x Issue | -0.026* | 0.007* | -0.053* | 0.005 | 0.000 | 0.032 | -0.005 | -0.000 | 0.008 |
| | (-1.67) | (1.65) | (-1.64) | (0.18) | (0.29) | (0.56) | (-0.22) | (-0.07) | (0.16) |
| Green | -0.029*** | 0.002 | -0.119*** | -0.078*** | -0.004*** | -0.240*** | -0.081*** | -0.026*** | -0.220*** |
| | (-2.69) | (0.57) | (-4.82) | (-4.34) | (-4.70) | (-5.59) | (-5.38) | (-7.67) | (-6.15) |
| Issue | 0.028** | 0.001 | 0.050** | -0.011 | -0.002** | -0.035 | -0.001 | -0.005 | -0.011 |
| | (2.51) | (0.15) | (2.14) | (-0.57) | (-2.07) | (-0.87) | (-0.07) | (-1.38) | (-0.32) |
| ROA | -0.068 | -0.108 | 0.696 | -0.151 | 0.050** | 0.845 | -0.031 | -0.230*** | 1.017 |
| | (-0.25) | (-1.36) | (1.04) | (-0.33) | (2.24) | (0.72) | (-0.08) | (-2.64) | (1.05) |
| Size | -0.003 | -0.000 | 0.014** | 0.012*** | 0.001*** | 0.032*** | 0.014*** | 0.004*** | 0.032*** |
| | (1.02) | (-0.21) | (2.03) | (2.64) | (4.28) | (2.65) | (3.52) | (4.38) | (3.15) |
| Leverage | 0.153*** | 0.005 | 0.633*** | 0.115** | 0.011*** | 0.620*** | 0.168*** | 0.032*** | 0.688*** |
| | (5.25) | (0.52) | (6.42) | (2.36) | (4.44) | (3.61) | (4.07) | (3.30) | (4.82) |
| Constant | -0.056 | 0.047*** | -0.529*** | -0.132*** | -0.003 | -0.683*** | -0.078*** | 0.069*** | -0.631*** |
| | (-2.25) | (5.99) | (-4.35) | (-3.12) | (-1.56) | (-3.23) | (-2.17) | (8.04) | (-3.58) |
| Industry | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Year | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| N | 1,326 | 740 | 586 | 1,326 | 740 | 586 | 1,326 | 740 | 586 |
| R-squared | 0.065 | 0.016 | 0.114 | 0.054 | 0.212 | 0.104 | 0.100 | 0.245 | 0.137 |
| F | 15.70 | 2.16 | 13.02 | 11.16 | 27.09 | 8.80 | 22.47 | 36.78 | 11.96 |

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

At a significance level of 1%, leverage has a positive effect on the implied cost of capital, implying that firms with more leverage will face higher risks and therefore costs of capital will increase (Zhang et al., 2020). Furthermore, the size of a firm is a significant factor in determining a firm's implied cost of capital. As shown in Table 4, the corporate size has a significantly positive effect on the implied cost of capital. A potential explanation could be that larger firms have a higher reputation and less efficient management than small firms. These findings contradict to Zhang et al. (2020), because they found that corporate size has a negative effect on the implied cost of capital. According to Column 2 and 3 in Table 4, the cross terms of $ICC_{PE}$ and $ICC_{OJN}$ are not significant and indicate that green bond financing has not a significant effect on these proxies.

## 5.2 Changes in cost of equity after green bond issuance including industry, size and CSR

In this section, the effects of industry, size and level of CSR on cost of equity after green bond issuance are discussed. In order to achieve this empirical objective four regressions are done for each cost of equity proxy.

First, we review the size effects, which are presented in Table 5. In column 2, we see that the first proxy shows significant results at 5%. The coefficient is negative and indicates that large firms face a reduction in cost of equity after green bond issuance. More specifically, large firms that issued green bonds experience a -0.116 decrease in $ICC_{PEG}$. Some studies provide evidence that CSR disclosure is positively related to firm size (Neu et al., 1998; Reverte, 2012). This implies that disclosure of green bond issuance by large firms reach more institutional and private investors. A larger and more diversified investor base can be an explanation for the reduction in the cost of equity of large firms. Unfortunately, the cross term estimates of small firms are statistically insignificant.

Furthermore, all coefficients of *Leverage* are significant and positive, indicating that higher leverage results in a higher cost of equity. The outcomes show that leverage has more impact on the cost of equity of small firms compared to large firms. The additional risk of more debt is for large firms often smaller than for small firms, which explains the difference in results.

**Table 5 - Changes in cost of equity after green bond issuance including size effects**

This table reports the results of the DiD model that estimates the changes in cost of equity after green bond issuance. Firm size is added as third interaction term in order to estimate the firm size effects. *Large* is a dummy variable that is 1 if a firm belongs to the largest 10% of all firms. *Small* is a dummy variable that is 1 if a firm belongs to the smallest 10% of all firms.

| | $ICC_{PEG}$ | | $ICC_{PE}$ | | $ICC_{OJN}$ | |
|---|---|---|---|---|---|---|
| | Small (1) | Large (2) | Small (3) | Large (4) | Small (5) | Large (6) |
| Green x Issue x Size | 0.061 | -0.116** | -0.017 | 0.059 | 0.024 | -0.047 |
| | (1.16) | (-2.46) | (-0.19) | (0.73) | (0.33) | (-0.68) |
| Green x Issue | -0.032* | -0.010 | 0.007 | 0.006 | -0.008 | 0.005 |
| | (-1.92) | (-0.60) | (0.25) | (0.21) | (-0.33) | (0.21) |
| Issue x Size | -0.033 | 0.114*** | 0.016 | -0.057 | -0.004 | 0.043 |
| | (-0.95) | (3.14) | (0.28) | (-0.92) | (-0.08) | (0.82) |
| Green x Size | 0.016 | -0.194*** | 0.095 | -0.381*** | 0.037 | -0.053*** |
| | (0.46) | (-5.95) | (1.61) | (-6.82) | (0.75) | (-5.81) |
| Green | -0.030*** | -0.010 | -0.088*** | -0.041** | -0.086*** | -0.053*** |
| | (-2.67) | (-0.94) | (-4.66) | (-2.16) | (-5.37) | (-3.41) |
| Issue | 0.033*** | 0.015 | -0.010 | -0.007 | 0.002 | -0.006 |
| | (2.73) | (1.29) | (-0.52) | (-0.39) | (0.15) | (-0.38) |
| Size | -0.001 | 0.178*** | -0.069* | 0.343*** | -0.033 | 0.253*** |
| | (-0.09) | (6.93) | (-1.78) | (7.80) | (-1.00) | (6.79) |
| ROA | -0.019 | -0.029 | -0.081 | -0.088 | 0.032 | 0.027 |
| | (-0.07) | (-0.11) | (-0.18) | (-0.20) | (0.08) | (0.07) |
| Leverage | 0.176*** | 0.123*** | 0.197*** | 0.136*** | 0.261*** | 0.205*** |
| | (7.83) | (5.50) | (5.22) | (3.55) | (8.19) | (6.34) |
| Constant | -0.041 | -0.020 | -0.045 | -0.042 | 0.014 | 0.027 |
| | (-2.19) | (-1.13) | (-1.43) | (-1.38) | (0.53) | (1.03) |
| Industry | Yes | Yes | Yes | Yes | Yes | Yes |
| Year | Yes | Yes | Yes | Yes | Yes | Yes |
| N | 1,326 | 1,326 | 1,326 | 1,326 | 1,326 | 1,326 |
| R-squared | 0.065 | 0.170 | 0.045 | 0.119 | 0.084 | 0.160 |
| F | 10.76 | 29.45 | 7.15 | 18.14 | 13.68 | 25.74 |

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

Table 6 reports the DiD results from the estimation of model 2, where *Utility* is added as a third interaction term. The cross-term *Green x Issue* of $ICC_{PEG}$ is negative and statistically significant at 10%, which is in line with the results of regression 1. The coefficients of *Green x Issue x Utility* are not statistically significant, so there is no evidence

that firms operating in the utility and energy sector experience are more affected by green bond financing than other firms.

**Table 6 - Changes in cost of equity after green bond issuance in the energy and utility sector**

This table presents the results of the DiD model that estimates the changes in cost of equity of firms operating in the energy or utility industry. *Utility* is a dummy variable that is 1 if a firm is in the energy or utility industry, otherwise it is 0. This regression is only controlled for year fixed effects.

| | $ICC_{PEG}$ | $ICC_{PE}$ | $ICC_{OJN}$ |
|---|---|---|---|
| | (1) | (2) | (3) |
| Green x Issue x Utility | 0.031 | -0.014 | 0.002 |
| | (0.90) | (-0.24) | (0.04) |
| Green x Issue | -0.033* | 0.007 | -0.007 |
| | (-1.74) | (0.24) | (-0.26) |
| Issue x Utility | -0.042 | 0.016 | 0.006 |
| | (-1.59) | (0.35) | (0.16) |
| Green x Utility | 0.059** | 0.105*** | 0.094*** |
| | (2.48) | (2.60) | (2.77) |
| Green | -0.041*** | -0.096*** | -0.097*** |
| | (-3.33) | (-4.62) | (-5.53) |
| Issue | 0.038*** | -0.016 | -0.004 |
| | (3.00) | (-0.74) | (-0.20) |
| Utility | -0.018 | -0.078*** | -0.066*** |
| | (-1.01) | (-2.59) | (-2.56) |
| ROA | -0.235 | -0.538 | -0.379 |
| | (-0.97) | (-1.32) | (-1.10) |
| Size | 0.007*** | 0.019*** | 0.021*** |
| | (2.73) | (4.46) | (5.58) |
| Leverage | 0.111*** | 0.058 | 0.115*** |
| | (4.27) | (1.33) | (3.11) |
| Constant | -0.071*** | -0.153*** | -0.100*** |
| | (-2.85) | (-3.67) | (-2.85) |
| Year | Yes | Yes | Yes |
| N | 1,326 | 1,326 | 1,326 |
| R-squared | 0.080 | 0.064 | 0.112 |
| F | 11.42 | 8.91 | 16.51 |

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

To test the effect of green bond issuance on firms with a low CSR score, a third interaction term *Low* is added to the regression. Firms are defined as low, if they have a CSR

score below 70.0. The regression estimates are shown in Table 7. According to column 1, the cross term *Green x Issue x Low* is positive and significant at 5%. This indicates that firms with a CSR score below 70.0 experience an increase in their cost of equity after issuing green bonds. This result shows that for firms with a low CSR score green bond financing is not an effective resource to reduce the cost of equity. One of the reasons could be that the signal of CSR through green bond financing not attracts enough new sustainable responsible investors to lower the cost of equity. Investors value compensation of prior corporate social irresponsibility but issuing green bonds once apparently does not have enough impact to lower the cost of equity of firms with low CSR.

The results only apply to the 8-quarter event window after green bond issuance. It can take a while before sustainable investors pick up the signal, as result that the effect of a larger investors base only has impact on the longer run. This long-term effect is not included in the estimated cost of equity, so on the long run green bond financing may have a negative effect on the cost of equity. El Ghoul et al. (2011) found that there is an increase in investor awareness about socially responsible stocks over time. This supports the assumption that cost of equity may experience a decline on the long run. The estimates of *Green* show that firms with low CSR have a lower cost of equity at the time green bonds are issued than firms with high CSR. This result is not in line with the findings of El Ghoul et al. (2011), they found that firms with better CSR scores have significantly lower cost of equity.

**Table 7 - Changes in cost of equity of firms with low CSR after green bond issuance**

This table presents the results of the DiD model that estimates the changes in cost of equity of firms with a low CSR score after green bond issuance. *Low* is a dummy variable that is 1 if a firm has a CSR score below 70.0 at the moment of issuance, otherwise it is 0.

| | $ICC_{PEG}$ | $ICC_{PE}$ | $ICC_{OJN}$ |
|---|---|---|---|
| | (1) | (2) | (3) |
| Green x Issue x Low | 0.064** | -0.011 | 0.025 |
| | (2.07) | (-0.21) | (0.57) |
| Green x Issue | -0.057*** | 0.011 | -0.016 |
| | (-2.61) | (0.30) | (-0.53) |
| Issue x Low | -0.049** | 0.018 | -0.013 |
| | (-2.22) | (0.48) | (-0.41) |
| Green x Low | 0.040** | 0.130*** | 0.088*** |
| | (1.90) | (3.72) | (3.00) |
| Green | -0.045*** | -0.137*** | -0.121*** |
| | (-3.10) | (-5.61) | (-5.85) |
| Issue | 0.054*** | -0.018 | 0.007 |
| | (3.44) | (-0.69) | (0.31) |
| Low | -0.052*** | -0.124*** | -0.102*** |
| | (-3.44) | (-4.93) | (-4.78) |
| ROA | -0.055 | -0.083 | -0.019 |
| | (-0.20) | (-0.18) | (-0.05) |
| Size | 0.001 | 0.010** | 0.011*** |
| | (0.24) | (2.05) | (2.74) |
| Leverage | 0.155*** | 0.121** | 0.170*** |
| | (5.37) | (2.51) | (4.16) |
| Constant | -0.009 | -0.049 | 0.002 |
| | (-0.34) | (-1.05) | (0.06) |
| Industry | Yes | Yes | Yes |
| Year | Yes | Yes | Yes |
| N | 1,326 | 1,326 | 1,326 |
| R-squared | 0.095 | 0.076 | 0.125 |
| F | 14.14 | 10.52 | 18.13 |

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

As for control variables, I observe that *Leverage* has a significantly positive effect on all cost of equity proxies and is in line with earlier expectations. Firms with higher leverage experience higher risks and therefore investors demand a higher return, which in turn leads to a higher cost of equity. The positive impact of leverage is consistent with findings of Gode and Mohanram (2003), Dhaliwal et al. (2006) and El Ghoul et al. (2011). Combining all

results, the conclusion is that green bond financing is not beneficial for firms with low CSR, because it increases the cost of equity. Therefore, $H_2$ is not supported.

## 5.3 Changes in corporate financial performance after green bond issuance

This section reviews the effects of green bond financing on corporate financial performance of firms from Europe and the U.S. Table 8 shows that all coefficients for the cross-term *Issue*Treat* are statistically insignificant. These results reveal that there is no relationship between green bond issuance and financial performance, and therefore $H_3$ is not supported. According to column 2, the individual variable *Green* is negative and significant at 10%. This result shows that ROA of firms in the U.S. that issue green bonds is 0.0044 lower than ROA of firms that issue conventional bonds. Comparing these results with the coefficient in Column 5, we see that ROA of firms in Europe that issue green bonds is 0.0063 higher than ROA of firms that issue conventional bonds.

Looking at the control variables, I observe that in the U.S. corporate size has a positive effect on ROE with a significance level of 10%. Pervan and Višić (2012) examined the relationship between firm size and the profitability of a firm and found a significant positive relation. There are several reasons for this positive effect. Larger firms are able to charge higher prices due to market power, which result in higher profits. In addition, stronger bargaining power provides larger firms more favourable financing conditions and higher profits could also be caused by economies of scale.

In almost all regressions, higher leverage significantly reduces the profitability of a firm. The use of excessive debt creates agency problems among creditors and shareholders, which can lead lower profitability (Fama and French, 1998). Gill et al. (2009) and Afza and Hussain (2011) also found a negative effect of leverage on corporate profitability. Furthermore, in the U.S. a higher turnover to total assets ratio increases the firm's profitability and decreases the gross profit margin. The latter is an unexpected result, since my predictions were that more revenue increases the gross profit margin due to economies of scale. To sum up, this study does not provide enough evidence to determine the impact of green bond financing on the financial performance of firms.

**Table 8 - Changes in ROA, ROE and GPM after green bond issuance**

This table presents the results of the DiD models that estimate the changes in ROA, ROE, and GPM after green bond issuance. Due to data availability ROE and GPM are only estimated for firms from the U.S.

| | $ROA_{POOLED}$ | $ROA_{US}$ | $ROE_{US}$ | $GPM_{US}$ | $ROA_{EU}$ |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| Green x Issue | 0.0003 | -0.0015 | -0.0128 | 0.0027 | 0.0010 |
| | (0.17) | (-0.69) | (-1.45) | (0.11) | (0.48) |
| Green | 0.0008 | -0.0044*** | -0.0021 | -0.1440*** | 0.0063*** |
| | (0.78) | (-3.14) | (-0.36) | (-8.97) | (4.12) |
| Issue | -0.0008 | -0.0006 | 0.0028 | -0.0141 | -0.0008 |
| | (-0.74) | (-0.36) | (0.45) | (-0.81) | (-0.59) |
| Size | 0.0002 | 0.0002 | 0.0101*** | 0.0072 | -0.0007 |
| | (0.68) | (0.40) | (5.95) | (1.51) | (-1.62) |
| Leverage | -0.0202*** | -0.0245*** | -0.1041*** | 0.2319*** | -0.0149** |
| | (-6.94) | (-6.08) | (-6.30) | (5.05) | (-2.41) |
| ATO | 0.0161** | 0.0647*** | 0.1806** | -2.044*** | -0.0039 |
| | (2.18) | (3.70) | (2.51) | (-10.24) | (-0.28) |
| Constant | 0.0202*** | 0.0227*** | -0.0252 | 0.4691*** | 0.0258*** |
| | (7.34) | (5.69) | (-1.54) | (10.32) | (3.29) |
| Industry | Yes | Yes | Yes | Yes | Yes |
| Year | Yes | Yes | Yes | Yes | Yes |
| N | 1,326 | 740 | 740 | 740 | 586 |
| R-squared | 0.071 | 0.145 | 0.124 | 0.281 | 0.129 |
| F | 15.08 | 16.56 | 9.20 | 64.89 | 5.88 |

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

# 6. Conclusion

This study examines whether green bond financing affects the cost of equity of listed firms. The cost of equity is calculated using analysts' earnings forecasts and stock prices. The main sample consists of 1,326 quarterly observations of firms from the U.S. and Europe. In order to conduct multiple DiD regressions two groups are individually matched based on industry and size: treated group that issued green bonds and control group that never issued green bonds but issued conventional bonds instead. Using a DiD approach and controlling for ROA, corporate size and leverage, I found that green bond issuance has a significantly negative effect on $ICC_{PEG}$. The calculation of this cost of equity proxy is based on the abnormal growth valuation model constructed by Easton (2004). This decrease indicates that there is some evidence that green bond financing reduces cost of equity of firms from the U.S. and Europe.

However, the regression results based on a sub-sample with only firms from the U.S. show that the third implied cost of capital proxy ($ICC_{OJN}$) has a significantly positive effect on the cost of equity. According to Europe, $ICC_{PEG}$ is negative with a low significance, which means that this study found some evidence that green bond financing negatively affects the cost of equity of firms from Europe. A possible reason for the difference in results between Europe and the U.S. could be that investors trading in stocks of European firms attach more value to sustainability, which is supported by Amel-Zadeh & Serafeim (2018).

In addition, this study examined the effects of green bond financing on the cost of equity of firms with low CSR. Firms with a high CSR score have a larger investor base and lower perceived risk than firms with a low CSR score (El Ghoul et al., 2011), so the prediction was that green bond financing has more impact on the cost of equity of firms with low CSR. In contradiction with this expectation, the estimated coefficient of $ICC_{PEG}$ offers direct evidence that firms with a low CSR score face an increase in their cost of equity. Furthermore, leverage affects cost of equity positively in all regressions, which is consistent with previous studies of Gode and Mohanram (2003), Dhaliwal et al. (2006) and El Ghoul et al. (2011). The economics behind this effect is that firms with higher leverage experience higher risks and therefore investors demand higher return on equity. Unfortunately, all cross term estimates that relate to corporate financial performance are insignificant.

Overall, the findings contribute to an improved understanding of green bond issuance and its impact on the cost of equity and corporate performance of a firm. The results related to firms from the U.S. show that the cost of equity increases after green bond issuance, which

contradicts earlier expectations. However, there is some evidence that green bond issuance has negatively related to cost of equity, but the significance is low. A possible reason could be that the sample of this research is too small. Green bonds are a relatively new instrument to finance green projects, so the sample of firms that issued green bonds was limited. Moreover, the financial data forecasted by analysts and institutions was limited as well, especially for firms from Europe, which lowered the sample even more. Fortunately, the green bond market is still an emerging market with continuous growth every year, marking limited data availability less a problem in the future.

# 7. Limitations and further research

Only 28 firms from the U.S. and 19 firms from Europe satisfied the requirements and had enough data available, as result that the sample of firms that issued green bonds was quite small. To achieve more statistically significant results, this study recommends a larger sample of firms that issued green bonds in order to prove significant changes in cost of equity after green bond issuance. In 2019, Europe experienced the largest growth in volume since the total amount of green bonds issued was $50 billion more than in 2018 (CBI, 2019). This indicates that the green bond market is still emerging, and it has not reached its peak yet. The continuous growth directly ensures a larger sample of firms that used green bonds, which improves further research on this subject.

In addition, the sample of firms that issued green bonds were mostly large banks or utility companies, hence there may be some selectivity bias in this study. To understand the green bond market in a broader sense, it is interesting to extent the diversity of issuers. Each year the number of new issuers is growing, which will increase the diversity of issuers (CBI, 2019). The industry effects on cost of equity after green bond issuance were shortly discussed in this study. It would be interesting to examine the industry effects more extensively in order to determine which industry is more favourable by green bond financing.

At the Paris climate conference (COP21) in 2015 several sustainable deadlines were set to mitigate the climate change and these deadlines are approaching. Besides that, the green bond market is exponentially growing and due to continuous developments, it is hard to predict where the market is going. For example, the Dutch government has introduced tax benefits for investors who satisfy certain sustainable conditions (PWC, 2016). At this moment, the green bond market is highly exceeded by demand with only limited investment options in comparison to the conventional bond market. Authorities may introduce fiscally preferable treatments on green bonds to obtain the sustainability goals, which can raise the demand for green investments even more. This study proposes to further investigate the impact of such tax benefits on the green bond market and evaluate the actual effects of its rapid growth.

Moreover, the debt and equity market are anticipating on the increased demand for green investment opportunities. A recent development in this market is the issuance of green convertible bonds. Until November 2020 only eleven firms had issued green convertible bonds, which makes it a fairly new asset class (Crehalet et al., 2020). The potential growth

in the green convertible market creates opportunities for firms to attract a whole new group of investors. Therefore, this study recommends to further investigate the relationship of green convertible bonds with stock prices, cost of equity and corporate performance.

Overall, this study recommends that one should perform the same analysis again at a later point in time and that this analysis should also be applied on green convertible bonds. A more developed green bond market will enlarge the sample period and it will increase the amount of green bonds issuers, which helps the researcher to make better statements.

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# Appendix A: Definition and description of variables

This table presents all variables used in the DiD regressions, including dependent variables, independent variables, and control variables.

| Type | Variable name | Symbol | Variable definition |
|---|---|---|---|
| Dependent variables | Implied cost of Capital | $ICC_{PEG}$ | $ICC_{PEG} = [(EPS_2 - EPS_1)/P_0]^{1/2}$ |
| | Implied cost of Capital | $ICC_{PE}$ | $ICC_{PE} = \frac{EPS_1}{P_0}$ |
| | Implied cost of Capital | $ICC_{OJN}$ | $ICC_{OJ} = A + \sqrt{A^2 + \frac{EPS_1}{P_0} * [g - (\gamma - 1)]}$ |
| Independent variables | Post event | Issue | For observations before first green bonds issuance, it is 0. Otherwise, it is 1. |
| | Treatment | Green | For firms that have issued green bonds, it is 1. Otherwise, it is 0. |
| | Cross term | Green x Issue | Cross term of Green and Issue. |
| Independent variables | Interaction term | Size small | The smallest 10% firms of total sample. Size as logarithm of total assets. |
| | Interaction term | Size large | The largest 10% firms of total sample. Size as logarithm of total assets. |
| | Interaction term | Utility | For firms operating in the energy or utility industry, it is 1. Otherwise, it is 0. |
| | Interaction term | Low | For firms with low CSR, it is 1. Otherwise, it is 0. |
| Control variables | Profitability | ROA | Net profit scaled by total assets |
| | Size | Size | Logarithm of total assets |
| | Leverage | Leverage | Total liabilities scaled by total assets |
| | Turnover | ATO | Total asset turnover ratio |