The impact of Corporate Green Bond Announcements on Shareholder wealth: Evidence from Asia-pacific

Bachelor Thesis
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Abstract

Over the years the corporate green bond market has seen a drastic increase in the volume of bonds issued, thus this thesis provides an insight on the impact of an announcement of a green bond issue on the financial performance of a corporate located in Asia. Using a sample of 99 green bond announcements and 241 conventional bond announcements during the time-period of 2016 until 2019, I provide evidence with the help of event study methodology that green bond issuance announcements result in positive cumulative average abnormal returns of 0,875% in a two-day event window. Furthermore, I provide evidence that green bond issuance announcements produce significant cumulative abnormal returns of 0,745% higher relative to conventional bond issue announcements within two days surrounding the announcement date. Lastly, I estimate that inaugural green bond issue announcements yield significantly positive 0,250% cumulative average abnormal returns relative to subsequent green bond issue announcements for a corporate. After controlling for firm characteristics and bond related attributes at the time of the announcement of a bond issue through multivariate regressions, I strengthen the prior stated evidence, that green bond issue announcements exhibits a significant higher positive impact on the share price of a corporate in Asia relative to conventional bond issue announcements. In addition to the prior, the tangibility and leverage ratio of a corporate significantly drive the cumulative abnormal returns as well. Conclusively, I present thorough evidence that green bond issue announcements are value enhancing for shareholders of corporates located in Asia.

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1. Introduction

Climate change is affecting everyone, from every country to every continent in the world. Weather patterns are changing, the water levels are rising from an ocean perspective in addition to greenhouse emissions being at the highest level in history. In aim to tackle this problem, the Paris agreement under the United Nations Framework Convention on climate change and the Sustainable Development goals came into action in November 2016. The aim of this agreement is to strengthen the global response to the threat of climate change by keeping a global temperature rise this century below two degrees Celsius to limit the rapidly growing global temperatures (United Nations, 2016). As of April 2018, 175 parties had accepted the Paris Agreement in addition to ten developing countries submitting their first documents in the fight against climate change. A major component in implementing the Paris agreement is the vast amount of required financing to accelerate the transition through investments into clean water, low-carbon transportation and renewable energy. A main source of financing from corporates to financial institutions comes from debt and this is where the concept of green bonds comes into play.

Green bonds are defined as bonds whose proceeds are used for the financing of environmentally friendly projects, such as renewable, water and energy efficiency, low carbon transport and bioenergy projects (Banga, 2019). In 2019, the total issuance volume from non-financial corporates doubled from 29.5$ billion in 2018 to 59.3$ billion in 2019, clearly indicating the continued increase in supply of this type of debt instrument. Moreover, Asia-pacific saw an increase of close to one third from 2018 to 2019 in terms of total volume of green bonds issued, being the second largest region of green bond issuances after Europe (Climate Bonds Initiative, 2020).

Green bonds are a relative new type of debt instrument resulting in limited empirical research, nevertheless existing research does suggest contradicting evidence relating to the value attributed to the issuance of green bonds relative to conventional debt. Flammer (2018) Roslen, Yee, & Ibrahim (2017) and Tang & Zhang (2018) provided evidence that shareholders of publicly listed corporations witness a positive increase in cumulative abnormal returns in the share price following a green bond issue announcement. However, Lebelle, Lajili Jarjir, & Sassi (2020) suggests that the stock price of a publicly listed corporations react negatively to the announcement of a green bond issue. Lastly, Pedersen & Thun (2019) applied a similar methodology on solely the European green bond market and provided evidence that shareholders of publicly listed corporations witness significant positive cumulative abnormal returns following a green bond issuance announcement. Taking into account that the green bond market in Asia is the second largest market after the green bond market in Europe, I deduce the following research question:

To what extent do green bond issuance announcements impact shareholders of publicly listed corporations located in the Asia-pacific region?

In aim to tackle the research question, a sample of 99 green bonds and 241 conventional bonds during the time-period of 2016 until 2019 of publicly listed corporations located in Asia is analysed. I first apply event study methodology using the capital asset pricing model (CAPM), to estimate the abnormal returns relative to the normal performance of publicly listed corporations surrounding the announcement of the issuance of a green bond. Furthermore, the same methodology is implemented in calculating the abnormal returns associated to conventional bond issuance announcements of the same corporations for comparability sake. Similar to the ideology implemented by Tang & Zhang (2018) which suggests that issuers witness a less pronounced effect on the share price of a corporation following susequent green bond annoucments, I investigate the abnormal returns of inaugral green bond issueance annocuemnts relative to subsequent green bond issuance annoucments for the Asian green bond market. Lastly, to further enfroce the evidence provided by the event study, I control for firm specific characteristics and bond realted attributes using corss-sectional analysis.

This thesis provides evidence that green bond issuance announcements result in positive cumulative average abnormal returns of 0,875% in a two-day event window. Moreover, I provide evidence that green bond issuance announcements produce significant cumulative abnormal returns of 0,745% higher relative to conventional bond issue announcements within two days surrounding the announcement date. Lastly, I estimate that inaugural green bond issue announcements yield significantly positive 0,250% higher cumulative average abnormal returns relative to subsequent green bond issue announcements for a corporate in Asia. After controlling for firm specific characteristics and bond related attributes at the time of the announcement of a bond issue through multivariate regressions, I strengthen the prior stated evidence, that green bond issue announcements exhibits a significant higher positive impact on the share price of a corporate in Asia relative to conventional bond issue announcements. In addition to the prior, the tangibility and leverage ratio of a corporate significantly drive the cumulative abnormal returns as well. Conclusively, I present thorough evidence that green bond issue announcements are value enhancing for shareholders of corporates located in Asia. Furthermore, the share price of publicly listed corporates in Asia on average witness a positive increase in their share price following a green bond issuance announcement.

The scientific relevance of this thesis is that it is the first research conducted on the green bond market in the region of Asia in regard to shareholder implications. Thorough empirical research has been performed on the global green bond market, nevertheless with an increase of issuance volume in particular in Asia, this thesis is the first of its kind to provide a thorough overview and insight into the corporate green bond market. The social relevance is that green bonds proceeds are used to fight climate change, thus with the increase threat to society this thesis enforces and complements the value attributed to green bonds.

2. Theoretical Framework

For a long period of time the prime concentration for stock market reactions lay with equity related topics, nevertheless as fixed income instruments have become increasingly diverse in terms of the range of products (hybrid bonds, covered bonds, convertible bonds etc) more thorough research has been conducted from the debt perspective. First, a brief overview on the green bond market will be elaborated on, after which past empirical research regarding announcement effects on firm value and drivers in the traditional bond market (non-green bond) will be discussed. Finally, recent studies surrounding announcement effects on firm value specifically tailored to the green bond market will be reflected on.

2.1. Green bond definition

Literature surrounding the green bond market is very limited due to the fact that this type of debt instrument is a relative new product resulting in most literature including working papers having been published within the last four years. Furthermore, green bonds have also attracted a large quantity of scepticism and critic in the financial and academic universe which will be elaborated on.

The transition to a lower carbon-economy with the aim of combating climate change requires a significant amount of investments from the private and public sector which requires financing. A recent development in the exploration of financial mechanism relating to this cause, is the introduction of a debt instrument, namely green bonds. Green bonds are classified as bonds whose proceeds are used for the financing of environmentally friendly projects, such as renewable, water and energy efficiency, low carbon transport and bioenergy projects (Banga, 2019). From the perspective of the issuer, green bond issuance has an impact on attracting a diversified investor base in addition to achieving a lower cost of capital relative to conventional bonds (Tang & Zhang, 2018). Investors in the green bond market are made up of both institutional clientele and retail clientele aiming at positively increasing their environmental, social and governance (ESG) score and obtaining green mandates. Furthermore, investments into green bonds are reflected on as an opportunity to directly invest into projects with tangible impacts due to the vigorous reporting required by the issuer (Wood & Grace, 2011). A green bond announcement is accompanied by a green bond prospectus in which the commitment to green projects is realized resulting in increased media attention (Pedersen & Thun, 2019). Conclusively, investor clientele aiming to increase the ESG score of their portfolio can achieve this through investing in the fixed income instrument, green bonds or directly in the corporate itself being reflected in the stock price.

A key obligation for issuers when they come to the market with a green bond is the transparency required in form of the reporting regarding the use of proceeds. Moreover, investors require this additional transparency to confirm that the proceeds from the bond issuance are indeed used for environmentally friendly projects and align with the green bond standards. In the research paper, "Green bond finance and certification" highlight and discuss the degree of heterogeneity in terms of green bond standards globally (Ehlers & Packer, 2017). They suggest that investors place value on the green label, nevertheless critic that numerous developments need to take place for this niche market to expand. The main development being that the universal definitions and frameworks relating to the issuance of green bonds needs to converge for investors to benefit from consistent standards (Berensmann, 2017; Ehlers & Packer, 2017). Lastly, the conclusion drawn signifies that the current heterogeneity of green bond definitions and frameworks attracts a varying investor base resulting in fluctuating stock market reactions across demographics.

2.2. Conventional bond market

The stock market reaction from the issue of convertible and exchangeable bonds in Germany and Switzerland during the time period of 1996 until 2003 is analysed by Ammann, Fehr, & Seiz (2006), in which they suggest that the stock market reacts negatively by a significant -1.500% on the announcement day itself. Interestingly, the announcement of the bond had a larger negative impact on issuers in Germany compared to Switzerland due to possible institutional aspects. In respect to motives that impacted the negative abnormal return, they elaborated on the concept that the pre issue market condition in terms of volatility and return played a vital role on how the announcement of the debt instrument got perceived in the market. Furthermore, the issuance of bonds during market downturn might signal the market that the issuer is in financial distress, thus impacting the abnormal return negatively at a higher magnitude (Ammann, Fehr, & Seiz, 2006).

Similarly, convertible bond issuance in Japan during 1996 to 2002 proved to show the same characteristics as the prior, where the stock market reacted significantly negative to the announcement of convertible bonds. In terms of the drivers for this, an increase in firm size proved to increase the negative abnormal returns, whereas growth characteristics impacted the abnormal return positively. Furthermore, the level of leverage of a firm had no impact on the abnormal returns at announcement (Cheng, Visaltanachoti, & Kesayan, 2005). The issuance of convertible bonds in China followed the same trend as in Japan, where the abnormal return showed to be significantly negative on the announcement day with a value of -1.870%. Additionally, the research paper concludes that the choice of market index plays a crucial role in the estimation of abnormal returns as the Shenzhen Stock Exchange witnessed a much larger negative effect from the announcement of a bond in comparison to the Shanghai Stock Exchange (Wang, Miao, & Wang, 2014). In conclusion, the characteristics of a market index play a vital role in the results drawn even within the same country.

Focusing further on Asian markets, the research paper written by Kim, and Abdullah (2011) went into great depth regarding stock market reactions on the issuance of debt in Malaysia. Using a time period from 2000 until 2007, they reported a positive significant cumulative abnormal return of the corporate surrounding the announcement. Additionally, multivariate regressions showed that firm characteristics such as profitability, asset tangibility, growth, size and ownership structure did not have a significant impact on the abnormal returns surrounding the event date (Kim & Abdullah, 2011). Comparably, another research paper investigated the differing market reactions between ordinary conventional and Islamic bond announcements of corporates in Malaysia. The research paper deduced that the announcement of Islamic bonds resulted in a significant positive effect on the value of the corporate, whereas ordinary conventional bond announcements did not result in any significant impact on the value of the corporate. Furthermore, cross sectional analysis suggested that the offering size of a Islamic bond had a negative significant effect on the abnormal returns whereas the firm size impacted the abnormal returns significantly positive (Ashhari, Mohd, Chun, & Nassir, 2009).

2.3. Green bond market

In respect to the impact of green bond announcements on the value of a firm, Flammer (2018), Tang & Zhang (2018), Lebelle, Lajili Jarjir, & Sassi (2020) and Roslen, Yee, & Ibrahim (2017) have conducted thorough research which will be elaborated on. Flammer (2018) analysed the global green bond market from 2013 until 2018, in particular the impact of green bond announcements on the valuation of a firm and the drivers surrounding the announcement. Conclusively, the research paper deduces a significant positive cumulative abnormal returns (CAR) of 0.670% on the value of a corporate surrounding the announcement of a green bond. Furthermore, Flammer (2018) suggests that green bond announcements have a positive impact on the long-term value of a corporate measured by Tobin's Q, along with a significant increase in the return on assets (ROA). The deduced results by Tang & Zhang (2018) align with the findings by Flammer (2018).

Tang & Zhang (2018) extrapolated the methodology applied by Flammer (2018) from focussing on corporates to incorporating both corporates and financial institutions. Moreover, they deduced that market participants react significantly positive to the announcement of a green bond in a 20-day event window with a CAR of 1.400%. Interestingly, they suggest that first time green bond issuers experience a higher significant positive impact on the stock price relative to subsequent issuers, indicating that market participants have incorporated the information regarding the 'green' commitment of the firm with the first issuance of the green bond. Conclusively, they claim that the observed positive impact of green bond announcements on the value of a firm is due to the increase in investor attention from elevated media exposure. These findings coincide with the conclusions drawn by Fatemi, Glaum, & Kaiser (2018), who provide evidence that corporate social responsibility (CRS) and environmental, social and governance (ESG) actions have a weak yet significantly positive impact on the value of a corporate and the financial performance of the firm.

Contradicting to the prior research, a more recent study focussing on the global corporate green bond market in the period from 2009 to 2018 discover that investors react in a negative manner to green bond announcements (Lebelle, Lajili Jarjir, & Sassi, 2020). They suggest that the stock market surrounding the announcement react significantly negative by -0.500%, where developed markets experience a higher negative reaction compared to emerging markets. Similar to Tang & Zhang (2018), they provide evidence that the stock market reaction to announcements of green bonds is more pronounced for first-time issuers relative to subsequent issuers. Lastly, Lebelle, Lajili Jarjir, & Sassi (2020) examined whether firm specific characteristics drive the variation in CARs surrounding the announcement date and deduced that the estimated negative stock market reaction is mitigated for issuers with more growth opportunities and lower financial constraints.

Similar to Lebelle, Lajili Jarjir, & Sassi (2020), significant negative CARs surrounding the 2-day event window of a green bond issue was suggested by Roslen, Yee, & Ibrahim (2017). Using a multi-country setting, they focus on global green bond issues of publicly listed corporates and deduce a significant negative impact on the issuers stock price by -2.198%. Interestingly, they propose that the negative market reception of the issuance is due to the increase in probability of default which outweighs the positive value creation from the use of proceeds from green bonds.

2.4. Hypothesis development

Flammer (2018) and Tang & Zhang (2018) deduced that green bond announcements significantly positively impact the cumulative abnormal returns on a publicly listed institution. Moreover, both research papers concluded that green bond announcements attract a varying investor base that value the natural environment and the long run. Nevertheless, Lebelle, Lajili Jarjir, & Sassi (2020) and Roslen, Yee, & Ibrahim (2017) provide contradicting evidence relating to green bond announcements, namely that green bond announcements have a significant negative impact on the stock performance of the issuer. Following the conclusions drawn by Flammer (2018) and Tang & Zhang (2018), this study hypothesizes the following:

H_1: Green bond issue announcements lead to significant positive cumulative abnormal returns for a corporate

The announcement date of green bonds provides market participants with two types of information: the issuance of debt and the long-term commitment to the environment. The information relating to the long-term commitment to the environment by the issuing corporate is incorporated into the valuation of the corporate by market participants with the first (inaugural) green bond announcement. However, with subsequent green bond announcements this type of information relating to the long-term commitment to the environment is known and incorporated by market participants already. Tang & Zhang (2018) and Lebelle, Lajili Jarjir, & Sassi (2020) deduce that the impact of green bonds announcements on the stock price of a corporate is significantly more pronounced for inaugural green bond announcements relative to subsequent green bond announcements leading to the following the hypothesis for this study:

H_2: Inaugural green bond issue announcements result in higher positive cumulative abnormal returns for a corporate relative to subsequent green bond issue announcements

Reiterating the above, multiple empirical studies have deduced contradicting results relating to conventional debt announcements on the stock performance of the issuer. Ammann, Fehr, & Seiz (2006), Cheng, Visaltanachoti, & Kesayan (2005), Wang, Miao, & Wang (2014) reported significant negative abnormal returns for the firm on the announcement date of conventional debt, whereas Kim & Abdullah (2011) suggest that publicly listed Malaysian firms experience positive abnormal returns and Ashhari, Mohd, Chun, & Nassir (2009) provides evidence that there is no significant effect on abnormal returns following a debt issuance announcement.

Lastly, to ensure robustness regarding the perceived value of the “Green” label of a debt issuance announcement by stock market participants, financial performance measures of the corporate and bond specific features are incorporated into a multivariate regression. Incorporating these characteristics will provide a true indication of the impact of the “Green” label on the cumulative abnormal returns when accounting for additional features which possibly drive the cumulative abnormal returns at the announcement date of a debt issuance of a corporate, thus we hypothesize the following:

H_3: Green bond issue announcements achieve significantly higher positive cumulative abnormal returns relative to conventional bond issue announcements

3. Data

In this section of the research paper, the data collection process is elaborated on. The data used can be broken down into data required for the event study and for the cross-sectional analysis. Event study data is made up of stock, index, risk free rate and bond data whereas the cross-sectional analysis consist of financial data. Lastly, descriptive statistics regarding the data sample will be reflected upon.

3.1. Event study data

3.1.1. Bond data

All Green bonds are retrieved from the Fixed Income database in Bloomberg terminal which have been issued from 01.01.2016 until 31.12.2019. Additionally, the country of domicile for the issuer of the debt instrument is selected to be in Asia Pacific (excluding Australia/Oceania). A critical selection criterion is the use of proceeds which can be classified in Bloomberg as a "Green Bond/Loan" resulting in a total sample size of 324 corporate green bonds. Due to the heterogeneity in definitions regarding Green bonds, Bloomberg assigns the title 'Green Bond/Loan' in accordance to the "Green Bond Principles" published by the International Capital Market Association, meaning that a 100% of the use of proceeds needs to be aligned with green activities (International Capital Market Association, 2017). The implication of this is that bonds carrying the title "Green Bond" which are not in accordance with the Green Bond Principles by ICMA will not be considered in the sample. An essential feature of Bloomberg terminal is the 'Announcement Date' which is provided for each bond as this is a crucial element in performing the event study. Data retrieved for each of the bonds included: issuer, coupon rate, announcement date, issue date, maturity date, industry, issued amount, currency, and country of issuance. Appendix A provides a breakdown in regard to the volume of issued bonds for both green bonds and conventional bonds per sector and industry. Moreover, the largest issuance industry for green bonds is power generation (31,773%), whereas for conventional bonds the largest issuance industry is utilities (31,664%). Since the issued bonds vary in currencies, all issued amounts are standardised and converted to USD. As suggested by Flammer (2018), Bloomberg's Fixed Income Database is expected to provide an accurate representation of the corporate green bond market.

Table 1: Green bond market

Table 1 provides descriptive statistics for the green bond market in Asia where columns (1) represents all green bond issues and column (2) and (3) correspond to green bond issues by private corporates and public corporates. # of Green Bonds indicates the total number of green bond issues. Amount ($m) is the issued amount per green bond standardized to USD. Life (years) represents the time to maturity of the issued green bond. Fixed-rate bond (1/0) takes the value of one when the issued green bond has a fixed coupon structure and zero otherwise. Coupon (%) is the coupon rate per issued green bond given it has a fixed coupon structure.

	(1) All	(2) Private	(3) Public
# of Green Bonds	324	225	99
Amount ($m)	151,185	143,025	169,024
	(177,368)	(185,411)	(158,822)
Life (years)	7,747	8,511	5,981
	(4,969)	(5,066)	(4,261)
Fixed-rate bond (1/0)	0,821	0,876	0,697
	(0,384)	(0,331)	(0,462)
Coupon (%)	4,179	4,699	2,999
	(2,024)	(1,725)	(2,163)

In regard to the scope of this research paper, financial institutions which issue green bonds will be excluded in accordance with multiple other studies (Flammer, 2018; Lebelle, Lajili Jarjir, & Sassi, 2020). The reason for excluding financial institutions are because the green bond proceeds are used to provide green loans to their borrowers or invest in others firms' green projects in comparison to corporates who issue green bonds to finance their own green projects (Tang & Zhang, 2018). Conclusively, stock market participants are informed in respect to this difference in the use of proceeds and act accordingly, possibly diluting the true effect of green bond issue announcements on the stock market. All green bond announcements with the issuer having a SIC code within the interval 6000-6799[1] have been excluded from this study (U.S Securities and Exchange Commission, 2020).

[1] SIC code interval: 6000-6282 are financial institutions, insurance companies and REITS

In order to perform the event study, the sample of green bond issues is restricted to only green bonds issued by publicly listed corporations. With the help of Bloomberg, each of the equity tickers corresponding to the direct issuer of the bond must be a publicly listed corporate trading on a stock exchange to be considered. This results in 55 distinct corporate green bond issuers with a total number 73 green bond announcements.[2] Furthermore, the ease of information retrieval and the required reporting to be listed on a stock exchange enhances and standardizes the quality of financial data used in the cross-sectional analysis.

Lastly, conventional bonds issued by the same public issuers of green bonds prior are retrieved using Bloomberg within the same period. The total number of issued bonds from 01.01.2016 to 31.12.2019 are 241 conventional non-green bonds. All issued amounts are standardized to USD. Furthermore, as seen with other studies, if a corporate came to the market with multiple transactions on the same day resulting in the same announcement date for each, the issued amounts in USD were accumulated (Tang & Zhang, 2018; Flammer, 2018; Cheng, Visaltanachoti, & Kesayan, 2005). Lastly, an industry breakdown of the corporates inin terms of the total volume issued in USD is shown in Appendix B providing evidence that

3.1.2. Stock data

For this research paper, the adjusted daily stock prices (P_t) for all corporate issuers in the data sample from Bloomberg terminal. The adjusted daily stock price is used instead of the closing price to accurately reflect any corporate actions such as dividends or stock splits which impact the true value of the stock (Campbell, Cowan, & Salotti, 2010). The daily returns are calculated using the simple return method:

$$R_t = \frac{P_t}{P_{t-1}} - 1 \tag{1.0}$$

If a stock does not trade daily, challenges arise for both the estimation of expected returns and the calculation of abnormal returns. Multiple studies have focused on methods to reduce the impact of thin trading causing biased and inconsistent OLS estimates of β in the market model such as Scholes & Williams (1977) and Dimson (1979). Nevertheless, the problem of thin trading and missing stock prices is avoided when these stocks are excluded from the

[2] Some issuers came to the market with multiple Green Bonds, resulting in 73 announcements

analysis which is adopted by Brown and Warner (1985). This results in dropping events for which stocks have missing prices during the event window in addition to if the stocks have less than 30% of price data during the estimation window (Maynes & Rumsey, 1993).

3.1.3. Index data

In order to measure the abnormal returns associated to the announcement, the market returns for each event are required on a daily level. As the scope of the research paper is focused on Asia, bond announcements occurring in varying countries require the adequate local market index. Similar to past research, each country's leading stock market index will be used to represent the market in which the event occurs which is expressed in (Borges & Gairifo, 2013). This results in seven value weighted indexes, each representing the specific market sentiment over time. Additionally, the MSCI Asia Pacific index price data is also retrieved for robustness purposes. Lastly, the daily index prices are used to calculate the simple daily returns, in accordance with the calculation in section: 3.1.2.

3.1.4. Risk free rate

Lastly, each of the seven market indices require the country specific risk-free rate in order to perform the event study. A risk-free return can be defined as a hypothetical investment into a risk-free asset having no default risk nor reinvestment risk. In much of the empirical research involving the risk-free rate, the yield to maturity of a sovereign bond can be considered the risk-free rate. Furthermore, governments in developed markets such as Germany which has a credit rating of AAA[3] is significantly different from India which as a credit rating of BBB-[5]. This signalizes that the default risk in India on a treasury bond is significantly higher than Germany, implying that longer dated bonds for emerging markets are a realistic representation of the risk free-rate (Damodaran, 1999). Lastly, the daily yield to maturity of a 10-year treasury bond denominated in local fiat currency for each of the countries in the sample is retrieved and transformed to a daily risk free rate given the number of trading days in the given year within the specific country.

3.2. Cross-sectional data

In comparison to previous studies regarding Green Bond announcement, the deduced CARs from the event study will be used as control variables in a multivariate regression to verify

[3] Rating by Standard & Poor's

the factors which have an influence on the CAR. The control variables can be classified into two categories: bond specific characteristics and firm specific characteristics which will be elaborated on below.

3.2.1. Bond specific characteristics

Similar to previous research, specific bond related characteristics on the announcement date can have an impact on the degree the market perceives the announcement (Ammann, Fehr, & Seiz, 2006; Flammer, 2018; Tang & Zhang, 2018). Thus, the coupon rate of the bond, the issued amount and the life of the bond will be taken into consideration for the robustness of the event study. All bond related attributes have been retrieved using Bloomberg terminal.

Coupon rate is expressed as a percentage and is the rate of interest paid to the bondholder by the bond issuer based on the face value of the bond. Furthermore, the coupon rate is set at the announcement date of the bond. The issued amount is standardized to USD for all bonds in the data set and expressed as the natural logarithm of the issued amount:

$$Amount_t = \ln\left(Issued\ Amount_i\right) \tag{1.1}$$

Lastly, the life of the bond is the total duration of the bond in terms of the maturity date. This attribute is calculated as the difference between the issue date of the bond and the maturity date, which is expressed in years. This is shown in equation 1.2:

$$Life_i = \text{Maturity Date}_i - \text{Issue Date}_i \tag{1.2}$$

3.2.2. Firm specific characteristics

Firm specific attributes are included in the multivariate regression to control for several variables that possibly have an impact on the stock market reaction to green bond announcements. Based on the deduced conclusions of prior studies, the most relevant variables will be included such as Size, Return on Assets (ROA), Tangibility and Cash Flow Ratio (Lebelle, Lajili Jarjir, & Sassi, 2020; Cheng, Visaltanachoti, & Kesayan, 2005). Additionally, all financial data regarding the corporates has been retrieved from COMPUSTAT Global on a quarterly as yearly level. Additionally, the retrieved figures are converted to USD for comparability purposes across the corporates in varying demographical locations.

3.2.2.1. Size

Prior studies have incorporated size of the firm as the natural logarithm of the firm's total assets at the time of announcement. Total assets of a firm are reported on the balance sheet and serve as an indication for the resources used to generate future economic benefits. Total assets are made up of the sum of total liabilities and owners' equity of the corporate. Thus, the total assets of a corporate serve as a proxy for the firm's size. Furthermore, the total assets are transformed to the natural logarithm to minimize the impact of outliers on the distribution of the size of the firm as seen in multiple empirical research (Titman & Wessel, 1988; Gaud, Jani, Hoesli, & Bender, 2005; Devic & Krstic, 2001). The transformation applied can be seen in the following equation:

$$Size_i = \ln(Total\ Assets_i) \tag{1.3}$$

3.2.2.2. Return on Assets (ROA)

ROA is characterized as a profitability ratio which indicates how profitable a company is relative to the total assets. Moreover, ROA serves as an indicator to how efficiently a corporate is able to convert its investments into assets resulting in a change in net income. Similar to Flammer (2018) and Lebelle, Lajili Jarjir, & Sassi (2020) net income before depreciation will be used in determining the ROA. This profitability measure is derived through the following equation:

$$ROA_i = \frac{Net\ income\ before\ depreciation_i}{Total\ Assets_i} \tag{1.4}$$

3.2.2.3. Asset tangibility

Prior research has focused largely on the impact of asset tangibility, in particular the explanatory power asset tangibility has on the capital structure of a corporate (Hall, 2012). Tangible assets can be classified as the assets on a balance sheet which have finite monetary value in addition to mostly being of physical form. In accordance with prior empirical research, asset tangibility is expressed as the ratio in percentage terms of property, plant, and equipment (PPE) located on the balance sheet to the total assets of the corporate (Kim & Abdullah, 2011; Lebelle, Lajili Jarjir, & Sassi, 2020). Translating this into equation form, please see the following:

$$Asset\ Tangibility_i = \frac{Property, Plant\ \&\ Equiptment_i}{Total\ Assets_i} \quad (1.5)$$

3.2.2.4. Leverage

The leverage ratio of a corporate provides an indication to the level of debt, consisting of short-term debt/obligations and long-term debt/obligations relative to the total capital/assets employed on the balance sheet. Furthermore, the leverage ratio provides insight on the financing decisions undertaken by the corporate. To further elaborate on this, given a constant level of total assets, a bond issue will have a positive impact on the leverage ratio. This ratio is derived in accordance with past empirical research, shown below (Borges & Gairifo, 2013; Ammann, Fehr, & Seiz, 2006; Flammer, 2018):

$$Leverage_i = \frac{(Debt\ in\ current\ liabilities_i + Debt\ in\ long\ term\ liabilities_i)}{Total\ Assets_i} \quad (1.6)$$

3.2.3. Descriptive Statistics

This section of thesis will elaborate on the descriptive statistics of the bond related attributes and the firm specific characteristics, shown in Table 2. Furthermore, Appendix B provides an overview of the correlations for the prior mentioned variables. Interestingly, the variable Green is negatively correlated to all variables except for Leverage. The issued amount for green bonds is more likely to be higher than conventional bonds, however the median amount for both types of bonds is approximately the same. Green bonds at issuance have a shorter maturity relative to conventional bonds. Additionally, the coupon rate for green bonds is on average lower than conventional bonds which can be attributed to the increase of costs relating to the certification and increased reporting for green bond issuers. Lastly, conventional bonds tend to be issued more with a fixed coupon structure relative to green bonds.

In regard to firm characteristics, all variables are well distributed seen in the comparison of the mean and the media. Nevertheless, the sample compromises of some large firms seen with the maximum value of 19,076 $bn. Furthermore, the mean leverage ratio is slightly lower relative to the media leverage ratio indicating more firms having lower leverage ratios. Return on assets is well distributed whereas the tangibility ratio of firms proves to have a mean slightly higher relative to the median, suggesting that is skewed to the right.

Table 2: Descriptive statistics

Note: Life (years) is the difference between the maturity date and the issue date of the bond. Coupon is the coupon rate in percentage terms per debt issuance given it has a fixed coupon. Amount is standardized to USD and expressed in millions. Green is a dummy variable carrying the value of 1 if the debt instrument is labelled Green and 0 otherwise. Size is the natural logarithm of total assets expressed in billion USD. Leverage is total debt (current + long term) divided by total assets. ROA is net income before depreciation divided by total assets. Tangibility is property, plant and equipment (PPE) divided by total assets.

	Panel A: Green Bond					
	Observations	Mean	Median	SD	Min	Max
Amount ($m)	99	169,024	92,536	158,822	16,273	565,881
Life (years)*	94	5,981	5,027	4,261	0,748	30,038
Coupon (%)	99	2,999	3,250	2,163	0	7,900
Fixed-rate (1/0)	99	0,697	1	0,462	0	1,000
	Panel B: Conventional Bond					
	Observations	Mean	Median	SD	Min	Max
Amount ($m)	241	153,048	94,476	131,528	14,115	940,396
Life (years)*	237	8,778	5,567	6,969	0,558	38,758
Coupon (%)	241	3,178	3,125	2,656	0	8,100
Fixed-rate (1/0)	241	0,858	1,000	0,349	0	1,000
	Pane C: Firm attributes					
	Observations	Mean	Median	SD	Min	Max
Size ($bn)	244	13,305	13,203	2,356	8,602	19,076
Leverage (%)	244	0,377	0,392	0,167	0,024	0,693
ROA (%)	244	0,057	0,056	0,334	0,004	0,195
Tangibility (%)	244	0,503	0,485	0,254	0,007	0,856

4. Empirical Analysis

This section of the research paper will first cover the applied methodologies including the event study and cross-sectional analysis, after which the results will be displayed in aim to answering the research question on the impact of green bond announcements in Asia. Firstly, the event study methodology and inferred results will be elaborated on. Lastly with the deduced results from the event study, the cross-sectional analysis methodology will be developed in which firm and bond characteristics are controlled for, before presenting the results corresponding to it in section 4.2.2.

4.1. Event study

Section 4.1.1. will provide a detailed breakdown of the methodology employed within the event study, after which the derived results relating to the event study will be discussed in section 4.1.2.

4.1.1. Methodology

Event study methodology has been used in several studies, to analyse the impact of an event on how the equity is perceived in terms of its value in the stock market. Thus, the stock price reaction to the announcement on a specific day of an event[4], in this case the announcement of a green bond issuance in Asian markets will be the focus point. Furthermore, announcements of conventional bonds[5] issued will be incorporated for compatibility purposes. A data point of crucial importance in regard to performing the event study is the 'Announcement Date' available from Bloomberg terminal. The announcement date corresponds to the first instance in which market participants have access to two types of new information, in this case the issuance of the green bond, in addition to the commitment of the corporate to sustainability. Moreover, the corresponding issue date of the bond conveys no additional information to stock market participants implying no reaction on the stock price (Flammer, 2018). Kim & Abdullah, (2011) argued that only one-third of announcements of corporate debt successfully came to the market on the proposed issue date, thus only successful debt announcements are considered in this research paper.

Several empirical studies have employed various models within the event study methodology, *i.e.* Market model (MM), the Mean Adjusted Returns Model (MAR), the 3-Factor model (FM), and the Capital Asset Pricing Model (CAPM). Repeatedly, empirical studies have employed the MM and the CAPM model in event studies and have deduced that the estimators in the market model have shown to be noisy, absorbing the variance due to the absence of the risk free rate which is present in the CAPM model, nevertheless both models produce similar results (Maitra & Dey, 2012; Binder, 1998; Armitage, 1995). Taking the prior into account, in addition to having a data sample consisting of events in a cross-country setting, where risk-

[4] Example: IPO announcement, merger & acquisition announcement, stock repurchase, bond issuance, macroeconomic events

[5] Non-Green bond announcements

free rates differ significantly the CAPM model will be used in the event study such as with the research paper written by Tang & Zhang, (2018).

In order to perform an event study, the estimation window will be used to estimate the normal performance of the equity ticker on the day of the announcement in absence of the issuance of the debt instrument, thus how the stock price would be behaving if no new information was conveyed to the market. The adopted timeframe in terms of trading days for the estimation window are 200 trading days, having a long enough time frame to minimize the variance associated to the abnormal returns, in addition to being short enough to incorporate the most relevant stock price behaviour (MacKinlay, 1997). Moreover, the event study timeline is visually presented in Figure 1, where the lower bound of the estimation period corresponds to T_{-2} (-220 trading days) and the upper bound corresponds to T_{-1} (-21 trading days). This length of estimation window corresponds to the methodologies applied by Flammer, 2018; Im, Dow, & Grover, 2001 and McWilliams & Siegel, 1997.

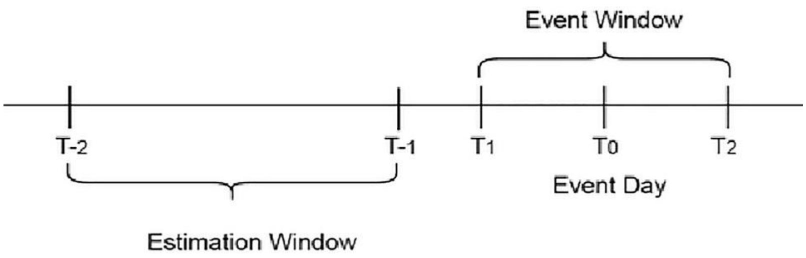

Figure 1- From Ishikawa & Sakurai (2017) - Time frames (Event study)

Regarding the event window, T_0 corresponds to the announcement date of the debt instrument and T_1/T_2 represent the lower bound/upper bound of the event window, respectively. The length of the event window is a crucial design feature in determining the abnormal returns as seen in past empirical research where long event windows severely reduce the power of the test statistic leading to false inferences concerning the significance of the event. Furthermore, short event windows have proven to absorb the significant impact of the event as the stock prices have shown to adjust to new information within 15 minutes after the announcement of firm-specific information (McWilliams & Siegel, 1997). According to Ryngaert & Netter, (1990) the length of the event window shall be determined by the nature of the event implying that if leakage of information is plausible, the event window should incorporate time prior to the event to capture the total effect of the announcement.

The main event window of interest will consist of two days, namely the announcement day of the bond issuance (T_0) in addition to one day prior to the event date to account for leakage of information resulting in the following interval, [-1, 0]. In addition to the main event of interest, additional event windows are incorporated into the event study for robustness purposes and for compatibility across recent empirical research surrounding this topic of interest. The additional event window intervals are: [-20, 20], [-5, 5], [-3, 3] and [-1, 1] which align with the intervals used by Lebelle, Lajili Jarjir, & Sassi (2020) focussing on Corporate Green Bond announcements impact on the stock market. Furthermore, financial markets in emerging markets are assumed to be less efficient in terms of the stock market participants incorporating new information at a slower rate than developed economies (Godlewski, Turk-Arissl, & Weill, 2013).

Cofounding events in this event study relates to information that has been released to the market within the event window other than the announcement of the debt issue of interest which impacts the perceived value of the corporate by stock market participants, thus distorting and diluting the abnormal returns associated to the event of interest. Furthermore, it is frequent for debt capital markets to see multiple debt issues within a fiscal year for a given corporate, in particular larger scaled corporates in need for constant liquidity. In this research paper, debt announcements by corporates other than the debt issue announcement of interest are considered cofounding events (McWilliams & Siegel, 1997). Additional cofounding events which have been screened for during the event window consist of stock splits, dividend announcements, merger and acquisitions, and share repurchases. In the instance of a cofounding event occurring, the event of interest is excluded from the event study to ensure the validity of the deduced abnormal returns (Meznar, Nigh, & Kwok, 1994).

The parameters will be estimated to compute the normal performance during the event window by means of Ordinary least square (OLS) regression using daily stock prices from Bloomberg Terminal within the time interval of [-220, -21] trading days, which is expressed in equation (1.7):

$$R_{i,t} = R_{f,t} + \beta_i\left(R_{m,t} - R_{f,t}\right) + \varepsilon_{i,t} \tag{1.7}$$

$$E(\epsilon_{i,t}) = 0 \qquad Var(\epsilon_{i,t}) = \sigma^2_{\varepsilon_i}$$

In Equation 1.7: R_{it} is defined as the return on the stock of corporate i on day t, R_{ft} represents the risk-free rate on day t and R_{mt} is the return on market portfolio m at day t. Furthermore, the error term ε_{it} has a variance of $\sigma^2_{\varepsilon_i}$ and an expected value of zero following the assumption of OLS regression. Given these attributes, OLS regression is used to estimate the parameter β_i in the CAPM over the estimation window of 200 trading days for each distinct debt announcement in the data sample. R_{ft} and R_{mt} are country specific, meaning that for each of the countries the most appropriate market indices and risk-free rate[6] are taken into consideration.

The estimated abnormal return on the stock of firm i on day t is defined by the difference between the actual return of firm i on day t and the estimated normal return of firm i on day t as seen in equation 1.8:

$$AR_{i,t} = R_{i,t} - (R_{f,t} + \bar{\beta}_i(R_{m,t} - R_{f,t})) \quad (1.8)$$

In order to estimate the abnormal returns over a series of days for a given firm i over a given time period, namely the event window [T_1, T_2] the cumulative abnormal returns (CAR) for each corporate is derived in the equation 1.9 below:

$$CAR_i[T_1, T_2] = \sum_{T_1}^{T_2} AR_{i,t} \quad (1.9)$$

The estimated CARs for each of the corporates from Equation 1.9 are required for the cross-sectional analysis in section 4.2 of this research paper. Lastly, to obtain the cumulative average abnormal returns (CAAR) over the entire event window, the average abnormal returns (AAR) for all events N at a given point in the event window is defined in equation 2.0:

$$AAR_t = \frac{1}{N} \sum_{i=1}^{N} AR_{i,t} \quad (2.0)$$

Importantly, the CAAR [T_1, T_2] over the pre specified event windows for all corporates having a debt announcement is derived through the sum of the AARs during the event window. The

[6] Country specific risk-free rate: Daily yield to maturity on a 10-year treasury bond given the country

CAAR over an event window having several events N with a lower boundary T_1 and an upper boundary T_2 is calculated in equation 2.1:

$$CAAR[T_1, T_2] = \frac{1}{N}\sum_{i=1}^{N} CAR_i[T_1, T_2] \tag{2.1}$$

After the CAARs for each of the event windows have been deduced, statistical tests are performed to draw statistical inferences on the impact of debt announcements in different event windows and markets. Additionally, test statistics provide clarification whether the abnormal returns are due to chance or can be attributed to the event under investigation. In modern event study methodology, two types of statistical tests are commonly used, namely parametric tests and non-parametric tests. Parametric tests rely on a critical assumption that the individual firm's abnormal returns are normally distributed, whereas with non-parametric tests this assumption is relaxed (Cowan, 1992).

Recent empirical research has suggested that independence across abnormal returns is commonly violated due to cross-sectional correlation being present when the event day, thus the bond announcement date is the same for multiple firms[7]. This violates the independence of abnormal returns resulting in the over-rejecting of the null hypothesis of zero CARs when it is indeed true. In addition to the prior, Boehmer, Musuemi & Poulsen (1991) suggest that event induced volatility changes in the abnormal returns cause a downward bias in the standard deviation resulting in an over rejection of the null hypothesis, thus they developed a test statistic robust to this phenomena by standardizing the event windows CARs with information from both the estimation window and event window (Boehmer, Musumeci, & Poulsen, 1991). In order to test the significance over the event window, this research paper will use the test statistic developed by Kolari & Pynnönen (2010) which builds on to the test statistic robust to event induced volatility changes by accounting for cross-sectional correlation in the abnormal returns, thus producing a test statistic robust to both (1) event induced volatility changes and (2) cross-sectional correlation within the abnormal returns. (Schmidt & Werner, 2011; Fernando, May, & Megginson, 2012; Ederington, Guan, & Yang, 2015). In addition to the incorporated parametric test, a non-parametric test, namely the

[7] The accumulated sample of green bond and conventional bond announcements have 71 events which are overlapping, thus the same event day for multiple firms causing cross-sectional correlation

Wilcoxon signed-rank test is included to reinforce the conclusion drawn from the parametric test.

The test statistic by Boehmer, Musuemi & Poulsen (1991) is expressed in equation 4.8, after which this test statistic is adjusted in order to account for cross-sectional correlation in the abnormal returns which is derived by Kolari & Pynnönen (2010) in equation 4.9.

In equation 2.2, the standardized CAR$_i$ ($SCAR_i$) is estimated for each event i occurring, in this instance the announcement of the debt instrument after which the mean standardized CAR ($\overline{SCAR}$) is deduced across all events.

$$SCAR_i = \frac{CAR_i}{\sigma_{CAR_i}} \qquad \overline{SCAR} = \frac{1}{N}\sum_{i=1}^{N} SCAR_i \tag{2.2}$$

Furthermore, the variance of the average standardized CAR ($\overline{SCAR}$) is expressed in equation 2.3, which is required in the calculation of the test statistic presented in equation 2.4. In equation 2.3, N represents the total number of events for which cumulative abnormal returns have been estimated.

$$\sigma^2_{\overline{SCAR}} = \frac{1}{N-1}\sum_{i=1}^{N}(SCAR_i - \overline{SCAR})^2 \tag{2.3}$$

Lastly, test statistic by Boehmer, Musuemi & Poulsen (1991) is derived in equation 2.4, in which changes of variance during the event window are accounted and adjusted for.

$$z_{BMP} = \sqrt{N}\frac{\overline{SCAR}}{\sigma_{\overline{SCAR}}} \tag{2.4}$$

Since cross-sectional correlation across abnormal returns is not accounted for in the test statistic from equation 2.4, Kolari & Pynnönen (2010) correct this by introducing the parameter $\bar{r}$ in equation 2.5. The parameter $\bar{r}$ is defined as the average sample cross-sectional correlation of the residuals in the estimation period. The derived test statistic follows a student-t distribution.

$$z_{KP} = z_{BMP}\sqrt{\frac{1-\bar{r}}{1+(N-1)\bar{r}}} \tag{2.5}$$

In order to account for the departure from normality of the distribution of abnormal returns as assumed in the previously discussed parametric test, a non-parametric test is incorporated for robustness. The Wilcoxon Rank sum test is especially popular among empirical research where both the sign and magnitude of the CARs are accounted for. Moreover, equation 2.6 expresses this, where N represents the total number of events:

$$W = \sum_{i=1}^{N} rank(CAR_i)^{+} \tag{2.6}$$

$$E(W) = \frac{N(N+1)}{4} \qquad \sigma_W^2 = \frac{N(N+1)(2N+1)}{12}$$

4.1.2. Results

In this section of the research paper the results relating to the applied methodology from section 4.1.1. will be presented. First the results relating to the CAAR will be compared between Green bond announcements and conventional announcements in section 4.1.2.1. Furthermore, the CAARs between first time issuers and subsequent issuers given that the issuer is announcing a green bond is elaborated on in section 4.1.2.2. Lastly, for robustness purposes the event study incorporates the MSCI Asia pacific index for all debt issues in section 4.1.2.3.

4.1.2.1. Green bond announcements

In Table 3, the results relating to the debt announcement is presented where the impact of the debt announcement on the stock market is distinguished between green bond announcements and conventional bond announcements. The primary interval which will be focused on is the two day [0, 1] CARs surrounding the announcement date (day 0). Additional event window intervals are considered for robustness accounting for information leakages and delayed information processing within the stock market, particularly in emerging markets.

Based on the estimated CAARs, publicly listed green bond issuers in Asia see a positive impact on the stock market in the short term whereas the CAARs in the long run are negative suggesting that green bond announcements have a damaging impact in the long run on the stock market. The event windows, [-20, 20], [-5, 5] and [-3, 3] are all statistically insignificant according to the parametric test statistic and the non-parametric test statistic. Flammer (2018) discovered similar results, where longer dated event intervals are statistically insignificant. The shorter dated event window [-1, 1] has a reported CAAR of 0,765% and is insignificant based on the Kolari & Pynnönen (2010) test statistic but is significant at the 5% significance level based on the Wilcoxon Rank sum test[8], implying that the null hypothesis of zero cumulative abnormal returns can be rejected. Most importantly, the CAAR for the two-day event window [0, 1] is positive and significant at the 1% significance level for both the parametric test and non-parametric test. The CAAR has a value of 0,875% suggesting that market participants on average positively value the announcement of the green bond issues in Asian markets. This corresponds to the findings of Flammer (2018) in which the CAAR for the same event window interval was statistically positive at the 1% significance level. Furthermore, Tang & Zhang, (2018) reported a statistical positive effect of green bond announcements on the firm value in both the [-10, 10] and [-5, 10] event window intervals. Interestingly, Lebelle, Lajili Jarjir, & Sassi, (2020) discovered that on average green bond announcements had a statistical significant negative impact on the perceived value of the corporate in the following event window intervals: [-20, 20], [-1, 1] and [0, 1]. This can be due to incorporating the aggregated global green bond market which can dilute the effect on a more specific geographical level and the use of different estimation parameters. Conclusively, the hypothesis of zero CAAR of a corporate surrounding the announcement date of a green bond in Asia can be rejected.

In regard to the issuance effect of conventional bonds on corporates in Asia, the deduced CAARs are positive for both the short-term and long-term event window intervals. However, all event window intervals are statistically insignificant according to the parametric test whereas only the event window [-1, 1] is statistically significant at the 10% significance level based the non-parametric test. These results correspond to the findings by Godlewski, Turk-Arissl, & Weill (2013), Ashhari, Mohd, Chun, & Nassir (2009) in which conventional bond announcements of corporates in Malaysia reported statistically insignificant CAARs focussing on similar event windows. Furthermore, the statistically insignificant CAARs based on the

[8] Non – parametric test

parametric test, suggest that the stock market participants do not consider conventional bond announcements value enhancing for the corporates in Asia.

Conclusively, corporate green bond announcements in Asia have on average a significantly positive impact on the perceived value of the corporate by market participants, whereas conventional bond announcements on average do not significantly impact the value of the corporate listed on the stock exchange. In Table 3, the deduced results suggest that corporates issuing green bonds in Asia see a 0,745%[9] increase in the stock price within the [0, 1] event window relative to announcing a conventional bond indicating the announcement of green bonds provides favourable information regarding the value of the corporate. Moreover, Appendix C which provides evidence on the estimated daily average abnormal returns relating to the event window, suggest that green bond announcements witness a drastic increase on days surrounding the announcement whereas for conventional bonds the average abnormal return remains stable throughout. These results align with the findings by Flammer (2018) and Tang & Zhang (2018) where the global green bond market have been analysed. Furthermore, the deduced results in this research paper suggest that corporates in Asian markets react more positively in the two-day event window surrounding the announcement date of green bonds compared to the European corporates issuing green bonds providing evidence that market participants digest the information differently (Pedersen & Thun, 2019). Relating these findings to the search question, green bond announcements in Asia have a significant positive effect on the stock price of a corporate relatively to ordinary conventional bond announcements.

[9] Difference between CAAR (%) of Green bonds and conventional bonds in the [0, 1] event window

Table 3: CAAR for Green vs Conventional bond announcements

Note: EW represent the event window intervals in terms of trading days with the corresponding Cumulative average abnormal return (CAAR) expressed in percentage terms. The parametric test statistic (Z_{KP}) by Kolari & Pynnönen (2010) is accompanied with the corresponding probability (P_{KP}). Furthermore, the non-parametric test statistic (Z_{WC}) and the probability (P_{WC}) are expressed. Lastly, N represents the total number of events.

	Green bonds					Conventional bonds				
EW	[-20, 20]	[-5, 5]	[-3, 3]	[-1, 1]	[0, 1]	[-20, 20]	[-5, 5]	[-3, 3]	[-1, 1]	[0, 1]
CAAR (%)	-0,328%	-0,121%	0,013%	0,765%	0,875%	0,363%	0,407%	0,301%	0,243%	0,130%
Z_{KP}	0,146	-0,701	-0,035	1,578	2,428	0,093	0,752	0,380	1,177	0,583
P_{KP}	0,884	0,484	0,972	0,116	0,016	0,926	0,453	0,704	0,240	0,560
Z_{WC}	1,587	0,468	0,385	2,010	3,015	1,638	1,641	1,485	1,876	1,165
P_{WC}	0,113	0,640	0,700	0,044	0,003	0,101	0,101	0,138	0,061	0,244
N	73	73	73	73	73	173	173	173	173	173

4.1.2.2. First vs subsequent issues– Green bond issuers

This section of the research paper will cover the difference in CAARs for first time green bond issuers and frequent green bond issuers in Asian markets which can be seen in Table 4. In respect to corporates coming to the market with a first inaugural green bond, all event windows except for the event window surround the announcement date, [0, 1] are statistically insignificant. The event window [0, 1] has a CAAR of 1,000% on average which is both significant with the parametric as with the non-parametric test at the 10% significance level. Furthermore, the null hypothesis of zero CAAR occurring in the event window [0, 1] can be rejected.

In respect to issuers that have come to the market repeatedly with green bond announcements, longer dated event window intervals have a higher CAAR relative to inaugural green bond issuers, whereas shorted dated event window intervals see a higher positive reaction for first time green bond issues. Interestingly, all event windows for subsequent green bond issues in Table 4 are insignificant except for the event window [0, 1] based on the parametric test whereas the event windows [-20, 20], [0, 1] are significant at the 5% significance level and the event windows [-5, 5] and [-1, 1] are significant at the 10% significance level based on the non-parametric test. Comparatively, inaugural issuers for the [0, 1] event window surrounding the announcement date have on average witnessed a 0.250% higher CAAR relative to a subsequent issue of the same corporate. Higher significant CAAR for first-time green bond issuers relative to subsequent issues have also been deduced in studies by Tang & Zhang (2018) and Flammer (2018). Nevertheless, Lebelle, Lajili Jarjir, &

Sassi (2020) suggest contradicting results where inaugural green bond issuers face a more negative significant CAAR relative to subsequent green bond issuers. An explanation for the prior could be due to the inclusion of non-corporates such as governments and financial institutions which dilutes the effect of corporates only. In relation to the research question, first time green bond issuers experience a higher significant CAAR suggesting that investors pay more attention to inaugural green bond announcements than with subsequent green bond announcements.

Table 4: CAAR for First-Time Issues vs Subsequent Issues: Green Bonds

Note: EW represent the event window intervals in terms of trading days with the corresponding Cumulative average abnormal return (CAAR) expressed in percentage terms. The parametric test statistic (Z_{KP}) by Kolari & Pynnönen (2010) is accompanied with the corresponding probability (P_{KP}). Furthermore, the non-parametric test statistic (Z_{WC}) and the probability (P_{WC}) are expressed. Lastly, N represents the total number of events.

	First-Time Issues					Subsequent Issues				
EW	[-20, 20]	[-5, 5]	[-3, 3]	[-1, 1]	[0, 1]	[-20, 20]	[-5, 5]	[-3, 3]	[-1, 1]	[0, 1]
CAAR (%)	-1,400%	-0,600%	0,100%	0,900%	1,000%	0,850%	0,400%	-0,100%	0,610%	0,750%
Z_{KP}	-0,567	-1,128	-0,091	1,257	1,700	0,788	0,078	0,038	0,942	1,775
P_{KP}	0,571	0,261	0,927	0,210	0,090	0,431	0,938	0,970	0,347	0,077
Z_{WC}	0,027	-1,017	-0,248	1,163	1,703	2,256	1,714	0,804	1,693	2,496
P_{WC}	0,978	0,309	0,804	0,245	0,089	0,024	0,086	0,422	0,091	0,013
N	38	38	38	38	38	35	35	35	35	35

4.1.2.3. Robustness

Similar to past studies, measures to ensure robustness of the deduced results relating to green bond announcements are incorporated. In table 5, the MSCI Asia Pacific index representing the market index in the CAPM is used in estimating the CAARs for all corporates across Asia. Comparatively to the results drawn from Table 3, the announcement of green bonds on the value of corporates in Asia are significantly positive with a value of 0.876% CAAR in the [0, 1] event window surrounding the announcement. Furthermore, the estimated CAAR for the [0, 1] event window is statistically significant at the 5% significance level for both the parametric and non-parametric test. In respect to the CAARs from the announcement of conventional bonds, all event windows are insignificant based on the parametric test. However, event windows [-3, 3] and [-1, 1] are statistically significant at the 10% significance level based on the non-parametric test. Conclusively, the results from Table 5 in respect to green bond announcement effects on the stock price of a corporate in Asia yields very similar results to Table 3, where country specific indices are used as the market benchmark.

Furthermore, in respect to the impact of conventional bond announcements on the corporate stock price, similar conclusions can be drawn as in section 4.1.2.1 although deduced significance of the event windows has altered. Lastly, corporates in Asia experience significant positive CAAR after announcements of green bonds resulting in the rejection of the null hypothesis of zero CAAR surrounding the announcement date. Flammer (2018) implemented a similar methodology for robustness and reported similar yielding results compared to the use country specific benchmarks.

Table 5: CAAR for Green vs Conventional bond announcements - Robust

Note: EW represent the event window intervals in terms of trading days with the corresponding Cumulative average abnormal returns (CAAR) expressed in percentage terms. The parametric test statistic (Z_{KP}) by Kolari & Pynnönen (2010) is accompanied with the corresponding probability (P_{KP}). Furthermore, the non-parametric test statistic (Z_{WC}) and the probability (P_{WC}) are expressed. Lastly, N represents the total number of events.

	Green bonds					Conventional bonds				
EW	[-20, 20]	[-5, 5]	[-3, 3]	[-1, 1]	[0, 1]	[-20, 20]	[-5, 5]	[-3, 3]	[-1, 1]	[0, 1]
CAAR (%)	-0,860%	0,020%	0,056%	0,700%	0,876%	0,179%	0,388%	0,398%	0,247%	0,222%
Z_{KP}	-0,106	-0,277	-0,109	1,121	2,134	-0,100	0,713	0,510	0,900	0,887
P_{KP}	0,916	0,782	0,913	0,264	0,034	0,921	0,476	0,610	0,369	0,376
Z_{WC}	0,531	0,250	-0,027	1,160	2,314	1,350	1,486	1,650	1,689	1,520
P_{WC}	0,595	0,803	0,978	0,246	0,021	0,177	0,137	0,099	0,091	0,128
N	73	73	73	73	73	173	173	173	173	173

4.2. Cross-sectional analysis

In this section of the research paper, firstly the methodology of the cross-sectional regression will be elaborated on after which the corresponding results will be discussed. Section 4.2.1. will cover the applied methodology for the cross-sectional analysis in aim to explain the drivers behind the CARs surrounding the announcement of a debt instrument. Lastly, section 4.2.2. will reflect on the deduced results.

4.2.1. Methodology

To further investigate potential drivers of the cumulative abnormal returns (CARs), Ordinary least square (OLS) regression will be applied to verify weather bond specific characteristics or firm specific characteristics influence the magnitude of the CARs. Previous empirical research suggests that several bond attributes in addition to equity related attributes impact the stock market reaction to debt issuance announcements by corporates Lebelle, Lajili Jarjir, & Sassi 2020; Ammann, Fehr, & Seiz, 2006; Boehmer, Musumeci, & Poulsen, 1991; Flammer, 2018;

Kim & Abdullah, 2011). Furthermore, to minimize diluting the true effect of the debt issuance announcements on the stock market only the event window interval of [0, 1] surrounding the announcement date will be of interest in the cross-sectional regressions (Lebelle, Lajili Jarjir, & Sassi, 2020).

The OLS regression expressed in equation 2.7, will consist of two types of attributes: firm specific attributes and bond specific attributes. Firm specific attributes will consist of the size (β_2), return on assets (β_3), tangibility (β_4) and leverage (β_5). Furthermore, bond related attributes are made up of the amount issued standardised to USD (β_6), coupon rate (β_7), life (β_8)and importantly a dummy variable[10] (β_1) indicating type of debt instrument. The error term ($\varepsilon_{i,t}$) in equation 2.7 has an expected value of zero and a variance of $\sigma^2_{\varepsilon_i}$. Additionally, significant coefficients of the attributes will provide evidence regarding the type of information that equity investors incorporate in the valuation of the corporate surrounding the announcement date of the debt instrument. Lastly, the dependent variable will be the estimated CAR surrounding each event in the event window [0, 1] surrounding the announcement date.

$$CAR_i[t_1, t_2] = \alpha_i + \beta_1 * Green_{i,t} + \beta_2 * Size_{i,t} + \beta_3 * ROA_{i,t} + \beta_4 * Tangability_{i,t} + \beta_5 * Leverage_{i,t} + \beta_6 * Amount_{i,t} + \beta_7 * Coupon_{i,t} + \beta_8 * Life_{i,t} + \varepsilon_{i,t} \quad (2.7)$$

$$E(\epsilon_{i,t}) = 0 \qquad Var(\epsilon_{i,t}) = \sigma^2_{\varepsilon_i}$$

In equation 2.7, the dummy variable 'Green' identifying the type of debt issuance event is the primary attribute of interest in the cross-sectional analysis. Furthermore, the coefficient β_1 will provide an indication whether a significant statistical importance is placed on the 'Green' label of a bond issue on the perceived value of the corporate from the investor perspective. A significant positive β_1 coefficient will indicate that investors positively value the 'Green' label of a debt instrument relative to conventional bonds. However, a significant negative β_1 coefficient provides insight that investors negatively value the 'Green' label of a debt instrument relative to conventional bonds and adjust their valuation of the corporate on the stock market accordingly. Lastly, an insignificant β_1 coefficient provides evidence that

[10] Dummy variable indicating whether the debt issuance event is Green (1) or Conventional (0)

investors do not differentiate between the information conveyed to the market whether it is a green bond or conventional bond.

Similar to past empirical research, fixed effects will be incorporated in the cross-sectional regression in other to control for time-invariant unobservable characteristics that are correlated with the independent variables (Lebelle, Lajili Jarjir, & Sassi, 2020; Tang & Zhang, 2018). Fixed effects across four categories will be included, namely in terms of year, industry, country and the firm specific effect to account for the remaining variation. Equation 2.8 incorporates the fixed effects in addition to the firm and bond specific attributes from equation 2.7.

$$CAR_i[t_1, t_2] = \alpha_i + \beta_1 * Firm\ Attributes_{i,t} + \beta_2 * Bond\ Attributes_{i,t} + Year_{FE} + Industry_{FE} + Country_{FE} + Firm_{FE} + \varepsilon_{i,t} \quad (2.8)$$

$$E(\epsilon_{i,t}) = 0 \qquad Var(\epsilon_{i,t}) = \sigma^2_{\varepsilon_i}$$

Following the assumption of OLS regression in producing the best linear unbiased estimator (BLUE), homoscedasticity across the error terms is required. Heteroscedasticity across the error term in equation 2.7 and 2.8 will not bias the estimators, nevertheless the variance-covariance matrix is incorrectly estimated causing the standard errors of the estimators to be approximated wrongly. Furthermore, inaccurate standard errors of the estimators will lead to inaccurately computing the test statistics and the corresponding probabilities resulting in the loss of efficiency. Taking the prior into account, the white test for heteroscedasticity across the error terms is incorporated and the most appropriate standard errors will be used throughout.

In order to determine whether an attribute presented in equation 2.7 has on average significant explanatory power on the $CAR_i[t_1, t_2]$ surrounding the debt issuance announcement, t-test statistics will be computed and the corresponding probabilities. An attribute is considered statistically significant based on whether the null hypothesis can be rejected: $H_0: \beta_j = 0$. Additionally, the null hypothesis is rejected if $|t_0| > t_{n-p}$[13], given the significance levels of 1%, 5% and 10%. The computation of the t-statistic is expressed in equation 2.9.

$$t_0 = \frac{\overline{\beta_J}}{\overline{SE}(\overline{\beta_J})} \sim t_n - p^{11} \qquad (2.9)$$

4.2.2. Results

In this section of the research paper, the results corresponding to the applied methodology presented in section 4.2.1 will be elaborated on. Table 6 displays the results for each model (1 to 4), where the independent variable is the estimated CAR_i during the event window [0, 1] and the independent variables represent the bond specific and firm specific attributes as discussed in above. Furthermore, to ensure robustness Model (1) and (2) exclude the bond specific attribute, 'Life' since the sample compromises of nine bonds which are perpetual, having no maturity date. Taking the prior into account, Model (3) and (4) include the variable 'Life' in the cross-sectional analysis. Fixed effects on year, industry, country and firm level are accounted for to absorb any remaining variation. Moreover, Model (1) and (3) exclude firm specific fixed effects but account for fixed effects on year, industry and on country level whereas, Model (2) and (4) take all fixed effects into account. Lastly, possible multicollinearity in the independent variables is addressed through a correlation matrix shown in Appendix B, in addition to estimating the tolerance statistics and variance inflation factors (VIFs) expressed in Appendix D, suggesting that multicollinearity is not present as the values for the VIFs are all lower than 2.5 (Adeboye, Fagoyinbo, & Olatayo, 2014; Mansfield & Helms, 1982).

Interestingly, the coefficient for the independent variable 'Green' is statistically positive significant at the 10% significance level for models: (1), (2) and (4), and at the 5% significance level for model (3), thus providing evidence that equity investors positively value the label 'Green' of a debt issuance relative to conventional debt issuance. After accounting for time-invariant unobservable characteristics, model (2) indicates that green bond announcements have on average 0.750% higher CARs relative to conventional bond announcements taking all bonds in the sample into consideration. Model (4) which takes only issuing bonds with a given maturity into consideration, estimates the coefficient for the variable Green to be 0.763%. Finally, the results of the multivariate regressions in table 9 provide significant evidence that the null hypothesis can be rejected resulting in green bond announcements positively

[11] Degrees of freedom regarding the T-distribution

impacting the CARs relative to the announcements of conventional bonds, thus green bond announcements statistically positively affect the value of a publicly listed corporate in Asia.

In addition to the primary variable of interest, the dependent variables leverage and tangibility are statistically significant at a 5% significance level in model (1) and at the 10% significance level in model (3).

Table 6: Cross-sectional analysis

Note: CAR [0, 1] is the independent variable for all four regressions. Regarding dependant variables: Green is a dummy variable carrying the value of 1 if the debt instrument is labelled Green and 0 otherwise. Size is the natural logarithm of total assets. ROA is net income before depreciation divided by total assets. Tangibility is property, plant and equipment (PPE) divided by total assets. Leverage is total debt (current + long term) divided by total assets. Amount is the natural logarithm of the issued amount in USD. Coupon is the coupon rate in percentage terms per debt issuance. Life is the difference between the maturity date and the issue date of the bond. Year FE represent the yearly fixed effects. Industry FE accounts for industry based fixed effects. Country FE account for fixed effects on a country level. Firm FE account for fixed effects on a firm level. The constant reflects the intercept for each regression. Lastly, all test statistics are computed using robust standard errors.

Model	(1)	(2)	(3)	(4)
Independent Variable	CAR [0, 1]	CAR [0, 1]	CAR [0, 1]	CAR [0, 1]
Green	0.724*	0.750*	0.843**	0.763*
	(0.377)	(0.383)	(0.390)	(0.388)
Size	0.039	0.103	0.060	-0.390
	(0.240)	(2.911)	(0.243)	(3.012)
ROA	-9.277	-4.941	-8.125	-4.106
	(7.579)	(10.06)	(7.774)	(10.44)
Tangibility	2.482**	13.420	2.107*	11.310
	(1.049)	-11.940	(1.120)	-12.300
Leverage	-2.904**	5.866	-2.786*	6.817
	(1.402)	(8.294)	(1.560)	(8.496)
Amount	0.313	-0.252	0.281	-0.271
	(0.294)	(0.361)	(0.300)	(0.362)
Coupon	-0.133	-0.176	-0.131	-0.120
	(0.195)	(0.327)	(0.215)	(0.380)
Life	-	-	0.031	0.023
	-	-	(0.028)	(0.033)
Constant	-4.131	-8.127	-4.035	-6.150
	(5.598)	(49.864)	(5.715)	(51.74)
Observations	246	246	235	235
R-squared	0.159	0.441	0.171	0.453
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes
Firm FE	No	Yes	No	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Tangibility has a significantly positive coefficient of 2.482 in model (1) and 2.107 in model (3), resulting in the rejection of the null hypothesis of a coefficient with a value of zero. Furthermore, this reflects the notion that corporates with a higher quantity of physical assets have a lower degree of financial distress due to the increase in collateral for creditors (Rampini & Viswanathan, 2013). Conclusively, equity investors take the magnitude of tangible assets into account when readjusting their valuation of a corporate in Asia after the announcement of a bond issue. The coefficient for the leverage ratio is -2.904 and -2.786 for model (1) and model (2) respectively and the null hypothesis of a coefficient with a value of zero can be rejected. Furthermore, this signifies that equity investors react negatively to a higher volume of leverage at the announcement of a debt issue, due to the increase of cost of debt in addition to a higher probability of default.

Conclusively, the estimated CARs surrounding debt issuance announcements mainly depend on whether the debt issuance has the 'green' label, the leverage ratio of a corporate and the tangibility ratio of a corporate in Asia. In relation to the research question, the 'Green' label of a debt issue plays a significant positive role in the reaction of stock market participants in Asia. Furthermore, stock market participants on average account for tangibility positively and leverage negatively when incorporating the announcement of a debt issue in the valuation of a publicly trading corporate in Asia.

5. Conclusion

This thesis investigates the green bond market for all publicly listed corporates located in Asia from 2016 until 2019. In order to tackle the research question, event study methodology is applied after which cross sectional analysis is performed taking into account bond and firm specific features for robustness purposes. We find that green bond announcements are associated to a significant[12] positive 0,875% cumulative average abnormal return in the event window surrounding the announcement of the issuance. Furthermore, for conventional bond announcements during the same event window, deduced cumulative average abnormal returns are 0,130%. Conclusively, the estimated results provide statistically significant evidence that green bond issue announcements by publicly listed corporates located in Asia on average exhibit positive cumulative abnormal returns relative to conventional bond

[12] Parametric test: 5% significance level and Non-parametric test: 1% significance level

announcements. Additionally, stock market participants positively value the information conveyed by the "green" label of a bond issuance regarding the long-term commitment to the environment. These results correspond to the findings by Flammer (2018) who reported a significantly positive 0,670% cumulative abnormal return for the two-day event window surrounding the announcement date of a green bond. Nevertheless, the deduced figure by Flammer (2018) is slightly deflated relative to the figure reported in this thesis due to multiple viable reasons. The first reason being the chosen time frame for the thesis incorporating more recent data, accounting for the large spike in the issuance volume present in the green bond market in recent years. In addition to the prior, Flammer (2018) incorporates the global green bond market, thus the reception of green bond announcements of corporates on investors may vary in demographic domiciles other than Asia. Correspondingly, Pedersen & Thun (2019) who focussed on corporate green bond announcements in Europe only, deduced a cumulative average abnormal return of 0,370% suggesting that the European investor clientele value green bond announcements less, thus the lower value deduced by Flammer (2018). The positive reception of green bond announcements on the value a corporate in Asia can be attributed due to the increase of interest in emerging markets issued debt, in which a survey by Invesco (2020) reports an increase in the allocation of emerging markets debt by 23% over the time period from 2017 until 2020. Moreover, this increase in demand from investors is primarily driven by investors in Asia, representing 82% of the 23% increase. Importantly, Invesco (2020) also reported that the volume of investors located in Asia who incorporated ESG metrices in their fixed income portfolio has increased from 29% in 2018 to 69% in 2020, clearly indicating that the spike in demand from investors is driving the positive stock price reaction to a green bond announcements of a corporate in Asia.

Additionally, I deduced that corporates entering the green bond market for the first time, saw a significantly positive higher cumulative average abnormal return of 0,250% in the share price relative to subsequent green bond issues surrounding the announcement date. These findings align with Flammer (2018), Tang & Zhang (2018) and Pedersen & Thun (2019), who provide evidence that the market has incorporated the information of the long term commitment to the environment by the corporate with the first green bond announcement, through the attraction of a varying investor base incorporating ESG matrices in their respective portfolios. However, subsequent green bond announcements do not provide new information triggering a revaluation of the corporate by the stock market, thus a lower cumulative average abnormal return.

Lastly, I provide evidence that green bond issuance announcements have a significant higher cumulative abnormal return on the stock price of a corporate relative to conventional bond announcements of the same corporate. Results corresponding to the event study produce cumulative average abnormal returns of 0,875% for green bond announcements relative to 0,130% for conventional bonds surrounding the two-day event window for corporates in Asia. In addition to the prior, multivariate regressions which accounted for financial and bond related attributes, enforced the evidence that green bonds announcements have a significantly higher positive effect on the stock price of the corporate relative to conventional bonds. Nevertheless, the tangibility and leverage of a corporate at the announcement date of a debt issuance proved to be statistically significant, driving the cumulative abnormal returns. Conclusively, I provide sufficient evidence that the “green” label of a debt issuance announcement by a corporate in Asia is valued significantly positively by Investors, which can be attributed to the attraction of a varying investor base in addition to the increase of transparency due to the mandatory reporting regarding the use of proceeds.

Lastly, a limitation present in this research paper is the total sample size of green bonds. The total number of green bond announcements amounts to 99 green bond issues, which may possibly not be a true indication of the current state of the Asian green bond, especially taking into account that public corporates are the dominant issuers with a number of 225 green bond issues. Moreover, the data sample faces possible biases in the estimation of the cumulative abnormal returns as larger countries such as china and japan have issued a larger volume of green bonds relative to other countries. Similar, larger issuers have issued higher quantity of green bonds having an impact on the results as well. Green bonds are a relative new type debt instrument with the largest issuance volume occurring in 2019, clearly signalling that as the green bond market matures further research in this field is required.

In addition to the prior, the inclusion of additional drivers in the multivariate regression would ensure a higher degree of robustness and provide a clearer indication whether the “green” label of the debt issuance is indeed a driver in the cumulative abnormal returns. In this research paper only financial and bond related attributes are included, whereas attributes relating to the cooperate governance, the corporate structure or the involved bookrunners can influence the reception of the debt issuance on the stock market. Lastly, Tang & Zhang, (2018) and Lebelle, Lajili Jarjir, & Sassi (2020) estimate cumulative abnormal returns using additional asset pricing models such as the Fama French 3-factor and 5-factor model for comparability purposes, whereas this research paper estimates the cumulative abnormal returns with only the capital asset pricing model. Nevertheless, both the previously mentioned research papers deduced similar cumulative abnormal returns for all asset pricing models.

In regard to future research, the long run effect of green bond issuance on the value of a corporate can provided further clarification. Moreover, analysis on the development of specific attributes such as financial characteristics over time after the issue of a green bond would provide further evidence regarding the impact of green bond issuance announcements As touched upon above, as the green bond market further matures and the total number of green bonds issued increased, a clearer picture can be provided to whether green bond issuance announcements have a positive impact on the value of a publicly listed corporate. Past empirical research has focussed on the global green bond market, nevertheless as green bond definitions vary across the globe investors react differently to the announcement of a green bond issue thus further research in local demographical domiciles can provide a better insight into the reception of the announcement of a green bond issue. This research paper focuses on the Asian green bond market only, further research into regions such as Australia, Europe or the United States is recommended.

6. References

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Appendix A: Industry breakdown

Note: Level 1 Classification is the sector of the issuer. Level 2 Classification is the industry within the sector of the issuer. Conventional bond contains the issued amount of conventional bonds expressed in percentage terms relative to the total issued amounts over all industries. Green bond contains the issued amount of green bonds expressed in percentage terms relative to the total issued amounts over all industries. Grand total contains the issued amount expressed in percentage terms relative to the total issued amounts over all industries

Level 1 Classification	Level 2 Classification	Conventional Bond	Green Bond	Grand Total
Consumer Discretionary	Airlines	2,816%	0,826%	2,269%
	Apparel & Textile Products	4,512%	0,945%	3,532%
	Automobiles Manufacturing	1,480%	6,721%	2,920%
	Department Stores	1,325%	0,826%	1,188%
	Travel & Lodging	8,469%	3,690%	7,156%
Energy	Refining & Marketing	0,247%	1,702%	0,646%
	Renewable Energy	0,839%	2,915%	1,409%
Industrials	Electrical Equipment Manufacturing	0,412%	1,854%	0,808%
	Industrial Other	3,626%	4,213%	3,787%
	Electrical Equipment Manufacturing	1,114%	0,000%	0,808%
	Transportation & Logistics	2,037%	2,759%	2,236%
	Waste & Environment Services & Equipment	0,662%	3,204%	1,361%
Materials	Chemicals	4,950%	12,631%	7,060%
	Construction Materials Manufacturing	0,232%	0,431%	0,287%
	Containers & Packaging	0,000%	0,353%	0,097%
	Forest & Paper Products Manufacturing	2,319%	1,233%	2,020%
Technology	Hardware	13,877%	7,037%	11,998%
	Semiconductors	0,756%	1,860%	1,059%
	Software & Services	1,159%	0,909%	1,091%
Utilities	Power Generation	17,504%	31,773%	21,424%
	Utilities	31,664%	14,117%	26,844%
Grand Total		100,000%	100,000%	100,000%

Appendix B: Correlation matrix

Green is a dummy variable carrying the value of 1 if the debt instrument is labelled Green and 0 otherwise. Size is the natural logarithm of total assets. ROA is net income before depreciation divided by total assets. Leverage is total debt (current + long term) divided by total assets. Tangibility is property, plant and equipment (PPE) divided by total assets. Coupon is the coupon rate in percentage terms per debt issuance. Life is the difference between the maturity date and the issue date of the bond. Amount is the natural logarithm of the issued amount in USD.

Variable	Green	Size	ROA	Leverage	Tangibility	Coupon	Life	Amount
Green	1,000							
Size	-0,277	1,000						
ROA	-0,172	0,316	1,000					
Leverage	0,039	-0,142	-0,107	1,000				
Tangibility	-0,050	0,326	0,153	0,522	1,000			
Coupon	-0,168	-0,407	-0,193	0,166	0,105	1,000		
Life	-0,142	0,083	0,050	-0,179	0,074	0,054	1,000	
Amount	-0,038	0,178	0,194	0,079	0,061	0,053	-0,104	1,000

Appendix C: Abnormal return estimation

Note: Note: ED represent the event day with the corresponding average abnormal returns (AAR) expressed in percentage terms. The parametric test statistic (Z_{KP}) by Kolari & Pynnönen (2010) is accompanied with the corresponding probability (P_{KP}). Furthermore, the non-parametric test statistic (Z_{WC}) and the probability (P_{WC}) are expressed. Lastly, N represents the total number of events.

	(1) Green Bond					(2) Conventional Bond				
ED	AAR (%)	Z_{KP}	P_{KP}	Z_{WC}	P_{WC}	AAR (%)	Z_{KP}	P_{KP}	Z_{WC}	P_{WC}
-20	0,255%	1,467	0,144	0,701	0,483	-0,136%	-0,704	0,482	-0,307	0,759
-19	0,054%	-0,196	0,845	0,316	0,752	0,007%	0,185	0,854	-0,553	0,581
-18	-0,045%	-0,474	0,636	-0,580	0,562	0,231%	1,666	0,097	1,939	0,052
-17	0,042%	0,595	0,552	0,410	0,682	0,047%	0,050	0,960	0,368	0,713
-16	0,002%	0,511	0,610	0,569	0,569	-0,056%	-0,386	0,700	0,207	0,836
-15	-0,061%	-0,235	0,815	0,415	0,678	-0,106%	-0,276	0,783	-0,600	0,549
-14	-0,253%	-0,848	0,397	-0,772	0,440	0,035%	0,005	0,996	0,208	0,835
-13	-0,014%	-0,314	0,754	0,074	0,941	0,116%	0,489	0,626	0,202	0,840
-12	0,047%	0,226	0,821	0,300	0,764	0,070%	0,593	0,553	0,983	0,326
-11	0,153%	1,018	0,310	1,844	0,065	0,035%	-0,012	0,991	-0,828	0,407
-10	0,220%	1,184	0,238	1,570	0,117	-0,069%	-0,722	0,471	-0,143	0,886
-9	0,052%	0,337	0,737	-0,278	0,781	-0,059%	-0,302	0,763	-0,133	0,894
-8	-0,104%	-0,720	0,472	-0,520	0,603	-0,114%	-0,987	0,325	-0,681	0,496
-7	-0,018%	-0,645	0,520	-0,025	0,980	0,121%	0,804	0,422	2,117	0,034
-6	0,086%	0,471	0,638	1,047	0,295	0,107%	0,846	0,398	1,233	0,218
-5	-0,175%	-1,099	0,273	-0,509	0,611	-0,014%	-0,114	0,909	0,298	0,766
-4	0,015%	-0,014	0,989	0,217	0,828	0,209%	1,313	0,191	1,585	0,113
-3	0,007%	0,017	0,987	0,767	0,443	-0,079%	-0,680	0,497	-0,628	0,530
-2	-0,198%	-0,661	0,509	-0,146	0,884	0,043%	0,337	0,737	0,089	0,929
-1	-0,109%	-0,353	0,724	-0,728	0,466	0,113%	0,850	0,396	1,474	0,140
0	0,408%	2,215	0,028	2,614	0,009	-0,011%	-0,246	0,806	0,622	0,534
1	0,466%	1,008	0,315	1,696	0,090	0,141%	1,167	0,244	1,024	0,306
2	-0,320%	-1,254	0,211	-1,421	0,155	0,022%	0,428	0,669	0,965	0,335
3	-0,242%	-1,620	0,107	-1,630	0,103	0,073%	0,007	0,994	0,322	0,747
4	-0,087%	-0,257	0,798	-0,212	0,832	0,012%	0,280	0,780	0,631	0,528
5	0,114%	-0,075	0,940	0,827	0,408	-0,101%	-0,878	0,381	-1,207	0,227
6	0,218%	0,663	0,508	0,992	0,321	-0,251%	-2,386	0,018	-2,555	0,011
7	-0,179%	-0,972	0,332	-1,042	0,298	0,040%	0,232	0,817	0,063	0,950
8	-0,349%	-1,139	0,256	-1,416	0,157	-0,121%	-0,957	0,340	-0,963	0,335
9	-0,107%	-0,386	0,700	-0,239	0,811	-0,242%	-1,570	0,118	-1,548	0,122
10	-0,251%	-0,685	0,494	-0,509	0,611	-0,065%	-0,070	0,944	0,459	0,647
11	0,081%	-0,091	0,928	0,866	0,387	0,047%	0,284	0,777	0,525	0,599
12	0,086%	0,163	0,871	1,058	0,290	0,057%	0,227	0,821	0,769	0,442
13	0,064%	0,022	0,982	0,981	0,326	0,053%	0,200	0,841	0,230	0,818
14	0,051%	0,144	0,885	0,910	0,363	0,088%	0,732	0,465	0,988	0,323
15	-0,112%	-0,701	0,484	-0,151	0,880	0,169%	0,926	0,355	1,216	0,224
16	-0,017%	0,204	0,839	-0,168	0,867	-0,019%	-0,199	0,842	0,192	0,848
17	0,045%	0,053	0,958	0,717	0,473	-0,003%	0,612	0,541	0,706	0,480
18	-0,125%	-0,849	0,397	-0,690	0,490	-0,258%	-1,353	0,177	-1,138	0,255
19	-0,087%	-0,039	0,969	1,075	0,282	0,187%	1,166	0,245	1,668	0,095
20	0,059%	0,877	0,381	0,888	0,375	0,043%	0,539	0,590	-0,121	0,904

Appendix D: Collinearity Diagnostics

Note: Variable column contains all the dependent variables. VIF represents the variance inflation factor being 1/Tolerance. SQRT VIF represents the square root of the variance inflation factor. Tolerance is the degree of variability in one variable that is not explained by the other variables. R-Squared is the coefficient of determination.

Variable	VIF	SQRT VIF	Tolerance	R-Squared
Green	1,120	1,060	0,891	0,109
Size	1,930	1,390	0,517	0,483
ROA	1,200	1,100	0,834	0,166
Tangibility	2,100	1,450	0,477	0,524
Leverage	1,890	1,370	0,530	0,470
Amount	1,190	1,090	0,840	0,160
Coupon	1,360	1,170	0,736	0,264
Life	1,110	1,050	0,901	0,099
Mean VIF	1,488			