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Master in Corporate Finance Program

GREEN BONDS ISSUANCE AS A WAY OF LONG-TERM VALUE CREATION

Master's Thesis by the 2nd year student

Concentration – Master in Corporate Finance

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ЗАЯВЛЕНИЕ О САМОСТОЯТЕЛЬНОМ ХАРАКТЕРЕ ВЫПОЛНЕНИЯ ВЫПУСКНОЙ КВАЛИФИКАЦИОННОЙ РАБОТЫ

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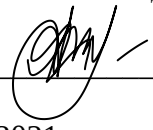

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Описание цели, задач и основных результатов	Целью настоящего исследования является оценка влияния выпуска зеленых облигаций на долгосрочные результаты деятельности компании. Чтобы найти потенциальный эффект, сначала была установлена связь между соотношением цены и балансовой стоимости компаний и долгосрочными показателями на основе всестороннего анализа предыдущих академических источников. Затем методология разность разностей была использована для оценки различных секторов бизнеса. Данные включали годовые показатели соотношения цены к балансовой стоимости компаний за 2012-2021 годы. Результаты оценки подтверждают, что для энергетического сектора наблюдается значительное негативное влияние выпуска зеленых облигаций на соотношение цены и балансовой стоимости, в то время как для технологического сектора этот эффект является положительным. Для других секторов эффект существенно не отличается от нуля.
Ключевые слова	Зеленые финансы, зеленые облигации, долгосрочная ценность, цена / балансовая стоимость

ABSTRACT

Master Student's Name	Alena Kononenko
Master Thesis Title	Green bonds issuance as a way of long-term value creation
Educational program	38.04.02 “Management”
Main field of study	Master in Corporate Finance
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Academic Advisor’s Name	Vitaly L. Okulov, Associate professor
Description of the goal, tasks and main results	The goal of the current research is to evaluate the effect that green bonds issuance has on a company’s long-term performance. To find the potential effect, first a link between companies’ price to book ratio and long-term performance has been made through a comprehensive analysis of previous academic sources. Then, difference in difference estimation methodology has been used for the evaluation of different sectors of business. Data included time-series price to book values for companies from years 2012-2021. The findings of the estimation confirm that for energy sector, there is a significant negative effect of green bonds issuance on price to book value, while for technology sector, the effect is positive. For other sectors, the effect is not significantly different from zero.
Keywords	Sustainable finance, green finance, green bonds, long-term value creation, price-to-book ratio

CONTENTS

INTRODUCTION

In the last couple of years, researchers have been increasingly challenging the idea that implementation of sustainability practices comes with a substantial cost for most of the organizations. Even though the world of business has been experiencing new governmental restrictions as well as policy changes, the common opinion still remains so that environmental, social and governmental (ESG) practices do not intercept with financial ones.

Still, more and more companies are increasing their awareness in regards to sustainability issues, resulting in the emergence of new financial mechanisms and instruments. One of the recent ones is the issuance of green bonds, which proceeds are aimed solely towards the financing of sustainability-related projects within the company. Green bonds have started to gain their popularity around seven years ago, with the issued amount outstanding increasing rapidly over the years.

The fact of green bonds emergence, however, does not act as a linking mechanism for sustainability and corporate finance. In general, most practitioners have been concerned with the reasons for green bond issuance and the role they play in the financial performance of a certain company. Intuitively, it seems questionable that a company would restrict its investment policy by issuing a green bond. Moreover, in order to label a bond “green”, most companies have to undergo an additional assessment, which results in increased costs for issuance. Nevertheless, said bonds are still being issued, with the amount outstanding increasing with each year, adding more questions to the mix.

The aim of the current research is the evaluation of the effect that green bonds issuance has on a company’s long-term performance, mainly through continuous assessment of price to book value before and after the fact of issuance. Hypothesis to be tested in this research is that the issuance of green bonds has an effect on a company’s long-term value creation.

Research objectives are the following:

1. To provide a full description of green bonds and long-term value creation and their peculiarities through a thorough literature analysis;
2. To analyze the relationship between green bond investment and long-term value creation;
3. To compile the green bond dataset that includes time-series price to book ratios in the last 10 years;

4. To divide the dataset according to the sector for the most reasonable results;
5. To perform a difference in difference estimation in order to find out whether there is a measurable effect that issuance has on a company's long-term performance;
6. To propose managerial implications after the analysis.

The results of the current research can be used in decision-making process both by financial specialists and executives in a company during strategy making. That way, before approval of issuance of the new kind of debt, managers can take into account the implications made from the analysis in order to understand its approximate effect on a company's performance.

The structure of the paper is designed so as to disclose both the aim and above-mentioned objectives. In the first chapter, previous theoretical considerations and the emergence of the green bonds phenomenon are discussed. The analysis of various scholar's work is presented. Then, a link to long-term value creation is provided.

In the second chapter, theoretical findings are extrapolated onto the empirical research. First, difference in difference estimation methodology and its characteristics are discussed. Then, a detailed description of data gathering for the sample is provided. To conclude, the research findings are presented along with managerial implications and justification.

CHAPTER 1: THEORETICAL BACKGROUND AND LITERATURE REVIEW

1.1 The concept of sustainable finance and emergence of green bonds

In the last few years corporate institutions have been experiencing the growing attention for the necessity of sustainable practices implementation in operations, coming both from their shareholders and the government. The usage of the term "sustainability" originated from the World Commission on Environment and Development in their report called "Our Common Future" (1987): "sustainable development is a development that meets the needs of the present without compromising the ability of future generations to meet their own needs". One of the examples of how practices of sustainability start to affect organizations from a higher perspective is an expanding number of international policy actions towards climate change, resulting in a convergence of business and political support for a green economy, as described in Linnenluecke et al., 2015.

Even though the application of sustainability to corporate finance is not as clearly understandable, given that most often finance-related literature is concentrated around the concept of shareholders wealth maximization rather than social and environmental impact, its relation to finance can still be seen if financial implications are analyzed from a different perspective. The issue of sustainable corporate finance has previously been addressed in Soppe (2004), where he stated that there is a possibility of showing two different aspects of linking sustainability to corporate finance. Firstly, companies raise and store their capital, therefore tackling "future generation's needs". One of the examples of such operation would be a pension fund's policy. Secondly, to operate successfully in the market and the ever-changing economy, companies are in need of constant optimization of their financial policy, therefore with growing amount of social and environmental restrictions in the global economy, businesses are required to design a financial policy aimed at sustainability in the longer run. In addition to this statement, Fatemi and Fooladi (2013) also suggest a change in the current approach of corporate finance from maximization of shareholder wealth to a sustainable value creation framework, where all relevant costs and benefits are accounted for in an appropriate manner, rather than simply externalized. Summarizing the statements above, Lebelle et al. (2020) note that the decreasing cost of renewable energy-based power generation assets, combined with the fact of uncertain coal, oil, and gas prices and availability of these resources provides a viable path for a secure business strategy as well as a profitable decision for a long-term perspective, all made through investment into energy transition.

In other words, we observe a growing need in green investment, and because it requires a considerable amount of capital which is not always possible through bank loans, institutes are switching towards raising capital through financial markets.

Current shift in the paradigm to investments into sustainable practices has resulted in a number of changes in the financial world. In the recent years, the world of corporate finance has experienced the emergence of green bonds – that is, a debt instrument issued by a company (financial or non-financial) or a public entity (city, region, government, development bank, etc.) on the financial markets to solely finance projects or assets that positively contribute to the environment. The expansion of the green bond market has been proven to be an essential lever, encouraging institutional investors to efficiently diversify their assets by moving towards sustainable investment projects.

The last few years have been very resourceful regarding the literature on green bonds and their effects. Since the emergence of this phenomenon, a substantial number of investors has been skeptical about green bonds, as early examples of bonds have been lacking legal enforcement mechanisms as well as a unified issuing standard. This problem has been tackled by the International Capital Market Association (ICMA) with the development of Green Bond Principles, which proposed a list of voluntary process guidelines for green bond issuance that included matters such as:

1. Use of Proceeds

According to the first principle, every green bond issuer should state the specific green project which all of the proceeds from the issuance would be utilized to. In the description provided in the legal document attached, clear environmental benefits of a green project have to be listed and assessed. The paper refers to the following eligible green project categories:

- Renewable energy;
- Energy efficiency;
- Pollution prevention and control;
- Environmentally sustainable management of living natural resources and land use;
- Terrestrial and aquatic biodiversity conservation;
- Clean transportation;
- Sustainable water and wastewater management;
- Climate change adaptation;

- Eco-efficient and/or circular economy adapted products, production technologies and processes;
- Green buildings.

It is important to mention that the list of categories is still in progress, however, as stated by the ICMA, currently it captures the most commonly used types of project supported by sustainable markets.

2. Process for Project Evaluation and Selection

Green bond issuers should disclose to investors the following:

- The sustainability objectives;
- The process for determining the reasons for why a certain project fits one or several of the categories described above;
- The criteria for eligibility as well as exclusion criteria or any other identification process for potentially material environmental and social risks associated with the projects, if applicable.

Other than promoting high transparency between the green bond issuer and an investor, the ICMA also suggests that the process described is evaluated by the third party.

3. Management of Proceeds

It is advised that the net proceeds of the issued Green Bond, or an amount equal to the proceeds, are credited to a sub-account, then moved to a sub-portfolio or, in other cases, tracked by the issuer in an appropriate manner, including statements in a formal internal process of operations being linked to the issuer's lending and investment for Green Projects. So long as the Green Bond is outstanding, the balance of the account should be periodically adjusted to match allocations to a certain Green Project made during that period. The issuer should make the intended types of temporary placement for the balance of unallocated net proceeds transparent for all investors.

4. Reporting

All of the use of proceeds made from the issuance of a green bond have to be documented and reported and reviewed on a timely basis, should there be a case of material developments, until full allocation.

The development of Green Bond Principles has lowered the skepticism of investors since they now had a paper to refer to when assessing green bonds. This paper has been the starting step for the popularization of green bond investment. In 2017, Morgan Stanley referred to the increasing popularity of such securities as a "Green bond boom", as in that year alone, the corporate sector issued green bonds worth $49B.

There is an overall trend of increasing green bond issues over the year, presented in the following graph:

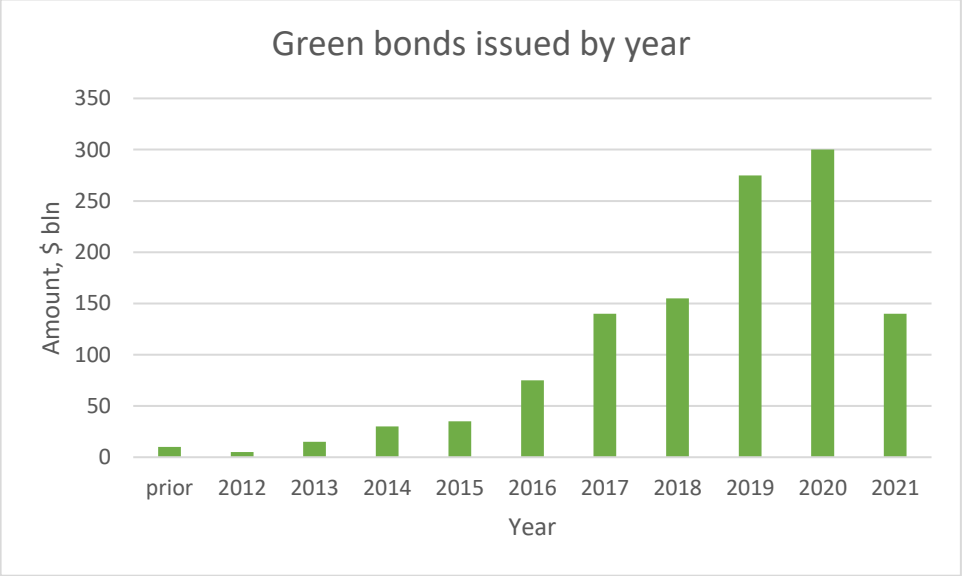

Figure 1. *Green bonds issued by year*

(Source: author's calculations based on EIKON Refinitiv data)

1.2 Drivers of green bond issuance

The rapid increase in the popularity of green bonds poses a question of the rationale for their issuance. The only difference between a conventional and a green bond is the use of proceeds from issuance towards a sustainable goal. Moreover, labeling a bond "green" has its own additional costs as is it advised that a special account is kept and reviewed by the expert and all of the transactions made from the proceeds are documented accordingly. Intuitively, one might say that simply issuing a conventional bond and using its proceeds towards a green project would be less costly. Therefore, some of the researchers have been looking into possible reasons for the issuance of green bonds.

One of the reasons, as stated by Lyon and Maxwell (2011), is that the issuance of a green bond could be used by the company for signaling about its commitment to switching towards sustainable practices, which might be valuable for the investors, as they usually lack credible

information on companies' attitude towards environmental issues. Labelling a bond "green" serves as a statement that all of the proceeds are to be used specifically for the green practices. The statement itself can be considered credible, because green bond serves as a contractual obligation to commit a substantial amount of money to sustainable initiatives. Moreover, green bonds are often certified by an independent third party (e.g., Climate Bond Standard Board) in order to prove the allocation and the "green" direction of profits.

Another reason for issuing green bonds might be as a means of "greenwashing" – a recently introduced term that describes selective disclosure of positive information about a company's environmental or social performance, omitting full disclosure of possibly negative information on these dimensions, in order to create an overly positive corporate image. This can be used by companies in order to be viewed as environmentally-conscious only by labelling their bonds "green". The "greenwashing" concern is based around the lack of public governance of green bonds, however, this issue is currently being addressed by the ICMA, as discussed above.

Another possible reason might be the nature of companies. In their paper discussing main drivers of green bond issuance, Glavas and Bancel (2018) perform a matching analysis of green and non-green bond issuers in 27 countries between 2013 and 2017, and point to the fact of the consistent significant negative coefficient of cash dividend payout, which implies that most of the green bonds' issuers suffer from agency issues. The authors also confirm the state-driven nature of stakeholders' motive by highlighting the predominance of the state ownership in the decision to issue green bonds.

Lastly, Flammer (2018) proposes that in case of investors' willingness to trade off financial returns for societal benefits when choosing green bonds over conventional ones, companies may issue them to obtain cheaper financing, which is related to a cheaper cost of capital. This prediction is derived from Fama and French's (2007) taste-based framework. If mean-variance investors have a preference towards holding green assets (or, when put in a broader way, assets from which they derive non-pecuniary benefits), those assets are going to trade at a premium compared to conventional assets. In addition to that, there is a growing literature that argues about the difference in the pricing of ESG- and non-ESG-backed securities, which should normally be priced in a similar manner, according to no-arbitrage arguments. Several studies (e.g., Friedman and Heinle, 2016; Geczy et al., 2005) present theoretical models which explore investors who are willing to give up financial benefits in order to invest in environmentally friendly or socially responsible assets.

1.3 Green bond characteristics

The argument around an existing premium among green bonds issuance created the idea of the "green premium", sometimes called "greenium", which occurs when a green bond is priced higher and has a lower corresponding yield than a conventional "vanilla" bond. The notion of a "greenium" has been one of the topics for further research by a number of authors. Patridge & Medda (2018) performed a yield curve analysis and stated the existence of a small but growing greenium in both primary and secondary markets. This analysis was between 2015 to 2017, and it compared green labelled municipal bonds that were issued at the same time by the same issuers as conventional vanilla bonds to make the results more comprehensive. Zerbib (2018), matching live green bonds with synthetic conventional ones, examined a small negative premium averaging at -2 basis points for the entire sample, and also determined that the premium was more pronounced for low-rated bonds. However, Larcker & Watts (2020) had contradictory opinion regarding the greenium, and by matching pairs of green and non-green bonds issued on the same day by the same municipality, with identical maturity and rating, stated that the premium was essentially zero. In fact, approximately 85% of the matching cases showed the differential yield of exactly zero. In her work, Flammer (2018) also adds that there is no green premium in the debt instruments. The findings reaffirm some of the researchers' statements on investors' lack of willingness to trade-off potential financial benefits for positive social and/or environmental externalities.

Given the similar nature of the research for the existing greenium, various results seem confusing. One of the explanations for those differences could be that authors were focused on different types of green bonds, since there are two major ones: municipal and corporate. The difference in the sample might answer the question of varying results.

Since the "Green bond boom", a substantial amount of the researchers has been invested into the analysis of green bonds, mainly their characteristics and risks that can be posed for the company. Mariani et al. (2019) investigate the risk and opportunities for both investors and companies which can be considered, compiling a set of reasonings from various authors famous for their works in sustainable finance. Overall, they show a shift in corporate finance toward finance as a means, which proposes a conclusion that nowadays companies are becoming more aware of their need to include sustainability reports and assessments into daily operations, including finance.

Some of the articles have also studied green bonds with the help of an event study analysis, mostly investigating how companies' share prices performed in the event of green bond issuance

announcement. Flammer (2018) comes up with a number of conclusions regarding the effect of green bonds announcement on companies. By performing the cumulative abnormal returns (CAR) methodology widely used in event studies, author finds out that the stock market responds positively to the news of green bonds announcement by companies — approximately in the [-1, 0] window around the announcement news, with CAR meaning around 0.67%. Such meaning suggests that corporate green bonds could be value-enhancing for the company. The results after second time issuing, however, show less of an abnormal return, partially due to decrease of attention from investors, since the company has already gone "green". Another important managerial implication made by Flammer is the increase in long-term investor clientele for the issuing companies, which can be a beneficial factor for the performance. Tang & Zhang (2018) make additional statement supporting Flammer's results considering short-term results for green bond issuers. The research offers that the cumulative returns on companies' shares stay positive even five days after the initial issuance announcement, which proves the point of market's positive reactions. Moreover, the results are accompanied by the fact of increased liquidity for issuers, which can be an indication for long-term value creation for companies. Lebelle et al. (2018), on the other hand, propose the fact of decreasing returns for green bond issuers, which can be an indicator of investor's skepticism regarding the overall performance of the company. The authors find the CAR between −0.5% and −0.2%, which depends on the asset pricing model (considering among CAPM, the 3-factor Fama and French models, and the 4-factor Carhart models). Overall, opinion on the market reaction is contradictory.

1.4 Sustainability as a means of long-term value creation

While transitioning to a sustainable economy, companies are increasingly reevaluating their business and operations in order to integrate ESG (environmental, social and governmental) perspectives into them. In the context of finance, attempts of such integration are usually met with difficulties due to a narrow focus on short-term financial results (Cort, 2018). As discussed in the previous section, setting shareholder profit maximization as the leading objective might pose a threat to a successful shift of the paradigm towards sustainable finance. The requirement towards the shift in paradigm can be seen in Dyllick & Muff (2016) where the authors state that the long-term effects require putting the same amount of weight in the decision-making process as the short-term effects, if sustainability issues are to be taken into consideration.

Most of the papers on the connection of ESG perspectives to neo-classical theory of economics as well as profit maximization theories are concerned with the notion of an externality. Buchanan and Stubblebine (1962) define an external effect, or an externality, as a cost or a benefit

caused by a business that is not financially incurred or addressed by that business. It occurs when a production or consumption of a certain good affects the third party without any particular relation. Proposal of an effective model that aims to link an externality with shareholders' interests could be beneficial for further explanation of their decision-making process, when it comes to socially responsible investing. Hart and Zingales (2017) separate shareholder value and shareholder welfare, the latter being a combination of financial value and externalities. By modelling the behavior of a company's shareholders, they come across some possible implications for the maximization of shareholder welfare. The authors propose the most successful strategy that includes sustainability into financial decisions for investors, which is "invest and engage", characterized by holding a stock of a particular company and performing a prosocial type of behavior, which is voting for the cleaner corporate policy. The action described can be viewed as a way to outsource the externality to shareholders.

The idea behind long-term value creation for the company can stem from two different types of beliefs. First one is that a company proves its high value in case of increased investors' attention to its equity, therefore producing continuous increased returns on its stock. Second belief is focused on the change in the financial indicators of a company. Current research aims to look at the long-term performance of companies issuing green bonds from a shareholders' perspective.

Current research is partially concerned with challenging the idea of the efficient market, first presented in (Fama, 1970). The work presented states that investors are not able to systematically beat the market, as all of the new information regarding a company's performance is immediately incorporated into its stock prices. For this scenario, arbitrage seems to work efficiently, always making the correct prices, since abnormal returns on assets quickly attract more investments, which in return increases the price and drives the returns back to the rate set by the efficient market. There is, however, a substantial number of cases that provide factual insight on the market being inefficient at times.

The idea behind investors' subjectivity when choosing a certain security comes from a substantial number of cases of inconsistency, mainly stock market anomalies. Poterba and Summers (1988) as well as Fama and French (1988) found the mean reversion in returns on stocks within three to five years investment horizons, implying that a long period of low return stocks tended to reverse, then generating above-average returns in the future. Most importantly, recent research shows that companies that make investments in material sustainability issues can produce value-enhancing results for shareholders. On the other hand, in case of investments in immaterial sustainability issues, companies do not show considerable value implications, either positive or

negative (Khan et al., 2016). This shows that in the recent years, behavioral anomalies in stock pricing are being replaced with sustainability-concerned anomalies in stock returns.

Adding to the continuous discussion on the link between investors behavior and sustainability issues, Schoenmaker and Schramade (2019) propose that widely used ESG ratings for companies' performance assessment are too narrow of a focus to be used for as an argumentation for future investments. Indeed, there is still of utmost importance to link financial measurements with respectable ESG ratings in order to get the full picture.

1.5 Research gap

As presented in the analysis from the literature above, there is a substantial number of contradictory points and opposite implications gained after the analysis. One possible explanation to this phenomenon might be the novelty of the topic itself, since green bonds started to gain their popularity and became a solid way of raising capital for firms only in 2014.

There has been a lot of research regarding the immediate market reaction to green bonds issuance, and a lot of the results proved the positive reaction. However, for most executives that are concerned with long-term strategic planning, there is still lack of clarity regarding the effect that issuing green bonds has on a company's long-term performance. It is important to assess whether there is a specific change or movement in investors' behavior that favors companies trying to go "green". This paper aims to discuss and propose a numeric estimation of described action. The results of the current research can be used for future managerial implications in order to understand the potential consequences for issuing new kind of debt for a company, as well as its relation to the financial performance in the future.

Summary

First chapter was concerned with the analysis of existing literature sources on sustainable finance and green bonds. In addition, the link between long-term performance of the company and potential effect from green bonds issuance has been made in order to make a successful financial model later. After thorough analysis, a comprehensive research gap has been found and justified for further use in the econometric analysis.

CHAPTER 2: ESTIMATION OF THE GREEN BONDS ISSUANCE EFFECT

2.1 Choice of financial measurements for the model

Current research is concerned with the fact of change in investors' behavior after green bonds issuance. One of the widely used ways to understand the performance of a company through the shareholders' eyes is Price to book ratio, otherwise called Market to book ratio. This is a financial metric used primarily for the evaluation of a company's current market value relative to the book value of its stock. In other words, it is a numerical estimation of how market currently evaluates a certain company compared with its actual valuation. Sometimes this metric is used to assess whether a stock is under- or overperforming by looking at the market perception.

The idea behind the use of a Price to book ratio comes from the hypothesis made in the beginning of the current research that issuance of green bonds somehow changes the perception that investors have on a company, thus driving the market value of the stock up in the long-term, resulting in the increase of its Price to book ratio. Therefore, for the econometrical analysis, time-series data on price to book metric is going to be used for each company in the dataset.

2.2 Difference-in-difference estimation

One of the most important things for current research is the choice of the correct model for estimation. The proposed method of analysis is Difference-in-difference (DID) estimation. The method itself is based on the estimation of the difference between post and after treatment for two different groups: treatment and a control one. In case of this research, treatment is considered to be the fact of first issuance of a green bonds for a company. Treatment group are all companies that have issued green bonds. Control group are the companies similar to the treatment group in a way that they have similar financial ratios and their change in the years.

The reasoning behind the choice of a DID model is that unlike other methods for long-term performance assessment (e.g. regression, buy-and-hold abnormal returns), difference in difference estimation is created specifically to single out the necessary effect from the described action. In other words, the model creates a possibility to analyze data from companies with all of the possible influences of the trend movement already accounted for. The effect can be presented in the form of a graph:

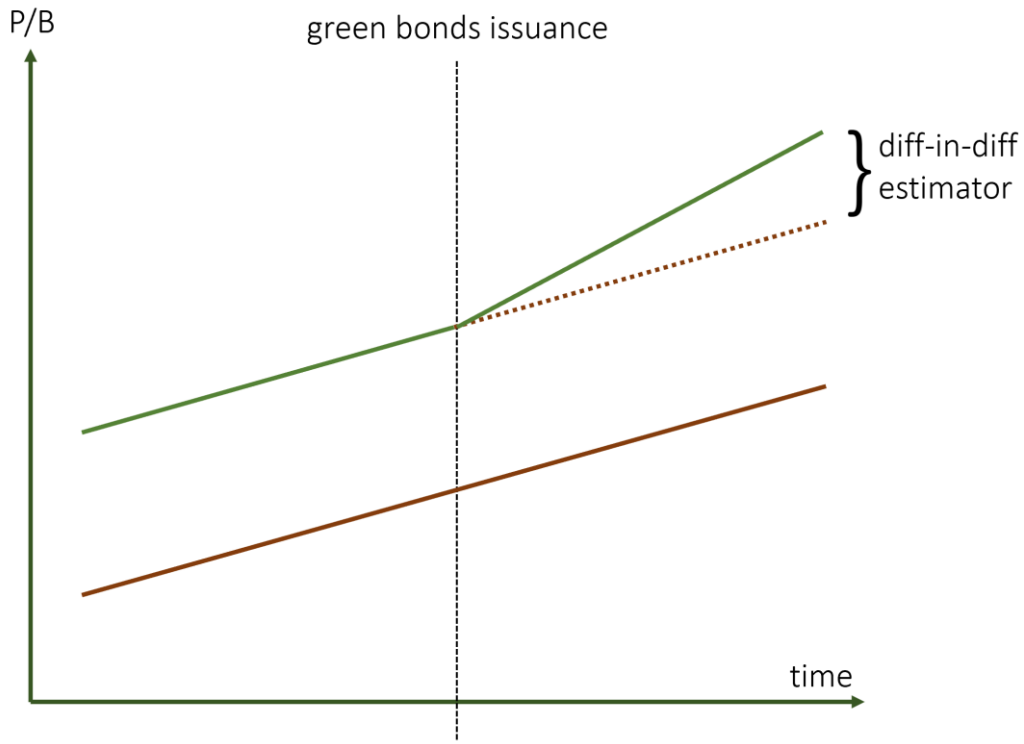

Figure 2. *DID estimation*

(Source: author's work)

As seen on the graph, the fact of issuance influences a change in the movement for the treatment group, which creates a numerical difference in price to book value between two groups, pointed out as the diff-in-diff estimator. That way, even though both groups already have their own trends and influences for price to book coefficient, DID model shows only the specifics of the estimator. Moreover, the model does not require the analysis of R squared and goodness of fit, as well as it does not require a substantial number of companies in the dataset, because it is not used for future estimation in the current research.

At the start of current analysis, a question first has to be defined, such as "Did the issuance of green bonds actually increase a company's price to book ratio?" This particular question is aimed at determining causality. That is, the research is planned to assess whether the fact of issuance caused chosen financial ratios to go up, not whether it went up for other reasons not discussed.

Next, the question needs to be transformed into a statistical quantity called a target estimand. The target estimand, or target parameter, is a numerical presentation of the green bond question. For example, the target estimand might be phrased as "the average difference in price to book ratios in chosen companies after the issuance of a green bond minus average price to book ratios in chosen companies if they haven't issued green bonds." This target estimand is written in

terms of potential outcomes. In the described scenario, companies that were chosen have two potential outcomes: price to book ratios with issued green bonds and price to book ratios without said bonds. Only one of these is observable (for those who already have green bonds); the other is unobservable because it didn't happen (so-called control group).

Third, an estimator is proposed, meaning that an algorithm that uses data to help with understanding the target estimand is constructed. Here, the main focus is on the difference-in-difference estimator, which relies on some strong assumptions, including that P/B ratios can help us understand what would have happened within the chosen set of companies without them having green bonds issued. That's how the observed data can be used to learn about a target estimand that is written in terms of unobservable outcomes.

With all these elements in place, there is enough actions taken to compute the DID estimate, a value of the estimand found by applying the estimator to the observed data.

The difference can be presented in the manner of the regression:

$$Y_{it} = \beta_1 \gamma_i + \beta_2 \lambda_t + \rho T_{it} + \varepsilon_{it}$$

Where $\boldsymbol{Y_{it}}$ – dependent variable for individual i at time t;

$\boldsymbol{\gamma_i}$ – dummy for the control/treated group, consisting of companies i;

Dummy for the control or treated group is needed for the separate analysis, so that there are different average numbers.

$\boldsymbol{\lambda_t}$ – dummy for the time period;

Dummy for the time period is needed to create additional averages for before and after treatment.

$\boldsymbol{T_{it}}$ – interaction term dummy for time and treated group;

Interaction term dummy is created to single out the effect for companies that have issued green bonds after the fact of issuance.

$\boldsymbol{\varepsilon_{it}}$ – error term;

$\boldsymbol{\rho}$ – the DID estimator.

DID estimator is the aim of the current analysis. The idea is to find out whether DID estimator is significantly different from zero with the help of t-statistics. If the estimator is significant, then the initial assumption that green bond issuance influences a company's price to book value is true.

As mentioned in the previous paragraphs, using difference in difference estimation in the current research allows to account only for a specific numerical measure of the effect that green bonds issuance has on a company's price to book metric. By doing that, other factors that might have influenced the movements of the chosen metric are omitted.

2.3 Sample selection

The data required comes from a former Thomson Reuters database, now called EIKON Refinitiv. In order to construct a set of companies that have issued green bonds, a query containing information on green bond issues has been formed.

From Appendix 2, it can be concluded that corporate green bonds share the most amount outstanding among other ones. Therefore, current research is going the be concerned specifically on corporate green bond issues. It is also important to note that the popularity started to increase in 2014, with the amount outstanding growing rapidly each year. The information on country of issue by year can be seen in Appendix 1.

In the next step of data gathering for the sample, the results were filtered to contain information on specifically corporate green bond issuances made from 2014 up to 2021. The reasoning behind construction of the time frame was that green bonds only started to gain their popularity from the year 2014.

After filtration of the results, they were exported to a separate excel file. Then, to follow the idea of price to book ratio selection, green bond issues have been linked to the companies, then followed by exclusion of companies that do not have shares outstanding, because those would not have the necessary data for ratios. To conclude, a set of similar companies has been constructed with the help of "Peers & Valuation" tab in EIKON Refinitiv.

For each company in the dataset, a query containing information on actual price-to-book ratio for the last 10 fiscal years has been formed. According to EIKON, actual price-to-book ratio can be described as "a security's price divided by its Book Value Per Share Actual. Book Value Per Share is a company's common stock equity as it appears on a balance sheet equal to total assets minus liabilities, preferred stock, and intangible assets such as goodwill, divided by the weighted average number of total shares outstanding for the year".

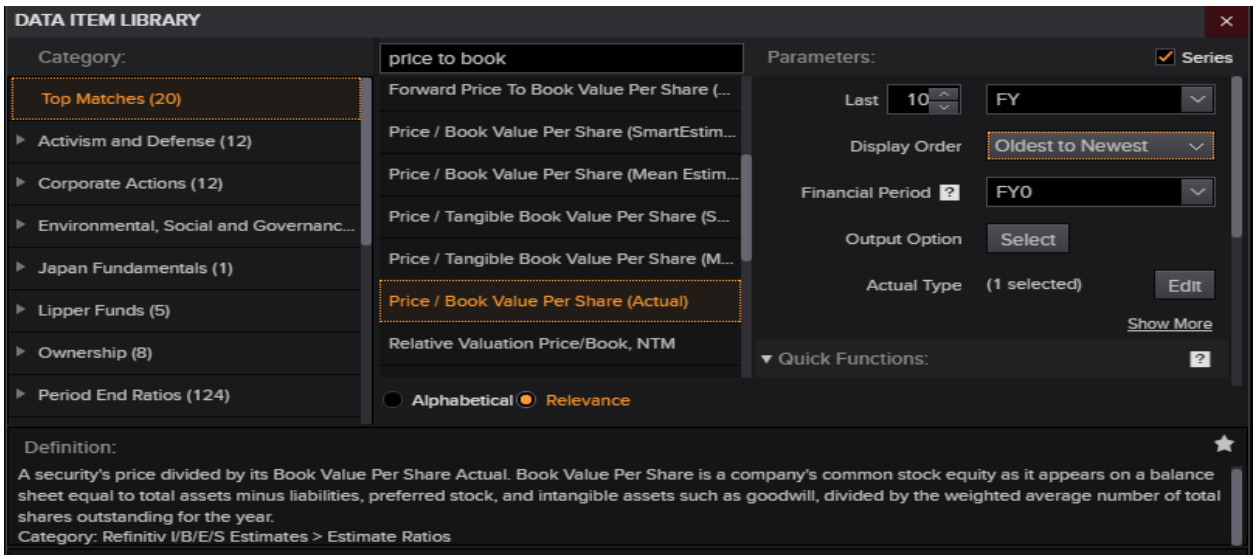

Figure 3. *EIKON Price to book query*

(Source: author's query in EIKON Refinitiv)

2.4 Peer selection criteria

The overall process of peer selection for the control group plays an important role in the following econometric analysis, since the accuracy of choice is going to possibly lead to a more precise result. For this reason, before start of the analysis, it was necessary to reach out to EIKON Refinitiv representative and ask for the explanation of peer selection performed by the database. Below you can see the quoted explanation from an official:

"The first time you visit the Peers page for a security, the page automatically populates the security's Peers using Refinitiv's proprietary Peer selection algorithm that combines competitor lists provided in filings, analyst cross coverage, business classification and revenue proximity. We have found that using this hierarchical approach produces very reasonable sets of Peer companies for most securities. Nevertheless, the Peers page allows you to edit the peer set with companies that you think are more appropriate.

The entire list of Refinitiv suggested Peers can be accessed and browsed by clicking the 'Edit Peers' button. Clicking on this button would display all available Refinitiv suggested Peers any custom peers that you might have added."

2.5 Description of industries for each sample

The sample of companies that have issued corporate green bonds is divided according to their The Refinitiv Business Classification (TRBC) Sector in EIKON Refinitiv database. TRBC is

a market-based classification scheme, which clusters companies on the basis of degree of impact on appropriate markets. Current classification scheme is used primarily in financial analysis, because it provides the most accurate way of sector comparison for the research[1]. For the current sample, sectors and industries included can be seen in Appendix 2.

Prior to econometric analysis, each of the industries was assessed according to factors such as area of issue (including countries that have the highest amount of green bonds outstanding), stated use of proceeds and the overall trend of green bond issues (increasing/decreasing/fluctuating) in order to differentiate the drivers of issuance among different sectors. The table summarizing information on each sector is presented below:

Table 1. TRBC sector information

TRBC Sector	Area of issue	Use of proceeds	Trend
Financials	Eurobond China United States	Eligible green projects, clean transportation, energy efficiency, green construction, renewable energy projects	Fluctuating with the highest amount issued in 2019
Utilities	Eurobond United States China France	Eligible green projects, energy efficiency, cleat transportation, renewable energy projects, sustainable water management	Fluctuating with the highest amount issued in 2019
Real estate	Eurobond United States Sweden Japan	Eligible green projects, energy efficiency, green construction, clean transportation, climate change adaptation	Increasing, fast-paced
Industrials	China Eurobond United States Japan	Eligible green projects, clean transportation, energy efficiency, renewable energy projects, alternative energy	Increasing, fact-paced

[1] The Refinitiv Business Classification. (n.d.). Retrieved April 26, 2021, from https://www.refinitiv.com/content/dam/marketing/en_us/documents/fact-sheets/trbc-business-classification-fact-sheet.pdf

Government activity	Sweden Indonesia	Eligible green projects, environmental protection projects, energy efficiency	Stagnant, the only issue is in 2018
Energy	China Eurobond United States South Korea	Eligible green projects, alternative energy, energy efficiency, clean transportation, equipment upgrade, pollution prevention & control	Fluctuating with the highest amount issued in 2019
Technology	United States Eurobond Taiwan Japan	Clean transportation, eligible green projects, energy efficiency, carbon reduction through reforestation and avoided deforestation, green construction, eco-efficient technologies	Rapidly increasing
Basic materials	United States Eurobond China Sweden	Eligible green projects, energy efficiency, clean transportation, green construction, alternative energy, land preservation, waste management	Fluctuating with the highest amount issued in 2019
Consumer cyclicals	Eurobond United States China South Korea Mexico	Clean transportation, eligible green projects, acquisition, environmental protection projects, eco-efficient technologies and processes	Sharp increase in 2020
Academic & educational services	United States Singapore Canada	Green construction, energy efficiency	Stagnant, only three issues in the recent years
Consumer non-cyclicals	United States Eurobond Norway China	Eligible green projects, clean transportation, energy efficiency, green construction, acquisition	Increasing, fast-paced
Healthcare	United States Eurobond France	Eligible green projects, energy efficiency	Stagnant, very few issues in the recent years

	New Zealand		

(Source: author's work using The Refinitiv Business Classification guide)

From the table above, some sectors that have very few issues and, therefore, that not have sufficient data for the analysis, can be omitted. Examples of those are Government activity, academic & educational services and healthcare. Other sectors show the growing trend of green bond issuance overall, though the use of proceeds varies. The possible reason for this variety is the nature of the market that companies operate in: for example, companies concerned with basic materials would invest their proceeds into land preservation, given that their operations can damage the land. In general, a lot of companies state that the proceeds from green bond issuance go toward eligible green projects, which is a considerably general term to use for sustainable financing.

2.6 Econometric analysis by sector

For the ease of results interpretation, econometric analysis was performed individually for each of the industries described above. That way, the peer selection for the control group would be as close as possible, which is going to help omit the possible deviations and outliers in the sample. The reason behind the elimination of the research for the whole sample that includes all of the factors is that it would undermine the assumption that both control and treatment group share the same trend characteristics. It is crucial to divide the sample according to different sectors so that various trend influences can be accounted for.

It is necessary to mention that for most of the industries analyzed below, the year chosen for the treatment year varies. The reason behind that choice is the availability of data, in other words, for the sample to be as comprehensive and representative as possible. In addition to that, the sample additionally needs to have a considerable amount of time in order to call the results long-term, which is not less than two years after the fact of issuance.

For some of the industries, sample was divided into different subsamples based on the median price to book ratio over the years. This action helped to omit possible outliers in data and achieve the closest results.

2.6.1 Basic materials

For basic materials, a total of 51 companies were selected. Out of those, 7 companies have issued green bonds in the year 2018, thus comprising the treatment group, with other 44 companies being selected as peers, thus comprising the control group. Both groups were analyzed based on their price to book ratios from 2012 to 2021.

For STATA analysis, first a time dummy variable needs to be generated, which is going to return 1 for all of the data after 2018 included, and 0 for all of the data before:

gen time = (year>=2018) & !missing(year)

Then, it is necessary to generate the interaction term that is going to provide more insight into what is happening specifically with the companies that have issued green bonds over time, meaning that it is going to identify how the relationship between the two independent variables (in our case, two dummy variables with the time and treatment effect) change the relationship with the dependent variable (in our case, price to book ratio).

*gen DID = time*treated*

The idea behind difference in differences estimation is that it allows to control for a substantial number of different factors that might otherwise cause endogeneity. By including both time and treatment, there occurs the possibility to isolate the effect of green bond issuance in the regression. To run the DID regression, four variables are needed: pb (price to book ratio), time (dummy variable), treatment (dummy variable) and did (interaction term).

```
. reg pb time treated did
```

Source	SS	df	MS		
Model	16.7963935	3	5.59879785	Number of obs =	461
Residual	2142.51107	457	4.68820804	F(3, 457) =	1.19
				Prob > F =	0.3115
				R-squared =	0.0078
				Adj R-squared =	0.0013
Total	2159.30747	460	4.69414667	Root MSE =	2.1652

pb	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
time	.0572407	.2182671	0.26	0.793	-.371691	.4861724
treated	-.7089686	.4142657	-1.71	0.088	-1.52307	.1051332
did	.4295848	.6052347	0.71	0.478	-.7598034	1.618973
_cons	2.374228	.1427708	16.63	0.000	2.09366	2.654797

Figure 4. *Regression results for basic materials sector*

(Source: author's calculations in STATA)

The regression presented above gives the actual estimated treatment effect.

The results show that the *time* variable has a positive coefficient, meaning that the price to book value of our dataset had an upwards trend overtime. *Treated* variable, which represents companies that had issued green bonds, regardless of the fact of green bond issuance, had actually

decreased their price to book values. Finally, the interaction term, in our case *did*, gives us a positive coefficient, suggesting that the fact of green bonds issuance by itself increased price to book values of companies.

Similar results can be achieved with STATA's built-in difference in difference estimation command *diff*:

```
. diff pb, t(treated) p(time)

DIFFERENCE-IN-DIFFERENCES ESTIMATION RESULTS
Number of observations in the DIFF-IN-DIFF: 461
            Before          After
   Control: 230             172          402
   Treated: 31              28           59
            261             200
```

Outcome var.	pb	S. Err.	|t|	P>|t|
Before				
Control	2.374			
Treated	1.665			
Diff (T-C)	-0.709	0.414	-1.71	0.088*
After				
Control	2.431			
Treated	2.152			
Diff (T-C)	-0.279	0.441	0.63	0.527
Diff-in-Diff	0.430	0.605	0.71	0.478

```
R-square:    0.01
* Means and Standard Errors are estimated by linear regression
**Inference: *** p<0.01; ** p<0.05; * p<0.1
```

Figure 5. *DID estimation results for basic materials sector*

(Source: author's calculations in STATA)

As shown above, DID estimator is equal to 0,43 with the same p-value.

Essentially, what difference in difference estimation does is it takes the average changes in price to book values of the control group before and after 2018, then it takes the average changes in price to book values of the treatment group before and after 2018, to then take an additional difference between those differences for the final estimation. To clearly demonstrate this, a *collapse* command can be used in STATA:

Collapse (mean) pb, by(time treated)

This command gives us four following categories:

	treated	time	pb
1	0	0	2.37
2	1	0	1.67
3	0	1	2.43
4	1	1	2.15

Figure 6. *Results after collapse command*

(Source: author's calculations in STATA)

As shown above, there are four different average price to book values:

- companies **before** 2018 that **have not** issued green bonds (1);
- companies **before** 2018 that **have** issued green bonds (2);
- companies **after** 2018 that **have not** issued green bonds and (3);
- finally, companies **after** 2018 that **have** issued green bonds (4).

To calculate the DID estimator in other way, data can be copied to excel and then it is possible to subtract two differences, (4) – (2) and (3) – (1), which would return the same result as in the regression discussed above: approximately 0,43.

Though the DID estimator can be calculated in much easier way than regression analysis, in case of current research it is crucial to understand whether there is an effect after green bonds issuance at all. For this purpose, t-statistic is needed, therefore for the following analyses on other industries regression analysis is recommended. In the case of basic materials industry, the estimator is not significantly different from zero, meaning that the fact of green bonds issuance has no effect on companies' price to book ratio in this sector.

2.6.2 Industrials

For basic materials, a decision was made to divide the sample into two different subsamples.

First subsample was comprised of treated companies with a median price to book ratio of less than 1, and consisted of total of 13 companies. Out of those, 2 companies have issued green bonds in the year 2018, thus comprising the treatment group, with other 11 companies being selected as peers, thus comprising the control group. Both groups were analyzed based on their price to book ratios from 2012 to 2021.

Difference in difference estimation in STATA gave the following results:

DIFFERENCE-IN-DIFFERENCES ESTIMATION RESULTS

Number of observations in the DIFF-IN-DIFF: 128

	Before	After	
Control:	66	43	109
Treated:	11	8	19
	77	51	

Outcome var.	pb	S. Err.	|t|	P>|t|
Before				
Control	1.170			
Treated	0.864			
Diff (T-C)	-0.305	0.146	-2.09	0.039**
After				
Control	1.029			
Treated	0.816			
Diff (T-C)	-0.212	0.173	1.23	0.222
Diff-in-Diff	0.093	0.227	0.41	0.682

R-square: 0.06

* Means and Standard Errors are estimated by linear regression

**Inference: *** p<0.01; ** p<0.05; * p<0.1

Figure 7. *DID estimation results for industrials sector (p/b <1)*

(Source: author's calculations in STATA)

As shown above, DID coefficient is not significantly different from zero, meaning that the fact of green bonds issuance has no effect on companies that have low price to book ratio in industrials sector.

Second subsample was comprised of treated companies with a median price to book ratio of more than 1, and consisted of total of 52 companies. Out of those, 8 companies have issued green bonds in the year 2018, thus comprising the treatment group, with other 43 companies being selected as peers, thus comprising the control group. Both groups were analyzed based on their price to book ratios from 2012 to 2021.

The results are the following:

DIFFERENCE-IN-DIFFERENCES ESTIMATION RESULTS

Number of observations in the DIFF-IN-DIFF: 489

	Before	After	
Control:	244	44	288
Treated:	169	32	201
	413	76	

Outcome var.	pb	S. Err.	|t|	P>|t|
Before				
Control	1.847			
Treated	1.936			
Diff (T-C)	0.088	0.122	0.72	0.469
After				
Control	2.288			
Treated	1.962			
Diff (T-C)	-0.326	0.282	1.15	0.249
Diff-in-Diff	-0.414	0.307	1.35	0.179

R-square: 0.01

* Means and Standard Errors are estimated by linear regression

**Inference: *** p<0.01; ** p<0.05; * p<0.1

Figure 8. *DID estimation results for industrials sector (p/b>1)*

(Source: author's calculations in STATA)

As shown above, DID coefficient is not significantly different from zero, meaning that the fact of green bonds issuance has no effect on companies that have high price to book ratio in industrials sector.

2.6.3 Consumer cyclicals

For consumer cyclicals, a total of 25 companies were selected. Out of those, 4 companies have issued green bonds in the year 2019, thus comprising the treatment group, with other 21 companies being selected as peers, thus comprising the control group. Both groups were analyzed based on their price to book ratios from 2012 to 2021.

The results are the following:

DIFFERENCE-IN-DIFFERENCES ESTIMATION RESULTS

Number of observations in the DIFF-IN-DIFF: 242

	Before	After	
Control:	142	61	203
Treated:	27	12	39
	169	73	

Outcome var.	pb	S. Err.	|t|	P>|t|
Before				
Control	2.095			
Treated	2.078			
Diff (T-C)	-0.016	0.557	-0.03	0.977
After				
Control	2.657			
Treated	2.456			
Diff (T-C)	-0.201	0.838	0.24	0.811
Diff-in-Diff	-0.185	1.006	0.18	0.855

R-square: 0.01

* Means and Standard Errors are estimated by linear regression

**Inference: *** p<0.01; ** p<0.05; * p<0.1

Figure 9. *DID estimation results for consumer cyclicals sector*

(Source: author's calculations in STATA)

As per the analysis, the DID coefficient is not significantly different from zero, meaning that for companies operating in the consumer cyclicals segment, green bonds issuance has no effect on price to book value.

2.6.4 Consumer non-cyclicals

For consumer non-cyclicals, a total of 17 companies were selected. Out of those, 3 companies have issued green bonds in the year 2019, thus comprising the treatment group, with other 14 companies being selected as peers, thus comprising the control group. Both groups were analyzed based on their price to book ratios from 2012 to 2021.

The results are the following:

DIFFERENCE-IN-DIFFERENCES ESTIMATION RESULTS

Number of observations in the DIFF-IN-DIFF: 168

	Before	After	
Control:	96	21	117
Treated:	42	9	51
	138	30	

Outcome var.	pb	S. Err.	|t|	P>|t|
Before				
Control	3.564			
Treated	3.795			
Diff (T-C)	0.232	0.664	0.35	0.728
After				
Control	4.696			
Treated	6.229			
Diff (T-C)	1.534	1.431	1.07	0.285
Diff-in-Diff	1.302	1.577	0.83	0.410

R-square: 0.03

* Means and Standard Errors are estimated by linear regression

**Inference: *** p<0.01; ** p<0.05; * p<0.1

Figure 10. *DID estimation results for consumer non-cyclicals sector*

(Source: author's calculations in STATA)

As per the analysis, the DID coefficient is not significantly different from zero, meaning that for companies operating in the consumer non-cyclicals segment, green bonds issuance has no effect on price to book value.

2.6.5 Energy

For energy sector, a total of 26 companies were selected. Out of those, 3 companies have issued green bonds in the year 2016, thus comprising the treatment group, with other 23 companies being selected as peers, thus comprising the control group. Both groups were analyzed based on their price to book ratios from 2012 to 2021.

The results of DID estimation are the following:

DIFFERENCE-IN-DIFFERENCES ESTIMATION RESULTS

Number of observations in the DIFF-IN-DIFF: 246

	Before	After	
Control:	82	11	93
Treated:	135	18	153
	217	29	

Outcome var.	pb	S. Err.	|t|	P>|t|
Before				
Control	2.475			
Treated	2.535			
Diff (T-C)	0.060	0.558	0.11	0.915
After				
Control	10.245			
Treated	6.748			
Diff (T-C)	-3.497	1.527	2.29	0.023**
Diff-in-Diff	-3.557	1.626	2.19	0.030**

R-square: 0.19

* Means and Standard Errors are estimated by linear regression

**Inference: *** p<0.01; ** p<0.05; * p<0.1

Figure 11. *DID estimation results for energy sector*

(Source: author's calculations in STATA)

The estimation showed a statistically significant DID coefficient of -3,557, meaning that for companies operating in the energy sector, issuance of green bonds has a negative effect on price to book value. With average price to book values presented in a form of the graph, the following result is achieved:

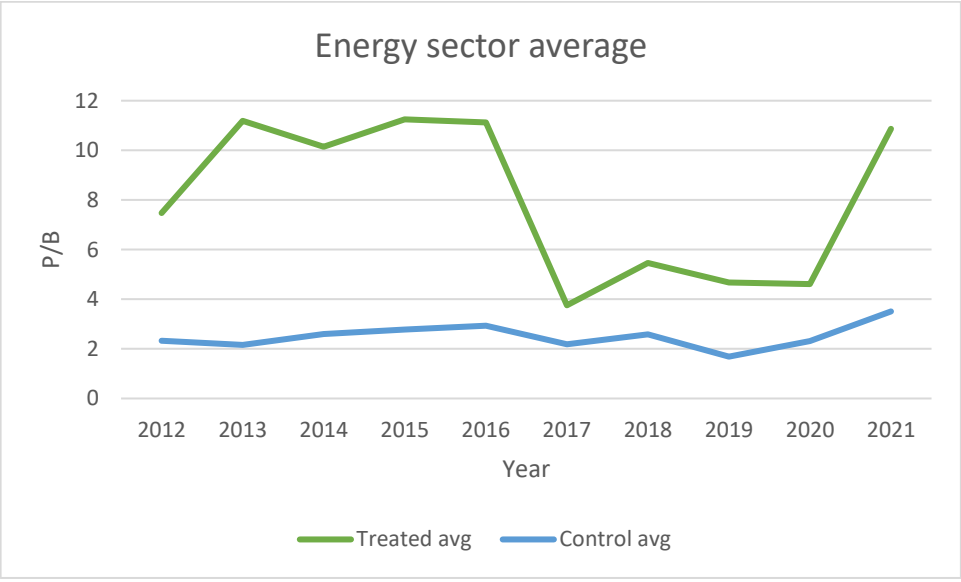

Figure 12. *Energy sector average for both groups*

(Source: author's calculations)

Even though there is a sharp decrease in price to book value after the year of issuance (2016), it is then followed by a gradual recovery. However, other than the fact of recovery, there was no improvement from its original state, while control group (companies who have not issued green bonds in the same year) increased by a bit. The result aligns with the negative significant effect found with the help of t-statistics.

2.6.6 Financials

For financials, a decision was made to divide the sample into two different subsamples.

First subsample was comprised of treated companies with a median price to book ratio of less than 1, and consisted of total of 54 companies. Out of those, 17 companies have issued green bonds in the year 2018, thus comprising the treatment group, with other 37 companies being selected as peers, thus comprising the control group. Both groups were analyzed based on their price to book ratios from 2012 to 2021.

The results for the first subsample are the following:

DIFFERENCE-IN-DIFFERENCES ESTIMATION RESULTS

Number of observations in the DIFF-IN-DIFF: 531

	Before	After	
Control:	218	100	318
Treated:	146	67	213
	364	167	

Outcome var.	pb	S. Err.	|t|	P>|t|
Before				
Control	0.974			
Treated	0.886			
Diff (T-C)	-0.087	0.041	-2.11	0.036**
After				
Control	0.790			
Treated	0.668			
Diff (T-C)	-0.122	0.061	1.99	0.047**
Diff-in-Diff	-0.034	0.074	0.46	0.643

R-square: 0.07

* Means and Standard Errors are estimated by linear regression

**Inference: *** p<0.01; ** p<0.05; * p<0.1

Figure 13. *DID estimation results for financials sector (p/b<1)*

(Source: author's calculations in STATA)

As shown above, DID coefficient is not significantly different from zero, meaning that the fact of green bonds issuance has no effect on companies that have low price to book ratio in financials sector.

Second subsample was comprised of treated companies with a median price to book ratio of more than 1, and consisted of total of 46 companies. Out of those, 10 companies have issued green bonds in the year 2018, thus comprising the treatment group, with other 36 companies being selected as peers, thus comprising the control group. Both groups were analyzed based on their price to book ratios from 2012 to 2021.

The results are the following:

DIFFERENCE-IN-DIFFERENCES ESTIMATION RESULTS

Number of observations in the DIFF-IN-DIFF: 458

	Before	After	
Control:	215	144	359
Treated:	59	40	99
	274	184	

Outcome var.	pb	S. Err.	|t|	P>|t|
Before				
Control	1.745			
Treated	1.544			
Diff (T-C)	-0.201	0.194	-1.04	0.300
After				
Control	1.877			
Treated	1.524			
Diff (T-C)	-0.353	0.236	1.50	0.135
Diff-in-Diff	-0.152	0.306	0.50	0.619

R-square: 0.01

* Means and Standard Errors are estimated by linear regression

**Inference: *** p<0.01; ** p<0.05; * p<0.1

Figure 14. *DID estimation results for financial sectors (p/b>1)*

(Source: author's calculations in STATA)

As shown above, DID coefficient is not significantly different from zero, meaning that the fact of green bonds issuance has no effect on companies that have price to book ratio of over 1 in financials sector.

2.6.7 Real estate

For real estate, a decision was made to divide the sample into two different subsamples.

First subsample was comprised of treated companies with a median price to book ratio of approximately 1, and consisted of total of 33 companies. Out of those, 9 companies have issued green bonds in the year 2019, thus comprising the treatment group, with other 24 companies being selected as peers, thus comprising the control group. Both groups were analyzed based on their price to book ratios from 2012 to 2021.

The results for the first subsample are the following:

DIFFERENCE-IN-DIFFERENCES ESTIMATION RESULTS

Number of observations in the DIFF-IN-DIFF: 321

	Before	After	
Control:	160	72	232
Treated:	62	27	89
	222	99	

Outcome var.	pb	S. Err.	|t|	P>|t|
Before				
Control	1.252			
Treated	1.358			
Diff (T-C)	0.105	0.076	1.38	0.169
After				
Control	1.259			
Treated	1.312			
Diff (T-C)	0.053	0.115	0.46	0.646
Diff-in-Diff	-0.052	0.138	0.38	0.705

R-square: 0.01

* Means and Standard Errors are estimated by linear regression

**Inference: *** p<0.01; ** p<0.05; * p<0.1

Figure 15. *DID estimation results for real estate sector (p/b<1)*

(Source: author's calculations in STATA)

As per the analysis, the DID coefficient is not significantly different from zero, meaning that for companies with a median price to book ratio of approximately 1, green bonds issuance has no effect.

Second subsample was comprised of treated companies with a median price to book ratio of more than 1, and consisted of total of 34 companies. Out of those, 6 companies have issued green bonds in the year 2019, thus comprising the treatment group, with other 28 companies being selected as peers, thus comprising the control group. Both groups were analyzed based on their price to book ratios from 2012 to 2021.

The results for the second subsample were the following:

DIFFERENCE-IN-DIFFERENCES ESTIMATION RESULTS

Number of observations in the DIFF-IN-DIFF: 332

	Before	After	
Control:	189	42	231
Treated:	83	18	101
	272	60	

Outcome var.	pb	S. Err.	|t|	P>|t|
Before				
Control	2.093			
Treated	2.180			
Diff (T-C)	0.086	0.109	0.79	0.429
After				
Control	2.159			
Treated	2.416			
Diff (T-C)	0.257	0.234	1.10	0.273
Diff-in-Diff	0.170	0.258	0.66	0.510

R-square: 0.01

* Means and Standard Errors are estimated by linear regression

**Inference: *** p<0.01; ** p<0.05; * p<0.1

Figure 16. *DID estimation results for real estate sector (p/b>1)*

(Source: author's calculations in STATA)

From the analysis shown above, the DID coefficient does not differ significantly from zero, meaning that for companies with a median price to book ratio of more than 1, green bonds issuance has no effect.

2.6.8 Technology

For technology sector, a total of 18 companies were selected. Out of those, 3 companies have issued green bonds in the year 2019, thus comprising the treatment group, with other 15 companies being selected as peers, thus comprising the control group. Both groups were analyzed based on their price to book ratios from 2012 to 2021.

The results of an estimation are the following:

DIFFERENCE-IN-DIFFERENCES ESTIMATION RESULTS

Number of observations in the DIFF-IN-DIFF: 174

	Before	After	
Control:	102	21	123
Treated:	43	8	51
	145	29	

Outcome var.	pb	S. Err.	|t|	P>|t|
Before				
Control	2.416			
Treated	3.015			
Diff (T-C)	0.599	0.562	1.07	0.288
After				
Control	5.249			
Treated	8.991			
Diff (T-C)	3.742	1.284	2.91	0.004***
Diff-in-Diff	3.143	1.401	2.24	0.026**

R-square: 0.21

* Means and Standard Errors are estimated by linear regression

**Inference: *** p<0.01; ** p<0.05; * p<0.1

Figure 17. *DID estimation results for technology sector*

(Source: author's calculations in STATA)

The estimation showed a statistically significant DID coefficient, meaning that for companies operating in the technology sector, issuance of green bonds has a positive effect on price to book value. With average price to book values presented in a form of the graph, the following result is achieved:

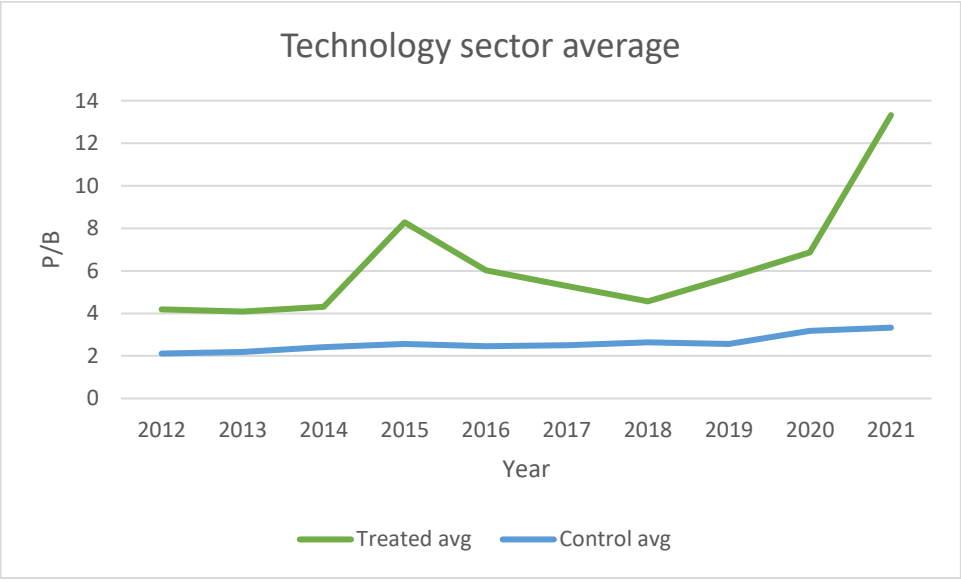

Figure 18. *Technology sector average for both groups*

(Source: author's calculations)

There is a sharp increase in average price to book value in the treated group after the year of issuance (2018), which supports the results from difference in difference analysis that significant positive effect is present.

2.6.9 Utilities

For utilities sector, a decision was made to divide the sample into two different subsamples.

First subsample was comprised of treated companies with a median price to book ratio of less than 1, and consisted of total of 23 companies. Out of those, 5 companies have issued green bonds in the year 2018, thus comprising the treatment group, with other 18 companies being selected as peers, thus comprising the control group. Both groups were analyzed based on their price to book ratios from 2012 to 2021.

The results for the first subsample are the following:

DIFFERENCE-IN-DIFFERENCES ESTIMATION RESULTS

Number of observations in the DIFF-IN-DIFF: 221

	Before	After	
Control:	101	30	131
Treated:	71	19	90
	172	49	

Outcome var.	pb	S. Err.	|t|	P>|t|
Before				
Control	1.881			
Treated	2.108			
Diff (T-C)	0.227	0.167	1.37	0.174
After				
Control	1.036			
Treated	1.080			
Diff (T-C)	0.043	0.315	0.14	0.891
Diff-in-Diff	-0.184	0.357	0.52	0.607

R-square: 0.12

* Means and Standard Errors are estimated by linear regression

**Inference: *** p<0.01; ** p<0.05; * p<0.1

Figure 19. *DID estimation results for utilities sector (p/b<1)*

(Source: author's calculations in STATA)

From the analysis shown above, the DID coefficient does not differ significantly from zero, meaning that for companies with a median price to book ratio of less than 1, green bonds issuance has no effect.

Second subsample was comprised of treated companies with a median price to book ratio of more than 1, and consisted of total of 36 companies. Out of those, 7 companies have issued

green bonds in the year 2018, thus comprising the treatment group, with other 29 companies being selected as peers, thus comprising the control group. Both groups were analyzed based on their price to book ratios from 2012 to 2021.

The results for the second subsample were the following:

DIFFERENCE-IN-DIFFERENCES ESTIMATION RESULTS

Number of observations in the DIFF-IN-DIFF: 351

	Before	After	
Control:	169	39	208
Treated:	115	28	143
	284	67	

Outcome var.	pb	S. Err.	|t|	P>|t|
Before				
Control	1.994			
Treated	2.362			
Diff (T-C)	0.367	0.135	2.73	0.007***
After				
Control	1.818			
Treated	2.333			
Diff (T-C)	0.515	0.276	1.86	0.063*
Diff-in-Diff	0.148	0.307	0.48	0.631

R-square: 0.03

* Means and Standard Errors are estimated by linear regression

**Inference: *** p<0.01; ** p<0.05; * p<0.1

Figure 20. *DID estimation results for utilities sector (p/b>1)*

(Source: author's calculations in STATA)

From the analysis shown above, the DID coefficient does not differ significantly from zero, meaning that for companies with a median price to book ratio of less than 1, green bonds issuance has no effect.

2.7 Summary of the results

The results from the DID estimation analysis are presented in the table below:

Table 2. Summary of the DID estimation results for each sector

TRBC sector	Year	Sample specifics	Results
Basic materials	2018	51 companies (7 treated, 44 control)	No effect on P/B
Industrials	2018	P/B <1: 13 companies (2 treated, 11 control)	No effect on P/B

		P/B >1: 52 companies (8 treated, 43 control)	
Consumer cyclicals	2019	25 companies (4 treated, 21 control)	No effect on P/B
Consumer non-cyclicals	2019	17 companies (3 treated, 14 control)	No effect on P/B
Energy	2016	26 companies (3 treated, 23 control)	Negative effect on P/B
Financials	2018	P/B <1: 54 companies (17 treated, 37 control) P/B >1: 46 companies (10 treated, 36 control)	No effect on P/B
Real estate	2019	P/B <1: 33 companies (9 treated, 24 control) P/B >1: 34 companies (6 treated, 28 control)	No effect on P/B
Technology	2019	18 companies (3 treated, 15 control)	Positive effect on P/B
Utilities	2018	P/B <1: 23 companies (5 treated, 18 control) P/B >1: 36 companies (7 treated, 29 control)	No effect on P/B

(Source: author's work)

2.8 Limitations of the current research

Due to the novelty of the research in green bonds and the use of difference in difference estimation techniques in corporate finance, there is a number of important limitations that have to be mentioned. By accounting for a specific limitation in the future, substantial improvements can be made in order to achieve the nearest possible result, and subsequently, provide clearer statements on managerial implications. The list of limitations include:

- Lack of data on price to book values for certain companies

Lack of price to book ratio data is explained solely by the dataset being limited to the companies that currently have shares outstanding. Manual search for the values resulted in the discovery that a big part of the initial sample consisted of limited liability companies. In addition, some of the companies had missing data on price to book ratios for some of the years, while other

companies have just recently participated in the initial public offering, which made it difficult to include them in the dataset, because it would make it less representative.

- DID model has a certain date as a benchmark for the analysis

Even though difference in difference estimation model provides the opportunity to focus the research on the effect of green bonds issuance, it has one crucial limitation which is the necessity to link the model to a certain time. In other words, the results can only be time-specific for the companies that have issued green bonds in a certain year. That way, the implications do not provide a full view, because analysis is performed separately each year.

- It is difficult to assess whether there is a first-time or a consequent issue in a DID model

The nature of the sample of companies and green bond issues constructed has a significant limitation, because the difference in difference estimation does not give more weight to those companies or estimators that have issued green bonds the first time, thus increasing the attention of investors. As stated in the literature review, first-time issuers had higher short-term abnormal return after the announcement. Linking those results to the current research, an assumption can be made that a company will not have significant changes in is price to book value after consecutive green bond issues.

- Choice of peers for the control group might influence the results of the DID estimation

For the analysis, a set of peers was chosen for each company that has issued green bonds at a certain time. Even though it was done with the intent to construct a control group that has similar qualities to treated companies, there could still be a possibility of two groups behaving in a different manner for reasons other than green bonds issuance. One of the ways to check for this occurrence in the future studies is to construct a synthetic control group that would have different weights for each of the peers chosen in the control sample, so that both groups behave in a similar manner before the fact of issuance.

2.9 Managerial implications

From the econometric analysis performed above, a number of managerial implications can be discussed. Firstly, for most of the sectors, there is no significant effect of green bonds issuance

on price to book values over the years. This fact means that companies operating in the following sectors:

- Basic materials;
- Industrials;
- Consumer cyclicals;
- Consumer non-cyclicals;
- Financials;
- Real estate;
- Utilities;

that are planning on issuing this new kind of debt have to keep in mind that approximately, they are not going to get an additional financial effect other than the raised capital from issuance. Moreover, the increased costs from additional operations aimed towards confirmation that a bond is green, discussed in the literature review, compared to the costs of issuance of a plain vanilla bond, point at the unnecessary nature of green labelling. For the companies listed above, it would be less costly and easier to issue a plain vanilla bond and then use its proceeds towards sustainable projects. That way, a company would still work towards ESG principles and can still get governmental support for its actions. Nonetheless, the research has proven that there is a limited number of companies that can be analyzed (for more information, please look at the Limitations section of this paper), so there is a significant opportunity for improvement.

Secondly, two sectors were proven to have an effect from green bonds issuance, which are:

- Energy;
- Technology;

With energy sector observing a negative effect on price to book value of the companies from green bonds issuance, and technology sector observing a positive effect on said value from issuance.

Though the numbers cannot be used for estimation, this fact can still be taken into account by managers in the company. For example, companies issuing green debt in technology sectors can expect a shift in the behavior of investors towards favoring their shares. On the other hand, companies issuing green debt in energy sector have to be conscious of the change in the investors' behavior towards increased skepticism about the company. Nevertheless, this negative effect that is observed in the energy sector could be because most of the companies are paying high dividends

to their shareholders, and dividends are included in the calculation of the price to book ratio in EIKON Refinitiv database.

Summary

Second chapter was concerned with the empirical estimation of the effect that green bonds issuance has on companies' price to book value. First, data on various sectors has been gathered through a special query in EIKON Refinitiv database. Then, difference in difference analysis was performed for each of the sectors. To conclude, the results have been gathered in one table, with two sectors having a significant DID coefficient: energy sector, which observed a significant negative effect of green bonds issuance on price to book value, and technology sector, which observes a positive effect. For other sectors, the effect is not significantly different from zero.

CONCLUSION

The general aim of this research paper was to link sustainable practices of a company to its financial performance. In order to achieve the necessary results, a number of objectives as well as a research hypothesis was stated.

In the beginning, a thorough analysis of the existing literature on topics such as sustainable finance, green bonds and long-term value creation for companies using financial metrics has been conducted. The analysis resulted in the formalization of the research gap for the current master thesis, specifically, due to the lack of information on the effect of green bonds issuance on a company's long-term performance.

Then, moving towards the empirical part of the current research, a comprehensive green bond dataset was constructed using information from EIKON Refinitiv database. This dataset included information on companies' price to book values, both those that have issued green bonds and their peers, for the last 10 years. Afterwards, the dataset was divided into various sectors according to the companies' contribution in order to achieve the closest estimation results.

Following the data gathering process, a difference in difference estimation was performed for each of the sectors. Financial indicator chosen for evaluation was price to book ratio of a company, which gave insight on market evaluation of a company in regards to its actual value. To understand the existence of the effect, t-statistic for DID estimator was analysed. As a result of the empirical analysis, two sectors were found to be affected by green bonds issuance: energy and technology. Energy sector had negative influence on price to book ratios, while technology sector had positive one.

To conclude, managerial implications were derived from the results, showing that for sectors with no effect, there is no necessity to label a bond green, as this is not going to change the strategic investors' perception about the company. On the contrary, sectors that had a certain effect can use the findings for managerial decision-making, mainly for the approximation of investors' reaction towards the company.

Overall, the idea behind the speculative nature of green investment emergence has been challenged: it was concluded that most of the time, strategic investors do not change their opinion regarding a certain company based solely on the fact of green bond issuance.

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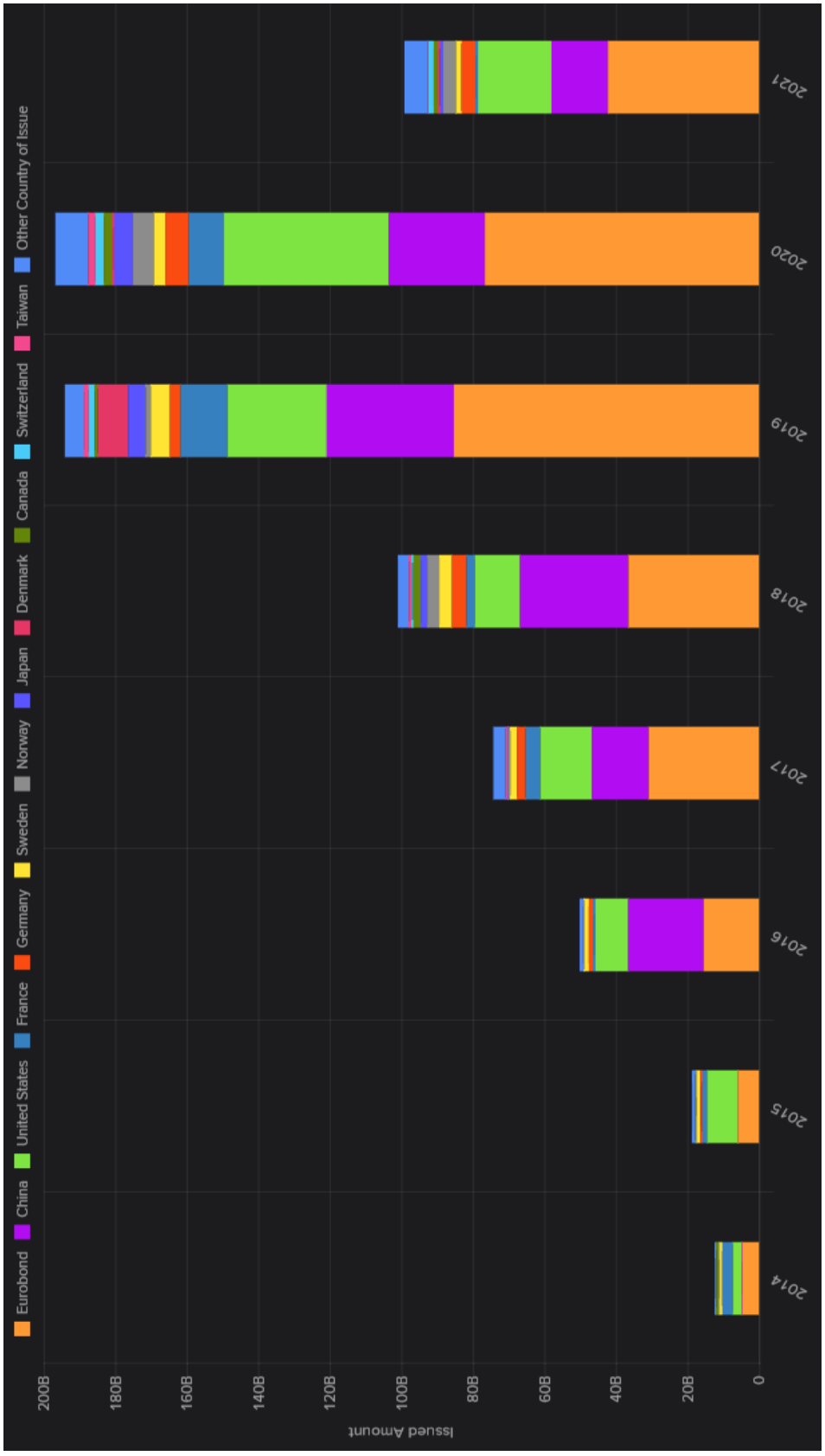
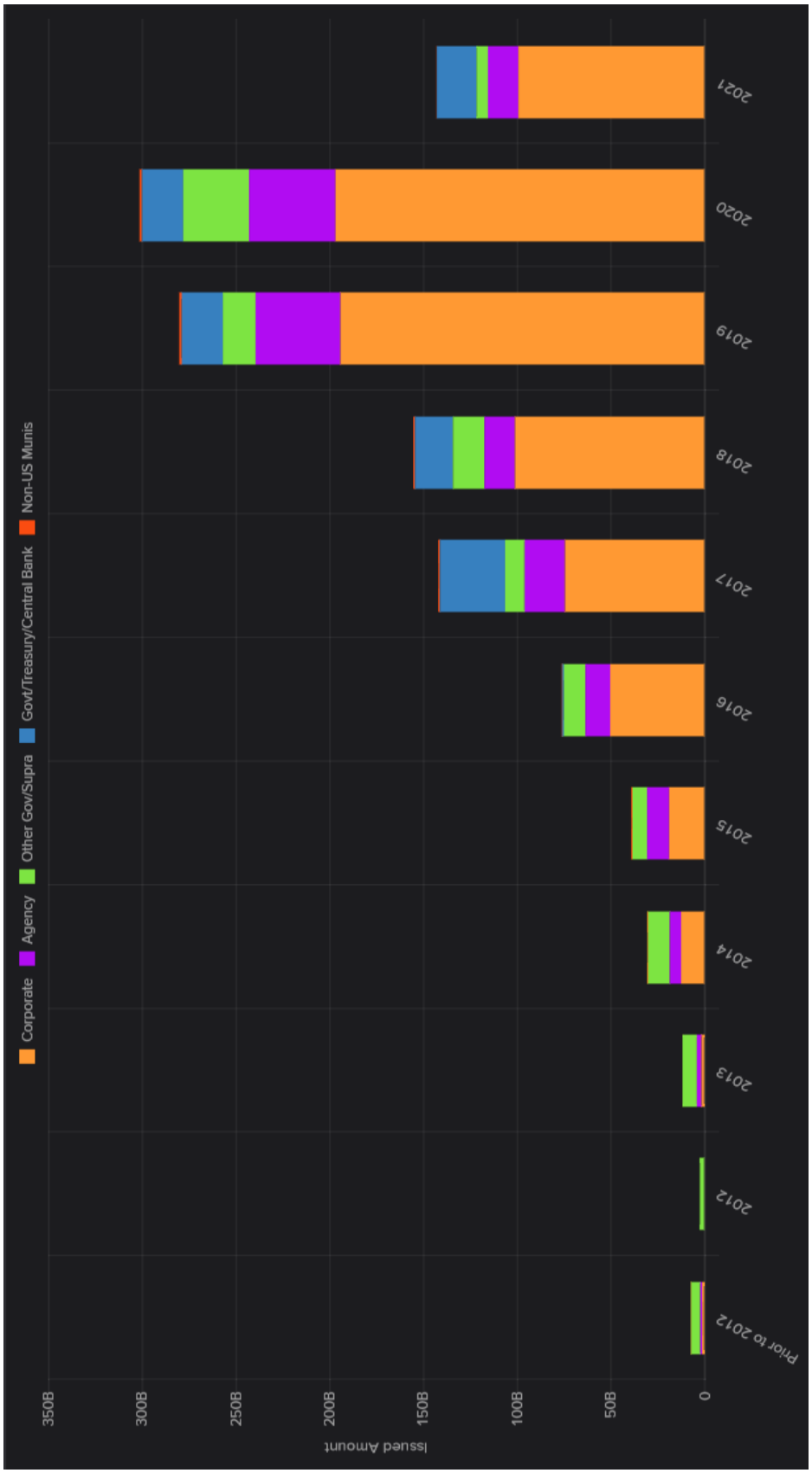
APPENDIX 1. GREEN BOND ISSUES BY COUNTRY



(Source: author's query in EIKON Refinitiv)

APPENDIX 2. GREEN BOND ISSUES BY BOND TYPE



(Source: author's query in EIKON Refinitiv)

APPENDIX 3. INDUSTRIES BY TRBC SECTOR

TRBC Sector	Content
Basic materials	Paper Products (NEC), Paper Mills & Products, Pulp Mills, Forest & Wood Products (NEC), Logging & Sawmills, Glass Containers & Packaging, Metal Containers & Packaging, Non-Paper Containers & Packaging (NEC), Plastic Containers & Packaging, Paper Packaging Wholesale, Commodity Chemicals (NEC), Plastics, Paints & Coatings, Diversified Chemicals, Synthetic Fibers, Adhesive & Epoxy, Specialty Chemicals (NEC), Fertilizers, Iron, Steel Mills & Foundries, Iron & Steel (NEC), Metal Merchant Wholesale, Iron Ore Mining, Nonferrous Metal Processing, Specialty Mining & Metals (NEC), Aluminum Rolling, Gold Refining, Mining Machinery & Equipment Manufacturing, Construction Material Wholesale
Consumer cyclicals	Auto & Truck Manufacturers (NEC), Automobiles & Multi Utility Vehicles, Auto & Truck Wholesale, Auto, Truck & Motorcycle Parts (NEC), Automotive Body Parts, Guided Tour Operators, Amusement Parks and Zoos, Leisure & Recreation (NEC), Hotels, Motels & Cruise Lines (NEC), Hotels & Motels, Residential Builders - Multifamily Homes, Homebuilding (NEC),Construction Supplies, Construction Supplies & Fixtures (NEC), Construction Supplies & Fixtures Wholesale, Plumbing Fixtures & Fittings, Synthetic Fabrics, Apparel & Accessories (NEC), Appliances, Tools & Housewares (NEC), Department Stores (NEC)
Consumer non-cyclicals	Consumer Goods Conglomerates, Personal Services (NEC), Funeral Services, Personal Products (NEC), Sanitary Products, Brewers (NEC), Carbonated Soft Drinks, Seafood Product Preparation & Packaging, Meat Processing, Aquaculture, Fishing & Farming Wholesale, Organic Farming, Food Retail & Distribution (NEC), Supermarkets & Convenience Stores
Energy	Renewable Energy Equipment & Services (NEC), Photovoltaic Solar Systems & Equipment, Wind Systems & Equipment, Renewable Energy Services, Coal (NEC), Oil & Gas Refining and Marketing (NEC), Petroleum Refining, Gasoline Stations, Petroleum Product

	Wholesale, Integrated Oil & Gas, Oil & Gas Exploration and Production (NEC), Oil & Gas Transportation Services (NEC)
Financials	Banks (NEC), Corporate Banks, Retail & Mortgage Banks, Corporate Financial Services (NEC), Commercial Leasing, Commercial Loans, Consumer Leasing, Consumer Lending (NEC), Personal & Car Loans, Consumer Credit Cards Services, Investment Management & Fund Operators (NEC), Investment Management, Hedge Funds, Wealth Management, Private Equity, Financial & Commodity Market Operators & Service Providers (NEC), Clearing, Settlement & Custodial Service, Securities & Commodity Exchanges, Investment Banking & Brokerage Services (NEC), Brokerage Services, Investment Banking, Diversified Investment Services, Investment Holding Companies (NEC), Life & Health Insurance (NEC), Multiline Insurance & Brokers (NEC), Property & Casualty Insurance (NEC), Property & Casualty Reinsurance, UK Investment Trusts, Closed End Funds, Mutual Funds (NEC)
Industrials	Construction & Engineering (NEC),Land Division & Subdivision,Civil Engineers & Architects,Highway & Bridge Construction,Commercial Buildings,Water & Sewage Construction,Industrial Plant Construction,Railway Construction,Electric Power Plant Construction,Gas Infrastructure Construction,Power & Communications Network Construction,Business Support Services (NEC),Industrial Equipment Rental,Management Consulting Services,Security Services,Transaction & Payment Services,Waste Management, Disposal & Recycling Services,Environmental Services & Equipment (NEC),Diversified Industrial Goods Wholesale,Commuting Services,Passenger Transportation, Ground & Sea (NEC),Rail Services,Passenger Car Rental,Inter-Modal Passenger Transportation,Airlines (NEC),Ground Freight & Logistics (NEC),Railway Freight Operators,Courier Services,Courier, Postal, Air Freight & Land-based Logistics (NEC),Deep Sea Freight,Marine Freight & Logistics (NEC),Highway Operators,Highways & Rail Tracks (NEC),Railway

	Operators,Airport Operators,Airport Operators & Services (NEC),Port Operators,Heavy Electrical Equipment (NEC),Electrical Transmission & Grid Equipment,Turbine Manufacturing,Industrial Machinery & Equipment (NEC),Industrial Machinery,Industrial Machinery & Equipment Wholesale,Pump & Pumping Equipment,Batteries & Uninterruptable Power Supplies,Electrical Components & Equipment (NEC),Heating, Ventilation & Air Conditioning Systems,Switchgear,Agricultural Machinery,Heavy Machinery & Vehicles (NEC),Shipbuilding (NEC)
Real estate	Real Estate Rental, Development & Operations (NEC),Residential Real Estate Rental & Development,Office Real Estate Rental & Development,Retail Real Estate Rental & Development,Industrial Real Estate Rental & Development,Real Estate Services (NEC),Residential Real Estate Services,Retail Real Estate Services,Commercial REITs (NEC),Industrial REITs,Office REITs,Retail REITs,Diversified REITs,Residential REITs,Healthcare REITs,Hospitality REITs
Technology	Semiconductors (NEC),Integrated Circuits,Semiconductor Equipment & Testing (NEC),Semiconductor Equipment Wholesale,Output Devices,Household Electronics (NEC),Phones & Smart Phones,Display Screens,Integrated Telecommunications Services (NEC),Wireless Telecommunications Services (NEC),IT Services & Consulting (NEC),Internet Security & Transactions Services,Search Engines
Utilities	Electric Utilities (NEC),Alternative Electric Utilities,Hydroelectric & Tidal Utilities,Fossil Fuel Electric Utilities,Solar Electric Utilities,Wind Electric Utilities,Geothermal Electric Utilities,Nuclear Utilities,Renewable IPPs,Independent Power Producers (NEC),Fossil Fuel IPPs,Nuclear IPPs,Multiline Utilities,Water Supply & Irrigation Systems,Water & Related Utilities (NEC),Sewage Treatment Facilities,Natural Gas Distribution,Natural Gas Utilities (NEC)

(Source: author's work using EIKON TRBC guide)

APPENDIX 4. COMPANIES USED IN THE DATASET BY SECTOR

Sector	Treated	Control
Basic materials	China Jushi Co Ltd Far Eastern New Century Corp Zhejiang Huayou Cobalt Co Ltd HBIS Co Ltd Xinjiang Tianye Co Ltd Daio Paper Corp Ence Energia y Celulosa SA	Beijing Oriental Yuhong Waterproof Technology Co Ltd Anhui Conch Cement Co Ltd Beijing New Building Materials Public Ltd Co Zhuzhou Kibing Group Co Ltd Huaxin Cement Co Ltd Formosa Plastics Corp Formosa Chemicals & Fibre Corp Nan Ya Plastics Corp Formosa Petrochemical Corp China General Plastics Corp Eclat Textile Co Ltd Makalot Industrial Co Ltd Ganfeng Lithium Co Ltd Zijin Mining Group Co Ltd China Molybdenum Co Ltd Yunnan Aluminium Co Ltd Sungrow Power Supply Co Ltd GEM Co Ltd Hyundai Steel Co Angang Steel Co Ltd Hunan Valin Steel Co Ltd Shandong Iron and Steel Co Ltd Tata Steel Ltd Maanshan Iron & Steel Co Ltd CITIC Pacific Special Steel Group Co Ltd Hangzhou First Applied Material Co Ltd Zhejiang Hangmin Co Ltd Lier Chemical Co Ltd Lianhe Chemical Technology Co Ltd Guangzhou Tinci Materials Technology Co Ltd NGK Insulators Ltd Rengo Co Ltd Oji Holdings Corp Nippon Electric Glass Co Ltd Sumitomo Osaka Cement Co Ltd Taiheiyo Cement Corp Nippon Paper Industries Co Ltd Construcciones Y Auxiliar De Ferrocarriles SA Altri SGPS SA Fluidra SA CIE Automotive SA Gestamp Automocion SA Corticeira Amorim SGPS SA Zardoya Otis SA
Consumer cyclicals	BYD Co Ltd Electrolux AB Host Hotels & Resorts Inc Owens Corning	BAIC Motor Corp Ltd Great Wall Motor Co Ltd Geely Automobile Holdings Ltd Guangzhou Automobile Group Co Ltd BAIC Motor Corp Ltd Dongfeng Motor Group Co Ltd Zhongsheng Group Holdings Ltd Rockwool International A/S China Jushi Co Ltd Dow Chemical Co Fortune Brands Home & Security Inc

		Mohawk Industries Inc Rockwool International A/S China Jushi Co Ltd Dow Chemical Co Fortune Brands Home & Security Inc Mohawk Industries Inc Rockwool International A/S China Jushi Co Ltd Dow Chemical Co Fortune Brands Home & Security Inc Mohawk Industries Inc
Consumer non-cyclicals	BayWa AG PepsiCo Inc Woolworths Group Ltd	K&S AG KWS SAAT SE & Co KgaA Evonik Industries AG Suedzucker AG Lanxess AG Coca-Cola Co Monster Beverage Corp Mondelez International Inc Kellogg Co Wesfarmers Ltd Metcash Ltd JB Hi-Fi Ltd Treasury Wine Estates Ltd Harvey Norman Holdings Ltd
Energy	Power Construction Corporation of China Ltd Tesla Inc Xinjiang Goldwind Science & Technology Co Ltd	China State Construction Engineering Corp Ltd Metallurgical Corporation of China Ltd China Gezhouba Group Co Ltd Sinoma International Engineering Co Ltd Shanghai Construction Group Co Ltd Larsen & Toubro Ltd China Communications Construction Co Ltd China National Chemical Engineering Co Ltd SunPower Corp LG Chem Ltd Siemens AG Samsung Electronics Co Ltd General Motors Co Ford Motor Co Aptiv PLC Lear Corp LONGi Green Energy Technology Co Ltd Tongwei Co Ltd Titan Wind Energy Suzhou Co Ltd China Longyuan Power Group Corp Ltd Xinyi Solar Holdings Ltd NARI Technology Co Ltd Sungrow Power Supply Co Ltd
Financials (P/B<1)	National Australia Bank Ltd Bank of America Corp HSBC Holdings PLC Banco Bilbao Vizcaya Argentaria SA Bank of China Ltd China Construction Bank Corp Industrial and Commercial Bank of China Ltd Bank of Chongqing Co Ltd China Everbright Bank Co Ltd Industrial Bank Co Ltd BNP Paribas SA	JPMorgan Chase & Co Citigroup Inc Wells Fargo & Co Goldman Sachs Group Inc Morgan Stanley U.S. Bancorp Banco Santander SA Caixabank SA Banco de Sabadell SA Bankinter SA Liberbank SA UniCredit SpA Agricultural Bank of China Ltd

	Societe Generale SA Credit Agricole SA ING Groep NV Commerzbank AG Raiffeisen Bank International AG Mitsubishi UFJ Financial Group Inc Sumitomo Mitsui Financial Group Inc	China Merchants Bank Co Ltd China Citic Bank Corp Ltd Ping An Bank Co Ltd Bank of Communications Co Ltd Natixis SA KBC Groep NV Deutsche Bank AG Julius Baer Gruppe AG Credit Suisse Group AG UBS Group AG Aareal Bank AG Erste Group Bank AG Standard Chartered PLC Lloyds Banking Group PLC Natwest Group PLC Barclays PLC Bank of Ireland Group PLC OTP Bank Nyrt Komercni Banka as Powszechna Kasa Oszczednosci Bank Polski SA Mizuho Financial Group Inc Sumitomo Mitsui Trust Holdings Inc Resona Holdings Inc Shinsei Bank Ltd
Financials (P/B>1)	Westpac Banking Corp National Australia Bank Ltd Prologis Inc MTR Corp Ltd Swedbank AB Svenska Handelsbanken AB Dnb ASA Skanska AB KBC Groep NV State Bank of India	Commonwealth Bank of Australia Australia and New Zealand Banking Group Ltd Bank of Queensland Ltd Bendigo and Adelaide Bank Ltd Macquarie Group Ltd Duke Realty Corp Boston Properties Inc Eastgroup Properties Inc Equity Residential Federal Realty Investment Trust Corporate Office Properties Trust Wharf Holdings Ltd CK Hutchison Holdings Ltd Hongkong Land Holdings Ltd Swire Properties Ltd Link Real Estate Investment Trust Sun Hung Kai Properties Ltd Skandinaviska Enskilda Banken AB Danske Bank A/S Nordea Bank Abp Jyske Bank A/S NCC AB Peab AB Veidekke ASA JM AB Castellum AB ING Groep NV Credit Agricole SA Societe Generale SA BNP Paribas SA Natixis SA Axis Bank Ltd ICICI Bank Ltd Kotak Mahindra Bank Ltd HDFC Bank Ltd Federal Bank Ltd

Industrials (P/B<1)	Hitachi Zosen Corp Toda Corp	JGC Holdings Corp Chiyoda Corp Toyo Engineering Corp Mitsui E&S Holdings Co Ltd Sumitomo Heavy Industries Ltd IHI Corp Kawasaki Heavy Industries Ltd Mitsubishi Heavy Industries Ltd Kinden Corp Takasago Thermal Engineering Co Ltd Taikisha Ltd
Industrials (P/B>1)	ACS Actividades de Construccion y Servicios SA ANA Holdings Inc China Gezhouba Group Co Ltd Power Construction Corporation of China Ltd Getlink SE Guoxuan High-tech Co Ltd Nordex SE Obayashi Corp	Ferrovial SA Eiffage SA Fomento de Construcciones y Contratas SA Vinci SA Atlantia SpA Acciona SA Aeroports de Paris SA Japan Airlines Co Ltd Yamato Holdings Co Ltd Central Japan Railway Co West Japan Railway Co Hitachi Transport System Ltd East Japan Railway Co Nippon Express Co Ltd China State Construction Engineering Corp Ltd China National Chemical Engineering Co Ltd Larsen & Toubro Ltd Anhui Construction Engineering Group Corp Ltd Fraport AG Frankfurt Airport Services Worldwide Flughafen Zuerich AG Guangzhou Automobile Group Co Ltd Weichai Power Co Ltd SAIC Motor Corp Ltd Ningbo Shanshan Co Ltd Beijing Easpring Material Technology CO LTD Brilliance China Automotive Holdings Ltd Vestas Wind Systems A/S SMA Solar Technology AG Abb Ltd Jungheinrich AG Trelleborg AB Kion Group AG Prysmian SpA Taisei Corp Kajima Corp Shimizu Corp Comsys Holdings Corp Kyowa Exeo Corp Lixil Corp Metallurgical Corporation of China Ltd Sinoma International Engineering Co Ltd Shanghai Construction Group Co Ltd China Communications Construction Co Ltd
Real estate (P/B<1)	Argosy Property Ltd Atrium Ljungberg AB Fabege AB Fastighets AB Balder Sagax AB Wallenstam AB City Developments Ltd	Precinct Properties New Zealand Ltd Property for Industry Ltd Goodman Property Trust Kiwi Property Group Ltd Vital Healthcare Property Trust Wihlborgs Fastigheter AB Hufvudstaden AB

	Mitsui Fudosan Co Ltd Zug Estates Holding AG	Castellum AB Platzer Fastigheter Holding AB (publ) Mapletree Industrial Trust CapitaLand Integrated Commercial Trust Mapletree Logistics Trust Mitsubishi Estate Co Ltd Sumitomo Realty & Development Co Ltd Tokyu Fudosan Holdings Corp Tokyo Tatemono Co Ltd Nomura Real Estate Holdings Inc Daiwa House Industry Co Ltd Sekisui House Ltd Mobimo Holding AG PSP Swiss Property AG Allreal Holding AG Flughafen Zuerich AG Swiss Prime Site AG
Real estate (P/B>1)	Alexandria Real Estate Equities Inc Duke Realty Corp Boston Properties Inc Nexity SA UDR Inc Welltower Inc	Prologis Inc EPR Properties Digital Realty Trust Inc SL Green Realty Corp Equity Residential Hudson Pacific Properties Inc Vornado Realty Trust Corporate Office Properties Trust Essex Property Trust Inc Eastgroup Properties Inc First Industrial Realty Trust Inc STAG Industrial Inc Highwoods Properties Inc Kaufman & Broad SA Trigano SA Teleperformance SE Hexaom SA Beneteau SA Camden Property Trust Avalonbay Communities Inc Regency Centers Corp Ventas Inc Healthpeak Properties Inc Healthcare Realty Trust Inc Healthcare Trust Of America Inc Sabra Health Care REIT Inc Medical Properties Trust Inc Omega Healthcare Investors Inc
Technology	Apple Inc Millicom International Cellular SA Verizon Communications Inc	Cisco Systems Inc Microsoft Corp Samsung Electronics Co Ltd Nokia Oyj Sony Group Corp BlackBerry Ltd America Movil SAB de CV AT&T Inc Telefonica SA Empresa Nacional de Telecomunicaciones SA Sonda SA Totvs SA AT&T Inc T-Mobile US Inc Comcast Corp

Utilities (P/B<1)	China Everbright Ltd China Longyuan Power Group Corp Ltd Engie SA Iberdrola SA Iren SpA	China Merchants Securities Co Ltd Haitong Securities Co Ltd CITIC Securities Co Ltd Xinyi Solar Holdings Ltd Xinjiang Goldwind Science & Technology Co Ltd China Everbright Environment Group Ltd China Resources Gas Group Ltd LONGi Green Energy Technology Co Ltd Beijing Enterprises Water Group Ltd E.ON SE RWE AG Electricite de France SA Fortum Oyj Acea SpA Hera SpA Snam SpA Terna Rete Elettrica Nazionale SpA A2A SpA
Utilities (P/B>1)	Aguas Andinas SA Brookfield Renewable Partners LP Duke Energy Corp Enel SpA Iberdrola SA Terna Rete Elettrica Nazionale SpA SSE PLC	Enel Americas SA Enel Generacion Chile SA Companhia de Saneamento Basico do Estado de Sao Paulo SABESP Algonquin Power & Utilities Corp Northland Power Inc Innergex Renewable Energy Inc Boralex Inc TransAlta Renewables Inc Emera Inc Exelon Corp Southern Co Nextera Energy Inc Entergy Corp American Electric Power Company Inc DTE Energy Co Dominion Energy Inc Snam SpA E.ON SE EDP Energias de Portugal SA Naturgy Energy Group SA Red Electrica Corporacion SA Endesa SA Enagas SA EDP Renovaveis SA Centrica PLC National Grid PLC Severn Trent PLC United Utilities Group PLC Pennon Group PLC

(Source: author's work)