Financing rewards for the sustainable firm: the effect of ESG scores on the corporate bond spread and the mediating effect of country emission levels

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Statement of originality

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Abstract

The evolving awareness of climate issues raises the question if there is more involved than ethicality for firms that try to mitigate their environmental impact. Research on the financial performance of such firms is rich in academic literature, whereas the effects on financing costs are not. Firms with admirable moral values incorporated in their business along with ambitions for improving their sustainability levels ought to be rewarded by their stakeholders since they exhibit decreased measures of risk. Substantiated by a solid theoretical base, this study looks into the effect of ESG levels on the corporate bond spread of issues by Real Estate Investment Trusts (REITs). Using a large sample of bonds issued from fifteen different countries, the effect of the ESG rating, computed from the Refinitiv Eikon database, on the corporate bond spread is estimated. Congruent with instrumental stakeholder theory, results show that ESG negatively affects the corporate bond spread. This result is validated by several robustness tests controlling for possible endogeneity and sample selection issues. Moreover, the mediating effect of countrywide emission levels on the relationship is estimated. Results indicate that the previously established effect is dependent on the severity of emission levels of the real estate sector on a national scale. This finding is in accordance with motives for ESG engagement based on legitimacy and institutional theory and refutes the normative stakeholder model, which argues that stakeholder value is static and inherent.

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1. Introduction

Sustainability is an inevitable point on the agenda for many firms and because of better awareness also increasingly important to stakeholders. With sustainability comes the practice of ESG or CSR activities. CSR refers to the efforts of the firms to generate a more positive impact on its stakeholders and the environment, whereas ESG measures these activities to arrive at some performance indication. However, both terms are commonly used interchangeably. ESG activities primarily find theoretic ground in three theories, which are the stakeholder theory, legitimacy theory, and institutional theory. Stakeholder theory argues that the impact on all stakeholders should have some weight in the decision-making process of the firm and that there is an inherent and instrumental value to be gained from stakeholder engagement (Donaldson & Preston, 1995; Freeman, 1984). Legitimacy theory considers the existence of a social contract between a firm and the society (all stakeholders), to which the firm has to conform to retain the right to existence (Deegan, 2006; Deegan et al., 2000). Institutional theory is an extension of legitimacy theory and considers the impact of regulations and norms set by society on the firm (Scott, 2004). ESG and CSR have seen exponential growth in academic research as a substantial contributor to firm value and financial performance (Waddock & Graves, 1997; Tsoutsoura, 2004; Orlitzky et al., 2003; Sun, 2012; Wang et al., 2016). Better CSR performance is associated with Improved reputation, higher employee loyalty, lower absenteeism, higher job satisfaction, the increased capability of attracting good quality employees, higher productivity rates, and improved customer satisfaction (Bhattacharya et al, 2008; Fombrun & Shanley, 1990; Fombrun et al., 2000; Greening, & Turban, 2000; Luo and Bhattacharya, 2006; Maignan et al, 1999; Sims and Keon, 1997; Turban & Greening, 1997). In commercial real estate, there is a clear additional and distinct benefit of improved sustainability practices. Sustainable buildings are associated with higher rents, improved and more stable occupancy and retention rates, and reduced operating expenses (Eichholtz et al., 2010; Eichholtz et al., 2013; Fuerst & Mcallister, 2010; Reichardt, 2015). Research has documented that firm value and operating performance are positively affected by an increased effort in sustainability for REITs (Eichholtz et al., 2012; Fuerst, 2015; Sah et al, 2013).

Much less explored territory is the effect of ESG on the cost of debt. The mechanisms described above do, however, potentially carry over to this type of analysis. Higher and more stable occupancy rates imply more stable cash flows to investors. This translates into decreased systematic risk and lowers default risk (An & Pivo, 2018). Real estate firms that exhibit lower default risk might be able to get more favorable conditions on their debt. Moreover, engagement in ESG activities improves a company's reputation, which also might lead to enhanced conditions in the capital market (Fombrun & Shanley, 1990; Fombrun et al., 2000). Improved borrowing conditions can also result from an increase in the overall financial performance of the company. Testing if the ESG rating with the proposed benefits affects the cost of debt for REITs should yield interesting results. Eichholtz et al. (2019) find that the cost of debt for REITs with a higher share of environmentally certified buildings is significantly lower. The tested relationship in this study is similar but has increased internal and external validity through the creation of an overall ESG rating instead of merely examing one aspect and testing the relationship on a global sample. This extension of previous research leads to the main research question of this thesis: Is there a significant effect of ESG on the cost of debt for REITs?

An additional research question is proposed in this thesis. High CO2 emissions of the building industry and the goals of drastically reducing emissions in a relatively short time frame over the next few decades raise the question if the effect of ESG activities is relative and dependent on, for example, countrywide ESG activities. The second research question, therefore, reads: Is there an interaction effect of the corporate ESG rating and annual national emission levels on the cost of debt for REITs? The reasoning for such an effect is quite intuitive. ESG activities for REITs are more urgent in a country that is itself relatively polluted, given that regulations will become increasingly stringent over time and society will increasingly value sustainability. In such a country, firms that consider the environment or act in a socially responsible manner have a higher impact on their risk of default compared to firms that operate in a less polluted country. This increased impact on default risk translates into a more pronounced negative effect on the cost of debt.

For both managers and investors, it is crucial to understand the consequences of engagement in sustainability activities, in order to make proper and accurate financing and investment decisions and understand their impact on value and risk. This research will contribute to this understanding and provide further evidence on the intuitive notion that firms with a sense of responsibility on the social impact of their operations are rewarded by their stakeholders. Substantiated by legitimacy theory, institutional theory, and in part by stakeholder theory this study demonstrates the existence of a causal relationship between ESG and the corporate bond spread as well as the mediating effect of country emission levels on this relationship. The research provides added value to the literature on the relationship between the cost of debt and ESG by implementing an overall ESG measure that is real estate oriented. Previous academic research on the effect of ESG on bond spreads has looked into a measure of CSR strengths versus weaknesses or merely one dimension of a firm’s actions that reduce its environmental impact. The Refinitiv Eikon ESG measure used in this thesis can be broken down in a multitude of dimensions, which are in turn weighted to match the ESG priorities in the real estate industry. This allows for more accurate and relevant results of the relationship. This study also separates the effect of the three dimensions of ESG. This allows us to test more accurately the effect of environmental factors that are so relevant for explaining the mechanisms that lead to possible reductions in default risk. The relationship is tested to a great extent for its robustness by the implementation of a Heckman model and an Instrumental Variable (IV) regression model. Also, the study provides first international evidence of the relationship between ESG and the cost of debt. Additionally, it connects for the first time countrywide CO2 emissions as a mediating mechanism for the effect of ESG activities on the cost of debt, thereby showing that inclusion of this variable nullifies the previously established effect of ESG on the cost of debt. This finding reinforces legitimacy and institutional motives for ESG activities that argue flexibility of the effect and it refutes the normative value of the stakeholder theory that suggests an inherent value of ESG activities.

This study is split up into several sections. The literature review provides information on all relevant findings on topics including the cost of debt, CSR/ESG, both topics in the context of real estate, and environmental concerns. CSR and ESG will be used interchangeably in the literature review, as earlier studies mostly looked at CSR and more contemporary studies predominantly look at ESG. Following the literature review is the hypothesis development, from which the expectations for the results of this study are derived. The methodology section elaborates on the research method, possible issues, corrections for these issues, regression models along with all included variables, their transformations, and expected coefficient signs. The data section discusses the data retrieval procedure and provides summary statistics of the acquired sample. The results section discusses the main results and the significance levels of the provided coefficients. The robustness section discusses the internal validity of the model and tests different specifications to test the robustness of the relationship. The discussion section elaborates on the obtained results and places these results in the context of the literature and the hypotheses. It also discusses the limitations of the study, implications, and fruitful directions for further research.

2. Literature review

2.1 Cost of debt

As Merton (1973) explains in his paper on option pricing, interest rates on debt are based on three separate factors. These factors include the risk-free rate, bond characteristics such as time to maturity or liquidity, and default risk, which is the probability that the borrower is not capable of meeting its payment obligations. The risk-free rate is commonly estimated by the interest rate on government bonds. The default risk is proxied in part by credit ratings. Higher default risk is associated with higher yield spreads. Contrary to common belief, yield spreads are more than what can be explained by default risk alone (Collin-Dufresne; Huang & Huang, 2012). It is one of the many determinants of the corporate bond spread, as Huang and Hang (2012) show in their paper on the effect of credit risk on yield spreads. Still, the majority of the corporate bond spread can be explained by the default risk (Longstaff, 2004). Underlying characteristics influence the yield spreads on bonds in a variety of ways. For example, an otherwise similar bond with a longer tenor will have a higher yield spread compared to a bond with a shorter tenor. This is explained by interest rate risk. The longer the tenor, the higher is the probability of a change in interest rates, which affects the price and return of the bond. Another important premium which affects spreads is the (il)liquidity premium. Yield spreads are negatively affected by the illiquidity of a bond since investors want to be compensated for the decreased ease with which the bond can be traded (Chen et al. ,2007). Another factor that has a significant effect on corporate bond spreads is the tax premium, which arises from the difference in taxation between corporate and governmental bonds (Elton et al., 2001).

2.2 ESG/CSR motives

The Brundtland report (1987) served as a reaction to the increasing awareness of corporate social responsibility (CSR) matters. The report, written by the World Commission on Environment and Development, tosses the concept of sustainable development as a response to recent environmental issues. It explores the causes of environmental degradation and the interconnectedness of social equity, environmental problems, and economic growth. Recognizing the incompatibility of current operations for a sustainable future, the authors propose ways to deal with these issues, such as strengthening international cooperation and raising the level of awareness among individuals, businesses, and governmental institutions. They define sustainable development as ‘development that meets the needs of the present without compromising the ability of future generations to meet their own needs’. This is closely related to present definitions of CSR and ESG. The European Commission (2011) defines CSR as ‘the responsibility of enterprises for their impact on society’. Broadly speaking, there are four distinct CSR strategies (Garriga, & Melé, 2012). These are meeting objectives that produce long-term profits, responsibly using business power, integrating social demands, and contributing to a good society by doing what is ethically correct. CSR and ESG, as well as this research, are mainly informed by three theories: the stakeholder theory, legitimacy theory, and institutional theory, which will elaborately be discussed.

2.2.1 Stakeholder theory

The conventional view on value-maximizing strategies for corporations is based on the shareholder theory. Elaborately worked out by Friedman (1970), the theory proposes that the approach to utmost profitability is by acting in the best interest of the shareholders at all times. Through the work of Freeman (1984), this view was subjected to opposition by the formulation of the stakeholder theory. Instead of purely focusing on the interests of shareholders, this theory stresses the importance of other parties to consider in the decision-making process, which involves customers, employees, competitors, media, suppliers, governmental institutions, and neighboring communities. Moreover, he goes on to explain in what ways a company is affected by each of these parties and vice versa. Donaldson and Preston (1995) split up stakeholder theory in three separate dimensions, which are descriptive, instrumental, and normative. The descriptive model explains the functioning of the firm and the impact of operations on its stakeholders, similar to what Freeman worked out. The instrumental aspect considers the possible enhanced profitability of a company through the mechanism of stakeholder management. The engagement is a means to an end, in contrast to the normative model. That is, stakeholders other than shareholders have a legitimate stake in a company’s operations and have inherent value, such that acting in their best interest releases this value. The normative model is used to justify the stakeholder theory by Donaldson and Preston. Jones (1995) extends the theory and argues that ethical principles such as trustworthiness and cooperativeness instead of opportunistic behavior may result in a competitive advantage for firms over those that do not incorporate these criteria since these firms exhibit reduced agency costs, transaction costs, and other costs associated with team production. Jones thereby effectively reinforces motives for stakeholder engagement. The stakeholder theory is closely related to the enlightened shareholder theory, a term coined by Jensen (2000). In his paper on value maximization, he argues that there is a more appropriate way to think about value maximization, which combines that shareholder and stakeholder theory. Instead of maximizing shareholder value at all times, the optimal strategy is to maximize long term value for shareholders. This implies that sometimes decisions are made that negatively affect shareholders and positively affect other stakeholders short term but eventually will positively affect shareholders.

2.2.2 Legitimacy theory

Legitimacy theory considers organizations to have no inherent right to existence, and only to receive this right to operate when it is conferred upon them by society (Magness, 2006). Considering society as a whole instead of a collection of individuals, legitimacy theory considers the existence of a social contract between a firm and its societies (Deegan, 2006). The social contract exists out of explicit terms such as legal requirements, but also on implicit terms such as expectations (Deegan et al, 2000). All of the social contract's terms are not to be breached for an entity to maintain its legitimacy. This implies that not only the expectations of investors are to be fulfilled, but also those of all other affected stakeholders. In other words 'organizations can only continue to exist if the society in which they are based perceives the organization to be operating to a value system that is commensurate with the society's value system' (Gray et al., 2010). Moreover, the state of the contract is not fixed but varies in place and time (Suchman, 1995). This means that if society adjusts its attitude towards certain values, organizations are to adjust as well to remain viable. If a firm does not adjust to changing values of society, or if there are unexpected occurrences that affect an organization's reputation such as fiscal scandals this will result in a legitimacy gap, which could be a threat to a company's continuity if not properly dealt with (Fernando & Lawrence, 2014). To narrow the gap, an organization must employ a suitable legitimization strategy, which is not without cost. Such a strategy is considered a CSR activity since it involves realigning the objectives between the firm and society as a whole, not just shareholders. According to Lindblom (1994), there are four strategies a firm can use for legitimization. These are: educating stakeholders on actual performance, changing the perception of stakeholders on the issue, divert the attention of stakeholders to something else, and try to change the expectations of stakeholders on the performance of the organization. Companies tend to disclose only positive information about their CSR activity, which can be considered to be a way of the company to legitimize itself with society (Gray et al, 2010).

2.2.3 Institutional theory

Institutional theory considers 'the processes by which structures, including schemes, rules, norms, and routines, become established as authoritative guidelines for social behavior' (Scott, 2004). Institutional forces align the beliefs of firms with those of societal norms by internalization of norms or external pressures (Scott, 2004). Usually, these forces take on the form of regulations (Campbell, 2007). However, not only the regulations itself matter but also the way these regulations are enforced is crucial since discrepancies in enforcement can result in totally different outcomes (Campbell, 2007). According to DiMaggio and Powell (1983), there are three ways in which institutions bring uniformity to a firm's operations. These are coercive, mimetic, and normative forces. Coercive forces aim to realign business practice with societal expectations, mimetic forces can be understood as the pressure of a firm's peers to comply to a certain behavior, and normative forces refer to internalizing beliefs about the suitability of a firm's behavior.

Often research has found globally differing results and moderating effects strengthening or weakening the relationship between CSR and performance. These moderating effects are consistently the result from a discrepancy in institutional pressures in time and place (Brammer et al., 2012). As an example, consider the regulation for Dutch offices as of 2023 (Rijksdienst Voor Ondernemend Nederland). Offices in the Netherlands will legally be required to have a minimum energy label C to be utilized as an office. Consequently, real estate operators will exhibit improved CSR ratings, but merely out of regulatory considerations. The risk that is associated with increasingly stringent regulations is Stranded asset risk (CRREM, 2019). This is defined as the risk that an asset becomes obsolete as a result of regulations and contributes to a firm's default risk. As Campbell (2007) shows in his research, several conditions increase or decrease the probability of an organization employing CSR practices, such as financial performance, the level of competition but above all, strong regulations that ensure social behavior. According to institutional theory, ESG is for the most part an involuntary practice and is dependent on many external factors. As Brammer et al (2012) argue: 'from an institutional perspective, CSR, as a voluntary, ad hoc and discretionary set of practices, is just a fraction of corporate activities at the interface of business and society'.

2.3 Established benefits of ESG

Now that the motives for CSR are established, let us look at the consequences. Both benefits and costs are associated with CSR. Acts of corporate social responsibility involve short-term costs and typically pay-off only in the long-term, in whatever form that may be. Neo-classical economists assume these costs to outweigh benefits, putting the firm at a competitive disadvantage (Aupperle, 1985), and instead put the sole focus on shareholder value maximization (Waddock & Graves, 1997). The benefits of stakeholder management are, however, apparent in academic research. Maignan et al. (1999) show that, in a sample of

American companies, CSR is positively linked to employee commitment and customer loyalty. Moreover, CSR engagement positively affects customer satisfaction, as demonstrated by a study of Luo and Bhattacharya (2006). However, when a firm has few prospects of innovativeness, the relationship between CSR and customer satisfaction is shown to be negative. More engagement in CSR may make a firm more attractive to new employees and current employees in that retention rates are higher, as well as allowing the firm to attract more capable ones (Turban & Greening, 1997; Greening, & Turban, 2000; Bhattacharya et al, 2008). Sims and Keon (1997) find that an ethical work environment lowers absenteeism and increases productivity and job satisfaction. Communicating with stakeholders on the CSR performance of the organization may well strengthen the image of the company to the external parties (Fombrun & Shanley, 1990; Fombrun et al., 2000). According to a survey done by McKninsey (2014) on more than 3,000 executives, the most important motivation for engagement in sustainability practices involved alignment with goals of the firm, reputation management, and cost-cutting. Furthermore, reputation has shown to be an important mediator for the effect of CSR and financial performance (Orlitzky et al., 2003), implying that the effect of CSR on financial performance is more pronounced for firms that communicate their CSR activities well and use it to build a positive image.

The link between corporate social responsibility and financial performance has been thoroughly researched and is not conclusive, but the bulk of the research tends to agree that the relationship is positive. The main finding is that financial performance is superior for more heavily CSR engaged firms (Waddock & Graves, 1997; Tsoutsoura, 2004; Orlitzky et al., 2003; Sun, 2012; Wang et al., 2016). Using the KLD rating as a proxy for corporate social performance (CSP) Waddock & Graves (1997) find that the effect of CSP on financial performance is significantly positive, which supports the theory of improved CSP through good management. The relationship between the two variables is considered to be bidirectional, with both variables simultaneously and positively affecting one another. Tsoutsoura (2004) finds a similar positive link between CSR and financial performance. By using data from the S&P 500, the author finds a significant relationship, also recognizing the possibility of a reversed causality. This simultaneous causal relationship can be explained by the good management theory and the slack resources theory (Waddock and Graves, 1997). The good management theory entails that increases in the ESG performance result in a better relationship between a firm and its stakeholders, which in turn leads to a higher corporate financial performance. The slack resources theory implies that a company that has more access to capital because of sound financial performance, is more likely to invest long-term in good employee relationships or invest resources in environmental concerns, whereas companies that have poor financial performance are more likely to invest short-term without the possibility to invest in the interest of other stakeholders than its investors. Orlitzky et al. (2003) and Wang et al. (2016) both carried out a meta-analysis of the CSR-financial performance link to establish a greater degree of certainty regarding the relationship. Ortlitzky et al. (2003) employ 52 studies with a total of 33,878 observations. The authors find that social responsibility and, to a lesser but still significant extent, environmental responsibility is associated with improved corporate financial performance (CFP). Wang et al. (2016) carry out a meta-analysis based on 42 studies and find similar results. In support of the instrumental stakeholder theory, they find a significantly positive effect of CSR on CFP. Moreover, they find a moderating effect of country market development, which explains in part the varying results in studies differing in time and place.

2.4 ESG and cost of debt

Waddock and Graves (1997) state that a firm's disregarded implicit claims by one of their stakeholders may well result in uncertain future explicit claims. Relating to a company's risk, Spicer (1978) shows that firms that have low social performance are considered to be riskier investments. This extra risk stems from not recognizing the value in the ever-increasing awareness of environmental and social issues and not incorporating these issues in firm operations in a socially responsible way. Using a sample of firms in a pollution prone industry, the author finds that for firms with good pollution control, price/earnings ratios are higher, profitability is higher, and total risk and systematic risk are lower than for firms with bad pollution control. Not only systematic risk but also idiosyncratic risk is lowered through CSR practices (Boutin-Dufresne & Savaria, 2004; Lee & Faff, 2009). More recently, Albuquerque et al. (2019) model CSR as an investment for enhanced product differentiation, predicting a decrease in systematic risk. Congruent with expectations, they find that CSR activity negatively affects systematic risk. They also account for endogeneity problems, finding similar results when CSR is instrumented. Another risk that is mitigated through engagement in CSR activity is default risk (Sun & Cui, 2014; Rizwan, 2017). Rizwan (2017) finds that activities concerning primary stakeholders have a significantly negative effect on default risk. These activities include employee relations, product quality, diversity, and governance. Sun and Cui (2017) observe a decreased probability of default for firms with higher CSR scores as measured by credit rating scores from Standard and Poor's. A reduction in risk can be linked to favorable outcomes in the capital market. As Merton (1973) explains in his paper on option pricing, debtholders can only experience limited gains but can be faced with sufficient losses that can accrue up to the entire invested amount. Therefore, they highly value good management and punish any risks to their small upside possibilities.

Firms that have significant CSR concerns, experience higher interest rates on bank loans (Goss and Roberts, 2011). This premium varies from 7 to 18 basis points. The authors show that poor quality borrowers that engage in discretionary CSR activities are charged with higher interest rate spreads, but lenders are indifferent to discretionary CSR spending by good quality borrowers. Firms that have environmental concerns are shown to experience higher interest rates on loans, higher required return by investors, and exhibit lower credit ratings (Bauer & Hann, 2010; Chava, 2014). Moreover, fewer banks participate in loan syndicates of these firms (Chava, 2014). Through improved environmental risk management, firms can lower their cost of capital, cost of equity, and typically shift more to debt financing, thereby increasing the tax shield (Sharfman & Fernando, 2008). Good corporate social performance is associated with improved corporate bond yield spreads, as well as improved credit ratings (Attig et al., 2013; Bauer & Hann, 2010; Cooper & Uzun, 2015; Oikonomou et al., 2014). Oikonomou et al. (2014) explain improved credit ratings by lower default risk for firms with high CSP. Yield spreads, in turn, are lower through a decreased susceptibility of negative consequences of poor social performance (Oikonomou et al., 2014). Overall, research finds a significant effect of several control variables on the cost of debt including the size of the firm as measured by total assets, capital intensity, leverage, interest coverage, and financial performance measures such as ROA (Attig et al., 2013; Bauer & Hann, 2010; Chava, 2014; Cooper & Uzun, 2015; Goss and Roberts, 2011; Oikonomou et al., 2014; Sharfman & Fernando, 2008). Those who have included bond spreads as the dependent variable found significant effects for the control variables time to maturity, bond value, and bond rating (Attig et al., 2013; Bauer & Hann, 2010; Cooper & Uzun, 2015; Oikonomou et al., 2014).

2.5 Real estate

2.5.1 ESG in Real estate

Socially responsible and sustainable firms benefit from signaling information about their quality. Without forms of quality signaling, there is an adverse selection problem. Akerlof (1970) explains this principle by using the example of the market for second-hand cars. Uniformed parties in the market for cars will offer average prices to sellers if they do not receive any information on their quality. Average offers harm good-quality sellers. If there is no possibility of sending quality signals, good quality sellers withdraw and only bad quality cars remain, which leads to an adverse selection problem. However, if the possibility is present, good quality sellers have sufficient incentive to do so.

Signaling theory directly stems from this insight. Developed to a great extent by Spence (1973), the signaling theory explains the potential benefits that come with sending credible quality signals. In his paper about job market signaling, Spence shows that signaling one's quality is valuable for good quality workers because if they do, they receive higher wages. The same reasoning applies to real estate companies. By sending credible quality signals, firms can be rewarded.

To signal one's quality about the assets they possess, which for real estate companies consists predominantly of buildings, there are some tools. A firm can apply for sustainability certifications, which ensure some sustainability standard. Sustainability certifications such as BREEAM, LEED, or Energy Star indicate sustainability performance of buildings, taking into consideration criteria such as energy efficiency, sustainable materials and resources, and sustainable sites (Berardi, 2012). Another way to signal the sustainability of one's assets is the issuance of green bonds. Green bonds are bonds of which the proceeds are used to finance investments with environmental benefits (Green Bonds Initiative, 2019). This shows the bond investor that the firm has good intentions with the money raised. Current outstanding green bonds are estimated at a value of USD 500 billion (Green Bonds Initiative, 2019). Real estate firms can make use of this financing strategy to signal their intention to invest in a sustainable real estate portfolio. There is also a more indirect way to signal quality through ESG ratings. These are ratings that can be derived from the Refinitiv Eikon database as is done in this study or from KLD, which is used in most researches that looked into the effect of CSR on the cost of debt (Bauer & Hann, 2010; Chava, 2014; Cooper & Uzun, 2015; Goss and Roberts, 2011; Oikonomou et al., 2014). These ratings are extensively used by firms to legitimize their efforts of improving the impact on the environment and wider communities.

2.5.2 Effects of ESG in real estate

This thesis puts the focus on real estate companies and in specific Real Estate Investment Trusts (REITs), which are companies that own real estate and often also operate it, obtaining income through rents and capital gains. Real estate companies have increased awareness for and put increased effort into sustainability due to several reasons. Most significantly, managers and all stakeholders have become more aware of climate change. The building sector has a colossal share in worldwide greenhouse gas emissions and energy use (Otto, 2016; UN Environment, 2017, 2019). Awareness, together with increasingly stringent regulations leads investors and managers to look for more sustainable options in real estate. Companies that operate buildings and invest in ESG enjoy, apart from earlier mentioned perks that concern all firms, several additional benefits unique to real estate assets. Buildings awarded with sustainability certifications exhibit benefits such as rental premia and sale price premia (Fuerst & Mcallister, 2010; Eichholtz et al., 2010; Reichardt, 2015). Eichholtz et al. (2010) use a sample of about 10,000 firms and find a rental premium for certified buildings of about 3.5 percent and a sale price premium of around 16 percent. These results are ceteris paribus, thus comparing rents and sales of otherwise identical properties. Fuerst and Mcallister (2010) find similar results, with premia of 4 to 5 percent and sale price premia of 24 to 25 percent. Sale price premia can be explained by increased rental values, decreased operational costs due to efficiency of energy use, as well as more stable but primarily higher occupancy rates, which more than offset the higher construction costs for these types of buildings (Eichholtz et al., 2010; Eichholtz et al., 2013; Fuerst & Mcallister, 2010; Reichardt, 2015).

It is not merely individual buildings that display benefits associated with certifications. Portfolios that consist in part of certified buildings do enjoy similar benefits (Eichholtz et al., 2012; Sah et al, 2013). As Eichholtz et al. (2012) show in a study of portfolio greenness on financial performance, a higher rate of certified buildings is associated with improved financial performance, as measured by ROA, ROE, and FFO. Additionally, there is found to be no relationship between portfolio greenness and abnormal stock returns. However, the authors do find evidence of lower market betas, suggesting some superiority in the risk-return relationship for green portfolios. Fuerst (2015) finds additional evidence of this relationship, making use of the GRESB rating as the explaining variable, which specifically tracks real estate companies. The author finds evidence of improved financial performance for REITs that invest more sustainably. Moreover, such firms display lower volatility and systematic risk, which combined with similar absolute returns, implies a greater risk-return relationship as measured by the Sharpe ratio. Likewise, Devine et al. (2017) researched the effect of the share of green buildings on financial performance but looked at differences in the effect in the UK versus the US. In the US they find higher rental values, lower operating costs, lower interest costs, and higher cashflows to shareholders for 'green' REITs compared to their non-green counterparts. In the UK they find insignificant results. In the UK there is mandatory environmental disclosure for leased properties or those for sale. This obligatory disclosure raises the average level of greenness among the population of properties, which reduces the marginal benefit of voluntary environmental disclosure. This paper's findings are in support of the institutional theory of

CSR, as the discrepancy in the effect between the US and UK is a result of the degree of institutional pressure.

An and Pivo (2018) tested the greenness (share of sustainably certified buildings) of a portfolio for its effect on default risk. Using a sample of about 600 buildings while controlling for LTV, current DSCR, a refinance incentive, macroeconomic variables, loan characteristics, building characteristics, nearby public transit, MSA-fixed effect, vintage-fixed effect and baseline hazard, they find a reduced default risk for green buildings of about 34 percent. They explain the effect on default risk through improved cash flows and improved equity positions in the loan-to-value (green buildings are associated with a price premium and therefore LTV is reduced, which is a positive sign). As default risk becomes larger the interest rate increases. Improved cash flows and equity positions decrease default risk since the probability that the firm will suffice its payments increases. Therefore the interest rate can reasonably found to be lower for greener firms. Most influential for this thesis is the study conducted by Eichholtz et al. (2019). Based on a sample of over 200 REITs, the authors seek to find a relationship between portfolio greenness and both mortgage spreads of individual assets and bond spreads for individual REITs. Controlling for firm characteristics such as size, market-to-book ratio, debt ratio, age, mortgage characteristics such as time to maturity, LTV, and a fixed rate dummy, and time and entity fixed effects they conclude that the mortgage spread is about 25 to 29 basis points lower for buildings that have a sustainability certification. Additionally, for bond spreads as the dependent variable, they estimate a model while controlling for similar firm characteristics with the addition of a non-green dummy, and bond characteristics such as Moody's rating, bond value, time to maturity, and dummies for callable or convertible bonds. They find that the share of green buildings in a REIT's portfolio is negatively associated with the bond spread, all else constant. The authors argue that the lower default risk and a lower loss in case of default (since values are consistently higher for these types of buildings and they display higher liquidity) allow for lower risk premia resulting in a lower cost of debt.

2.5.3 Environmental concerns

The interest in the mediating effect of country pollution levels is based on the share of the building sector in global greenhouse gas emissions and energy use, and the recent agreements that have been made regarding this major pollution-contributing sector. Buildings make up about 30 percent of total worldwide energy use and about 40 percent of greenhouse gas emissions, making them a major actor in global climate change and a huge point on the agenda of many governments around the world in their mission to limit the consequences of climate change (Otto, 2016; UN Environment, 2017). Moreover, the total world population is forecasted to increase with 2.5 billion in 2050 (UN environment, 2019). Therefore, the building sector affects energy use and global emission levels even more significantly. One of the most notable happenings regarding climate change is the Paris agreement of 2015, which affects about 175 countries worldwide. The agreement outlines a path towards a reduction of at least 80 percent in greenhouse gas emissions by 2050 and a cut of around 90 percent from buildings. For the building sector, this means avoiding at least 50 percent of projected growth in energy consumption through mainstreaming of highly energy-efficient, net-zero energy, or energy-plus new buildings, and a deep renovation of the existing stock of buildings by 2030 (Otto, 2016). Research suggests that environmental regulations lead to reductions in CO2 emissions by firms (Ben-David et al., 2018). The consequence, however, is that companies are more likely to displace their most polluting activities to countries with weaker environmental laws. This finding reinforces the necessity for international environmental regulations if it is desired to suppress greenhouse gas emissions. Furthermore, environmental regulations increase a company's R&D spending, indicating that it makes them strive for innovation, which is another sign that stricter laws have positive consequences (Jaffe & Palmer, 1997).

2.6 Research gap

Hitherto research has established the possible motives for ESG practices with the application of the stakeholder theory, legitimacy theory, and institutional theory. Its cost and benefits have also widely been established on a multitude of dimensions. A selection of these benefits is distinctively relevant for the real estate industry, mostly concerning the effects of environmental factors of ESG. These benefits bring with them potential enhancement of corporate financial performance and a reduction in multiple measures of risk for firms. CSR strengths and some dimensions of ESG have been shown to reduce the cost of debt. However, where literature lacks value is on the effect of overall measures of ESG performance on the cost of debt, as well as the generalizability of the results as all relevant studies have been performed on US data. Moreover, research on the topic does not necessarily place the results in a wider theoretical framework and does not concern itself with the validation of the outcomes based on its motives. It is on these shortcomings that this study aims to provide added value.

3. Hypothesis development

CSR has many proven benefits from the instrumental stakeholder point of view. Improvements in employee commitment, customer loyalty, customer satisfaction, attractiveness to new employees, the capability of attracting more capable employees, absenteeism, productivity, job satisfaction, and a company's image are examples of the instrumental social value of stakeholder engagement. High corporate social performance is also associated with improved financial performance, even though it is hard to isolate one direction of this simultaneous relationship. Similarly, for the cost of debt, the effect of ESG, most times measured by a generic rating, has been shown to improve bank loan spreads and bond spreads for US-based firms based. Eichholtz et al. (2019) have established a similar relationship by regressing the share of environmentally certified buildings on bond spreads for REITs in the United States. Environmental certification is one of the primary ESG practices in the real estate industry. However, it is still only one of the many aspects of ESG. This study makes use of a more appropriate and more encompassing ESG rating and applies it to a wider range of countries. However, the expected results should be similar. ESG activities have a wide variety of benefits, as mentioned above. This, in turn, leads to reduced default risk through the lower probability and a lower loss in case of default (An & Pivo, 2018; Sun & Cui, 2014; Rizwan, 2017). This reduced default risk translates into a lower spread for corporate bonds (Attig et al., 2013; Bauer & Hann, 2010; Cooper & Uzun, 2015; Eichholtz et al., 2019; Oikonomou et al., 2014). Based on the literature of ESG and the cost of debt, it follows that the cost of debt tends to decrease as ESG activities are increased. ESG, therefore, has instrumental value. I hypothesize that ESG negatively affects the cost of debt for REITs through a reduction in the corporate bond spread.

H1: the ESG score negatively affects the corporate bond spread for REITs

Environmental concerns are a given in the current state of the world. However, they do differ per country in the degree of severity. Companies are increasingly aware of these concerns and tackle them in various ways. Signaling of these resolutions to environmental concerns to stakeholders is as important as tackling them. Buildings that are energy sufficient and are built with sustainable materials can get sustainability certifications such as BREEAM, LEED, or Energy Star. Just as a green bond or an ESG rating, these certifications serve as a signaling device to investors and tenants that value sustainability. This signaling of one's ESG performance is not motivated by normative stakeholder motives, which explains its outcomes such as reputational benefits and operational advantages by the inherent value of ESG, but is motivated on a more fundamental level by legitimacy theory. As an obligation to society, a firm has to prove its commitment to improving its environmental impact, if that is what society values. If not adhered to this obligation, the firm will ultimately seize to exist. In an extension to legitimacy theory, institutional pressures are a primary motive for ESG activities. Regulations, which can be viewed as the embodiment of expectations by society, push the building sector towards a more sustainable stock. In order to function, real estate operating firms that are subject to these regulations are obliged to upgrade the sustainability levels of their assets. If they do not, the stranded asset risk of their real estate assets rises, which translates into an increased probability of default. Governmental or industrial institutions set the rules and the limits regarding sustainability requirements, and the real estate operators and developers have the sole function to adhere and upgrade the sustainability of their buildings. Discrepancies in such regulations lead to differences in outcomes and valuations of ESG practices. For example, in the study by Devine et al. (2017), the difference in the effect of the green buildings share in a portfolio on the financial performance between the US and the UK stems solely from the difference in institutional pressures by the government on the average green buildings share of the country.

Not all countries have similar emission levels in the national building sector, so to meet the target of a maximum two degrees rise in global temperature, some countries have to adjust more than others. Real estate developers and operators in high polluting countries will need to upgrade their existing stock to a higher degree and put more attention on CO2 reductions in new buildings than firms in countries with lower pollution levels. If they do not adjust properly, they will not survive as an organization. Following institutional and legitimacy theory, this will be caused by either a lack of adherence to sustainability requirements or incapability to adjust one's values to that of society. Since firms in high-polluting countries have to adjust to a higher degree, the stranded asset risk and consequently the default risk (which is a relevant variable for determining the cost of debt) of organizations that do not incorporate sustainability in high polluting countries is higher. In turn, the effect of ESG on the cost of debt in countries that have high pollution levels is more significant than the effect of ESG on the cost of debt in countries that have low pollution levels. It follows from this reasoning that the interaction effect of the ESG rating and CO2 emissions per capita is negative.

H2a: The interaction effect of ESG and CO2 emissions per capita on corporate bond spreads is negative

This thesis substantiates the effect of ESG on the cost of debt with the use of three separate theories: stakeholder theory, legitimacy theory, and institutional theory. The normative part of the stakeholder theory explains the beneficial effects as derived from the fixed inherent value of stakeholder engagement. However, based on the motivational theories of ESG, the effect of ESG on the cost of debt appears to be a function of social and institutional pressures instead of a function of inherent value in ESG practices. There is an instrumental value of ESG activities, but this is not inherent. The normative stakeholder theory is therefore refuted. Proxying the function of social and institutional pressures using the interaction variable of ESG and country pollution, the ESG variable itself is a function of the inherent value as proposed by the normative stakeholder theory. It is expected that, with the inclusion of the interaction effect, the effect of ESG on corporate bond spreads is insignificant.

H2b: The effect of ESG on the corporate bond spread is insignificant with the inclusion of the interaction between ESG and CO2 emissions

4. Methodology

In this section, the research methodology and the regression models are discussed. The research methodology section elaborates on the type of analysis used in the study, the possible violations of the regression assumptions, and how to account for these violations. The regression models section discusses all the regression models tested in this study, the appropriateness of these models to test the hypotheses, and its included variables.

4.1 Research methodology

To research the causal effect of ESG on corporate bond spreads, a quantitative analysis with panel data is performed, as it is preferred to observe a multitude of individuals over multiple years. This allows for a more accurate inference of model parameters as the degrees of freedom for this type of analysis are higher compared to a simple cross-sectional analysis. The panel data in this thesis will be mainly analyzed using a pooled analysis approach. This is in line with prior research on the topic (An & Pivo, 2018; Attig et al., 2013; Bauer & Hann, 2010; Cooper & Uzun, 2015; Eichholtz et al., 2019; Oikonomou et al., 2014).

Several models are used to analyze the data while controlling for heteroskedasticity and serial correlation. Both serial correlation and heteroskedasticity are violations of the second OLS assumption of independent and identically distributed random variables (Stock & Watson, 2015, p.201). Heteroskedasticity implies that the error term is not constant and depends on the independent variable (Stock & Watson, 2015, p.159). Serial correlation occurs when observations are not randomly sampled from the population and the omitted variables that make up the error term are persistent in the dataset (Stock & Watson, 2015, p.329). Since the regression model in the study will not perfectly explain the data (will not have an R-squared of one) and multiple firms are tracked over time, serial correlation is a problem to be dealt with. To resolve the problems of serial correlation and heteroskedasticity, it is possible to apply Heteroskedasticity and Autocorrelation-Consistent (HAC) standards errors. One type of HAC standard errors is clustered standard errors, which allow for correlation within a certain group but assume independence between different groups (Stock & Watson, 2015, p.367). To test for heteroskedasticity, the Breusch-Pagan test is applied. Under the null hypothesis, the error term is uncorrelated with the independent variables from the model. Under the alternative hypothesis, there is a dependence of the error term on the independent variables. Next to heteroskedasticity, the data is tested for serial correlation. Since the spreads of bonds are measured over time, there is a high probability of serial correlation in the dataset. To test for serial correlation, the Wooldridge test is applied. Under the null hypothesis, there is no serial correlation in the regression model, while under the alternative hypothesis the opposite is true. As is found in similar research designs (Attig et al., 2013; Bauer & Hann, 2010; Cooper & Uzun, 2015; Eichholtz et al., 2019; Oikonomou et al., 2014), the regression estimates in this study are significantly heteroskedastic and serially correlated, which can be observed from the table in appendix table 1. Consequently, it is necessary to control for this deficiency. This is done by clustering of standard errors. Since it is most likely that error terms are correlated within firms, clustering on firm-level is applied in the analyses.

Other large concerns for this analysis are endogeneity issues. Specifically, simultaneous causality could be a threat to the internal validity of the model. Simultaneous causality implies that there is a bidirectional relationship between independent variable x and dependent variable y, both affecting the other simultaneously. For the relationship between ESG and the cost of debt, the simultaneous causality is best illustrated by the slack resources theory and the good management theory discussed by Waddock & Graves (1997). There are two solutions to this problem. One is to use a controlled randomized experiment. The remaining option is to use an instrumental variable (IV) regression. Another way to reduce the endogeneity issues is to take lagged values for the independent variables, although it does not necessarily remove the bias in the results. In this thesis lagged values are applied for the independent variables in the main analyses to reduce some of the issues. Also, an IV regression is applied, of which the model and results will be discussed in the robustness section.

4.2 Regression models

4.2.1 Hypothesis 1

The first hypothesis is tested in line with prior research. The dependent variable, which is the corporate bond spread, is regressed on the ESG rating and a subset of control variables, both on issue and issuer level. See section 4.2.3.1 to 4.2.3.3 for a description of respectively the dependent, independent, and control variables. The main model to test is of the following form:

$$Spread_{ij,t} = \beta_0 + \beta_1 ESG_{i,t-1} + \beta_2 Size_{i,t-1} + \beta_3 Market\text{-}to\text{-}Book_{i,t-1} + \beta_4 Leverage_{i,t-1} + \beta_5 ROA_{i,t-1} + \beta_6 Amount_{ij} + \beta_7 Tenor_{ij} + \beta_8 Duration_{ij} + \beta_9 Call_{ij} + \gamma_1' Year + \gamma_2' Country + \gamma_3' Asset\text{-}type + \gamma_4' Rank + \varepsilon_{ij,t} \quad (1)$$

The specified regression above considers annual secondary market data of bond spreads. Subscript j in the regression equation indicates the bond, i indicates the firm, and t indicates the time. $Spread_{ij,t}$, therefore, refers to the corporate bond spread of bond j from firm i at time t. This model is also estimated using a fixed-effects specification.

To research the separate effects of the environment, social, and governance score, another regression is performed with the inclusion of the individual dimensions of the ESG score.

$$Spread_{ij,t} = \beta_0 + \beta_1 Environment_{i,t-1} + \beta_2 Social_{i,t-1} + \beta_3 Governance_{i,t-1} + \beta_4 Size_{i,t-1} + \beta_5 Market\text{-}to\text{-}Book_{i,t-1} + \beta_6 Leverage_{i,t-1} + \beta_7 ROA_{i,t-1} + \beta_8 Rank_{ij} + \beta_9 Tenor_{ij} + \beta_{10} Duration_{ij} + \beta_{11} Call_{ij} + \gamma_1' Year + \gamma_2' Country + \gamma_3' Asset\text{-}type + \gamma_4' Rank + \varepsilon_{ij,t} \quad (2)$$

This is a relevant model to consider since ESG in the real estate sector mostly prioritizes the environmental dimension. The effects of ESG discussed in the literature review also mainly refer to environmental aspects, which are the possible default risk-reducing mechanisms for REITs. Reviewing these separate effects allows us to draw conclusions on the existence of these suggested risk-reducing activities. The environment score is expected to have a negative effect on the corporate bond spread.

To research the effect of ESG on spreads at issuance, another regression model is estimated.

$$PrimarySpread_{ij,t} = \beta_0 + \beta_1 ESG_{i,t-1} + \beta_2 Size_{i,t-1} + \beta_3 Market\text{-}to\text{-}Book_{i,t-1} + \beta_4 Leverage_{i,t-1} + \beta_5 ROA_{i,t-1} + \beta_6 Rank_{ij} + \beta_7 Tenor_{ij} + \beta_8 Amount_{ij} + \beta_9 Duration_{ij} + \beta_{10} Call_{ij} + \gamma_1' Year + \gamma_2' Country + \gamma_3' Asset\text{-}type + \gamma_4' Rank + \varepsilon_{ij,t} \quad (3)$$

This model differs in the fact that primary market data is used for measuring spreads. Therefore, there is no time series included. It is cross-sectional data that is analyzed using standard OLS. Still, the moment measurement of all included variables differs and varies from 2010 to 2019. All firm characteristics are still lagged to reduce endogeneity issues and ensure that the data was public knowledge when the spreads were measured. This type of analysis is applied in a study by Eichholtz et al. (2019). Environmental awareness is relatively novel and growing recently. For some bonds in the sample, ESG might not or not fully have been priced in at issuance since investors were not aware of its implications. Therefore, the expected effect for the model at issuance is expected to be smaller than the effect in the secondary market.

A further step is to analyze quantile scores for REITS. This displays the effect of more pronounced changes in the ESG scores instead of slight changes in the continuous ESG score that is applied in previous regression models. To perform this regression, the ESG scores are split up in ten quantiles. Firms in the first quantile have the lowest measured ESG scores.

$$Spread_{ij,t} = \beta_0 + \beta_1 Quantiles_{i,t-1} + \beta_2 Size_{i,t-1} + \beta_3 Market\text{-}to\text{-}Book_{i,t-1} + \beta_4 Leverage_{i,t-1} + \beta_5 ROA_{i,t-1} + \beta_6 Tenor_{ij} + \beta_7 Amount_{ij} + \beta_8 Duration_{ij} + \beta_9 Call_{ij} + \gamma_1'Year + \gamma_2'Country + \gamma_3'Asset\text{-}type + \gamma_4'Rank + \varepsilon_{ij,t} \quad (4)$$

The expectations of the outcome do not change compared to the expectations for the continuous score. It is expected that ceteris paribus, a firm in a higher quantile has a lower corporate bond spread compared to a firm in a lower quantile.

This same model is also estimated including firms that do not have an ESG score. Firms that do not have an ESG score get a zero for the quantile score. Since the effect of an increase in the quantile score from zero to one is probably not similar to the effect of an increase in the quantile score from one to two, there is a dummy included for firms without an ESG score.

$$Spread_{ij,t} = \beta_0 + \beta_1 NoESG_{i,t-1} + \beta_2 Quantiles_{i,t-1} + \beta_3 Size_{i,t-1} + \beta_4 Market\text{-}to\text{-}Book_{i,t-1} + \beta_5 Leverage_{i,t-1} + \beta_6 ROA_{i,t-1} + \beta_7 Tenor_{ij} + \beta_8 Amount_{ij} + \beta_9 Duration_{ij} + \beta_{10} Call_{ij} + \gamma_1'Year + \gamma_2'Country + \gamma_3'Asset\text{-}type + \gamma_4'Rank + \varepsilon_{ij,t} \quad (5)$$

To give more insight into the effects of separate quantiles, a regression model is included with dummies for each quantile. The model then includes ten dummies for all quantile scores from one to ten, excluding the dummy for the REITs with no ESG score

$$Spread_{ij,t} = \beta_0 + \beta_1 Quantile1_{i,t-1} + \beta_2 Quantile2_{i,t-1} + \beta_3 Quantile3_{i,t-1} + \beta_4 Quantile4_{i,t-1} + \beta_5 Quantile1_{i,t-1} + \beta_5 Quantile1_{i,t-1} + \beta_6 Quantile6_{i,t-1} + \beta_7 Quantile7_{i,t-1} + \beta_8 Quantile8_{i,t-1} + \beta_9 Quantile9_{i,t-1} + \beta_{10} Quantile10_{i,t-1} + \beta_{11} Size_{i,t-1} + \beta_{12} Market\text{-}to\text{-}Book_{i,t-1} + \beta_{13} Leverage_{i,t-1} + \beta_{14} ROA_{i,t-1} + \beta_{15} Tenor_{ij} + \beta_{16} Amount_{ij} + \beta_{17} Duration_{ij} + \beta_{18} Call_{ij} + \gamma_1'Year + \gamma_2'Country + \gamma_3'Asset\text{-}type + \gamma_4'Rank + \varepsilon_{ij,t} \quad (6)$$

Every dummy in this model shows the effect of ESG on the corporate bond spread compared to firms that have no ESG score. Therefore the coefficients of these are expected to be negative as the effect of ESG on spreads is hypothesized to be negative. Moreover, it is expected that the effect increases in magnitude as the quantile score increases, with significant coefficients for at least the last few quantiles. Only the first quantile is expected to have no effect since there is a good amount of firms included in this first quantile that do have an ESG score but have been assigned a value of zero.

Similarly to the regression models using ESG scores, a regression is performed using primary spreads as the dependent variable.

$$PrimarySpread_{ij,t} = \beta_0 + \beta_1 NoESG_{i,t-1} + \beta_2 Quantiles_{i,t-1} + \beta_3 Size_{i,t-1} + \beta_4 Market\text{-}to\text{-}Book_{i,t-1} + \beta_5 Leverage_{i,t-1} + \beta_6 ROA_{i,t-1} + \beta_7 Tenor_{ij} + \beta_8 Amount_{ij} + \beta_9 Duration_{ij} + \beta_{10} Call_{ij} + \gamma_1 'Year + \gamma_2 'Country + \gamma_3 'Asset\text{-}type + \gamma_4 'Rank + \varepsilon_{ij,t} \quad (7)$$

The expectation for this model is similar to that of the continuous score. The effect of the ESG quantile score is expected to be less pronounced as in the specification using secondary market data.

The last model that is tested is that of quantile scores of the separate environmental, social, and governance scores, including only firms that have an ESG score.

$$Spread_{ij,t} = \beta_0 + \beta_1 Environment\text{-}quantiles_{i,t-1} + \beta_2 Social\text{-}quantiles_{i,t-1} + \beta_3 Governance\text{-}quantiles_{i,t-1} + \beta_4 Size_{i,t-1} + \beta_5 Market\text{-}to\text{-}Book_{i,t-1} + \beta_6 Leverage_{i,t-1} + \beta_7 ROA_{i,t-1} + \beta_8 Tenor_{ij} + \beta_9 Amount_{ij} + \beta_{10} Duration_{ij} + \beta_{11} Call_{ij} + \gamma_1 'Year + \gamma_2 'Country + \gamma_3 'Asset\text{-}type + \gamma_4 'Rank + \varepsilon_{ij,t} \quad (8)$$

The expectation again is similar to the expectation of continuous score. The effect of the most relevant variable, that of the environmental dimension, is expected to have a negative effect on bond spreads.

Together all these regressions test the first hypothesis: the ESG score negatively affects the corporate bond spread for REITs. If the coefficient of the ESG (quantile) score is significantly negative, the hypothesis is confirmed. This would indicate that an increase in ESG leads to a decrease in the corporate bond spread of a REIT.

4.2.2 Hypothesis 2

To test the second hypothesis, an interaction variable is added to the original model. The term that is used to interact with the ESG rating is the CO2 emissions per capita. This variable is measured annually for each country. This variable has manually been corrected for the share of the building sector in a country's GDP to arrive at a more correctly specified variable to measure emissions for the building sector. For example, CO2 emissions in Singapore seem rather large, but the building sector makes up merely one percent of the country's GDP. The high CO2 emissions, therefore, cannot be blamed on this sector. In contrast, for the UK the building sector makes up 20 percent of the country's GDP. High CO2 emissions here more probably trace back to the building sector. Consequently, in the UK, a gap between current countrywide emission levels and a company's effort to diminish its environmental impact is more likely to be punished in terms of the corporate bond spread compared to a similar difference in Singapore, which is why the correction is applied. For a more extensive substantiation of this correction, see the description of the interaction variable in section 4.2.3.2.

$$Spread_{ij,t} = \beta_0 + \beta_1 ESG_{i,t-1} + \beta_2 ESG*CO2/Capita_{ci,t-1} + \beta_3 CO2/Capita_{c,t-1} + \beta_4 Size_{i,t-1} + \beta_5 Market\text{-}to\text{-}Book_{i,t-1} + \beta_6 Leverage_{i,t-1} + \beta_7 ROA_{i,t-1} + \beta_8 Rank_{ij} + \beta_9 Tenor_{ij} + \beta_{10} Amount_{ij} + \beta_{11} Duration_{ij} + \beta_{12} Call_{ij} + \gamma_1 'Year + \gamma_2 'Country + \gamma_3 'Asset\text{-}type + \gamma_4 'Rank + \varepsilon_{ij,t} \quad (9)$$

Subscript c in this regression model indicates the country. For this model, a fixed-effects specification is also estimated. This is done to make sure that unobserved time-invariant effects are controlled for.

4.2.3 Variables

4.2.3.1 Dependent variables

- Spread (secondary market):

$$\text{Spread} = \ln(\text{corporate bond spread}) * 100$$

The corporate bond spread is calculated as the spread between the yield of the corporate bond and the yield of a government bond of similar maturity. It measures the risk premium issuers pay to their investors for collecting funds and is the most commonly used measure of the cost of debt in academic literature (Bauer & Hann, 2010; Cooper & Uzun, 2015; Eichholtz et al., 2019; Oikonomou et al., 2014). The bond spread is measured on an annual basis, each spread measurement taking place twelve months after the last. If a bond is issued in September 2016, the bond spread is measured for the first observation in the secondary market in September 2016, September 2017, September 2018, and so on. For correction of positive skewness, the natural logarithm of the spread is taken. The result of this logarithmic transformation is multiplied by 100 for a more convenient interpretation of coefficients. For example, if the coefficient of ROA is minus two, this indicates that if ROA increases with one unit, the corporate bond spread decreases with two percent.

- Spread (primary market):

For the regressions on primary market data, the corporate bond spread at issuance is used. Every bond then has one observation for the corporate bond spread. Again, the natural logarithm of the spread at issuance is taken to correct for the skewness of the distribution and is multiplied by a factor of 100.

4.2.3.2 Independent variables

- ESG score:

The ESG score indicates the main independent variable and measures the ESG score for each firm on a year to year basis. It is computed from scores on different dimensions of ESG using the methodology from Thomson Reuters (2017). There are ten dimensions on which firms get assigned an annual score, which all can be categorized under environmental, social, or governance. From these ten scores, it is possible to create individual environmental, social, and governance scores as well as total ESG scores. In order to create the scores, next to the individual dimension scores, the relative weights are required. The weights are dependent on the industry in which the organization operates and for this thesis are extracted from Thomson Reuters (2017), which explains the methodology behind ESG scores as computed by the Refinitiv Eikon database. Both the dimensions and the weights used for the calculation of ESG scores are displayed in appendix table 2. Since only REITs are sampled in this study, there is just one set of weights to be applied to the different dimensions of ESG to retrieve the ESG scores, which are the weights applicable for the real estate sector. Because ESG scores are measured on an annual basis, the lagged ESG score is applied in the model for determining the corporate bond spread so as to be sure that the ESG ratings are known to the market when it sets an appropriate yield for a bond. Making use of lagged values reduces possible endogeneity and simultaneity problems common in this type of research (Oikonomou, 2014). The sign and significance level of the coefficient of this variable test the first hypothesis. If the coefficient of the ESG score in this estimation is significantly negative, the first hypothesis is confirmed. It follows then that an increase in ESG activities leads to a decrease in the corporate bond spread on the secondary market for REITs.

- Quantile score:

The quantile score is based on the ESG score. The ESG scores are divided into ten different quantiles for every observed year. Then, to take into consideration firms without an ESG score as well, the value zero is assigned to firms that have no observations for the ESG score. The value of the variable including firms without an ESG score thus can take on eleven different values, ranging from zero to ten. Similarly, if the coefficient of the quantile score in this regression is significantly negative, the first hypothesis is confirmed, which implies that an increase in ESG activities leads to a decrease in the corporate bond spread on the secondary market for REITs.

- Interaction ESG – CO2/Capita:

This variable measures the interaction effect between the ESG score and the CO2 emissions per capita corrected for the building sector share in a country's GDP. Based on the legitimacy theory and institutional theory, it is expected that the interaction term negatively affects the corporate bond spread. From legitimacy theory, it follows that the rights of firms are conferred upon them by society. If society changes its values, the firms need to adjust in order to remain viable. As firms along with society currently take a bigger interest in ESG and value sustainability to a greater extent (Unruh et al., 2016), the perceived risk of low-ESG firms in highly polluted countries is bigger than in less polluted countries. Consequently, the effect of a firm engaging in ESG activities on the corporate bond spread is more pronounced in highly polluted countries compared to less polluted countries. The same reasoning follows from institutional theory. As regulations surrounding climate change get increasingly stringent over time, the default risk associated with low ESG activity increases in countries with high emission levels. Since countries with higher emission levels have to adjust more to meet future regulations, the effect of a firm engaging in ESG activities on the corporate bond spread is higher in countries that have high emission levels compared to countries with low emission levels. However, if the building sector is very undeveloped and small in a single country, the gap between a firm's effort for reducing emissions and the actual emission levels contains no valuable information. To illustrate this, imagine a situation in which one country has very high emission levels and another one has relatively low emission levels. However, the county with high emission levels has a building sector that makes up only half a percent of the GDP. The other country has a building sector that takes up 50 percent of the GDP. Uncorrected, the interaction effect measures greater values for the country with high emission levels. This implies that a company that puts some effort into ESG has a greater effect on its default risk in the high polluting country than if it operated in the lower polluting country. However, in the highly polluted country, there is a lower probability that regulations for the real estate sector will become stricter since the industry carries so little responsibility for the high emissions. The level of ESG effort here is not so influential for the default risk. In contrast, even though the emissions in the lower polluted country are not as high, regulations for real estate assets here are more probable to become increasingly stringent as the building sector makes up such a large part of the country's total emissions. The change in default risk associated with changes in the level of effort to reduce emissions in this country is therefore very high. The correction for the share of the building sector adjusts for this insight and provides a more accurate measure of the seriousness of the discrepancy between a company's ESG rating and a country's emissions.

4.2.3.3 Control variables

There are numerous control variables included in the regression models. Although only a selection has been included in the main models, several other controls have been tested, which are excluded because of insignificance or added during robustness tests. Dummies to indicate convertible and green bonds are usually valuable in this type of research as they affect corporate bond spreads, but are excluded in the main analyses. There are no convertible bonds observed in the sample and observations for green bonds are too scarce. Descriptive statistics for observations of green bonds are still included in appendix table 8 and they are included in robustness tests as well. Other variables added during robustness tests are discussed in the robustness section.

- No-ESG dummy:

In the quantile score regression, a dummy is included for firms that have no observations for the ESG score. The dummy takes on a value of one if the firm has no ESG score and a value of zero if it has. It is included since there might be a distinct effect of having an ESG score compared to not having an ESG score, apart from the effect of an increase in the quantile score.

- Size:

$$\text{Size} = \ln(\text{Total assets})$$

The first control variable is size. It is proxied by total assets and transformed using a natural logarithmic function since its normal distribution is significantly skewed. In prior research, the size variable proved to be negatively related to the corporate yield spread, implying that large firms tend to have lower bond spreads (Bauer & Hann, 2010; Cooper & Uzun, 2015; Eichholtz et al., 2019; Oikonomou et al., 2014). Fama and French (1996) similarly argue that relative size differences proxy risks of financial distress. Larger firms are perceived to be less risky compared to small firms and thought to have better capability to pay back debts, which would allow for lower bond spreads. In contrast, Dichev (1998) looks into the relationship between bankruptcy risk and systematic risk and argues that it is unlikely that size effects proxy factors relevant for explaining bankruptcy risks. Vassalou and Xing (2004) find that there is an effect of size on default risks, but the effect is only present for firms in the highest quintile of default risk.

- Market-to-book ratio:

$$\text{Market-to-book ratio} = \frac{\text{Market capitalization / Common shares outstanding}}{\text{book value of equity per share}}$$

The market-to-book ratio is a consistently recurring control variable for these types of analyses in academic literature (Bauer & Hann, 2010; Cooper & Uzun, 2015; Eichholtz et al., 2019; Oikonomou et al., 2014). High market-to-book ratios are an implication of growth opportunities whereas a low ratio is an indication that the firm is a value stock. Firms with high ratios and high future profitability opportunities are expected to be less risky and therefore should incur lower spreads on their debts.

- Leverage:

$$\text{Leverage} = \frac{\text{Total debt}}{\text{Total debt+Total equity}} * 100$$

An important measure of financial risk that is included in all related studies is leverage (Bauer & Hann, 2010; Cooper & Uzun, 2015; Eichholtz et al., 2019; Oikonomou et al., 2014). As leverage increases, the capability of a firm to repay its debt diminishes, resulting in a higher risk of default and a lower corporate bond spread (Baron, 1974).

- Return on assets:

$$\text{Return on assets} = \frac{\text{Net income before extraordinary expenditures}}{\text{Total assets}} * 100$$

As a proxy for financial performance, return on assets is used as a control variable, as is done in other relevant studies (Bauer & Hann, 2010; Cooper & Uzun, 2015; Oikonomou et al., 2014). When the financial performance of a firm is good, the corporate bond spread should be lower as there is less risk of the firm not being solvent and repay its debts. The link between financial performance and corporate bond spreads is extensively demonstrated in research and the majority of academics tend to agree on the presence of a positive relationship (Waddock & Graves, 1997; Tsoutsoura, 2004; Orlitzky et al., 2003; Sun, 2012; Wang et al., 2016).

- Duration:

$$\text{Duration} = \frac{\sum_{t-1}^{n} \frac{t * C}{(1+r)^t} + \frac{n * M}{(1+r)^n})}{\text{Bond price}}$$

Where:

t = time period

r = interest rate

C = periodic coupon payment

n = total number of periods

M = maturity value

Duration is a standard measure for a bond’s sensitivity to interest rate risk and is expressed in years. It measures the average time to receive the payments of a bond. It has been applied as a control variable in a related study by Eichholtz et al. (2019). Default risk will fluctuate alongside with interest rate risk. As the duration increases, the interest rate risk rises. This results in a higher bond spread for bonds with a longer duration.\

- Tenor:

The tenor or time to maturity measures the time in years from origination to the maturity date. It is used in similar studies as a control variable (Bauer & Hann, 2010; Cooper & Uzun, 2015; Eichholtz et al., 2019). As Goss and Roberts (2011) point out, there are two possible relations between tenor and bond spreads. One is positive and is based on the higher probability of negative shocks for a longer lending period. The other is negative and is based on the expectation that long term borrowers signal good credit quality by issuing longer-term bonds, which is congruent with signaling theory models (Spence, 1973). Rodriguez (1988) finds that yield spreads are a complex function of the time to maturity and are not always monotonically increasing, in contrast to common belief. To model this complexity to some extent, two different functions of the time to maturity are added to the regression models as controls. Since duration is also included in the regression models, it is expected that the effect of tenor on bond spreads is negative. Duration measures interest rate risk sensitivity and therefore proxies the beforementioned positive relationship. Tenor will mainly proxy the credit quality and therefore is expected to be positively related to the corporate bond spread.

- Amount:

$$\text{Amount} = \ln(\text{issued amount})$$

Amount is a variable indicating the issue amount of the bond. It has been proven a relevant control variable in this type of analysis (Bauer & Hann, 2010; Cooper & Uzun, 2015; Eichholtz et al., 2019; Oikonomou et al., 2014). As is the case with tenor, there is a possibility for two effects by this variable on corporate bond spreads (Eichholtz et al., 2019). It could be positive since a big issue increases total debt, increasing a company's risk of default. On the contrary, the effect could be negative, proxying the credit quality of a firm since only financially healthy firms could afford to issue high amounts of debt. To adjust for positive skewness, the natural logarithm of the amount issued is applied.

- Callable:

A dummy for callable bonds is also included. In similar research, callable bonds are either included by the use of a dummy variable to control for their specific effect on spreads (Eichholtz et al., 2019) or excluded from the sample altogether (Bauer & Hann, 2010; Oikonomou et al., 2014). Callable bonds tend to have higher spreads since the borrower can redeem the bond before the maturity date, which is an additional risk for lenders.

- CO2/Capita:

$$\frac{CO2}{Capita} = \frac{\text{total CO2 emissions in tonnes}}{\text{total population}} * \text{share of the building sector in country GDP}$$

This variable measures the CO2 emissions per capita adjusted for the share of the building sector in a country’s GDP on an annual basis. As specified in the description of the interaction variable in section 4.2.3.2, with the addition of the correction for the building share, the CO2 per capita variable measures more accurately the relevance of a country’s emission levels compared to the ESG activities of a company. It is a necessary control variable when implementing interaction terms. It is hard to predict anything about the coefficient of this variable as it seems unrelated to the spread of a firm’s bond but is a necessary control to estimate the interaction effect.

- Rank fixed effects:

The rank of a bond is based on the credit rating, which is a proxy for a firm’s default risk. The rating is usually assigned to every bond that is issued and is most commonly provided by Standard & Poor’s, Moody’s, or Fitch. From these ratings, a rank from 1 to 25 applies, 25 being the bond carrying the lowest default risk. It is an important control variable since default risk is one of the well-known determinants of bond spreads (Merton, 1973). Firms with a higher rank have lower default risk and are therefore expected to have lower bond spreads. It is included as a fixed effect so that the effect of each rank on bond spreads is more flexible than if it were added to the regression as a control variable. For example, the effect of an increase from rank one to rank two is not necessarily and most probably not the same as the effect of an increase from rank 20 to 21.

- Year fixed effects:

Other fixed effects that are added to the model are year fixed effects. Firms are engaging more in ESG activities as awareness becomes better over time. Similarly, bond spreads fluctuate with economic cycles and therefore also display a pattern over time. To prevent bias in the regression estimates, year fixed effects are included.

- Country fixed effects:

In the sample, various countries are included, which vary in their average levels of the corporate bond spread. For example, Argentina tends to have higher corporate bond spreads than Japan.

This is related to differences in inflation risk and interest rate risk. Since these risks are hard to proxy but are expected to remain fairly stable over time, country fixed effects will control for these differences.

- Asset-type fixed effects:

REITs all invest in real estate but they tend to have specific areas of focus such as healthcare or residential real estate. Since asset-types can be expected to differ in riskiness, bonds of firms differing in investment strategy will also vary in yields and spreads. If ESG activity is also correlated with asset-types, a bias in the results might emerge. To correct for this possible bias, the different asset-types are added as fixed effects.

5. Data

5.1 Data collection

To analyze the effect of ESG ratings on the cost of debt, data on ESG ratings, bond spreads, firm characteristics, and bond characteristics are required as is used in comparable research designs (Attig et al., 2013; Bauer & Hann, 2010; Cooper & Uzun, 2015; Eichholtz et al., 2019; Oikonomou et al., 2014). To extract this data, the Refinitiv Eikon database is used. Eikon is a product from Refinitiv, which can be accessed online. This database provides information on all the data needed for testing the main hypothesis. For information on CO2 emissions that is needed to test the second hypothesis, Our World in Data is consulted. A preliminary search led to the conclusion that ESG scores before 2011 are scarce, so only data from 2011 till 2019 is included in the dataset. First, a list of bonds is extracted from the database. The only criterium for this search is the GICS industry classification. Only extracting bonds from REITs, this results in a list of 1,011 bonds issued by 208 companies. For these bonds, information on the corporate bond spread is extracted, which is the difference in yield to maturity between the bond and a benchmark (which in this case is the government bond with the closest resemblance to the corporate bond regarding the time to maturity), the issue amount, issue date, tenor, duration, a variable indicating a green bond, a variable indicating a callable bond, a variable indicating a convertible bond, country of incorporation, coupon, coupon type, instrument type, original spread (spread at issuance), rating of the bond, and the rank of the bond (a function of the rating of the bond). Thereafter, firm characteristics are added to the data. These include market capitalization, Earnings Before Interest and Taxes (EBIT), Net Income Before Extraordinary Items (NIBEI), total operating expenses, total assets, total debt, total equity, total shares, book value per share, total fixed assets, and the Interest Coverage Ratio (ICR). For the Heckman and IV regression model, there is additional information extracted on the percentage of institutional ownership and dummies indicating whether a REIT has defined targets on water efficiency and energy efficiency. After the removal of the observations with missing data points on any of the control variables or the dependent variable (corporate bond spread), the dataset consists of 2,448 observations of 679 bonds issued by 114 REITs. Lastly, data on ten different ESG dimensions are extracted from Refinitiv Eikon and included in the dataset. For reference, see appendix table 2.

5.2 Descriptive statistics

This section provides statistics on the dataset and elaborates on its notable features. In doing so, an idea of the distribution of the sample dataset is obtained, upon which further analysis can be built.

5.2.1 Distribution of dataset

To provide an indication of the distribution of the data, four tables are listed in the appendices. Appendix table 3 lists the distribution of the data by country. A total of fifteen countries are present in the dataset, though they do not appear at similar frequencies. The United States, Canada, Japan, France, and Singapore together make up about 90 percent of the sample, with the United States covering 44 percent of the observations. This sample distribution is congruent with reality since it correctly mirrors the distribution of REITs in the population, in which countries like Japan, Canada, and the United States are heavily represented.

Appendix table 4 displays the distribution of the observations of bonds by year. The sample contains data from 2011 to 2019, so nine years of data. The lowest number of observations appear in 2011, the first year. From there, the frequency of observations increases each year, with the most observations in 2019. The first five years of the sample make up about 20 percent of the sample, whereas the remaining four years make up 80 percent of the sample.

Appendix table 5 categorizes the sample by asset-types in which the REIT invests. All REITs are either specialized in some asset-type or diversified. Unspecified but specialized REITs are categorized under ‘Specialized REITs’. There are eight different categorizations in the sample. Most represented in the sample are Diversified and Retail REITs, which make up 53 percent of observations. The top four make up 83 percent of total observations.

Appendix table 6 tabulates the frequency of observations by rank. The rank varies from 0 to 25. However, rank one through seven does not appear in the sample. A rank of zero indicates a non-rated bond. No one rank is overly represented, yet the ranks 18 through 21 make up the bulk of the observations with about 61 percent.

5.2.2 Correlations

Table 1 below displays the correlation coefficients of the main included variables in this thesis. For a more extensive correlation table see Appendix table 7. Most of the variables specified in this table do not display big correlations. ESG and firm size are an exception. The correlation is 0.474, which is quite large, and indicates that ESG intensive firms tend to be larger. Another interesting correlation coefficient is that of Amount and spread, which is almost 0.55. The corporate bond yield spread is on average larger for issues of higher amounts. The biggest correlation coefficient in the table is that of tenor and duration, which is logical assuming both variables are a function of the time to maturity. The correlation coefficient is 0.83. A high correlation indicates imperfect multicollinearity, which harms the estimates of the variable coefficients (Stock & Watson, p.205-206). It still is reasonable to include both since, as mentioned before in the methodology section, the effect of tenor on corporate bond yield spreads is twofold. The duration variable best proxies the positive effect so that the tenor variable best proxies the negative effect.

Table 1: Correlation table

	Spread	ESG	Firm size	Market-Book	Leverage	ROA	Callable	Tenor	Amount	Duration
Spread	1									
ESG	0.0546	1								
Firm size	0.149	0.474	1							
Market-book	0.0897	0.0586	0.0528	1						
Leverage	0.0932	-0.0597	0.171	0.360	1					
ROA	-0.0144	0.00837	0.108	0.122	-0.245	1				
Callable	0.503	0.216	0.178	0.227	0.158	0.0198	1			
Tenor	0.0970	0.0274	0.0797	0.0915	0.0161	-0.0157	0.0795	1		
Amount	0.546	0.286	0.158	0.209	0.0906	0.0282	0.690	0.0607	1	
Duration	0.0167	0.0589	0.0574	0.0224	-0.0171	-0.0309	0.0751	0.830	-0.0341	1

This table displays correlation coefficients of the main variables included in the regression analysis. Spread indicates the main dependent variable, the corporate bond yield spread. ESG indicates the ESG score. Firm size is a logarithmic function of total assets. The market-to-book ratio and ROA are both winsorized on the 1st and 99th percentile. Tenor and duration are both denoted in years. Amount is a logarithmic function of the issued amount.

5.2.3 Summary statistics

Table 2 lists the descriptive statistics of the main variables used in this analysis. A more extensive version of this table can be found in Appendix Table 8a and 8b. The ESG score is observed 1,258 times out of the total 2,448 observations. Environment scores are on average lower compared to social and governance scores, indicating a relative lack of attention on this area by the REITs. Most striking of this table on descriptive statistics is the difference between firms that have available ESG information and those that have not, which will be further referred to as non-ESG firms. All except one of the variables are significantly different between the two. Spreads are on average larger for ESG firms compared to non-ESG firms, as are initial spreads. The firm size is also greater for ESG firms. This difference is quite large, as the average for ESG firms is 22 on a natural logarithmic scale, whereas non-ESG firms have a firm size of around 20 on a natural logarithmic scale. This translates into a factor difference of about seven. The market-to-book ratio is on average almost 25 percent higher for ESG firms compared to non-ESG firms, which is rather strange since larger firms would usually be expected to have lower market-to-book ratios as they are more often considered to be value stocks. Apparently, in this sample, the larger firms also have, on average, the most growth opportunities. ESG firms are levered to a higher degree than non-ESG firms, a difference of about 5 percent, on average. The average tenor is longer for ESG firms, which, as described in the methodology section, can be a signal of the credit quality of the issuer. The issued amount is significantly higher for ESG firms. Considering that these firms tend to be larger than the non-ESG firms in this sample, this corresponds with what was already observed. The duration is higher for ESG firms, which makes sense considering that their average tenor is longer. The rank of bonds issued by ESG firms is lower than the ranks for bonds issued by non-ESG firms, which is consistent with the observation that ESG firms have, on average, a higher corporate bond spread. Last, 65 percent of the bonds are callable for ESG firms compared to 45 percent for non-ESG firms. From these descriptive statistics, it can be concluded that it is crucial to control the regression model for numerous of these variables to prevent omitted variable bias. Exclusion of variables that differ greatly between ESG firms and non-ESG firms might distort regression estimates significantly if the controls affect both the dependent and independent variables.

Table 2: Descriptives

	Observations	Mean	Standard deviation	Minimum	Maximum	Mean ESG firms	Mean non-ESG firms	Difference	t-value difference
ESG score	1258	37.10	23.19	0.97	86.92				
Environment score	1258	29.03	31.27	0.00	92.16				
Social score	1258	42.88	26.75	0.00	95.80				
Governance score	1258	43.79	24.94	0.37	93.94				
ESG quantiles (excl. non-ESG)	1258	5.37	2.89	1.00	10.00				
Initial yield spread (log)	402	497.57	60.00	20.70	620.76	501.25	494.37	6.88	(1.13)
Yield spread (log)	2448	479.91	58.71	293.92	828.17	488.39	470.95	17.44^{***}	(7.42)
Year	2448	2017.06	1.79	2011.00	2019.00	2017.14	2016.98	0.16^{**}	(2.27)
Firm size (log)	2448	21.40	1.62	16.48	24.14	22.38	20.37	2.01^{***}	(38.62)
Market-to-book (winsorized)	2448	1.46	1.06	-0.15	6.16	1.61	1.29	0.32^{***}	(7.53)
Leverage	2448	46.60	18.57	0.00	151.46	48.69	44.38	4.31^{***}	(5.77)
Return on assets (winsorized)	2448	3.33	4.08	-12.15	22.32	3.50	3.15	0.35^{**}	(2.10)
CO2 emissions per capita	2369	1.41	0.48	0.12	2.64	1.47	1.35	0.11^{***}	(5.83)
Tenor (in years)	2448	10.62	5.29	2.00	31.00	11.24	9.97	1.27^{***}	(6.02)
Amount	2448	19.04	1.31	16.04	21.22	19.31	18.75	0.55^{***}	(10.64)
Duration	2448	4.69	3.40	0.00	22.61	4.93	4.45	0.48^{***}	(3.50)
Rank	2448	19.29	3.41	0.00	25.00	18.98	19.63	-0.66^{***}	(-4.78)
Callable(1=yes)	2448	0.55	0.50	0.00	1.00	0.65	0.45	0.21^{***}	(10.43)

This table provides summary statistics of the main varaibles used in the analyses. The first five columns respectively show the total number of observations, the mean, standard deviation, minimum value, and maximum value for each variable. The sixth and seventh column display the mean for each variable for respectively firms that have ESG scores and firms that have no ESG scores. The eighth columns displays the difference between the two means, with significance stars indicating the significance level. In the last column the t-value of the difference is depicted in parentheses.
Statistical significance indicators: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

6. Results

This section provides the main results from the analyses that are discussed in the methodology section and it tests the formulated hypotheses. First, the regression output for testing the first hypothesis is displayed and discussed, which tests the effect of the ESG score on corporate bond spreads. This is done using the full sample of firms with an ESG score, the sample including both firms with and without an ESG score, and for the sample containing only observations from the issuance date. Then, the results from the other regressions are discussed, which test the last two formulated hypotheses and look at the interaction effect of ESG with country emission levels per capita. Since preliminary checks showed that the sampled data is heteroskedastic and serially correlated, all panel regression models are clustered on firm-level.

6.1 ESG scores and corporate bond spreads

As specified in the methodology section, a total of ten models (including fixed effects specifications) are estimated to test the effect of ESG on corporate bond spreads. The first model specified in regression equation 1 uses the full sample of REITs with an ESG score. The results of this regression are depicted in column one of table three on the next page. For this model, all observed coefficients are discussed, including those of the control variables, in contrast to the other model specifications for which only the main independent variables are discussed.

First, the adjusted R-squared of this model is 0.820, which means that 82 percent of the variation of the corporate bond spreads is explained by the model. This is merely an indication of good predictive quality of the model and does not provide information on causal relationships. Total observations for the sample in this model specification equal 1,257. The main independent variable in this model, the ESG score, has a coefficient of -0.32 and is statistically significant on the one percent level. The negative sign indicates a negative relationship between ESG and corporate bond spreads. To see what the effect implies, recall the transformations of the dependent and independent variables. The dependent variable is transformed into a natural logarithmic function and thereafter multiplied by 100. This simplifies the interpretation of most corresponding coefficients since a coefficient X for some non-transformed independent variable implies that if the independent variable increases with one unit, the dependent variable increases with X percent. The independent variable ESG is continuous and has a value between zero and 100. Hence, the coefficient of -0.32 implies that a one-unit increase in the ESG score is associated with a decrease in the corporate bond spread of 0.32 percent. For example, if some REIT's ESG score is 10 units higher than that of an otherwise similar REIT and the corporate bond spread of the bond from the REIT with the lower score is 200 basis points, the expected corporate bond spread is 3.2 percent lower for the REIT with the higher score, equaling 6.4 basis points. Moving on to the control variables, the coefficient for the variable firm size is positive and equals 5.69. It is statistically significant on the one percent level. Ceteris paribus, as firm size increases with ten percent, the corporate bond

Table 3: ESG and corporate bond spreads

	(1) Panel OLS	(2) Panel OLS	(3) OLS	(4) Panel FE	(5) Panel FE
ESG score	-0.32^{***}		-0.49^{*}	-0.23^{**}	
	(0.06)		(0.26)	(0.10)	
Environment score		-0.01			-0.06
		(0.05)			(0.10)
Social score		-0.23^{***}			-0.16
		(0.07)			(0.11)
Governance score		-0.11^{**}			0.01
		(0.05)			(0.08)
Firm size (log)	5.69^{***}	4.95^{**}	13.03^{**}	5.69	6.99
	(1.73)	(1.92)	(6.52)	(5.02)	(5.31)
Market-to-book (winsorized)	0.17	-0.31	4.56	-0.08	-0.06
	(1.13)	(1.11)	(4.82)	(2.09)	(2.06)
Leverage	0.13	0.13	0.14	-0.06	-0.08
	(0.09)	(0.09)	(0.30)	(0.17)	(0.18)
Return on assets (winsorized)	-0.15	-0.11	-0.39	0.03	0.11
	(0.21)	(0.21)	(1.09)	(0.24)	(0.23)
Callable(1=yes)	10.16^{**}	10.24^{**}	2.96		
	(4.77)	(4.84)	(18.79)		
Tenor (in years)	-0.74^{**}	-0.78^{**}	-0.78		
	(0.33)	(0.33)	(2.80)		
Amount	-7.22^{***}	-7.45^{***}	3.56		
	(1.91)	(1.90)	(9.86)		
Duration	4.84^{***}	4.92^{***}	4.60		
	(0.51)	(0.51)	(4.97)		
Year FE	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Country FE	*Yes*	*Yes*	*Yes*	*No*	*No*
Asset-type FE	*Yes*	*Yes*	*Yes*	*No*	*No*
Rank FE	*Yes*	*Yes*	*Yes*	*No*	*No*
Observations	1257	1257	187	1258	1258
R^2	0.820	0.821	0.655	0.302	0.302

In columns 1 and 2, the full sample of REITs with an ESG score is used. In column 3, the sample of observations on the issuance date for REITs with an ESG score is used. In column 4 and 5, a fixed effects specification of the models in respectively column 1 and 2 is estimated. The R-squared for the models in column 1 to 3 is the adjusted R-squared, whereas for the fixed effects models it displays the within R-squared.

Standard errors in parentheses.

Statistical significance indicators: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

spread increases 0.569 percent. The coefficient for the market-to-book ratio is 0.17 and insignificant. The leverage coefficient is 0.13 and is not statistically significant. The same is true for the coefficient of the return on assets, which is -0.15. The coefficient for the dummy variable indicating a callable bond is 10.16 and is statistically significant on the five percent level. On average, a callable bond will have a corporate bond spread that is 10.16 percent higher compared to a bond that is not. The coefficient for tenor is -0.74 and significant on the five percent level. A bond with a tenor that is one year longer than on otherwise comparable bond will on average have corporate bond spread that is 0.74 percent lower. The coefficient for the amount variable is -7.22 and significant on the five percent level. Ceteris paribus, a bond with an issue amount that is ten percent higher is expected to have a corporate bond spread that is 0.722 percent lower. Lastly, the coefficient of the duration variable is 4.84 and is significant on the one percent level. If the duration of a bond increases with one unit, the corporate bond spread is expected to increase with 4.84 percent.

The second model specification from regression equation 2 uses the same sample but differs in independent variables. In this model, ESG effects ares separately estimated. The adjusted R-squared of this model is 0.821, similar to that of the first model. The coefficient of the environment score is -0.01 and insignificant. The coefficient of the social score is -0.23 and significant on the one percent level, indicating that a bond issued by a REIT with a social score that is ten points higher than a similar bond from an otherwise comparable REIT is expected to have a corporate bond spread that is 2.3 percent lower. The coefficient of the governance score is -0.11 and significant on the five percent level. A REIT with a governance score that is ten units higher than an otherwise similar REIT is expected to have a corporate bond spread on their bonds that is 1.1 percent lower.

The third model specified in regression equation 3 estimates the same regression model as the first but with the inclusion of only observations at the date of issuance. The sample here covers only primary market data. The R-squared of this model is 0.655. Total observations equal to 187. The coefficient for the ESG score is -0.49 and is significant on the ten percent level. A REIT with an ESG score that is ten units higher will, on average, have a primary spread on their bond issues that is 4.9 percent lower than bonds from otherwise comparable REITs.

In the previous models, fixed effects are added on four different dimensions, namely: year, country of incorporation, rank, and asset-type. Still, however, there might be unobserved time-invariant effects that affect the coefficient estimates. To correct for this, a full fixed-effects specification of the model from regression equation 1 is estimated, of which the results are tabulated in column 4 of table 3. The predictive power of this model is not noteworthy, as the

R-squared, which is the within R-squared, is only 0.302. The coefficient of the ESG score is slightly more positive than in the other specification in column 1, though the difference is not extreme. It has a value of -0.23 and is significant on the five percent level. The implied effect is that if a REIT upgrades its ESG score by ten units, the expected decrease in the corporate bond spread is 2.3 percent. The coefficient of firm size is somewhat different from the original model, turning from significantly positive to merely positive. There is an unobserved time-invariant effect on corporate bond spreads that is also correlated with firm size, affecting the standard error of the coefficient. Coefficients of other controls are all insignificant as they were before.

Column 5 of table 3 shows the estimation results of the fixed effects specification of the model from regression equation 2. The R-squared, which is the within R-squared, is 0.302. As in the other model for the separate effects, the effects of the social score and the governance score are negative but now they are both insignificant. The value of these coefficients also has changed somewhat in the positive direction compared to the other specification in column 2. The effect of the environmental score changed to some extent in the negative direction. It has a coefficient of -0.06 but is insignificant. The statistical insignificance for these three variables is mainly due to their big correlations, which causes very high standard errors.

6.2 ESG quantile scores and corporate bond spreads

Table 4 on the next page lists five other model specifications that test the effect of ESG on the corporate bond spread making use the scores separated in different quantiles, which allows for including firms that have no observations for the ESG score.

The first column shows estimates from the regression specified in equation 4 and includes only firms with an ESG score and has an R-squared of 0.819 and 1,257 observations. The coefficient of the ESG quantiles variable is -2.16 and is significant on the one percent level. By expectation, the corporate bond spread of a bond issued by a REIT in one quantile is 2.16 percent higher than the corporate bond spread of a similar bond, issued by a comparable REIT but with an ESG quantile score that is one unit higher.

The second model depicts estimates from the regression specified in equation 5 and includes both firms with and without an ESG score. The R-squared of this model is 0.816 and observations total up to 2,448. The coefficient for the dummy equaling one if the firm has no observation for the ESG score is -2.78. However, the coefficient is insignificant. The coefficient for the ESG quantiles variable is -0.80 and is significantly related to the corporate bond spread

Table 4: ESG quantile scores and corporate bond spreads

	(1) Panel OLS	(2) Panel OLS	(3) Panel OLS	(4) OLS	(5) Panel OLS
ESG quantiles (excl. non-ESG)	-2.16^{***}				
	(0.54)				
ESG quantiles (incl. non-ESG)		-0.80^{**}		-1.81	
		(0.35)		(1.14)	
Environment quantiles					-0.89^{*}
					(0.49)
Social quantiles					-0.75
					(0.70)
Governance quantiles					-0.89^{*}
					(0.46)
No ESG score(1=yes)		-2.78		-0.78	
		(2.42)		(7.73)	
First quantile (of 10)			1.23		
			(3.32)		
Second quantile (of 10)			-2.11		
			(2.97)		
Third quantile (of 10)			-6.32^{**}		
			(2.85)		
Fourth quantile (of 10)			0.17		
			(2.59)		
Fifth quantile (of 10)			5.13		
			(3.39)		
Sixth quantile (of 10)			2.06		
			(3.79)		
Seventh quantile (of 10)			-1.70		
			(3.11)		
Eighth quantile (of 10)			-5.93^{**}		
			(2.84)		
Ninth quantile (of 10)			-6.57^{**}		
			(2.78)		
Tenth quantile (of 10)			-9.17^{***}		
			(3.43)		
Firm characteristics	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Bond characteristics	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Year FE	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Country FE	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Asset-type FE	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Rank FE	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Observations	1257	2448	2448	402	1257
Adjusted R^2	0.819	0.816	0.816	0.733	0.819

In column 1 and 5, the sample of REITs with an ESG score is used. In columns 2 and 3, the full sample of REITs with and without ESG score is used. In column 4, the sample of observations on the issuance date for REITs with and without an ESG score is used.
Standard errors in parentheses.
Statistical significance indicators: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

with a p-value of under five percent. If a REIT moves from one quantile to the next higher-ranked quantile, the expected decrease in the corporate bond spread is 0.80 percent.

The third model estimates the specification from equation 6 and includes all quantile ESG scores separately as dummies to allow for more flexible effects. It provides insight into the effect of the ESG score at all levels. The R-squared of this model 0.819 and there is a total of 2,443 observations. Four of the included dummy variables have a coefficient that is significantly related to the corporate bond spread. Furthermore, negative effects are observed for the second, third, and seventh through the tenth quantile compared to non-ESG firms.

Similar to the fourth regression model of the first regression table, the fourth model specification tests the effect of the ESG quantile score on the corporate bond spread while only including data on the corporate bond spread from the date of issuance (primary market data). The model is specified in regression equation 7. The R-squared of this model 0.733 and total observations equal to 402. The coefficient for the dummy for firms with no ESG score is -0.78 and insignificant. The coefficient for the ESG quantile score is -1.81 and insignificant.

The last estimated model to test the first hypothesis is the model described in equation 8 and estimates the effect of ESG quantiles on the corporate bond spread including the environmental, social, and governance scores separately. The R-squared of this model is 0.819 and total observations are 1,257. In this model, all three ESG dimension scores have negative coefficients of about the same magnitude. The standard errors are rather large because of mutual correlations that vary from 0.75 to 0.92, which is extremely high. Still, two of the coefficients are significant. The coefficient of the environmental score is -0.89 and significant on the ten percent level. Similarly, the effect of the governance score is -0.89 and significant on the ten percent level. By expectation, if a REIT moves from one quantile to the next regarding their environmental or governance score, the expected decrease in the corporate bond spread is -0.89 percent. The coefficient of the social score is -0.75 but is insignificant.

6.3 Interaction effect of ESG and emissions

Table 5 displays the regression estimates from the models used for estimating the interaction effect between ESG and CO_2 emissions per capita. The limiting factor for observations in this regression model is that CO_2 emissions per capita are not observed for the Cayman Islands.

The first column estimates the model specified in equation 9 and tests the interaction effect of ESG and CO_2 per capita corrected for the share of the building sector in a country's GDP. The R-squared is 0.820 and observations equal 1,182. The first coefficient, that of the ESG score, is 0.02 and insignificant. The coefficient of the interaction term is -0.21 and also insignificant. The coefficient of CO2 emissions per capita is -49.92 and insignificant. This coefficient seems rather large. However, the variable of CO2 emissions per capita only varies from just over zero to just over two. The coefficient indicates the effect on the corporate bond spread after a one-unit increase in the corresponding variable, which is rather extreme and unrealistic.

Table 5: Interaction effect and corporate bond spreads

	(1) Panel OLS	(2) Panel FE
ESG score	0.02	0.53
	(0.35)	(0.43)
Interaction ESG- CO2/capita	−0.21	−0.49**
	(0.21)	(0.25)
CO2 emissions per capita	−49.92	−36.41
	(38.01)	(40.89)
Firm size (log)	5.49***	3.79
	(1.83)	(5.14)
Market-to-book (winsorized)	0.14	−0.25
	(1.12)	(2.04)
Leverage	0.15	−0.03
	(0.09)	(0.18)
Return on assets (winsorized)	−0.11	0.10
	(0.21)	(0.23)
Callable(1=yes)	9.65**	
	(4.76)	
Tenor (in years)	−0.72**	
	(0.34)	
Amount	−6.78***	
	(2.25)	
Duration	4.79***	
	(0.53)	
Year FE	*Yes*	*Yes*
Country FE	*Yes*	*No*
Rank FE	*Yes*	*No*
Asset-type FE	*Yes*	*No*
Observations	1182	1182
R^2	0.823	0.300

In both columns, the sample with observations for the ESG score and CO2 per capita is used. In the first column a panel model is estimated including several fixed effects. In the second column, a fixed effects panel model is estimated. The R-squared in the first column denotes the adjusted R-squared, whereas in the second column it denotes the within R-squared.
Standard errors in parentheses.
Statistical significance indicators: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

The second model estimates a similar model as the first but uses a full fixed-effects specification. The R-squared of this model is 0.300, which is the within R-squared. The total observations are 1182. The effect of CO2 emissions on the corporate bond spread is still insignificantly negative. The effect of firm size turns from significantly positive to merely positive, without any statistical power Apparently, there is some unobserved effect that is correlated with firm size, so that omission of this unobserved variable leads to a change in the coefficient of firm size. The coefficient of the leverage variable is -0.03 and insignificant. The coefficient of the ESG score is 0.53 and insignificant. Still, the positive coefficient is remarkable. Following these results, if a country would be CO2 neutral, there would be a positive effect of ESG on corporate bond spreads. The coefficient of the interaction effect between the ESG score and CO2 emissions is significantly negative on the five percent level, with a coefficient of -0.49. An increase in the CO2 emissions per capita corrected for the share of the building sector in a country's GDP of one unit increases the effect of ESG on corporate bond spreads with negative 0.49 percent. To comprehend this effect, imagine a bond issued by REIT A in country X, which has a value of one for the corrected CO2 emissions per capita. It also increased its ESG score as of this year with fifteen points. Another bond is issued by REIT B in country Y, which has a value of two for the corrected CO2 emissions per capita. Moreover, it has increased its ESG score as of this year with ten points. In and of itself, according to the estimation results from this model, the ESG score has a positive effect on corporate bond spreads of 0.53. Including the interaction effect of ESG and the corrected CO2 emissions yields interesting results. For REIT A in country X, the total effect of ESG on the corporate bond spread is around zero percent, so the corporate bond spread is expected to remain constant compared to its value of the previous year. This is a result of the interaction effect and the pure ESG effect approximately canceling each other out. For REIT B in country Y, the effect of ESG on the corporate bond spread is around -5 percent. Even though the increase in the ESG score is more significant for REIT A, the effect of ESG is more pronounced for REIT B since the building sector of the country it operates in is more polluted.

7. Robustness

In this section, the results from the main models are examined for their robustness through a variety of tests. There are five possible threats to internal validity, which are omitted variable bias, misspecification of the functional form, measurement errors in the regressors, sample selection, and simultaneous causality (Stock & Watson, 2015, p.330). Functional forms of the variables have been checked prior to inclusion in the models. For example, variables for firm size and the corporate bond spread more resembled a normally distributed variable when transformed into a logarithmic function. Measurement errors are hard to check since the measurements of the included variables are beyond the control of the researcher. However, there is great confidence in the legitimacy and accuracy of the observations retrieved from the Refinitiv Eikon database. For the other three possible issues related to multiple regression studies, robustness tests are performed. Included in these tests are robustness tests for omitted variables, checking a sample selection robust model, and an instrumental variable regression to control for possible simultaneous causality. Robustness tests on heteroskedasticity and serial correlation have already been performed and these issues have been dealt with by clustering on the firm level. For every robustness test, the model and included variables will be displayed and discussed. The corresponding results of the model are depicted in the appendix, whereas the economic meaning of these results is provided in this section.

7.1 Omitted variables

By a priori reasoning on important control variables and testing several of these, the main model displayed in regression equation 1 has been formulated. If relevant variables that both determine the dependent variable and are correlated with the main independent variable, there is omitted variable bias (Stock & Watson, 2015 p.233). This results in a bias in the estimated coefficient of the independent variable. The large panel dataset provides an opportunity to control for many effects. Still, even though several controls have been added, there is a possibility of missing important controls or simply not being able to control for some effects. To check whether this has indeed been a problem, numerous controls are added to the main regression model from equation 1 to check if these variables have wrongfully been excluded. Another solution to omitted variable bias is to perform an IV regression. This is discussed later in this section.

To identify variables that might be of value we refer to academic literature. The first variable that is added is the Interest Coverage Ratio (ICR), which is defined as the ratio of Earnings Before Interest and Taxes divided by the total interest expenses. This variable measures how many times one can pay its interest obligations. It has been used in similar research by Bauer and Hann (2011), Oikonomou et al. (2014), and Eichholtz et al. (2019). The effect of ICR should be positive. As the ICR increases, the capability of a REIT of paying its debts improves. Therefore, it is expected to decrease default risk and the corporate bond spread. The second variable that is added to the regression model is a dummy that indicates an investment-grade bond. The value of zero is assigned to bonds that are high yield. Apart from the individual effects of ranks, there might be an overall effect of investment-grade bonds on the perceived default risk by investors. A dummy variable indicating a green bond is also added to the model. This has been previously been excluded because of the low number of observations for green bonds. A green bond is expected to have, ceteris paribus, a lower corporate bond spread (Zerbib, 2019). The last added variable is the capital intensity, which is used in the research of CSR on bond spreads by Bauer and Hann (2010). Capital intensive firms have high operating leverage, which makes them vulnerable to shocks in their revenues. Default risk and corporate bond spreads are therefore expected to rise following increased capital intensity. The results for this additional model are displayed in the first column of appendix table 10.

$$Spread_{ij,t} = \beta_0 + \beta_1 ESG_{i,t-1} + \beta_2 Green\text{-}bond_{ij} + \beta_3 Investment\text{-}Grade_{ij} + \beta_4 ICR_{i,t-1} + \beta_5 Capital\text{-}intensity_{i,t-1} + \beta_6 Market\text{-}to\text{-}Book_{i,t-1} + \beta_7 Leverage_{i,t-1} + \beta_8 ROA_{i,t-1} + \beta_9 Rank_{ij} + \beta_{10} Tenor_{ij} + \beta_{11} Amount_{ij} + \beta_{12} Duration_{ij} + \beta_{13} Call_{ij} + \gamma_1' Year + \gamma_2' Country + \gamma_3' Asset\text{-}type + \gamma_4' Rank + \varepsilon_{ij,t} \quad (10)$$

Another control for robustness is the prime country of risk, which is similar to but not the same as the country of incorporation. It is a variable derived from a risk model, which ‘provides estimates on the countries to which a company is exposed, and estimates a fractional contribution to each. The fraction is a value between 0 and 1, where a higher value indicates the company has a higher exposure to the country. The primary country of risk is the country with the largest contribution’ (Refinitiv Eikon). It is a good alternative to the country of incorporation to check the model’s robustness. The results of this regression model are displayed in column 2 of appendix table 10.

$$Spread_{ij,t} = \beta_0 + \beta_1 ESG_{i,t-1} + \beta_2 Green\text{-}bond_{ij} + \beta_3 Investment\text{-}Grade_{ij} + \beta_4 ICR_{i,t-1} + \beta_5 Capital\text{-}intensity_{i,t-1} + \beta_6 Market\text{-}to\text{-}Book_{i,t-1} + \quad (11)$$

$\beta_7 Leverage_{i,t-1} + \beta_8 ROA_{i,t-1} + \beta_9 Rank_{ij} + \beta_{10} Tenor_{ij} + \beta_{11} Amount_{ij} + \beta_{12} Duration_{ij} + \beta_{13} Call_{ij} + \gamma_1' Year + \gamma_2' Prime\text{-}Country\text{-}of\text{-}Risk + \gamma_3' Asset\text{-}type + \gamma_4' Rank + \varepsilon_{ij,t}$

In the results from the first robust specification in equation 10, the coefficient of the ICR is positive and significant on the five percent level. This is opposite to expectations, as a better capability to pay interest expenses is expected to be associated with lower corporate bond spreads (In unreported regressions, the Debt Service Coverage Ratio has been added to the model instead of ICR, yielding similar results). The observed coefficient does, however, not stand alone since there has been earlier documentation of this finding by Thim et al. (2011). It might be explained in part by the big variance found in the ratio. In this sample, the winsorized ICR varies from -17 to +50. The reasoning for increased default risk for an ICR that dips under one makes sense, but it is harder to argue this effect for a case in which the ratio goes from ten to nine, for example. A decreasing ratio might also be an indication of good future investment opportunities or a lower expected risk of financial distress. Management is aware that there is a trade-off between interest expenses relative to its earnings (ICR) and default risk. When they are willing to take on more interest, the default risk associated with an increase in interest as perceived by management might have decreased. The result is a positive relationship between ICR and corporate bond spreads. Therefore, ICR does not affect the corporate bond spread, but there is a reversed causality, in which the default risk affects the ICR. The coefficient of the dummy indicating investment-grade bonds is negative and significant on the five percent level. It is coherent with expectations. Relative to high yield bonds, investment-grade bonds are expected to have a lower corporate bond spread. The coefficient for green bonds is negative as expected but insignificant. The coefficient of the last added variable in this model, capital intensity, has the expected positive sign but is insignificant. Most importantly, the effect of ESG on corporate bond spreads with the inclusion of these variables has changed very little, from -0.32 to -0.34. As a result, its robustness to this model specification can be confirmed.

The results of the model including fixed effects for the prime country of risk instead of the country of incorporation seem to have a noticeable effect on the estimates of the coefficients. Controls such as the market-to-book ratio and the firm size do have the expected negative sign now, whereas these first had positive coefficients. Moreover, the coefficients of these variables are statistically significant. The coefficient of size is -6.10, which indicates that if the firm size increases with ten percent, the corporate bond spread is expected to decrease with -0.61 percent. The coefficient of the market-to-book ratio is -3.76, which means that if the ratio increases with one unit, the expected decrease in the corporate bond spread is 3.76 percent. The coefficient of the ESG score variable has also changed quite significantly, from -0.34 in the first column to -0.47 in the second. Based on this specification, the ESG score is even more important for explaining corporate bond spreads. Even though the change in the coefficient is large, the effect of the ESG score has become more pronounced. Therefore, robustness can again be confirmed.

7.2 Sample selection

Another problem with the original specification might be the existence of sample selection. As Heckman (1979) argues, a model tested on a non-randomly selected sample can result in a bias in the estimates, which can be described as a specification error. In this study, a sample of REITs has been extracted from the Eikon database. Only a selection of these firms have observations for the ESG score. It is possible that this selection is non-random and that firms with observations for ESG scores have some unobserved characteristics that make it different from the general population of REITs. These unobserved characteristics can create a bias in the effect of ESG on the corporate bond spread so that it appears significant when the effect is in fact insignificant for the general population. It is to be corrected for by applying the Heckman correction model, which is a two-step least squares regression model. By altering the specification using this model, an unbiased estimate of the independent variable is derived.

To apply the Heckman model, two regression equations have to be estimated. These are called the selection equation and the outcome equation. The procedure starts with the estimation of the selection equation, which entails a probit regression of a dummy of the selection variable on the applied controls in the main regression model. In this study, the variable that serves as the dependent variable is a dummy indicating if a firm has an ESG rating (value of one indicates a firm with an ESG rating). Importantly, in this equation, there should be added at least one variable that is not included in the outcome equation, which is the regression equation that is estimated in the second step of the Heckman model estimation (Puhani, 2000). Such a variable requires similar characteristics as it would need to have for serving as a proper instrument, as will be applied later. For the ESG score, the percentage of institutional ownership can serve as the additional variable. As Dyck et al. (2016) show, it is relevant for explaining ESG activity. This finding is again demonstrated in appendix table 12, where the instruments for the IV regression are tested. Institutional ownership is significantly related to ESG. Moreover, according to a study by Al-najjar (2015), the percentage of institutional ownership is unrelated to financial performance. Exogeneity of institutional ownership as an instrument of ESG is also proved in appendix table 14, which will be discussed for the IV regression model. The first regression model of the Heckman model looks as follows.

$$ESGdummy_{i,t} = \beta_0 + \beta_1 Institutional\text{-}ownership_{i,t-1} + \beta_2 Size_{i,t-1} + \beta_3 Market\text{-}to\text{-}Book_{i,t-1} + \beta_4 Leverage_{i,t-1} + \beta_5 ROA_{i,t-1} + \gamma_1 'Year + \gamma_2 'Country + \gamma_3 'Asset\text{-}type + \varepsilon_{ij,t} \quad (12)$$

From these regression estimates, the Inverse Mills Ratio (IMR) is computed, which is the variable correcting for sample selection and is constructed as the ratio of the standard normal density divided by the standard normal cumulative distribution function (Puhani, 2000). Consequently, this variable is added to the second step regression model to correct for the possible sample selection. The second step in estimating the Heckman model is the estimation of the output equation, which is similar to the original model from equation 1, but differs in that it contains the additional variable correcting for the possible sample selection.

$$Spread_{ij,t} = \beta_0 + \beta_1 ESG_{i,t-1} + \beta_2 IMR_{i,t-1} + \beta_3 Size_{i,t-1} + \beta_4 Market\text{-}to\text{-}Book_{i,t-1} + \beta_5 Leverage_{i,t-1} + \beta_6 ROA_{i,t-1} + \beta_7 Tenor_{ij} + \beta_8 Amount_{ij} + \beta_9 Duration_{ij} + \beta_{10} Call_{ij} + \gamma_1 'Year + \gamma_2 'Country + \gamma_3 'Asset\text{-}type + \gamma_4 'Rank + \varepsilon_{ij,t} \quad (13)$$

The results of this model are depicted in appendix table 11. Sample selection is confirmed when the coefficient of the Inverse Mills Ratio is significantly related to the corporate bond spread. The R-squared of the model is 0.864 and total observations are 517. The coefficient of the Inverse Mills Ratio is -4.08 and insignificant. There seem to be no significant sample selection issues in the sample used to estimate the model from equation 1. The coefficient of the ESG score is altered from -0.32 to -0.24 compared to the original model, but it is still significant on the five percent level. The model is therefore robust to the correction of sample selection. Coefficients for size and the market-to-book ratio are negative, similar to the results from the specification including fixed effects for the prime country of risk in equation 11. However, they are insignificant using the Heckman specification. The coefficient for ROA is -0.82 and significant on the five percent level. This implies that an increase of one unit in the ROA is associated with a decrease in the bond spread of 0.82 percent.

7.3 Simultaneous causality

As mentioned before, a possible problem in this analysis is simultaneous causality since the ESG rating and the bond spread might simultaneously affect the other. Firms that have lower bond spreads might consequently invest more in ESG. Including lags of the independent variable reduces the problem but does not resolve it. To properly tackle this problem, an IV regression is performed, which corrects for both omitted variable bias and simultaneous causality (Stock & Watson, 2015, p.233, 328-329). An IV regression regresses the dependent variable on the exogenous part of the independent variable, which allows for unbiased estimates of the coefficient if two assumptions are fulfilled. The instrument has to be exogenous and relevant. Exogeneity implies that the instrument is uncorrelated with the error term (Stock & Watson, 2015, p.439). Instrument relevance implies that at least one instrument must have a non-zero coefficient in the population regression of the independent variable on the instrumental variable (Stock & Watson, p.439). The IV estimation procedure consists of a two-step regression, in which instruments are included to retrieve consistent estimators of unknown coefficients from the population regression equation (Stock & Watson, 2015, p.424).

The IV model here is estimated using several instruments. The first instrument is institutional ownership, which has also been included as the added variable for the selection equation in the Heckman model, for which the criteria are similar to that of an instrument. The second instrument is a local measure of the average ESG per country per year, similar to one of the instruments applied in Eichholtz et al. (2019). The last two instruments are dummy variables indicating whether a REIT has defined targets on water efficiency and energy efficiency, which could be relevant for explaining ESG. Moreover, they are likely to be unrelated to spreads since the formulation of a target does not entail any information on a firm’s risk and therefore should not affect the corporate bond spread. Since there are more instruments than endogenous regressors, the coefficients are overidentified and can be tested for exogeneity. The relevance of the instruments is tested in appendix table 12. As a rule of thumb, the F statistic of the regression of ESG on its instruments should have a value of at least 10 to be deemed relevant (Stock & Watson, 2015, p.444). Total observations for the instruments given the collected sample is 648. The F-statistic is 177. Therefore, the instruments are convincingly relevant. The first step is of the IV estimation is a regression of the endogenous independent variable on the instruments and controls.

$$ESG_{i,t} = \beta_0 + \beta_1 Institutional\text{-}ownership_{i,t} + \beta_2 AvgESG_{c,t} + \beta_3 Targets\text{-}water\text{-}efficiency_{i.,t} + \beta_4 Targets\text{-}energy\text{-}efficiency_{i,t} + \beta_5 Size_{i,t} + \beta_6 Market\text{-}to\text{-}Book_{i,t} + \beta_7 Leverage_{i,t} + \beta_8 ROA_{i,t} + \gamma_1'Year + \gamma_2'Country + \gamma_3'Asset\text{-}type + u_{ij,t} \quad (14)$$

Then, the estimates of the ESG scores are predicted. These estimates are thereafter included in the second step of the model. This second step resembles the model from regression equation 1 but differs in the values of the ESG variable. Contrary to the original model, the ESG variable in the second step only contains exogenous information. Therefore, the predicted ESG values are not dependent on the corporate bond spread and consequently are not correlated with the error term.

$$Spread_{ij,t} = \beta_0 + \beta_1 \widehat{ESG}_{i,t-1} + \beta_2 Size_{i,t-1} + \beta_3 Market\text{-}to\text{-}Book_{i,t-1} + \beta_4 Leverage_{i,t-1} + \beta_5 ROA_{i,t-1} + \beta_6 Rank_{ij} + \beta_7 Tenor_{ij} + \beta_8 Amount_{ij} + \beta_9 Duration_{ij} + \beta_{10} Call_{ij} + \gamma_1'Year + \gamma_2'Country + \gamma_3'Asset\text{-}type + \gamma_4'Rank + \varepsilon_{ij,t} \quad (15)$$

Estimation results of the second step in equation 15 are displayed in column 1 of appendix table 13. Next to this IV regression model, another IV regression model is estimated using a fixed-effects specification to control for unobserved time-invariant effects. The estimation results of this specification are displayed in column 2 of appendix table 13.

The total observations for both models are 648. The R-squared of the first model specified in equation 14 is 0.822. The significant coefficients of the control variables, which are size, ROA, leverage, a dummy indicating a callable bond, and duration, all have the expected sign. The negative signs of the size and market-to-book variables are counter to observations from the main models displayed in the results section. However, the negative signs are congruent with both the Heckman sample selection model discussed before as well as prior expectations. The coefficient of size is -12.39 and significant on the one percent level. All else equal, if the firm size increases with ten percent, the bond spread is expected to decrease with 1.239 percent. The coefficient of the market-to-book ratio is -1.40 and insignificant. The coefficient of leverage is 0.27 and significant on the five percent level. An increase in the leverage of one percentage point is associated with an increase in the corporate bond spread of 0.27 percent. The coefficient of ROA is -1.02 and significant on the five percent level. If the return on assets increases with one percent, the corporate bond spread is expected to decrease with 1.02 percent. The coefficient of ESG is not significant. It has a value of -0.20 with a standard deviation of 0.20. The IV estimation has reduced the magnitude of the ESG variable to some extent, but more noticeable is the increase in the standard error. Compared to the results from the original specification in equation 1, in which the standard error is 0.06, the standard error here has more than tripled. For this model, the instruments have been tested for exogeneity (this requires overidentification of instruments for the endogenous variables). This is done by applying the Sargan-Hansen test, of which the results are tabulated in appendix table 14. The statistic follows a Chi-squared distribution. The p-value of the statistic is 0.483. From this result, it is concluded that the instruments are exogenous. Together with the verified relevance depicted in appendix table 12, these instruments are deemed appropriate for the correction of the endogenous relationship between ESG and the cost of debt.

The R-squared of the second model, which is the within R-squared since we are using a fixed-effects model, is 0.311. The coefficient for firm size is positive in this model but is insignificant. The coefficient of the market-to-book ratio is positive but insignificant. The coefficient for ROA is still negative but insignificant. The coefficient of leverage is, with a value of 0.45, more pronounced compared to this first IV specification and is now significant on the one percent level. An increase in the leverage ratio of one percentage point is associated with a 0.45 percent increase in the corporate bond spread. The coefficient of the ESG score is -0.31 and significant on the ten percent level, in contrast to the previous IV specification. Also, it is not very dissimilar to the coefficient of the original model of the corporate bond spread on the ESG score specified in equation 1. Only the standard deviation is somewhat bigger. Overall, it can be concluded that the effect of ESG on corporate bond spreads is to a large extent robust to an IV specification since the fixed-effects model controls for more than the first specification and therefore has somewhat higher credibility.

8. Discussion

This section provides a discussion of the results found in the analyses, of which the estimates are displayed in the results section. First, a summary is provided of what has been studied in this thesis. Then, the results are repeated and placed in the context of the tested hypotheses and theory to provide substantiation and check the validity of the results. Also, the limitations of this study are examined. Thereafter, the implications of the found results for different stakeholders and managers are discussed. The study is concluded with possible directions for future research.

8.1 Summary

This study investigates the effect of ESG on corporate bond spreads. Academic literature has recorded many benefits of engagement in ESG activities. Real estate separates itself from other industries with some distinct advantages to ESG activities, predominantly on the environmental dimension. Higher ESG intensity is associated with enhanced financial performance and reduced measures of risk, such as systemic and default risk. A reduction in default risk is associated with a decrease in the spread of a corporate bond. It is therefore hypothesized that ESG scores negatively affect the corporate bond spread for REITs. Using panel data of REITs, ESG scores, financial information, and bond characteristics, a series of models has been estimated to test this hypothesis. Congruent with the instrumental stakeholder theory, results indicate a negative effect of the ESG score on the corporate bond spread. Next to the estimation of the effect of ESG on corporate bond spreads, the interaction effect of the ESG score with the CO2 per capita has been estimated to test the mediating effect of country pollution levels. The interaction effect is found to be negative while neutralizing the pure ESG effect. Following the estimation of the main models, a series of robustness tests have been performed to test the internal validity, with the conclusion that the results are robust to the tested specifications.

8.2 Results in a theoretical context

8.2.1 ESG

Based on the results found in the analyses, some conclusions can be drawn. For the main independent variable, the ESG score, the first model in table three finds a significantly negative effect. The effect appears to be rather small, but bear in mind that the model controls for many other factors related to default risk. The ESG score, in reality, does not move independently from these controls and in practice, the differences measured in the corporate bond spread after changes in the ESG score are expected to diverge from this isolated effect. Using a fixed-effects specification, the significant effect of ESG remains. For the quantile scores specification, similar results are found. Dividing the quantile scores in separate dummy variables, it is observed that the effect of ESG is not constantly negative but is pronounced for the higher quantiles. Overall, the effect of the ESG score is credibly negative. For the effect of both the ESG score and the ESG quantile score on primary spreads, the effect seems more pronounced, which is opposite to expectations and the findings in Eichholtz et al. (2019). By expectation, ESG has not been priced in by all investors since it is a relatively novel phenomenon. Investors might not have been aware of the implications of a firm's ESG activity on its default risk when they issued it since the knowledge on the topic was very limited. From this research, it can be concluded that investors do in fact price in ESG activities in the primary market, even to a somewhat higher extent than in the secondary market. This contrary finding might be caused by the high amount of issues in the years 2017 through 2019, in which knowledge on ESG was already quite developed, contrary to the somewhat more dated issues used in Eichholtz et al. (2019). When the effect of ESG is separated into the environmental, social, and governance score, the overall finding for the environmental score is twofold. In the specifications using the regular environmental score, the effect is slightly negative but insignificant. However, in the quantile score specification, the effect is negative and significant. This discrepancy in results might be caused by the lack of valuation by investors when small changes are made in the environmental activities. For example, investors do not value the fact that a firm reduces its emissions by 0.1 percent from one year to the next but do value a firm reducing its emissions by five percent over the course of a year. Overall, the environmental score is considered to have a significantly negative effect on the corporate bond spread. This is a relevant finding for this study. Many of the ESG activities in the real estate sector revolve around environmental factors, which stem from the industry's big climate impact and its sufficient potential to mitigate it. The finding is also in line with the study by Eichholtz et al. (2019), where the authors show that the share of environmental certifications in a REIT's portfolio is negatively related to the corporate bond spread. Moreover, the results correspond with findings in Bauer and Hann (2010), in which the authors find lower spreads for firms with more environmental strengths. The coefficient for the social score is also conclusively negative. This reinforces the social effects found in other studies discussed in the literature review, such as increased employee attraction, retention and commitment, improved customer and job satisfaction, lowered absenteeism, and higher productivity. The effect of the governance score is also negative. Similar to the effect of the environmental score, it only has a significant effect when big increases are measured. The effect of ESG has also been tested for its robustness to specifications correcting for possible omitted variables, sample selection issues, and simultaneous causality. The effect of ESG on the corporate bond spread proved to be robust to these model specifications. The negative coefficient remains fairly stable during robustness tests and is significant for all but one specification. Conclusively, all models confirm the effect of ESG on corporate bond spreads. This finding is in line with research on the effect of CSR on default risk measures (An & Pivo, 2018; Sun & Cui, 2014; Rizwan, 2017). Moreover, it is in accordance with other studies that looked into the relationship of ESG/CSR and corporate bond spreads (Bauer & Hann, 2010; Cooper & Uzun, 2015; Eichholtz et al., 2019; Oikonomou et al., 2014). The first hypothesis of this study, H1, is confirmed. The ESG score has a significantly negative effect on corporate bond spreads. This conclusion is in agreement with the instrumental stakeholder theory, which argues that proper stakeholder management entails enhanced economic performance instead of serving merely a moral purpose.

8.2.2 Control variables

For the control variables, the effect of the market-to-book ratio is consistently insignificant. When controlling for other risk factors, investors do not value growth opportunities among risk factors. It is opposite to findings in Eichholtz et al. (2019), which is the only related study that employs the market-to-book ratio as a control variable.

The coefficient of ROA is also insignificant in the main models of the analyses. In the Heckman model and the IV models, however, there is a significant negative effect found of ROA on the corporate bond spread. Since the coefficient of the ESG variable in the Heckman and IV models is more representative of its true effect, the results of controls in these models also gain more credibility. The negative effect is also in line with expectations, which are based on the enhanced capability of paying interest payments when the return is higher. Moreover, it is in line with the literature and previous findings on this subject as well as results from research into the effect of ESG on financial performance (Bauer & Hann, 2010; Cooper & Uzun, 2015; Orlitzky et al., 2003; Tsoutsoura, 2004; Sun, 2012; Waddock & Graves, 1997; Wang et al., 2016).

The coefficient of the firm size variable shows big discrepancies over different regression models. In the Heckman model, the second IV model, the specification including fixed effects for the prime country of risk, and all fixed-effects specifications the effect is insignificant. In the first IV specification, the effect is significantly negative. In other specifications, the effect is positive, of which some significantly. Overall, models that have the highest degree of internal validity (fixed effects, Heckman models, and IV model) find mostly insignificant (and negative) results for the firm size coefficient, which is the most credible. The negative effect that is found in other studies (Bauer & Hann, 2010; Cooper & Uzun, 2015; Eichholtz et al, 2019), which is based on the expectation that larger firms have better credit quality, might have been reduced here through the inclusion of the issue amount as an additional control variable. This variable also represents the credit quality of a firm since more financially sound firms are capable of issuing higher amounts of debt. The insignificance is in line with the findings of Dichev (1998) and Vassalou and Xing (2004), where both authors find no overall effect of size on default risk, although Vassalou and Xing (2004) find an effect of size for firms in the highest quintile of default risk.

The effect of leverage on the corporate bond spread is only found to be significant in the IV specifications. The IV specification captures only the exogenous part of the ESG variable. Apparently, the endogenous ESG variable in other specifications proxies some of the effects which are actually due to a company's leverage. The positive effect is considered to be the true effect of leverage. It is also in line with prior expectations, academic literature on the effect of leverage on default risk, and results from similar studies (Baron, 1974; Bauer & Hann, 2010; Cooper & Uzun, 2015; Eichholtz et al, 2019).

The remaining control variables for bond characteristics are consistently in line with expectations formulated in the methodology section. The coefficient for callable bonds is positive as expected. The option to call increases the power of the issuer compared to the investor. Consequently, investors want to be compensated for the extra risk that the issuer might redeem the bond. This finding is in accordance with the research from relevant studies on the topic (Bauer & Hann, 2010; Cooper & Uzun, 2015; Eichholtz et al, 2019).

The coefficient for the tenor is negative and in most model specifications observed to be significant. In other studies by Bauer and Hann (2010) and Eichholtz et al. (2019), a positive effect has been observed. However, they only included the time to maturity (tenor) as a control variable. In this study, both duration and tenor have been added as controls, as is done in Cooper and Uzun (2015). The inclusion of both variables is motivated by the expectation that both proxy a different effect on the corporate bond spread. The total effect of tenor and duration is still positive. This is verified by excluding the duration control variable in unreported regressions, where the coefficient of the tenor is significantly positive. This overall positive effect is coherent with Bauer and Hann (2010) and Eichholtz et al. (2019). The observed negative coefficient in this study represents the signaling effect of credit quality by REITs. Only financially healthy firms can afford to issue debt with a long tenor. As a result, these firms are rewarded by the market for their credit quality signal, congruent with predictions from signaling theory models (Spence, 1973).

The duration variable represents the sensitivity to interest rate risk. As this sensitivity increases, the default risk increases along with the corporate bond spread. In almost every regression model, the estimate of the coefficient of duration is significantly negative, coherent with observations by Bauer and Hann (2010), Cooper and Uzun (2015), and Eichholtz et al. (2019). Moreover, it is more pronounced than the coefficient of the tenor variable, so that the overall effect of bonds with a longer maturity on the corporate bond spread is positive. The finding of the opposite signs of tenor and duration coefficients verifies the complexity of the relationship as discussed by Rodriguez (1988) and the possibility of two separate effects as discussed by Goss and Roberts (2011).

The effect of the last control variable, issue amount, is conclusively negative. As with the tenor of a bond, the issue amount contains information on the credit quality of a firm. Merely firms that are convinced of their payback capability will issue high amounts of debt. Congruent with signaling theories, they are rewarded in terms of their bond spreads since they send a credible quality signal to investors. The negative effect is in line with previously formulated expectations as well as research by Cooper and Uzun (2015). Other related studies find negative but insignificant effects of the amount variable (Bauer & Hann, 2010; Eichholtz et al, 2019).

8.2.3 Interaction term

In table 5, the interaction effect of ESG and the corrected CO2 emissions is estimated. The first model finds a negative coefficient for the interaction effect but is insignificant. Using the fixed-effects specification, a significantly negative coefficient is found. Next to this, the effect of ESG itself in both model specifications is positive and insignificant. As stated before, the fixed-effects specification control for unobserved characteristics and therefore increases the internal validity of the model. Interpreting these results, the last two hypotheses, H2a and H2b, are confirmed. First, the effect of ESG on corporate bond spreads is insignificant with the inclusion of the interaction between ESG and CO2 emissions. In a theoretical context, this finding effectively refutes the normative value of the stakeholder theory (which considers stakeholder engagement to have inherent value) as the value is not absolute but relative. Stakeholder theory is not refuted as a whole since previous models confirm its instrumental value. Second, the interaction effect of ESG and CO2 emissions per capita on corporate bond spreads is significantly negative. This effect is a novelty, and its observation has not been preceded in academic literature. The observation of this interaction effect is a confirmation of the legitimacy theory and institutional theory. Similar to the dependence on place and time of the social contract between a firm and its society as discussed by Suchman (1995), The effect of ESG on the perceived default risk by the market is not static but varies by the norms and values of society. What is valued is the gap between a country's building sector pollution levels and a firm's effort to diminish its environmental impact. Investors anchor the sustainability efforts of the firm to their ideal, which is justified by either moral or regulatory motives. Moral motives imply that investors inherently value the ideal of a less polluted world to a certain degree. Firms that reflect this ideal are rewarded and those that ignore it are punished. The second motive is of regulatory nature. Increasingly stringent environmental regulations require the building stock to upgrade their sustainability levels. If regulations are not adhered to, there is a significant stranded-asset risk. This implies that the assets run a risk of losing value due to changes in the valuation by the market since buildings eventually become inoperative under law. This increased stranded asset risk directly translates into an increased default risk and a higher corporate bond spread.

8.3 Limitations

Though evidence on the relationship between ESG and the corporate bond spread is conclusive, the external validity of the results is restricted. The real estate sector is the population of interest in this study since it exhibits distinct values through ESG activities compared to other industries, which affect the risk of the firm. Consequently, results from the analysis cannot be generalized for the entire population of firms. External validity is also limited since the analysis includes only REITs, which is an undeveloped industry in many countries. This selection procedure has led to a sample that includes fifteen countries, which makes it hard to generalize the effect on a global scale.

Internal validity is not an issue for the models that established the effect of ESG and bond spreads. However, internal validity is imperfect in the models estimating the interaction effect. The interaction variable consists of the ESG score and the corrected CO2 emissions. The intention of the corrected CO2 emissions variable is that a higher value indicates that the real estate sector of a country has to adjust its emissions to a higher degree to fulfill future obligations to both society and regulations. This would imply that real estate companies in this country experience a higher stranded asset risk and default risk when they do not undertake action on the environmental dimension and have a greater impact when they do. It is most probably not true that regulations in all countries will set similar limits regarding CO2 emissions for real estate assets or firms. The default risk associated with incompatibility with regulations is also likely not identical for each firm and country. Moreover, the ESG score relative to CO2 emissions is not a perfectly accurate measure of the extent to which a company has to decrease its future emissions to remain viable. For example, a company with a high ESG score can have very high emission levels. Hence, this firm will probably have to diminish its emission levels to a great extent in the future to meet regulations and obligations to society, even though the interaction variable measures it as if the firm does not need to reduce its impact so much. A better measure would be to include company emission intensity levels instead of the overall ESG score, which originally was intended. However, observations for company-level emissions turned out too scarce to retrieve any possible statistical evidence of the relationship. The result of the imprecisions in the interaction variable is that there is a risk of measurement errors, which is a violation of internal validity. Still, the violations are not considered to be significant to such a degree that the findings ought to be refuted.

8.4 Implications

External validity is somewhat restricted in the analysis, but the implications are extensive. The study is conducted only in the real estate sector. Nevertheless, this sector is responsible for an exceptionally high share of global emissions and energy consumption and therefore plays a big role in the global battle against climate change. Results show that investors value the extent to which REITs engage in ESG activities. The study confirms that there is sufficient incentive for investors to shift the focus in their portfolios to ESG intensive firms as this can serve as a risk-reducing strategy. Managers of real estate developing or operating companies ought to upgrade their ESG ratings. This is justified on three levels. First, there is an instrumental value to increasing the ESG rating as it is associated with subsequent reductions in the cost of debt. Second, it increases the congruence of interest between stakeholders and companies. Awareness, along with the prioritization of ESG activities, continuously increases for all parties. Managers must react to this development by playing into the wants of the stakeholders. Third, to be relieved of stranded asset risks and avoid future economic obsolescence through incompatibility with environmental regulations, real estate operating and developing firms should reduce their climate impact. Last, from a theoretical but more importantly a motivational standpoint, there are implications for all stakeholders in ESG considering that the outcome of its activities is largely dependent on external factors such as the values of society and institutional norms and values. ESG is not be valued inherently, but as a product of valuations by all stakeholders.

8.5 Recommendations for future research

As a popularizing topic in academic research, much is uncovered on the motivation and implications of ESG. Still, there is more to be looked into since the stakes are so large. The best future research recommendations on the relationship between ESG and the cost of debt are to be found in the shortcomings of this study. It could be relevant to look into a similar relationship for other countries than applied in this analysis or make use of different industries in the sample analysis. If the effect remains valid, it does not only increase the external validity of the results but also enforces the motives to improve ESG for all involved parties. Moreover, research into the interaction effect using better measures of the gap between a company's effort to reduce environmental impact and what is expected by society or what the regulations entail could yield interesting results. It would extend the validity of the dependence of ESG on external factors and provide clear incentives to raise ESG levels.

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10. Appendix

Table 1: Tests for serial correlation and heteroskedasticity

Test	Distribution	Statistic	p-value	Conclusion
Wooldridge	F(1,229)	166.45	0.000	serial correlation
Breusch-Pagan	Chi-squared(9)	1205.08	0.000	heteroskedasticity

Table 2: Weights for computation of ESG score

ESG dimension	Weight ESG score	Weigt environmental score	Weight social score	Weight governance score
Environmental				
Environmental innovation	0.04	0.11	0.00	0.00
Resource use	0.17	0.46	0.00	0.00
Emissions	0.16	0.43	0.00	0.00
Social				
Human rights	0.02	0.00	0.07	0.00
Product responsibility	0.07	0.00	0.24	0.00
Workforce	0.10	0.00	0.34	0.00
Community	0.11	0.00	0.36	0.00
Governance				
Management	0.21	0.00	0.00	0.67
Shareholders	0.06	0.00	0.00	0.20
CSR strategy	0.04	0.00	0.00	0.13

The applied weights are derived from Thomson Reuters' (2017) methodology.

Table 3: Distribution by country

	Observations	Percentage	Cumulative percentage
United States	1081	44.16	44.16
Japan	499	20.38	64.54
France	313	12.79	77.33
Canada	208	8.50	85.83
Singapore	131	5.35	91.18
Cayman Islands	75	3.06	94.24
United Kingdom	48	1.96	96.20
Spain	16	0.65	96.85
Germany	13	0.53	97.39
Luxembourg	13	0.53	97.92
Australia	12	0.49	98.41
New Zealand	11	0.45	98.86
Thailand	11	0.45	99.31
Argentina	8	0.33	99.63
Italy	5	0.20	99.84
South Korea	4	0.16	100.00
Total	2448	100.00	

This table displays the frequency of observations for corporate bond spreads per country, therefore including recurring observations for the same bonds. The frequencies are derived from the data collected from the Refinitiv Eikon database.

Table 4: Distribution by year

	Observations	Percentage	Cumulative percentage
2019	646	26.39	26.39
2018	537	21.94	48.33
2017	469	19.16	67.48
2016	326	13.32	80.80
2015	221	9.03	89.83
2014	135	5.51	95.34
2013	75	3.06	98.41
2012	29	1.18	99.59
2011	10	0.41	100.00
Total	2448	100.00	

This table displays the frequency of observations for corporate bond spreads per year, therefore including recurring observations for the same bonds. The frequencies are derived from the data collected from the Refinitiv Eikon database.

Table 5: Distribution by asset type

	Observations	Percentage	Cumulative percentage
Retail REITs	704	28.76	28.76
Diversified REITs	604	24.67	53.43
Residential REITs	376	15.36	68.79
Office REITs	353	14.42	83.21
Hotel and Resort REITs	135	5.51	88.73
Industrial REITs	133	5.43	94.16
Health Care REITs	78	3.19	97.34
Specialized REITs	65	2.66	100.00
Total	2448	100.00	

This table displays the frequency of observations for corporate bond spreads per asset-type, therefore including recurring observations for the same bonds. The frequencies are derived from the data collected from the Refinitiv Eikon database.

Table 6: Distribution by rank

	Observations	Percentage	Cumulative percentage
0	27	1.10	1.10
8	12	0.49	1.59
10	7	0.29	1.88
11	2	0.08	1.96
12	8	0.33	2.29
13	55	2.25	4.53
14	56	2.29	6.82
15	25	1.02	7.84
16	104	4.25	12.09
17	145	5.92	18.01
18	246	10.05	28.06
19	537	21.94	50.00
20	503	20.55	70.55
21	260	10.62	81.17
22	62	2.53	83.70
23	158	6.45	90.16
24	229	9.35	99.51
25	12	0.49	100.00
Total	2448	100.00	

This table displays the frequency of observations for corporate bond spreads per rank, therefore including recurring observations for the same bonds. The frequencies are derived from the data collected from the Refinitiv Eikon database. The rank of a bond is a function of the credit rating assigned by Moody's, Standard and Poor's, or Fitch. A rank of 25 equals an AAA or prime credit rating and 1 equals an extremely speculative rating. Rank one through seven are not observed for the sample. 0 indicates a non-rated bond.

Table 7: Correlation table

	ESG	E	S	G	Issue spread	Spread	ICR	Firm size	M-to-B	Leverage	ROA	Intensity	Emissions	CO2	Tenor	Amount	Duration	Rank	Callable	Green	Cap	EBIT	NIBEI	Debt	Assets	Equity	Shares	Book	Fixed
ESG	1.000																												
E	0.875	1.000																											
S	0.915	0.721	1.000																										
G	0.744	0.383	0.633	1.000																									
Issue spread	0.017	-0.036	0.036	0.065	1.000																								
Spread	-0.022	-0.078	0.002	0.046	0.778	1.000																							
ICR	0.089	0.167	0.039	-0.023	-0.071	-0.039	1.000																						
Firm size	0.474	0.486	0.423	0.257	0.120	0.067	-0.101	1.000																					
M-to-B	0.033	0.026	0.042	0.016	0.089	0.018	-0.000	0.002	1.000																				
Leverage	-0.060	-0.120	0.006	-0.006	0.104	0.067	-0.126	0.171	0.000	1.000																			
ROA	0.009	0.025	0.041	-0.052	-0.045	-0.019	0.084	0.133	0.041	-0.121	1.000																		
Intensity	0.064	0.059	0.028	0.072	-0.081	-0.039	-0.042	0.140	-0.022	0.132	-0.017	1.000																	
Emissions	0.079	0.028	0.127	0.065	0.519	0.259	-0.048	0.107	0.092	0.114	0.078	-0.087	1.000																
CO2	0.079	0.451	-0.073	-0.122	0.305	0.251	0.035	0.208	-0.334	0.113	-0.029	0.173	-0.255	1.000															
Tenor	0.027	0.037	0.011	0.015	-0.031	-0.006	-0.005	0.080	0.042	0.016	0.002	-0.072	0.069	-0.022	1.000														
Amount	0.286	0.217	0.316	0.203	0.494	0.308	-0.053	0.158	0.092	0.091	0.036	-0.139	0.528	0.363	0.061	1.000													
Duration	0.059	0.040	0.034	0.082	-0.079	-0.052	0.001	0.057	0.012	-0.017	-0.007	-0.071	-0.042	-0.019	0.830	-0.034	1.000												
Rank	-0.142	-0.022	-0.194	-0.188	-0.584	-0.454	0.016	-0.130	-0.036	-0.111	0.058	0.077	-0.371	-0.204	0.053	-0.457	0.167	1.000											
Callable	0.216	0.108	0.295	0.179	0.451	0.301	-0.056	0.178	0.082	0.158	0.042	-0.173	0.607	-0.024	0.079	0.690	0.075	-0.403	1.000										
Green	-0.038	-0.012	-0.048	-0.046	-0.054	-0.043	-0.012	-0.039	-0.011	-0.080	-0.004	-0.032	-0.056	0.016	-0.036	0.064	0.024	0.041	-0.047	1.000									
Cap	0.438	0.377	0.461	0.274	0.054	0.058	-0.034	0.612	0.048	0.083	0.060	0.059	0.162	-0.215	0.125	0.216	0.083	-0.090	0.247	-0.030	1.000								
EBIT	0.545	0.552	0.516	0.277	0.080	0.053	-0.037	0.678	0.027	0.169	0.032	0.065	0.168	-0.120	0.097	0.232	0.063	-0.110	0.301	-0.045	0.831	1.000							
NEBEI	0.295	0.288	0.313	0.133	-0.044	-0.040	-0.021	0.411	0.028	-0.085	0.345	0.067	0.035	0.060	0.057	0.099	0.041	0.032	0.128	-0.008	0.549	0.536	1.000						
Debt	0.401	0.445	0.370	0.157	0.138	0.096	-0.042	0.719	-0.002	0.285	-0.025	0.078	0.147	0.257	0.079	0.236	0.046	-0.170	0.292	-0.046	0.773	0.903	0.450	1.000					
Assets	0.478	0.533	0.435	0.190	0.105	0.052	-0.042	0.749	0.015	0.097	0.021	0.043	0.128	0.184	0.090	0.225	0.067	-0.117	0.271	-0.034	0.797	0.917	0.540	0.957	1.000				
Equity	0.482	0.520	0.447	0.207	0.063	0.007	-0.041	0.731	0.036	-0.134	0.078	0.052	0.106	0.059	0.110	0.194	0.092	-0.062	0.215	-0.018	0.805	0.827	0.597	0.795	0.924	1.000			
Shares	-0.099	0.077	-0.146	-0.256	0.009	-0.013	-0.016	0.229	-0.042	-0.227	0.075	0.094	-0.031	-0.152	-0.084	-0.199	-0.063	0.067	-0.162	0.005	0.059	0.087	0.206	0.065	0.174	0.309	1.000		
Book	-0.239	-0.104	-0.298	-0.252	-0.115	-0.078	-0.009	0.155	0.002	-0.009	-0.023	0.087	-0.064	-0.250	0.103	-0.058	0.068	0.089	-0.071	-0.024	0.067	0.016	0.008	0.071	0.078	0.104	-0.117	1.000	
Fixed	0.475	0.526	0.433	0.194	0.091	0.046	-0.042	0.747	0.016	0.099	0.026	0.113	0.122	0.199	0.090	0.216	0.067	-0.108	0.258	-0.032	0.811	0.917	0.554	0.954	0.995	0.930	0.183	0.087	1.000

This table displays correlation coefficients of the variables used in the analysis. ESG indicates the ESG score, E indicates the environmental score, S indicates the social score, G indicates the governance score, Issue spread indicates the corporate bond yield spread at issuance, Spread indicates the corporate bond yield spread, ICR indicates the Interest Coverage Ratio as specified in the robustness section, Firm size indicates a logarithmic function of total assets, M-to-B indicates the market-to-book ratio, Leverage indicates the leverage ratio, ROA indicates the Return on assets, Intensity indicates the capital intensity ratio as specified in the robustness section, Emissions indicates the CO2 emissions per capita adjusted for the building sector share of a country's GDP, CO2 indicates the CO2 score from the Refinitiv Eikon database. Tenor indicates the tenor in years from issuance till maturity, Amount indicates a logarithmic function of the issue amount, Duration indicates a bond's duration as specified in the methodology section, Rank indicates a bond's rank as a function of the credit rating, Callable indicates a dummy equal to one for callable bonds, Green indicates a dummy equal to one for green bonds, Cap indicates a company's market capitalization, EBIT indicates the Earnings Before Interest and Taxes, NIBEI indicates the Net Income Before Extraodinary Items, Debt indicates the total debt, Assets indicates the total assets, Equity indicates the total equity, Shares indicates a firm's total common shares, Book indicates the book value per share, and Fixed indicates a firm's total fixed assets.

Table 8a: Descriptives

	Observations	Mean	Standard deviation	Minimum	Maximum	Mean ESG firms	Mean non-ESG firms	Difference	t-value difference
ESG score	1258	37.10	23.19	0.97	86.92				
Environment score	1258	29.03	31.27	0.00	92.16				
Social score	1258	42.88	26.75	0.00	95.80				
Governance score	1258	43.79	24.94	0.37	93.94				
ESG quantiles (excl. non-ESG)	1258	5.37	2.89	1.00	10.00				
Initial yield spread (log)	402	497.57	60.00	20.70	620.76	501.25	494.37	6.88	(1.13)
Yield spread (log)	2448	479.91	58.71	293.92	828.17	488.39	470.95	17.44***	(7.42)
Year	2448	2017.06	1.79	2011.00	2019.00	2017.14	2016.98	0.16**	(2.27)
Firm size (log)	2448	21.40	1.62	16.48	24.14	22.38	20.37	2.01***	(38.62)
Market-to-book (winsorized)	2448	1.46	1.06	-0.15	6.16	1.61	1.29	0.32***	(7.53)
Leverage	2448	46.60	18.57	0.00	151.46	48.69	44.38	4.31***	(5.77)
Return on assets (winsorized)	2448	3.33	4.08	-12.15	22.32	3.50	3.15	0.35**	(2.10)
CO2 emissions per capita	2369	1.41	0.48	0.12	2.64	1.47	1.35	0.11***	(5.83)
Tenor (in years)	2448	10.62	5.29	2.00	31.00	11.24	9.97	1.27***	(6.02)
Amount	2448	19.04	1.31	16.04	21.22	19.31	18.75	0.55***	(10.64)
Duration	2448	4.69	3.40	0.00	22.61	4.93	4.45	0.48***	(3.50)
Rank	2448	19.29	3.41	0.00	25.00	18.98	19.63	-0.66***	(-4.78)
Callable(1=yes)	2448	0.55	0.50	0.00	1.00	0.65	0.45	0.21***	(10.43)

This table provides summary statistics of the main varaibles used in the analyses. The first five columns respectively show the total number of observations, the mean, standard deviation, minimum value, and maximum value for each variable. The sixth and seventh column display the mean for each variable for respectively firms that have ESG scores and firms that have no ESG scores. The eighth columns displays the difference between the two means, with significance stars indicating the significance level. In the last column the t-value of the difference is depicted in parentheses.
Statistical significance indicators: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 8b: Descriptives

	Observations	Mean	Standard deviation	Minimum	Maximum	Mean ESG firms	Mean non-ESG firms	Difference	t-value difference
Environment quantiles	1258	5.04	3.20	1.00	10.00				
Social quantiles	1258	5.34	2.88	1.00	10.00				
Governance quantiles	1258	5.38	2.89	1.00	10.00				
Institutional ownership (percentage)	804	0.84	0.22	0.04	1.08				
Average annual national ESG	2337	37.13	14.65	4.08	83.03				
Formulated energy efficiency targets(1=yes))	2448	0.17	0.38	0.00	1.00				
Formulated water efficiency targets(1=yes))	2448	0.17	0.37	0.00	1.00				
Initial yield spread	1801	164.73	87.63	1.23	496.50	175.47	152.94	22.53***	(5.52)
Yield spread	2448	145.24	122.01	18.90	3950.90	155.86	134.01	21.85***	(4.41)
Interest coverage ratio (winsorized)	2448	3.87	7.25	-17.40	50.99	2.79	5.01	-2.22***	(-7.49)
Interest coverage ratio	2448	12.63	171.73	-723.84	3528.70	2.82	23.00	-20.18***	(-2.83)
Market-to-book	2448	1.37	4.31	-123.31	50.48	1.55	1.19	0.36**	(2.05)
Return on assets	2448	3.18	6.04	-98.81	33.38	3.50	2.85	0.65***	(2.63)
Capital intensity	2448	92.21	10.12	27.60	99.91	92.42	91.98	0.44	(1.07)
CO2 emissions per capita	2369	1.41	0.48	0.12	2.64	1.47	1.35	0.11***	(5.83)
Investment grade	2448	0.71	0.46	0.00	1.00	0.75	0.66	0.09***	(4.94)
Green bond(1=yes)	2448	0.01	0.12	0.00	1.00	0.01	0.02	-0.01**	(-2.16)
Market capitalization (in billions)	2448	3.48	5.41	0.00	29.76	5.97	0.85	5.12***	(27.26)
Earnings before interest and taxes (in billions)	2448	0.19	0.25	-0.01	1.42	0.30	0.06	0.24***	(27.75)
Net income before extraodinary items (in billions)	2448	0.16	0.35	-1.44	4.29	0.25	0.07	0.18***	(13.18)
Total debt (in billions)	2448	2.08	2.67	0.00	13.23	3.45	0.64	2.80***	(31.28)
Total assets (in billions)	2448	4.81	5.95	0.01	30.34	7.85	1.59	6.26***	(31.29)
Total equity (in billions)	2448	2.23	2.74	-3.38	14.81	3.59	0.80	2.79***	(29.82)
Total common shares (in billions)	2448	0.36	0.80	0.00	5.85	0.39	0.32	0.07**	(2.03)
Book value per share	2448	156.87	580.02	-30.03	4765.72	170.76	142.19	28.57	(1.23)
Total fixed assets (in billions)	2448	4.46	5.53	0.01	28.67	7.26	1.49	5.77***	(30.95)

This table provides summary statistics of the main varaibles used in the analyses. The first five columns respectively show the total number of observations, the mean, standard deviation, minimum value, and maximum value for each variable. The sixth and seventh column display the mean for each variable for respectively firms that have ESG scores and firms that have no ESG scores. The eighth columns displays the difference between the two means, with significance stars indicating the significance level. In the last column the t-value of the difference is depicted in parentheses.
Statistical significance indicators: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 9 : Hausman test for FE vs RE

Test	Distribution	Statistic	p-value	Conclusion
Hausman	Chi-squared(5)	136.35	0.000	FE appropriate

Table 10: Robustness to additional variables

	(1) Panel OLS	(2) Panel OLS
ESG score	-0.34^{***}	-0.47^{***}
	(0.09)	(0.13)
Green bond(1=yes)	-6.03	-6.97
	(10.49)	(10.12)
Investment grade	-32.37^{**}	-31.58^{***}
	(14.33)	(10.36)
Interest coverage ratio (winsorized)	0.56^{**}	0.40^{**}
	(0.24)	(0.17)
Capital intensity	0.08	0.35^{**}
	(0.11)	(0.15)
Firm size (log)	4.83^{*}	-6.10^{*}
	(2.78)	(3.60)
Market-to-book (winsorized)	-0.08	-3.76^{**}
	(1.67)	(1.79)
Leverage	0.11	-0.24
	(0.14)	(0.20)
Return on assets (winsorized)	-0.17	-0.18
	(0.27)	(0.31)
Callable(1=yes)	10.49	-8.99^{*}
	(6.36)	(5.10)
Tenor (in years)	-0.78	-1.25^{***}
	(0.48)	(0.39)
Amount	-6.27^{**}	-6.38^{***}
	(2.72)	(2.27)
Duration	5.05^{***}	5.76^{***}
	(0.68)	(0.64)
Year FE	*Yes*	*Yes*
Country FE	*Yes*	*No*
Prime country of risk FE	*No*	*Yes*
Rank FE	*Yes*	*Yes*
Asset-type FE	*Yes*	*Yes*
Observations	1257	1258
Adjusted R^2	0.825	0.815

In both columns, the full sample of bonds with observations for the ESG score is used. In both column 1 and 2, additional variables are added to the original model. In column 2, the prime country of risk for the REITs is added as fixed effects instead of the country of incorporation.
Standard errors in parentheses.
Statistical significance indicators: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 11: Robustness to sample selection

	(1) Heckman model
ESG score	-0.24^{**}
	(0.10)
Inverse Mills Ratio	-4.08
	(4.02)
Firm size (log)	-3.12
	(2.93)
Market-to-book (winsorized)	-1.14
	(2.27)
Leverage	-0.00
	(0.19)
Return on assets (winsorized)	-0.82^{**}
	(0.38)
Callable(1=yes)	16.33^{***}
	(5.07)
Tenor (in years)	-0.24
	(0.49)
Amount	0.14
	(3.22)
Duration	4.95^{***}
	(0.93)
Year FE	*Yes*
Country FE	*Yes*
Rank FE	*Yes*
Asset-type FE	*Yes*
Observations	517
Adjusted R^2	0.864

This model displays coefficients for the Heckman model, correcting for a possible sample selection.
Standard errors in parentheses.
Statistical significance indicators: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 12: Relevance test of instruments

	(1) OLS
Institutional ownership (percentage)	16.45***
	(4.01)
Average annual national ESG	0.34***
	(0.07)
Formulated water efficiency targets(1=yes)	27.76***
	(4.89)
Formulated energy efficiency targets(1=yes)	0.63
	(4.83)
Observations	648
Adjusted R^2	0.521
F	177.28

This model provides the estimation results for the regression of ESG on the applied instruments.
Standard errors in parentheses.
Statistical significance indicators: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 13: IV models

	(1) IV	(2) IV FE
ESG score	−0.20	−0.31*
	(0.20)	(0.18)
Firm size (log)	−12.39***	3.01
	(3.73)	(4.92)
Market-to-book (winsorized)	−1.40	2.51
	(1.57)	(1.76)
Leverage	0.27**	0.45***
	(0.13)	(0.17)
Return on assets (winsorized)	−1.02**	−0.27
	(0.41)	(0.41)
Callable(1=yes)	43.28***	
	(8.53)	
Tenor (in years)	0.56	
	(0.57)	
Amount	−3.99	
	(2.74)	
Duration	3.78***	
	(0.92)	
Year FE	*Yes*	*Yes*
Country FE	*Yes*	*No*
Rank FE	*Yes*	*No*
Asset-type FE	*Yes*	*No*
Observations	648	648
R^2	0.822	0.311

Column 1 provides the estimation results of the IV regression using fixed effects for year, country, rank, and asset-type. Column 2 displays the estimation results of the full fixed effects IV regression. The R-squared in column 1 denotes the adjusted R-squared, whereas in column 2 it denotes the within R-squared.
Standard errors in parentheses.
Statistical significance indicators: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 14 : overidentifying restrictions test for exogeneity

Test	Distribution	Statistic	p-value	Conclusion
Sargan-Hansen	Chi-squared(3)	2.85	0.483	instruments exogenous