

**Raising Capital with Purpose:
Challenges and Opportunities in Using Corporate
Debt for Environmental Sustainability**

Micol Alexandria Chiesa

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Dedication

I dedicate this thesis to my beloved brother as a reminder that, at first, dreams seem impossible, then improbable and then, if we summons the will, they soon become inevitable.

Publications and outputs

Paper 1: ‘Does a higher degree and cost of leverage worsen corporate environmental performance?’ is currently under review for the *Journal of Corporate Social Responsibility and Environmental Management*.

Paper 2: ‘Does a company’s environmental performance influence its price of debt capital? Evidence from the bond market’ is currently under review for *Organization and the Environment*.

Paper 3: ‘The surge of impact borrowing: the magnitude and determinants of green bond supply and its heterogeneity across markets’ was published in the *Journal of Sustainable Financing and Investment* in November 2018. With the same dataset, a second paper titled ‘Sustainable financing practices through green bonds: what affects the funding size?’ was published in *Business Strategy and the Environment* in April 2019.¹

Paper 4: ‘Learning curve effect and other determinants of green bonds spread’ is currently under review in the *International Review of Financial Analysis*.

1. This, however, is not included in the thesis because of co-authorship limitations.

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Abstract

Through a set of four empirical chapters, this research provides insights into and understandings of corporate finance in relation to its environmental exposure and pricing in financial markets. After considering the nature of the relationship between stakeholders and the firm, as well as the nature of the power that these stakeholders possess, I decided to focus this thesis on the creditors.

In the first part of this thesis, therefore, I investigate the relationship between debt structures and environmental sustainability. The outcomes of the first study suggest that companies are sensitive to the cost of debt when deciding whether to invest in environmental sustainability projects. The outcome of the second study finds a negative association between the cost of debt and the environmental sustainability of a company, implying that firms with higher environmental sustainability scores are perceived as less risky and therefore awarded cheaper costs when issuing new debt. Drawing on these theoretical insights, the second part of the thesis is dedicated to the green bond market, a distinct debt security created to raise financing for environmental projects. The third study, therefore, focuses on the supply side of green bonds, identifying major drivers for their surge among developed and developing countries. Finally, having investigated the existence of the yield premium of green bonds, I found that the market appears to perceive green bonds issued later by the same issuer as riskier and with higher levels of yield spread over the government bonds compared with those issued earlier.

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Acronyms

AMT	amount or size of bond issuances
BR	bond rating
CAPEX	capital expenditure
CBS	Climate Bond Standards
CEP	corporate environmental performance
CER	corporate environmental responsibility
CF	cash flow
CFP	corporate financial performance
COD	cost of debt
COP	Conference of the Parties
CR	coupon rates
CSM	Corporate sustainable management
CSP	corporate social responsibility performance
CSR	corporate social responsibility
CUREC	Central University Research Ethics Committee
DEQ	debt-equity ratio
DKSE	Driscoll-Kraay standard errors
EBRD	European Bank for Reconstruction and Development
ECB	European Central Bank
EIB	European Investment Bank
EMH	efficient market hypothesis
EP	environmental performance

ESG	environmental, social and governance
FCF	free cash flow
FCFA	free cash flow to total assets
GBP	Green Bond Principles
GDP	gross domestic product
GRI	Global Reporting Initiative
HSBC	Hongkong and Shanghai Banking Corporation
ICMA	International Capital Market Association
IPCC	International Panel on Climate Change
IPO	initial public offering
LAF	liquidity adjustment facility
LEV	degree of leverage
MA	moving average
NGO	non-governmental organization
NIP	new issue premium
OCD	optionally convertible debenture
OI	order of issuance
OLS	ordinary least square
PCSE	Prais-Winsten Panel Corrected Standard Errors
PG&E	Pacific Gas and Electric Company's
PPP	products, planets and people
PwP	Performance with Purpose
QE	quantitative easing
REIT	real estate investment trust
ROA	return on assets

ROS	return on sales
SDG	sustainable development goal
SRI	sustainable, responsible and impact investing
TA	total assets
TR	Thomson Reuters
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
VIF	variance inflation factor
YTM	yield to maturity

1

Introduction

1.1. Introduction to the subject

During the Earth Summit in Rio de Janeiro in 2012, the United Nations Environment Programme (UNEP) outlined what it called a ‘Green Economy’, defined as ‘one that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities. In its simplest expression, a green economy can be thought of as one that is low carbon, resource efficient and socially inclusive’ (UNEP 2011).

The report argued in favour of investing 2 per cent of global GDP in greening central sectors of the economy with a view to shifting development and unleashing public and private capital flows onto a low-carbon, resource-efficient path.

Likewise, the International Panel on Climate Change (IPCC 2015) has argued that substantial reductions in emissions:

would require large changes in investment patterns. For mitigation scenarios that stabilize concentrations in the range of 430 to 530 ppm CO₂-eq by 2100, annual investments in low carbon electricity supply and energy efficiency in key sectors (transport, industry and buildings) are projected in the scenarios to rise by several hundred billion dollars per year before 2030. Within appropriate enabling environments, the private sector, along with the public sector, can play important roles in financing mitigation and adaptation.

In 2015, more than 100 companies, including leading global giants, expressed their support for the Paris Agreement on climate change and moved towards swift action and a commitment to science-based targets to prevent dangerous global warming (UNFCCC 2018).

Paragraph (c) of Article 2 on such agreement points to the need to make ‘finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development’ (United Nations 2015). In addition to a green climate fund supporting the least developed countries and other developing country parties, Article 9 states that ‘developed country Parties should continue to take the lead in mobilizing climate finance from a wide variety of sources, instruments and channels’ (United Nations 2015).

Companies that commit to setting science-based targets¹ are showing their commitment to creating a well below 2°C world, working on their own and in partnership with governments to mobilize the technology, investment and innovation needed to transition to a sustainable carbon-neutral economy. To implement these commitments, companies include corporate sustainability strategies into their industrial strategic planes (Engert and Baumgartner 2016).

The Paris UN Climate Agreement of December 2015 refocused attention on the need to mobilize substantial private capital flows into corporate climate solutions at the pace and scale required to combat climate change with the required urgency. At the same time, countries around the world – including nearly all the industrialized and large emerging economies – have launched or are in the process of launching national policies aimed at reducing their emissions of GHGs

1. To learn more about science-based targets, please refer to <https://www.cdp.net/en/campaigns/commit-to-action/science-based-targets>

(Stavins 2019). As the implementation of clean energy or ‘green’ infrastructure plans will require unprecedented levels of private investment, it is critically important for policy-makers to understand the variables affecting corporate finance decisions, to establish effective conditions at the national level to facilitate the environmental investment case.

There are different types of environmental sustainability strategy (Baumgartner and Ebner 2005: 61; Dyllick and Hockerts 2002; Hardtke and Prehn 2001; Schaltegger et al. 2012), which can be classified into three main macro areas:

- ‘Quick wins’, meaning strategies that are ‘common practice’ and, as such, they may be a necessary condition to show engagement with the society or respond to activists criticism, but cannot be a sufficient condition for building a competitive advantage (Gartenberg et al. 2019). These are strategic opportunities to ‘show’ environmental commitments immediately, even before the strategy is fully baked. Examples of quick wins include a company’s recycling projects for the communities; a company’s support to the local farmers so that they can adopt sustainable farming practices; protection of environmental resources such as water; and planting trees to fight deforestation. These things are at the margin of what companies do rather than at the center and, therefore, are not practices through which they can achieve economic success (Porter and Kramer 2011: 4).
- ‘Industrial plans’, meaning between three- and five- year strategic plans to generate a competitive advantage and, therefore, which result in above average performance (that is ‘doing well by doing good’). Examples of industrial plans include efforts to reduce carbon gas emissions in the environment, renewable

energy projects, water infrastructure projects and waste reduction by using different suppliers or materials. These are big environmental opportunities requiring initial capital expenditure, but they are meant to decrease operational costs over time and therefore increase the equity value of the company by taking advantage of cost-saving positions (Sharfman and Fernando 2008).

- ‘Organizational change’ meaning sustainability initiatives that may transform the core value of the company, changing its current proposition or market to maximize valuation. The inclusion of these transformative opportunities can infect the performance of the business beyond opportunities originally identified. There are visionary strategies that can occur in a conventional or systemic way (Baumgartner 2009; Kok et al. 2001). Examples are the acquisition of a sustainable company with complementarily disruptive know-how, the introduction to the market of a new ‘environmental friendly’ product feature and, finally, entering new distribution markets and or production processes. By doing so, corporations take advantage of unexploited or underexploited positions through developing a unique strategy (Gartenberg et al. 2019). In this sense, by being different, a firm may benefit because it would face less competition (Deephhouse 1999; Porter 1991).

To develop sustainability strategies representing distinct sustainability profiles, it is necessary to be aware of the range of sustainability issues that have to be regarded and assigned in such a strategy (Baumgartner and Ebner 2010).

Therefore, in a first step, such issues are determined. Once the goals are established, specific systems and detailed processes need to guide the implementation of each initiative. Throughout the design, processes and policies in place must be taken into consideration and collaboration among areas

encouraged. At this point, gaining executive commitment is crucial and availability of financing must be obtained. Therefore, as a second step, the economic dimension of corporate sustainability is determined.

Policy, politics and regulation can have both a positive and negative impact on environmental investments. Specific policy support will be instrumental in determining project economics and the attractiveness of the proposition while facilitating specific pools of capital to invest. Conversely, policy uncertainties create investment risk, with retroactive changes being the most damaging (Hamilton and Zindler 2016). In fact, a detailed due diligence process will take place involving scrutiny of a range of potential risk factors – technical, economic, market, political and policy-related – ahead of securing internal approval through credit or investment committees. Capital often competes not only against other investment options within a firm, but also against other sources of capital for the project.

Corporate finance comes into two forms: it can be equity or debt based. When the source of capital raised is equity based, corporations sell the company's shares to investors (shareholders) who expect to see an upward trend in the company's value (or for it to appreciate in value) over time to make their investment a profitable purchase. Alternatively, corporations may rely on borrowed funds (debt capital or credit) as sources of investment to sustain ongoing business operations or to fund future growth.

Depending on the duration and the project's available resources, a company will have to source funds either internally or externally to fund the sustainability projects. As 'quick wins' are sustainable strategies meant to be accomplished in the shortest time possible (Baumgartner 2013), generally they take the form of

cash donations or grants, in-kind gifts, sponsorships, cause-related marketing, and pro bono services. The amount given is not refunded to the financing organization. Unless a company sets up a separately administered private foundation, the financing of these projects comes from the working capital, usually organized under the budgets of ‘corporate giving’ programmes. Some other companies allocate a fixed percentage of monthly cash reserves to effective sustainable environmental projects (Lam and Angel 2016).

On the other hand, implementing industrial plans and organizational change requires having investment strategies on capital budgeting, at least to ensure the financial payback return on the capital invested.² Therefore, mobilizing finance for investment and innovation for environmental sustainability becomes a key challenge for the corporation (Dangerman et al. 2013; Grubb 2014; Stern 2019).

While some may allocate working capital to research and development funds (Afonso and Jalles 2017), the majority of corporations need to raise capital to implement industrial plans and organizational change. This is because, unless they have a stable constant cash flow (Campiglio 2016), firms prefer to raise more financing without necessarily having to drain parts of their profits to fund the sustainability projects. Moreover, using working capital as a source of finance to fund a sustainability project may lead to failures in other parts of the business (Ioannou and Serafeim 2015). Usually, organizations choose debts as the best way to finance their sustainable goals (Eccles et al. 2014). The main advantage of debt is that it allows a company to implement an idea when it is best needed rather than

2. When it comes to initiatives implemented to comply with regulations, the return on the investment is calculated by the money otherwise used to pay for legal procedures and fines.

having to wait for several days or months for the corporation to find the required funds (Eccles et al. 2014).

The aim of this thesis is therefore to contribute to existing knowledge about how firms finance environmental sustainability strategies using debt capital. This is done first, by analysing the types of instruments corporations use to finance environmental sustainability; second, by studying the relationship between debt capital and corporate environmental performance, and; third, by deepening the study on the widely known and increasingly used security named ‘green bond’, the ad hoc debt tool developed in recent years to finance corporate environmental related projects.

This study is designed to contribute to the understanding of the relationship between types of finance and sustainability, and to provide an early response to the growing interest of financial markets and investment analysts in the interaction between corporate environmental strategies and debt instruments (Eccles et al. 2011), particularly since addressing this issue has sparked a recent growth in new and innovative financial solutions. For example, the growth in the green finance market for issuers has been especially strong since the introduction of green bonds.

This thesis spans the two academic disciplines of finance and corporate sustainability, but does not dwell on the usual merge of the two, so-called ‘sustainable finance’, which, as the European Commission defines it, is ‘the form of financial service that integrates environmental, social and governance (ESG) criteria into business or investment decisions, ... [so] studies finance and financial decisions more broadly’. Rather than looking at the amount of money that companies or investors must allocate towards sustainable activities, the choice

here was to study how investor decisions about how their money is being spent (in this thesis proxied by debt features) may influence or be influenced by corporation sustainability performance. The value of this is that no previous study has focused on debt, capital markets and corporate sustainability under regular economic cycles. In fact, the few studies that have looked at the cost of debt as a deterrent to sustainability (for example, Dr Antoniades's research group) seem to have examined corporate behaviour during a financial crisis. Moreover, the studies on how the debt market might include sustainability data in risk forecasting have never isolated the environmental component from the analysis.

A substantial literature on the green bond market has developed since the start of this thesis. My own work on the green bond market was the first to look at the supply side for differences between developing and developed countries. Moreover, my study on spread influences was also the first of its kind and had repercussions on investor decision making, particularly by increasing the amount of rigour with which they approached proceeds definitions.

Although the discussion of green bonds (see Chapters 6 and 7) provides a first overview of the role they play in financing the investment needed to achieve global climate and energy objectives and the UN's sustainable development goals, there is no attempt to predict where the market may be going. Rather, the attempt is to give a scientific explanation of what variables may influence the supply to lower levels or the spread to wider ones over time.

Moreover, in this thesis, it is important not to shift attention away from the capital raised and invested in goods and services purely to improve the quality of people's lives. However, the purpose is to bring to light how the debt capital that companies raise to fund normal operations, namely corporate operations not

intended to increase sustainability performance, are also directly connected to environmental performance. In other words, the climate challenge that corporations face is a more holistic issue than it used to be.

1.2. Importance of the subject

While it is agreed that corporate sustainability is relevant for companies, to date very little attention has been paid to its actual financing, that is to the concrete steps needed to translate an environmental sustainability strategy into practice. Given the evolving role of the corporation in society, it is becoming increasingly necessary to deepen academic knowledge of the role, influence and influencers of debt, the type of capital that companies widely use to increase their engagement in environmental activities. More specifically, developing this understanding is imperative for three main reasons:

First, the accelerating rate of adoption, implementation and reporting on sustainability practices highlights that, for more and more companies globally, sustainability has become a central issue for the practice of strategic management and finance; therefore, understanding the role of debt capital financing is of vital importance for future developments of corporate environmental performance and environmental financing.

Second, there is a large body of work showing that sustainability practices have a significant impact on a company's relationships with its material stakeholders (Clark et al. 2015), including its customers (Bhattacharya and Sen 2003; Luo and Bhattacharya 2006; Sen et al. 2004), its employees (Bode et al. 2015; Gartenberg et al. 2019), regulators, local authorities and the investment community (Cheng et al. 2014; Ioannou and Serafeim 2015).

Third, as firms refinance via the debt market more frequently than they increase their capital (Oikonomou et al. 2014a), understanding restrictions that may limit or enable corporations from issuing more debts for environmental projects is of interest to all market actors.

Therefore, insofar as the literature on sustainability in the banking sector can be divided into two broad groups (Zeidan et al. 2015) – one dealing with external practices, which include banks' communications with shareholders and stakeholders over sustainability issues, and the other with internal practices, which include how sustainability issues are incorporated into risk management models and lending or investment decisions (Cojoianu et al. 2017), this thesis is a contribution to the latter. In fact, it will, with any luck, make ongoing contributions to business practices by providing useful information to business leaders, government policy makers, investors, scholars and stakeholders. The findings of this study include helpful information for business leaders and policy makers on the extent and nature of the relationship between leverage and environmental performance, which is useful when making decisions about debt pricing to increase sustainability. Understanding the relationship could possibly help business leaders see the possible benefits of implementing certain policies for increasing corporate social initiatives that might improve financial performance and firm growth and thus reduce financial leverage.

1.3. Knowledge gap

While several researchers in recent years have investigated the role of stakeholder engagement in financial capacity for sustainability (Clark and Viehs 2014; Freeman 2010; Jensen 2001; Kiron et al. 2013), the main focus has been on the

relationship between corporate sustainability performance measures and the cost of equity (Ng and Rezaee 2015). The majority of literature agrees on the positive effect that environmental, social and governance (ESG) factors have on the cost of equity, in that an increase in ESG activities lowers the cost of equity (Borghesi et al. 2014; Crifo and Forget 2015; Dhaliwal et al. 2011; Easley and O'Hara 2004; Francis et al. 2004; Mina et al. 2013). Despite these efforts, very few studies examine the role of debt stakeholders in funding corporate sustainability decisions, which are often made in complex environments involving many stakeholder groups with various goals and competing interests. Little is known about how debt funding sources, particularly debt pricing, may promote or prevent financial capacity for sustainability. An investigation into how the cost of the corporate debt and capital structure (the degree of leverage) influences corporate sustainability is urgently needed. Especially since sustainability is mainly funded by debt securities (regular and green bonds), debt financing has an important effect on how an organization implements its strategies, including its environmental ones.

This thesis is thus positioned in this stream of literature (Gebhardt et al. 2001; Gode and Mohanram 2003; Hou et al. 2012; Lambert et al. 2012) with a view to establishing whether cost of capital is an incentive or barrier to corporate sustainability. The need of debt holders to generate financial returns could cause such barrier, remarkable phenomena to study and examine across countries and according to corporate type.

On the same note, however little is known about how sustainability performance, particularly environmental performance, may influence the risk perception of credit markets and therefore may influence the price of borrowing, a

lot of studies have been looking at the effects of corporate social responsibility (CSR) and corporate environmental performance (CEP) on stock performance. A study that seeks to shed light on the tensions between financial and non-financial (environmental) sustainability performance measures and their interactive and integrated impacts on the cost of debt is therefore imperative. As the few studies produced so far only examine the aggregated impact of ESG dimensions of sustainability and their integrated effect on the cost of equity debt, a study that isolates the environmental effect from the others could fill an important gap in the literature.

Moreover, given the potential environmental and economic benefits that debt structures, particularly the growing role of a specific security – ‘green bonds’ –, it is crucial to understand the nature of the supply of green bonds and their global determinants, which have still not been studied. Although the number of academic and practitioner publications on green bonds has increased lately, many of them focus on the drivers of the market and on its demand (investor) side. A focus on the supply (issuer) side of the market, both in developed and developing countries, is not only useful but also vital for gathering knowledge on the key market drivers of the main financing tool for achieving a green economy.

Finally, much of the recent literature on the green bond market focuses on green bond premiums, particularly between green and traditional bonds, thus yielding controversial results (Karpf and Mandel 2018; Reboredo 2018; Hachenberg and Schiereck 2018; Wulandari et al. 2018; Zerbib 2019). In this context, no study has looked at whether there could be a premium among green bonds from the same issuer, which could explain the current growth in these investments and predict their potential endurance. New research on bond

issuances over time is therefore needed, particularly to help forecast the potential of this market in future years.

1.4. Hypothesis, research questions and methodology

In this section the main hypothesis behind this thesis as well as supplementary research questions are introduced. These are based mostly on previous empirical results, close dialogue with field experts and document analysis. A question of primary importance here is how the availability of funding may influence the implementation of environmental strategies, with a focus on debt capital markets. Given that financial crises have shown that environmental strategies are the first to be abandoned in case of financial distress, it is logical to expect that, the higher the cost of debt, the lower the corporate capacity will be to implement an overall sustainability strategy and, as a consequence, the lower the capacity of the firm to raise funding for environmental corporate strategy as a necessary condition to increase corporate environmental performance. Therefore, the first hypothesis reads as follows:

H1: The lower the cost of future debt, the better the corporate environmental performance

Second, an environmental strategy may have a value to a corporation beyond the normal expected risk and return attributes of a security. This could happen because financial institutions are keen to see a corporation's credit rating before issuing debt financing. Environmentally sustainable companies are considered less risky (Eccles 2018); also, companies with lower credit ratings tend to pay higher prices for their debts because financial institutions consider them riskier or more speculative (Dhaliwal et al. 2011). The question of whether corporate

environmental performance has a positive effect on firm value consequently needs to be analysed from the perspective of the debt market, particularly since debt financing has exponentially increased in recent years (Blackrock 2016; Standard & Poor's 2018). The debt market is in fact highly important for the external financing of corporations as, according to pecking order theory, most companies rarely use the stock market as an external source of financing (Myers and Majluf 1984). Therefore, in principle, creditors have the potential to provide for a transmission of corporate environmental performance in the valuation. The hypothesis that arises is whether this potential is actually put into practice. Therefore, the second hypothesis reads as follows:

H2: The higher the environmental performance of a company, the lower its cost of debt

Given the above premises, the focus on environmental sustainability and a growing awareness of environmental issues, particularly among European investors, the need to study the factors influencing the size of the green bond market is stronger than ever. While there is academic and practitioner evidence of an overwhelming demand for green bonds (HSBC 2017; Kidney 2017), empirical work examining the factors that affect such supply of corporate green bonds and its heterogeneity across different markets remains unavailable. Therefore, the third hypothesis reads as follows:

H3: The size of green bond issuance is influenced by factors that differ across emerging and non-emerging markets

Intuition suggests that a bond being green should not affect its cost, for green bonds rank on an equal footing with other bonds from the same issuer and have

the same features. Hence, there is no credit enhancement of green bonds that can explain a different price. However, anecdotal evidence has emerged that, in some markets at least, green bonds are receiving better pricing than conventional bonds (Boulle et al. 2016), with Zerbib (2019) even suggesting that there is a small negative premium (the yield of a green bond is lower than that of a conventional bond). Gillis and James (2015) claims that this has been the case with normal bonds historically. However, in the case of green bonds, the issuers experience additional costs for reporting to investors, buying second opinions from independent parties and tracking bond proceeds. Consequently, there could be differences in pricing among different issuances from the same issuer. Therefore, the fourth hypothesis reads as follows:

H4: 'The price of green bonds is influenced by issuance order

To address the hypothesis above, a mixed methodological approach grounded in new economic geography research is chosen. This school of thought emphasizes the social, cultural and political underpinnings of capital flows and markets and therefore this thesis relies on a combination of quantitative data and open dialogue with field experts. Quantitative methods have been selected as the predominant form of enquiry for this thesis because Symonds and Gorard (2010) indicated that researchers should apply the quantitative approach if the research objective is to test hypotheses pertaining to relationships among numeric variables. Datasets have been created from Bloomberg and Thomson Reuters data services and statistics applied to them to test hypotheses using numerical data for all variables. Babbie (2010) and Muijs (2010) posited that quantitative studies are useful for generalizing concepts, predicting future results, and investigating

potential causal relationships among variables. Although the investigation of causal relationships is beyond the scope of this research, the focus was on predictor and criterion variables that can lead to generalizable results.

To that, qualitative research methods that involved subjective interpretations of in-depth data collected from samples of respondents were applied. This is in line with many studies in the geography of finance which is based on in-depth interviews, or close dialogues with industry respondents as they promote theoretical innovation and test empirical results against third party standards of significance, relevance and coherence (Clark 1998).

The research design of this study is correlational, which is suitable for the study of possible relationships among known quantifiable variables. Although the existence of a relationship is not an indication of causality (Agbedeyi and Igweze 2014), when two variables correlated in this study, it was possible to determine the strength and direction of the correlation and predict the value of a variable (Trochim 2006).

1.5. Structure and limitations

After an extensive review of the literature (in Chapter 2) and the methodology section (Chapter 3), in this thesis an attempt is made in the remaining chapters to provide an answer to the research gaps mentioned above.

In Chapter 4, which consists of an empirical attempt to establish the relationship between corporate debt and environmental sustainability, the suggestion is made that it is not the level of leverage that influences environmental performance but rather future expectations over the cost of the

debt. This finding is in line with the previous literature on corporate finance that found how capital constraints play a role in companies' investments decisions.

In Chapter 5, the effect of the environmental aspect of environmental sustainability on the cost of debt is examined with a sample of bonds issued in the EU and USA market. A negative association was found between environmental performance and actual cost of debt, proxied as the bond coupon rate (interest rate).

In Chapter 6, the focus is on a form of debt, the green bond. By employing a set of tridimensional elements (security characteristics, issuer characteristics and market characteristics) across emerging and non-emerging markets, the focus here is on what factors affect the size of borrowing.

In Chapter 7, the investigation into green bond spreads deepens to reveal that green bonds issued later by the same issuer appear to have higher levels of yield spread over the government bonds compared with those issued earlier. This shows that a main determinant of the green bond spread is the order of issuance – in other words, the more progressive the issuance, the higher the spread.

Therefore, in Chapters 4 and 5, I investigate the relationship between CEP and debt financing on the organizational level, that is, what is the impact of CEP on debt financing and vice versa. In Chapters 6 and 7, I subsequently explore the determinants of green bonds supply and market spreads on the market level. In a way, the first half of the thesis conducts a micro-economic and the second half a macro-economic analysis of the dynamics of debt financing and CEP.

As there are many ways to score a company on environmental, social, and governance criteria, ESG results are difficult to compare and may not always be a perfect measure for sustainability. The main limitation of this thesis, therefore, has

to do with the nature of the ESG data. Third-party ESG data providers play an important role, but there are limitations in terms of differing methodologies that lead to variance in scores, which researchers should understand. The absence of standardization and transparency in providers' data collection and scoring methodologies pose key challenges, and the use of Bloomberg and Thomson Reuters as the only sources of ESG data for this research limits the challenge of relying on any one provider, particularly since both databases are the point of reference for many private and institutional market participants. While these score can help verify whether a company is greener than others, ESG analysis, by its very definition, is subjective, and different providers will inevitably have different ways of classifying whether they think social concerns are more important or whether they are driven by carbon footprint.

A quantitative research methodology usually requires a large sample size. Therefore, an additional limitation of this study has been the limited number of green bonds issued, which restricted extensive statistical analysis, particularly the comparison between private and public companies as well as regional comparison among EU countries. Lastly, the requirements for successful statistical confirmation of results are very strict in quantitative research. Because hypotheses are proven with few experiments, there is ambiguity in the results. Although these were retested and refined several times, more extensive access to corporate private financial data would be necessary to reach unambiguous conclusions.

Finally, Chapter 8, which concludes the thesis contains an outline of some important and interesting extensions for future research.

2

Literature Review

2.1. Background

Corporate involvement in environmental sustainability has been a gradual process since the 1992 Earth Summit in Rio de Janeiro created a ‘new energy in environmental governance, engaging actors beyond the state and across scales, from local to global, from communities to large transnational networks’ (Andonova and Hoffman 2012: 57). Ten years later, the Rio +10 summit in Johannesburg promoted corporate responsibility and accountability further (La Vina et al. 2003). The UN Conference on Sustainable Development (Rio+20) went a step further, declaring that sustainable development ‘can only be achieved with a broad alliance of people, governments, civil society and private sector, all working together to secure the future people want for present and future generations’ (United Nations 2015). Moreover, the sustainable development goals (SDGs) adopted in 2015 set out a specific goal (that of SDG 17), which advocates that principles of sustainable production and consumption must be widely adopted by 2030. Finally, in 2018 companies across the economy reiterated their support of the Paris Agreement and the decisions made at COP 24 in Katowice, Poland, to implement it.

This literature review consists of information obtained from peer-reviewed journal articles that led to the finding of similar and opposing views pertinent to corporate environmental performance, debt capital markets and green bond markets. The search topics included (a) corporate social responsibility, (b) stakeholder theory, (c) corporate finance (d) debt instruments, (e) financing sustainability and (f) green bond market.

2.2. The corporation sustainability challenge

From philanthropy to corporate environmental sustainability

Corporations are often thought to have a duty to identify and implement sustainable solutions (Azapagic and Perdan 2000) and to have the resources needed to address sustainability issues effectively (Dyllick and Muff 2016). A specific connotation of corporate social responsibility (CSR) has not yet coalesced, but the idea that businesses have societal obligations beyond individual business philanthropy was evident at the beginning of the nineteenth century. This tendency has intensified over the last forty years (Carroll 2008; Hay and Gray 1974), with company approaches to sustainability evolving from community engagement and philanthropic programmes to integrate strategies that focus on long-term value for shareholders, society and the environment.

CSR is distinct from corporate philanthropy in that it treats social activities as ‘part of a company’s routine operations, with its economic profit serving the long-term goal of contributing to social welfare’ (Porter and Kramer 2006; Zollo 2004). This idea opposes the shareholder view that the firm should only think about its shareholders by increasing profits and its own long-term value (Friedman 1970; Gyves and O’Higgins 2008; Fuller and Jensen 2002), which is maximizing

shareholder value. This change is the result of an increasing realization that companies should incorporate sustainability as a key element of business strategy (Bonn and Fisher 2011) because commitment to sustainability may actually enhance performance (Nguyen and Slater 2010). In the academic arena, the expressions CSR, sustainability, triple bottom line and corporate social responsiveness are often used synonymously (UNEP 2007). Since, however, no single definition of CSR exists, neither in the existing literature nor in language use, divergent interpretations of the term are common (Bassen et al. 2006). The linguistic and partly conceptual diversity of the CSR idea has led authors to study different faces of CSR derived from different disciplines of management and finance (Carroll 1979; Matten and Crane 2005; Wood 1991). Therefore, different scholars have explored the theme of CSR and related notions derived from various perspectives, such as social obligation (Bowen 1953; Carroll 1979; Kok et al. 2001), marketing (Hartman 2011; Lawton 2011; Maignan and Ferrell 2004), stakeholder relation (Freeman 2010; Greenwood 2007; Phillips and Hebb 2010), integrated strategy (Moon 2004; Vogel 2005), and leadership (Bass and Steidlmeier 1999; Maak and Pless 2006; Waldman and Galvin 2008).

Corporate sustainability addresses the ethical orientation of sustainability in terms of sustainable resource use, conservation and preservation, a rights-based perspective and deep ecology, which should include the intrinsic value of nature (Schuler et al. 2017). In other words, strategy decisions about resource allocations should progress from an instrumental approach through which social, human and environmental interests are computed to an inherent attitude that creates value for all stakeholders (Clark et al. 2015; Freeman 2010; Schuler et al. 2017).

According to Aras and Crowther (2008), there are different stages of maturity to reflect CSR and the adoption of strategies. Initially, the firms begin by engaging in window dressing, that is changing their wording to reflect CSR language but without substance. During the second stage, cost containment, firms re-engineer the business process to lower their consumption of water and energy and thus reduce costs and improve financial performance. The third stage, called stakeholder engagement, is when they start to focus on employee and customer satisfaction. The fourth stage consists of communicating about these initiatives by developing CSR reports and the fifth stage, sustainability, involves radical changes to business practices and a significant amount of process re-engineering.

From corporate strategy to corporate environmental strategy

Hinterhuber (2004) defines strategy as a way of using the resources and capabilities of an organization. Boddy (2005) describes it as a way of deciding what business an organization should be in, where it wants to be and how it is going to operate. Strategic management theory distinguishes between the market-based view of strategic management (Porter 1980), the resource-based view (Barney 1991), the emergent strategies view (Mintzberg and Waters 1985) and the relational view (Dyer and Singh 1998).

Corporate sustainability strategies describe how sustainability issues are dealt with in practice. According to Bansal and Roth (2000), environmental strategies are a group of practices and initiatives that mitigate a firm's impact on the environment. The main reason for choosing a sustainability approach is to reduce the negative environmental and social impacts of corporate activities while improving (or at least not reducing) the economic performance of the corporation (Baumgartner and Rauter 2017). Researchers' opinions are not unanimous:

Fernández and Souto (2009) argue that CSR has a negative effect on company financial performance because of the extra costs imposed by its practices on businesses. This argument reinforces Friedman's (1970) theory that the resources allocated to CSR fall as direct costs that reduce the shareholders' profit shares. Therefore, this theory suggests that it unnecessary for a company to become socially responsible because these costs reduce its profitability (Orlitzky et al. 2003). Karaibrahimoğlu (2010) studied the financial performances of 100 socially responsible companies before and after the 2007 crisis and found a significant reduction in CSR projects during the financial crisis, while other companies cut their expenses for CSR projects that were about to start (Kemper and Martin 2010). Where capital is lacking, many companies therefore need to change their business strategy (Peters 2009) and objectives to comply with social expectations (Porter and Kramer 2002).

Sustainability management, instead, is the formulation, implementation and evaluation of both environmental and socioeconomic sustainability-related decisions and actions (Bell and Morse 2012; Benn et al. 2000; Starik and Kanashiro 2013: 12).

Corporate environmental strategy and stakeholder's theory

To explain the CSR practices of firms, a number of studies use shareholder theory (Friedman 1970; Jensen 2001; Rappaport 1981) and stakeholder theory (Freeman 2010; Porter and Kramer 2006). Shareholder theory contends that firms aim to maximize profits for their owners, and so conduct social responsibility only insofar as it increases the prosperity of the shareholders (Friedman 1970). In fact, considering social or environmental issues would only produce unnecessary costs that might conflict with the target of increasing the share price.

Stakeholder theory, however, contends that the existence of a company is not solely for the maximum benefit of its shareholders, but also includes the interests of other key stakeholders. Stakeholders are defined as ‘those groups and individuals who can affect or be affected’ by the actions connected to value creation and trade (Freeman 2010). A primary stakeholder is one whose continuing support for the corporation is required if the company is to continue as a going concern (Clarkson 1995). Examples of primary stakeholders are shareholders, creditors, employees, customers, suppliers and regulators. Secondary stakeholders, though, are groups with the capacity to mobilize public opinion in favour of or in opposition to the firm (Freeman 2010). Stakeholder theory is one of the major, if not the most frequently used, approach in social, environmental, and sustainability management research (Frynas and Yamahaki 2016; Montiel and Delgado-Ceballos 2014).

Mutual interest stakeholder theory is about creating value for all the stakeholders involved (Freeman 2010). It rejects the idea of separating ethical issues from business on the grounds that business and ethics are not contradictory, but fundamentally interlinked. Instead of separating these issues, to create real value for stakeholders, or to contribute improved environmental performance, both have to be linked to the core business of a company (Freeman 2010; Kolk and Pinkse 2007; Loorbach and Wijsman 2013). Due to the strong focus on integrating responsibility into daily business operations, stakeholder theory opposes the concept of residual CSR (Hörisch et al. 2014). Freeman (2010) felt that stakeholder power could be classified as voting for political and economic power. Shareholders exercise voting power by virtue of their equity stake in the firm, while regulators and lobby groups exercise political power. Customers,

suppliers and creditors are able to exercise economic power by switching to another firm, increasing prices and the cost of capital and withholding supply. Cornell and Shapiro (1987) demonstrate that creditors are important stakeholders whose influences should be managed as part of the firm's stakeholder strategy. The creditors' stake in a firm is to ensure that the firm taking on risky activities does not reduce the value of their claim on the firm. A firm that conducts its business in an environmentally irresponsible manner is increasing the risk of the creditors' claim because such activities attract severe and costly sanctions. Sanctions for socially undesirable corporate activities include monetary penalties under legislative enactment and regulations (Deegan and Rankin 1996), adverse judicial decisions and consumer retaliation (Spicer 1978). As controllers of access to financial resources, creditors are able to exercise their economic power by increasing the cost of capital or withholding debt finance (Kent and Chan 2009). The power of the creditors in relation to the firm can be measured by the degree to which the firm relies on debt financing for its activities (Roberts 1992).

CSR reporting

There has been an upsurge in regulation around the globe in recent years, which requires businesses to reveal data on their corporate social responsibility issues and associated activities (Amel-Zadeh and Serafeim 2018; Amel-Zadeh et al. 2016). Between 2013 and 2016, the number of CSR or CSR-related mandates around the world increased from 130 to almost 250, with the EU recently introducing a directive requiring around 6000 large European companies to publish such information for fiscal years starting in 2017 (Matuszak and Róžańska 2017). Moreover, the number of companies with a full-time executive position dedicated to CSR doubled between 2003 and 2008 (Miller and Serafeim 2014).

Authoritative scholars in this area have captured the distinction between ESG disclosures and ESG performance (Al-Tuwaijri et al. 2004; Dhaliwal et al. 2011; Yip et al. 2011). ESG disclosures are not specific performance metrics but rather indicate the degree to which a firm is reporting on ESG information (Eccles et al. 2011) while ESG performance follows accounting guidelines.

The environmental accounting field has grown considerably, having emerged from a ‘twenty-year niche issue’ to a widely recognized topic (Bennett and Kottasz 2012), playing an important role in sustainability and its development. Specific to the accounting field and profession, some of those advancements include the issuance of the first Global Reporting Initiative (GRI) guidelines in 2000 (GRI 2015), and the initiation and expansion of services offered by accounting firms regarding climate change and sustainability services, with last but not least the establishment of integrated reporting standards such as the ones from the Sustainability Accounting Standards Board.

In 2017, 63 per cent of the largest 100 companies (N100), and 75 per cent of the Global Fortune 250 (G250) stated that they had applied the GRI reporting framework (GRI 2018). Increasingly often, environmental accounting is being translated into public environmental reporting, with the main motivations being institutional pressures to increase transparency, risk management of stakeholder pressure and, particularly when results are promising, competitive advantage (Hart 1995; Porter and Kramer 2011; Sharma and Vredenburg 1998; Spicer and Lambdin 2012; Surroca et al. 2010).

In fact, of the 2874 managers and executives from 113 countries who recently participated in MIT’s 2011 annual ‘Business of Sustainability Survey’, two-thirds

indicated that corporate sustainability was ‘critically important to being competitive in today’s marketplace’ (Kiron et al. 2012: 70).

It is expected that key shareholders have an interest in disclosing environmental information, as when the distribution of ownership of a firm becomes less concentrated, wider dispersion of ownership leads to better or more environmental disclosures. (Keim 1978; Roberts 1992: 601). Some authors, however, argue that key shareholders are also more powerful in suppressing information they view as private or detrimental to the company (Bushee and Noe 2001; Cormier and Magnan 1999; Leuz and Verrecchia 2005).

2.3. The corporation financing challenge

Capital structure theory

A company’s goal is to find the capital structure that maximizes the value of the firm. A company’s operations can be financed through its own capital (equity) or by borrowing money (debt). Investments can be financed through debt by issuing bonds or taking loans from financial institutions. Equity investments can be made from money retained earnings or through issuing stocks, which effectively means that you are selling a share of the company on the open or private market. Bonds, instead, are security instruments and represents a loan made by an investor to a borrower (typically corporate or governmental). Classic financial theory assumes that investors choose to maximize their investments by selecting a portfolio that gives the highest expected return at a given level of risk. This means that rational investors invest in portfolios that give the highest possible return for their personal risk preference. Building on this, pecking order theory (Myers and Majluf 1984) assumes the presence of information asymmetries in the market because senior

financial managers vary in the amount of knowledge they have about their companies and about firm specific risks.

Because of the knowledge gap between investors and the senior management of a company, investors tend to value different sources of financing differently. (Fraser and Bhaumik 2015). This leads to what is referred to as the ‘pecking order’, where companies prefer first to finance their investments with internal capital such as retained earnings, second with debt such as loans or issuing bonds, and last with the issuance of new equity.

Financial instruments for corporate environmental sustainability

Financial capacity, defined as the financial ability of organizations to carry out their missions and achieve their aims (Honadle 1981; Ingraham et al. 2003; Johnson et al. 2002), is a critical condition for implementing sustainability projects. As such, to support the scaling up of environmentally sustainable projects, corporations use a wide range of financing instruments. McHugh et al. (2013) group these into three broad categories – funds for overcoming financing barriers; funds for addressing specific risks to sustainable investments; and funds that address both simultaneously. These instruments can be categorized according to the level of risk associated with using them. For instance, Panayotou (2013) regards pure grants as the riskiest because there is no third party with control over the funds. Although equity comes with controls, the World Bank (2016) finds it risky for shareholders who are the last to receive compensation from the project. Lam and Law (2016) therefore conclude that debt in its various forms carries least risk.

The decision to undertake any form of investment depends on the extent to which a corporation evaluates the balance between risks and returns (Lin et al.

2012). In developing environmentally sustainable projects, corporations must address concerns about the levels of risk associated with the investment and its expected returns before deciding on the appropriate financing instrument (Verbruggen et al. 2010).

Grants

Entities use grants to fund part of the investment costs of environmentally sustainable projects (World Bank 2016). According to Sovacool (2013), grants reduce the ultimate financial cost of undertaking a project while increasing its competitiveness. However, Sovacool (2013) notes that the use of grants provides minimal control over the project itself. In fact, Abolhosseini and Heshmati (2014) also mention that grants create no incentive to force corporations to deliver a viable project, which is unlike debts, where the project must bring in sufficient revenues for repayment. Sovacool (2013), however, finds that the potential of grants to reduce the cost of a project outweighs the risks, therefore making it affordable. Sovacool (2013) also argues that, considering that there is no need for due diligence on repayment, grants tend to be relatively simple to implement and manage. The World Bank (2016), by contrast, warns that this does not mean eliminating the need to ensure that projects funded by grants meet the objectives for which the grant was intended.

Equity

Corporations use capital equity funds to scale up environmentally sustainable projects (Theurillat and Crevoisier 2014). However, Bocken et al. (2015) notes that this funding instrument can include long-term investments. In this regard, Bocken et al. (2015) bases his argument on the notion that equity investments are

used to develop high-risk projects that are likely to be followed by an exit in case of failure. The main targets of capital equity financing are new technologies with high growth potential (World Bank 2016). Bocken et al. (2015) states that if capital equity financing is high risk, then the returns will reflect this. According to Theurillat and Crevoisier (2014), capital equity financing is best suited to sufficiently developed financial markets where the financiers can easily exit their investment by selling their shares. Along these lines, Bocken et al. (2014) confirm that firms earning profits are free to reinvest some of them in corporate environmental sustainability. This makes equity among the primary sources of financial capital for established companies. However, Umamaheswaran and Rajiv (2015) state that even large firms will experience a period of low profits or even suffer losses when investing in sustainable projects. McHugh et al. (2013), therefore, advise firms to consider sources of financial capital other than equity. Gersbach et al. (2015) use the Modigliani–Miller theorem to explain how incentives affect the decision about whether to use equity and debt financing tools to fund sustainable projects.

Debt

Boubakri and Ghouma (2010) describe the cost of debt as the cost paid by the company to carry the acquired debt. When corporations choose debt financing, the financial institution does not dictate how the corporation manages the company (Stretcher and Johnson 2011).

Banks have an incentive to grow and this depends on the interest earned from debts. Similarly, since interest payments are only charged on qualifying debts, through the use of tax shields debt financing reduces the amount of tax that financial institutions must pay to the government. This makes the banks more

willing to offer debt financing to fund sustainable investments. Debt financing also increases the value of the corporation because of the available capital equity that remains unused. In this spirit, Morley and Singh (2016) postulate that corporations that seek external financing are likely to prefer debt to equity because debt financing does not alter the value of the corporations. According to the World Bank (2018a), corporations primarily use debt funds to reduce the costs of projects. In this regard, they provide concessionary funds alongside other expensive commercial funding.

Lenders may be opposed to providing debt to environmentally sustainable investments in cases where they have little or no knowledge of the project's risks. In this regard, Williams (2015) notes that debt guarantees can come to the rescue of corporations seeking funding and financiers alike by generating the track record necessary for lenders to fund such projects without strict terms. Alternatively, corporations may use shareholders' assets as loan guarantees to secure debts (McHugh et al. 2013).

2.4. Financing challenges with bonds

Bonds

A debt security, also called a bond, 'is a claim on a specified periodic stream of income' (Bodie et al. 2011). When a corporation borrows money, the lender expects to get something in return (as do the shareholders). Consequently, the principle of bond securities is that the corporation promises to make interest payments on a regularly scheduled basis and to repay the initial amount at a predetermined time.

Unlike equity securities, the debtor or borrowers of debt securities do not give away ownership to the firm and, generally, the creditors do not have voting rights. What separates the debt securities from regular bank financed debt is that the investors buy a share of a debt. This means that the issuer of the bond has a higher number of creditors, unlike bank debt where the bank is the only creditor.

The maturity date of a bond is the number of years until the face value is repaid or the 'length of time the debt remains outstanding with some unpaid balance' (Hillier et al. 2011). Different types of bonds have different maturity dates, which can be classified into short (less than three years), medium (between three and five years) and long (more than five years) maturity bonds. Bonds are often labelled fixed-income securities. This is because the bonds are a contract between a borrower and a lender, with a fixed interest rate. Investors buy the bonds, or contracts, which say they are entitled to an annual or monthly interest. When the predetermined date of repayment arrives, the full amount is paid back by the issuer (Choudhry 2004).

Issuing bonds has several benefits. For example, a fixed interest rate secures the financing costs when the market rate increases; the bonds usually have a longer maturity period than traditional bank loans; and they can potentially reach a larger pool of investors, thus gaining diversification (Fabozzi 2005).

Some risks associated with bonds are linked to the issuer's ability to pay the promised coupon (the annual promised interest rate), and to get the predetermined principal at maturity. In other words, the highest risk of holding a bond is the issuer's credit risk. According to Choudhry (2006), the only debts entirely free of credit risk are a few high-quality government bonds and some supranational issuances. To determine the credit worthiness of a bond issuer, corporations often

appoint external firms, usually named rating companies like Fitch, Standard & Poor's, or Moody's, to rate their debt. When corporations want to raise capital by issuing bonds to the public, they usually hire special parties, typically investment banks, which, for a fee, assist them with the issuing process and act as underwriter for the bonds and evaluate and take on the company's bond risk.

Once a bond is bought, the bondholder can buy or sell it in secondary markets (Crabbe 1991). If it is sold before it matures, the length of time to maturity and the current market interest rate will affect its value. This results in a price that is constantly changing in response to changes in the interest rate (Berger et al. 2014). Because of the inverted relationship between interest rates and bond prices, the bond prices will fluctuate inversely with the interest rate in the market (Bodie et al. 2011).

Green Bonds

With public funding already stretched on existing projects, to meet the targets of the Paris Agreement it has become imperative to explore other options, such as private sector financing (Xu et al. 2016).

According to the IPCC (2014), international climate finance consists of the cross-border flows of finance aimed at reducing net GHG emissions and/or enhancing climate change adaptation. These flows include those from both the public sector (in the form of bilateral official development aid, export credits and multilateral concessional and non-concessional payments) and from the private sector (for example, carbon market finance, REDD+3, green bonds and foreign direct investment).

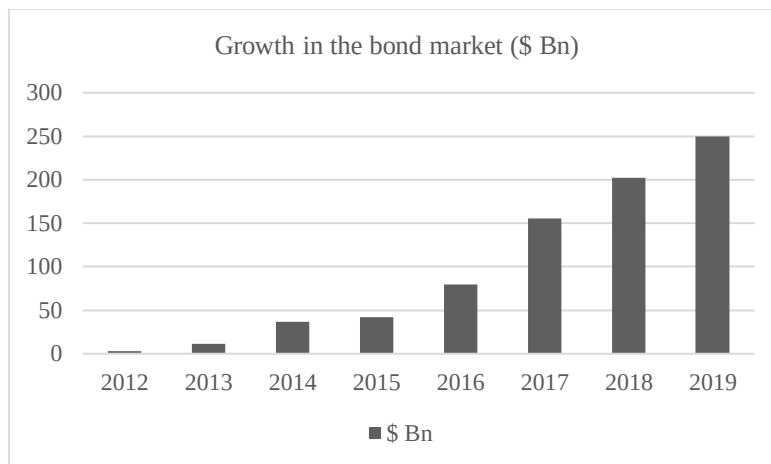
Private climate financial flows such as green bonds are still in their developmental stage. According to the Climate Bonds Initiative (CBI), the first

‘Climate Awareness Bond’ was issued by the European Investment Bank (EIB) and the World Bank in 2007, with the idea of mobilizing capital for green investments. This issue had a triple A investment grade and was listed on the Luxemburg Stock Exchange (LuxSE). In 2008, the World Bank, in close collaboration with the Skandinaviska Enskilda Banken (SEB), developed a framework in which the proceeds of these now called ‘green bonds’ went to green investments (World Bank 2018b). This marked the start of the market for green bonds.

There was minimal development in the green bond market during the the 2007/8 financial crisis, and its total market value remained below \$5 billion until 2012. The year 2013, though, became a milestone for the green bond market when, in March, the International Finance Corporation (IFC) issued a bond for \$1 billion that sold within one hour. The real turning point, however, came the following November when Vasakronen, the Bank of America and Électricité de France (EDF) issued the first corporate green bonds. From 2013 to 2014 the market size grew from \$11.1 billion in 2013 to \$36.6 billion in 2014, reaching 249.5 billion of total green bond issuance in 2018, with 625 issuers from 44 countries (CBI 2019a).

While supranational issuance classified the first years, companies and municipalities quickly followed.

Figure 2.1: Growth in the green bond market (total issuance | 2007–2018)



Source: Author analysis on Bloomberg data.

The most significant challenge seems to be the lack of an internationally agreed definition of what exactly constitutes climate finance (Bowen et al. 2017). Given that such a definition underlies the overall market, the absence of a standardized version makes it difficult to track and document the exact growth or flow in this market.

Although there is growing interest in creating a standardized definition, the market faces the challenge of lacking data that can accurately identify the various types of climate finance flows (Pickering et al. 2017). The market is therefore self-regulated and follows several regional/national guidelines. One of these, which the ICMA (International Capital Market Association) established, along with a consortium of investment banks, is called the Green Bond Principles (GBP). The ICMA defines green bonds as follows: ‘Green Bonds are any type of bond instrument where the proceeds will be exclusively applied to finance or refinance in part or in full new and/or existing eligible Green Projects and which are aligned with the four core components of the GBP’ (ICMA 2017: 2). Bonds that comply with this definition are now officially labelled ‘green bonds’.

The main investments in green bonds are in renewable energy, low carbon buildings, power efficiency, clean transportation, sustainable water management, sustainable waste management, sustainable soil use and adaptation forestry (Boulle et al. 2016). Some projects/investments are more difficult to categorize, for example the efficient use of energy in fossil fuel power plants would more than likely lead to an increase in cumulative carbon emissions over time. The Center for International Climate and Environmental Research-Oslo (CICERO) addresses this problem by emphasizing that such projects should be avoided when talking about green bonds (Clapp et al. 2015).

The primary stakeholders in the green bond market are issuers, investors, government and other non-governmental stakeholders (like industry associations, third-party verifiers and academia).

Most of the demand for green bonds comes from investors with ESG mandates (Andersson et al. 2017) and a substantial number of them are governmental investors, such as pension funds (Guttmann 2018). In a study conducted at Harvard Kennedy School (duPont et al. 2015), it was found that the green bond label does not yet allow issuers to access capital at a lower cost. In other words, investors are not yet willing to pay a premium for the green bond label, which in turn would give the borrower a lower interest rate. They predict, however, that since the green bond issuances have been significantly and consistently oversubscribed, such a high level of demand over time could increase the willingness of people to pay a premium for the green label. Barclays has found a high demand in the secondary market and observed growing price premiums over time (Preclaw and Bakshi 2015). A strong demand for green bonds in the secondary market is positive news for investors with liquidity concerns

(Ludvigsen 2015). However, although they are comparably priced in relation to traditional bonds, some studies show that green bonds might have lower risk-return profiles because of their emphasis on environmental diligence (Allen 2017). Furthermore, they can also increase overall capital flow by providing issuers access to finance at various stages of their project's lifecycle.

Primary stakeholders like issuers and investors are instrumental in determining the future direction of this market (Clark et al. 2015). Williams et al. (2017) summarize the main benefit for issuers in issuing green bonds. According to them,

Table 2.1: Types of green bonds

Type	Proceeds raised by bond sale are	Debt recourse	Example
'Use of Proceeds' Bond	Earmarked for green projects	Recourse to the issuer: same credit rating applies as issuer's other bonds	EIB 'Climate Awareness Bond' (backed by EIB); Barclays Green Bond
'Use of Proceeds' Revenue Bond or ABS	Earmarked for or refinances green projects	Revenue streams from the issuers though fees, taxes etc are collateral for the debt	Hawaii State (backed by fee on electricity bills of the state utilities)
Project Bond	Ring-fenced for the specific underlying green project(s)	Recourse is only to the project's assets and balance sheet	Invenergy Wind Farm (backed by Invenergy Campo Palomas wind farm)
Securitization (ABS) Bond	Refinance portfolios of green projects or proceeds are earmarked for green projects	Recourse is to a group of projects that have been grouped together (e.g. solar leases or green mortgages)	Tesla Energy (backed by residential solar leases); Obvion (backed by green mortgages)
Covered Bond	Earmarked for eligible projects included in the covered pool	Recourse to the issuer and, if the issuer is unable to repay the bond, to the covered pool	Berlin Hyp green Pfandbrief; Sparebank 1 Bolligkredit green covered bond

Source: The Climate Bond Initiative.

Table 2.2: Major publications on the relationship between sustainability and cost of debt

Study	Sample	Time period	Findings
Anis and Utama (2016)	Manufacturing industry (Indonesian stock exchange)	2011–2014	Indirect positive effect of CSR disclosure on cost of debt
Bauer and Hann (2010)	582 U.S. public corporations	1995–2006	Environmental practices associated with a lower cost of debt
Cooper and Uzun (2015)	US companies	2006–2013	Lower cost of debt
Ge and Liu (2014)	4260 new bond issues from 2317 firms	1992–2009	Issue bonds at lower cost
Goss and Roberts (2011)	3996 loans	1991–2006	Higher loan pricing
Hoepner et al. (2016)	470 loan agreements	2005–2012	Higher sustainability associated with lower cost of debt
Magnanelli and Izzo (2017)	332 companies worldwide	2016–2017	Positive relationship with cost of debt
Menz (2010)	498 bonds	2004–2007	Higher bond spread
Nandy and Lodh (2012)	3000 US firms	1991–2006	Lower cost of loan negotiation
Oikonomou et al. (2014a)	3000 bonds related to 742 firms	2005–2010	Good performance rewarded through lower corporate bond yield spreads
Schneider (2011)	Industries in the U.S. chemical and pulp and paper	2000–2008	Environmental performance correlated to bond yields
Sharfman and Fernando (2008)	267 US firms	2006	Environmental risk management is associated with a lower cost of capital
Zeidan et al. (2015)	Agricultural industry in Brazil	2012–2014	The lower the cost of debt, the lower the expected default probability

Source: Author.

corporates and commercial banks can get investor diversification, stakeholder engagement, oversubscription and reputational benefits. Government and development banks instead, can benefit by increasing liquidity in the market, raising awareness with domestic and international investors, signalling policies to the market and managing some macroeconomic and fiscal risk.

On the other hand, given that infrastructural growth and upcoming projects are more common across emerging and developing markets, investors have an opportunity to diversify their investment according to geographical area (Clark et al. 2012), while making it known that the investments are made with a view to mitigating climate change. Furthermore, given that they come with different mandates, investors play a crucial role in defining the growth of the domestic as well as the international green bond market. For example, local investors such as retailers or treasuries can reduce risks in capital markets by allowing people to borrow in the domestic currency (Williams et al. 2017), while wealth funds or development banks can usefully encourage other investors into emerging and developing markets.

2.5. Review of recent literature

The current, albeit limited, literature can be divided into two main streams of research. One of these concentrates the analysis on the cost and issuance of corporate bonds (Chen et al. 2012; Ge and Liu 2015; Menz 2010), while the focus of the other is on private debts and loans extended mainly by banks (Anis and Utama 2016; Cooper and Uzun 2015; Goss and Roberts 2011; Hoepner et al. 2016). Their findings are disparate and heterogeneous. On the one hand, initial evidence suggests that firms with better sustainability performance ratings

experience a lower cost of debt (Bauer and Hann 2010; Nandy and Lodh 2012). For example, Sharfman and Fernando (2008) demonstrate that improved environmental risk management is associated with a lower cost of capital and Ge and Liu (2015) point out that a higher CSR score is associated with lower yield spreads in new corporate bond issue and better credit ratings. On the other hand, Menz (2010) shows that firms with higher CSR commitments face higher risk premiums. Likewise, Suto and Takehara (2017) find that CSR is positively associated with the cost of debt, suggesting that ‘CSR is perceived as an expense rather than risk-reducing by debtors’ (Suto and Takehara, 2017: 809). A set of recent studies, however, provides support for the notion that higher CSR levels are associated with lower costs of debt in different geographies, including Europe (Amal and Rim 2019; Eliwa et al. 2019; Fernández-Cuesta et al. 2019; La Rosa et al. 2018), Australia (Bhuiyan and Nguyen 2019; Jung et al. 2018), China (Fonseka et al. 2019; Gong et al. 2018; Huang et al. 2018), and the USA (Erragragui 2018).

These contradictory results show that the topic is still open for scholarly debate. Further research is required in the field to overcome certain sample collection problems and, in order to isolate and understand the drivers better, to conduct the research specifically on ESG (namely environmental) issues. Moreover, the results also highlight the importance of investigating the direction of the relationship to establish whether the prospective cost of debt affects a sustainability strategy and if a positive ESG performance might have an impact on the cost of debt financing, thus creating a circular relationship.

In fact, current research shows that banks include an assessment of environmental aspects in the credit risk assessments of their lending decisions (Aintablian et al. 2007; Cowton and Thompson 2000; Gray and Bebbington 2001;

Jung and Jin 2014; Mengze and Wei 2015; Weber 2012; Weber et al. 2008)

influencing financial capacity for sustainability.

As Servaes and Tamayo (2013) highlight, while there is growing evidence of an association between ESG and CSR activities on security pricing (Christensen 2016; Christensen et al. 2017; Dhaliwal et al. 2011), comparatively little is known about the context in which specific environmental securities are growing, particularly through the strong rise in the demand of institutional investors for a financial tool that incorporates both the need for an adequate short-term portfolio risk and return balance and a decrease in the risk of long-term climate change (Clark et al. 2015).

Pricing is a hot topic. The results of prior studies are quite mixed, and, in most cases, the analysis is based on only a small set of securities (Climate Bonds Initiative 2017; Ehlers and Packer 2017). For instance, several studies present theoretical models in which investors are willing to give up pecuniary benefits to invest in environmentally friendly or socially responsible assets (Friedman and Heinle 2016; Geczy et al. 2005; Heinkel et al. 2001). The latest studies in this field can be found in the broader asset pricing literature that explores how investors' 'tastes' for assets with particular characteristics can affect asset prices as in the Fama and French model (Larcker and Watts 2019). Preclaw and Bakshi (2015) argue that green bonds have been traded at a premium in the secondary market. Karpf and Mandel (2018) found a green bond discount (positive yield differential), which means that green bonds are traded at a higher yield than would be expected from their credit profiles and that the market therefore seems to be penalizing the 'green nature' of the bond, whereas Baker et al. (2018) noted a green bond premium.

A recent study investigating green bond pricing in the secondary market shows a negative yield premium (Bos and Kolari 2018). To tackle this question, Zerbib (2017) studied 135 investment grade senior bullet fixed-rate green bonds issued worldwide, with controls to measure potential differences in liquidity. For each green bond, Zerbib applied a matching method to select the two most similar conventional bonds with which to construct a synthetic conventional bond (interpolated/extrapolated at the same maturity date) with the same characteristics that one would expect for that degree of liquidity. He found a green bond premium in a fixed-effects panel regression between the green bond and the synthetic bond on various liquidity controls. All the above studies indicate pricing implications for green compared with conventional bonds and that these vary between markets and the type of issuing entity using the matching method.

3

Methodology

Since the aim of this thesis is to broaden understanding of debt structures and how they relate to corporate environmental performance, a convergent parallel mixed methods approach is adopted to provide a side-by-side analysis of the qualitative and quantitative data (Creswell 2014). For this, evidence is taken from (1) semi-structured interviews with the top management of a publicly listed corporation; (2) document analysis; (3) open dialogue with experts; and (4) financial databases. This technique is used in economic geography to build theories based on empirical observation rather than vice versa so that the relationship between theory building and empirical observation is recursive rather than unidirectional. Following this technique, it is possible to move backwards and forwards from theory and observation, thus building better theories or models rather than assuming to be always empirical rather than theoretical (Clark 1998).

3.1. Semi-structured interviews

The Oxford Smith School of Enterprise and the Environment's close relationship with PepsiCo permitted unparalleled access to the company's key decision makers, with whom it was possible to discuss corporate issues across the entire company.

During my first year of study it was therefore possible to organize and conduct two site visits to PepsiCo with a view to exploring the question of corporate environmental sustainability and understanding its key drivers from the perspective of senior management. Questions were raised about corporate

strategies and related financing in response to both internal and external pressures and opportunities within the firm.

The six questions now presented are to illustrate the relevant issues raised during the site visit. However, they are not intended to be a complete list, for different questions pertained to different interviews.

1. First, what were (and are) the forces shaping the Performance with Purpose (PwP) agenda? Please explain why the PwP agenda was developed and how it was initially implemented. How did board members and senior executives engage in formulating the PwP agenda?
2. How does the company formulate strategic frameworks and track performance?
3. Were the three elements – products, planet and people (PPP) – in the foreground when the PwP agenda was formulated? If not, why are they important now? From where in the company did they originate?
4. Just as importantly, how does PepsiCo set goals for specific areas? What is the normal mode for assessing and monitoring programmes?
5. What were and are PepsiCo's metrics with respect to PwP? What has been learned since its inception in collecting the related data? Have the metrics changed?
6. Given the size and complexity of the company, how have the PwP metrics been adapted to 'local' conditions along with reporting and accountability? Who collects the data?

In total, 19 senior executives were interviewed during two site visits. Within PepsiCo, these include people with the highest level of expertise inside the

company, ranging from the c-suite to operations, purchasing, agriculture, and sustainability senior managers who are key informants because of their position as ‘boundary spanners’ (Simpson and Power 2005) and their level of experience regarding the specific corporate issues. Please refer to Annex 1 for a full list of people interviewed.

The main purpose of the questions listed above was to understand how multinational corporations make sustainability decisions and particularly to understand how its different tiers of management perceive financing. A multinational was chosen because, in today’s world, some publicly traded corporations have more financial and political power than countries (Clark 2016). Potential bias may nonetheless have influenced conversations with some respondents who may have strategically downplayed the knowledge they had about the corporation’s financing mechanisms to hide challenging information.

By engaging in participatory research with PepsiCo, it was possible to acquire insights into the sustainability financing processes contingent on their being a debt issuer, and a platform from which to address the practical issues that corporations face. Moreover, the time spent with PepsiCo managers enhanced my understanding of the interorganizational dynamics associated with implementing sustainability, for PepsiCo’s PwP¹ is to ensure best practice among all food and beverage corporations and the consumer goods industry more broadly. Consequently, PepsiCo’s contributions to this research are in the nature of the insights provided, and practical assistance in understanding the results of the

1. With a view to shrinking its environmental footprint and working to uplift people and families, PepsiCo is committed to expanding its portfolio of more nutritious products.

regression analysis and its theoretical relevance to the new frameworks that have been constructed.

However, in no shape or form did the useful insights that PepsiCo provided influence my relationship with the company, the topic of this thesis, its direction, or its conclusions; and in no way was any chapter of the thesis a response to PepsiCo's business needs.

3.2. Document analysis

Document analysis is a systematic procedure for reviewing or evaluating documents and, like other analytical methods in qualitative research, it requires data to be examined and interpreted in order to elicit meaning, gain understanding and develop empirical knowledge (Corbin and Strauss 2008; Rapley 2007).

Documents serve a variety of purposes, but here they are used to formulate some initial questions that need asking and to provide a context for the green bond market hypothesis. Apart from providing contextual richness, they are particularly useful in pre- and post-interview situations. As document analysis is less time-consuming – it requires data selection as opposed to data collection – it is a good way to start research. Insofar as they bear witness to past corporate events, the documents provide background information on and historical insights into corporate sustainability, which is necessary for an understanding of the historical roots of the specific financial issues related to it.

As part of this study, a range of financial documents have been examined, particularly organizational and institutional reports, for example annual reports, investor memos, sustainability reports and related articles from a randomly

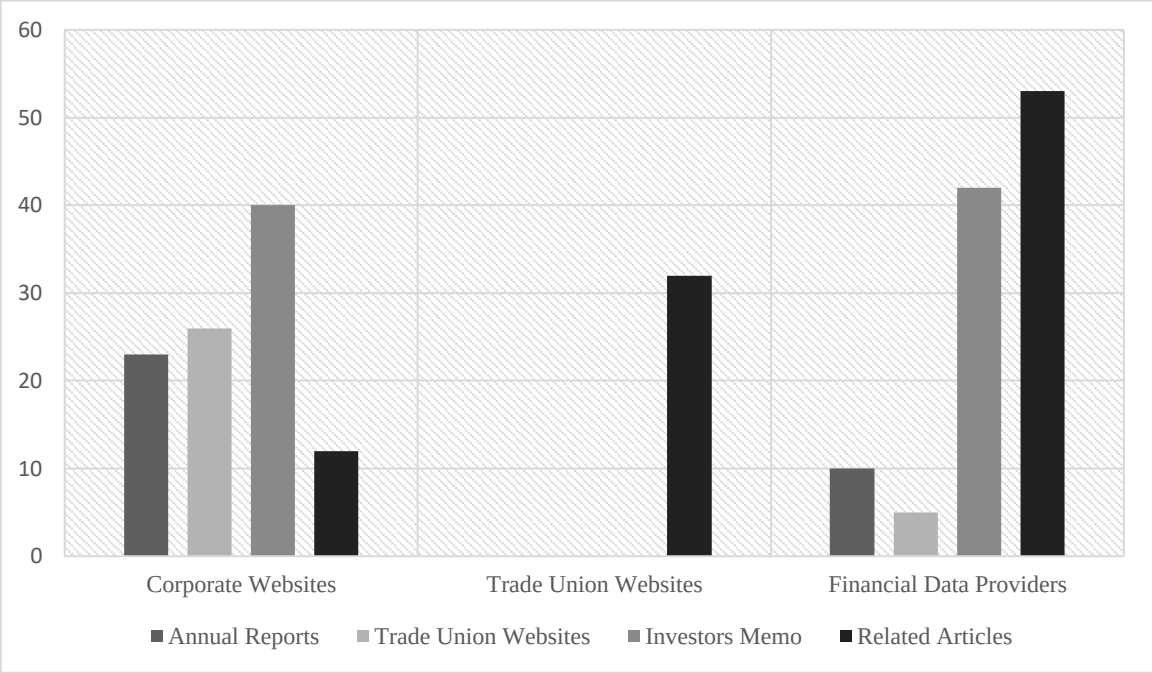
selected list of Fortune 100 companies and top 100 companies in Europe in terms of revenue.

Figure 3.1: Number of documents analysed for each corporation in the sample



Source: Developed by the author.

Figure 3.2: Number of documents from each provider



Source: Developed by the author.

To extract a sample from the immense population of corporations in the world, a random selection that might accurately represent corporate behaviour was used, with a focus on the EU and USA, but without them necessarily being leaders in sustainability. By examining information collected through random selections of document providers, the impact of potential biases was reduced.

These types of documents were found on company's websites, in company archives, on trade association websites, and on the platforms of the main financial data companies, namely Bloomberg and Thomson Reuters. A total of nearly 250 documents were examined.

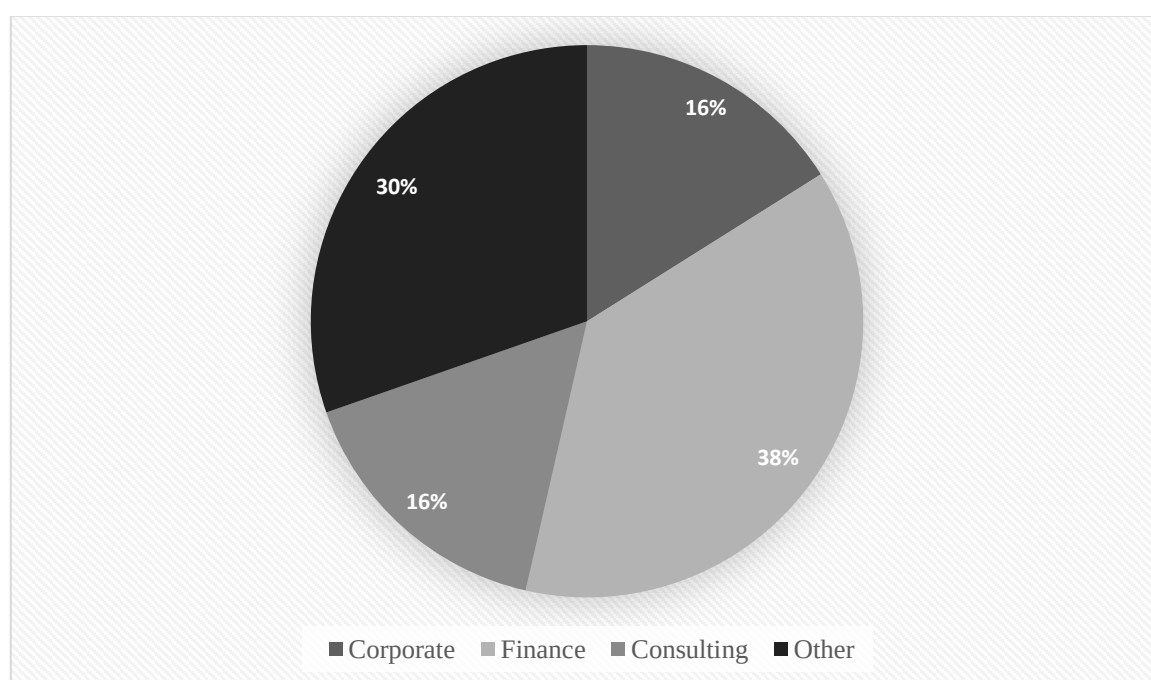
The document reviews were designed to identify how corporations finance sustainability strategies and to gather evidence on the importance of the role of structured debts in supporting such sustainability programmes. This prior document analysis was therefore essential for understanding how companies finance sustainability, their struggles with such financing and their position with regards to the green bond market. They were also key in providing a means of tracking change and development in the sustainability discourse over the years of the research and proved to be an excellent way of verifying findings and corroborating evidence.

A limitation of this method is that financial documents are produced for purposes other than research. Consequently, some of them failed to provide sufficient detail to answer background research questions, while others, particularly those based on secondary sources, lacked exactness (the inclusion of exact names, references, and details).

3.3. Open dialogue with experts

Document analysis is often used in combination with other qualitative research methods as a means of triangulation, namely ‘the combination of methodologies in the study of the same phenomenon’ (Denzin 1970: 291). Qualitative researchers are expected to draw on multiple (at least two) sources of evidence, for it is through the use of different data sources and methods that they find convergence and corroboration. For this reason, open dialogue with experts is an important means of gathering evidence and formulating an objective critique. The difference between open dialogues and interviews is that the first do not require a structure agenda and take place in a more informal setting under Chatham House Rule, where participants shared information and personal experiences and opinion, but neither the identity nor the affiliation of the participant, may be revealed. Several meetings with members of the Finance Working Group took place between October and December 2017, alongside additional interviews throughout 2018 with a wider pool of experts in the public and private sectors. More than 50 open dialogues have been conducted with various high-level stakeholders, including corporations (such as AB InBev, Danone, Diageo, Nestlé, Unilever and Walmart), regulators, industry consultants, academics, green bond issuers, underwriters, finance institutions and private investors (such as, among others, the World Bank, Blackrock, EBRD, HSBC, JPMorgan and Lazard).

Figure 3.3: Experts' background by sector



Source: Developed by the author.

Experts were able to identify which leading figures from the c-suite in top management were best placed to discuss the main themes of this thesis, namely sustainability, project finance, debt structuring – the role of debt in a corporation's sustainability strategy – the influence of non-financial factors in debt pricing and future trends in the green bond market. Participants were picked for their ability to influence the market's debt behaviour and there was equal representation of the different stakeholder interests.

The experts approached were key members of the various sectoral networks who attended the important global conferences (such as that of the ICMA, the Green and Social Bond Principles Annual General Meeting and Conference, and the Economist's Sustainability Summit) and had read all the various news articles and investors' reports. Since at the end of their interviews, many experts kindly suggested further names to contact, the 'snowballing technique' took form and became a powerful tool through which to gain exposure to different corporate

views. See Annex 2, for a full list of the people who engaged in this open dialogue.

The method used to contact people was an email outlining the study's research objectives, ethics clearance and an overview of the broad set of arguments that would be mentioned. Unlike standardized interviews, open dialogue is not arranged around a set of regulated questions and answers. Instead, it is organized around an interview guide that encompasses the key themes to be covered.

It was hoped that their insights would provide the practical, logical elements of the qualitative finance context. The main reason for the dialogues, at least in the US and European settings, was a lack of available literature in the field of finance and management on the nexus between debt financing and sustainability. In fact, one of the main purposes of this thesis is to access information of a sufficiently high quality to define research questions that have important implications for the 'real world'. Although the size of the interview group may have been a limitation of the study, the participants were exceedingly well informed on the topic and gave me impressive grounds for developing the hypothesis or this research further.

Given that Oxford University is committed to ensuring that its research involving human participants is conducted in an ethical way, before embarking on the discussions, approval was obtained from the Central University Research Ethics Committee (CUREC) and several integrity and ethics training sessions were attended. Being low risk research, that is research that does not touch on complex ethical issues such as political views or personal information, but merely involves interviewing experts in their fields, an oral informal consent process

sufficed. This entailed securing evidence that the participants understood and accepted all the information given to them, including any limits to confidentiality and anonymity, how the information would be used, and clarification of the participants' right to decline to comment.

3.4. Financial databases

The main financial data providers used here are Thomson Reuters Datastream and Bloomberg.

Datastream

Published by Thomson Reuters/Refinitiv, Datastream is a global financial and macroeconomic platform providing data on equities, stock market indices, currencies, company fundamentals, fixed income securities and key economic indicators for 175 countries and 60 markets (Reuters 2018a). Equity data are updated daily while the macro time series in the 'Economics' section appear on a monthly, quarterly and annual basis and contain up to 60 years' coverage.

A key feature of Thomson Reuters is its ESG scores platform launched in May 2018, which is an upgrade and replacement of the widely used ASSET4 database (Reuters 2018c). The database contains ESG scores on more than 7000 companies across the world, with time series data going back to 2002. Among the main ESG data providers, Thomson Reuters has the most historical ESG data on European and US companies and is the first to provide raw ESG data to investors (Huber et al. 2017). At the same time, they evaluate companies on more key issues than any other ESG data provider and are the only one that does not rely on company input in their assessment of ESG performance (Douglas et al. 2017). Being substantially less costly than its closest substitutes, it is the point of

reference for many private and institutional bond market participants (Cho et al. 2013).

More than 400 measures are used to calculate the ESG score, which is based on considerations around industry relevance, compatibility and data availability (Reuters 2018c). Of the 400 measures, the 178 most comparable and relevant are used in the final scoring process, grouped into three pillars (environmental, social and governance) and ten main categories.

According to Table 3.1, the environmental pillar consists of the weighted average of three specific scores – resource use (32.35 per cent), product innovation (32.3 per cent), and emission reduction (35.30 per cent). The resource use score reflects a company’s performance, as well as its capacity to reduce the use of materials, energy or water, and to find more eco-efficient solutions by improving supply-chain management. The innovation score reflects a company’s capacity to reduce environmental costs and burdens on its customers by creating new market opportunities through the adoption of new environmental technologies and processes, or through eco-designed products. The emission reduction score measures a company’s commitment to and success in reducing environmental emissions in its production and operational procedures.

Table 3.1: The main categories and weights of Thomson Reuter’s ESG scores

Pillar	Category	Indicators in rating	Weights (%)	Pillar Weights
Environmental	Resource use	19	11.0	(11+12+11)=34%
	Emissions	22	12.0	
	Innovation	20	11.0	
Social	Workforce	29	16.0	(16+4.5+8+7)=35.5%
	Human rights	8	4.5	
	Community	14	8.0	
	Product responsibility	12	7.0	

Governance	Management	34	19.0	
	Shareholders	12	7.0	
	CSR strategy	8	4.5	(19+7+4.5%)=30.5%
Total		178	100	100%

Corporate data, including firm characteristics, bond features and market performance, were retrieved from Datastream. Three databases were created from Datastream – two on corporate data to test the first (chapter four) and second hypotheses (chapter five), the other on green bond and Treasury spreads, to answer the fourth hypothesis (chapter seven). The corporate dataset only includes companies with a ≥ 0 ESG rating, which allowed to discard companies that lacked the environmental information that was fundamental to the analysis.

As the second paper only focused on the EU and US market, the industry grouping was used, in lieu of economic sectors, to guarantee that each cluster had enough observation to assure reliability of statistical analysis.

Table 3.2: Sample breakdown by country economic sector (Paper 1)

Name	Australia	Canada	UK	USA	Total
Basic materials	91	72	30	129	322
Consumer cyclicals	52	29	78	356	515
Consumer non-cyclicals	29	10	25	119	183
Energy	35	67	20	145	267
Financials	71	54	118	581	824
Healthcare	23	9	22	338	392
Industrials	47	30	75	342	494
Technology	20	14	17	315	366
Telecommunications Services	5	6	5	27	43
Utilities	8	14	9	70	101
Total	381	305	399	2422	3507

Source: Thomson Reuters data.

Table 3.3: Sample breakdown by country and industry group (Paper 2)

Name	EU	USA	Total
Financials	1165	1075	2240
Consumer Goods	73	147	220
Utilities and transport	202	631	833
Manufacturing	359	574	933
Services	275	608	883
Telecom	94	57	151
Total	2168	3092	5260

Table 3.4: Sample breakdown of bonds by country of issuance (Paper 4)

Name	Total
USA	143
EU	252
Sweden	109
China	114
Total	608

Thomson Reuters Fixed Income Database is used for the fourth paper. This database contains daily price and other bond characteristics on corporate and government bonds. The initial bond dataset contained a total of 934 bonds, with the ‘Green Bond’ tag, issued between January 2014 and December 2018. All the bonds issued in minor currencies, which did not provide a significant sample for observation, were eliminated from the sample, thus taking it to 599 bonds. The result yield data for each currency in the final sample was included in the dataset, and clustered for each maturity. Spread for each of the 599 bonds for the period January 2013 and December 2018 was calculated by matching comparable Treasury bonds against each green bond by maturity, coupon currency, and market of issuance.

Bloomberg

Uniquely, for the third paper (chapter six), a dataset of green bonds was extracted from Bloomberg Professional Services (hereafter Bloomberg). The explanation for this difference is in the timing of the project, which goes back to 2016 when Thomson Reuters Datastream was not yet available to students from the School of Geography.

Bloomberg is a major global provider of real-time financial news and information, including historical price data, financial data, trading news and analyst coverage. Bloomberg's fixed income trading platform provides data for all fixed income securities, derivatives and futures, and industry professionals consider this source to be the most comprehensive publicly available list of green securities (Larcker and Watts 2019).

Bloomberg tags bonds with the 'Green Bond' label in the use of the proceeds field when an issuer (a) self-labels its bond as 'green', or (b) identifies it as an environmental sustainability-oriented bond issue with clear additional statements about the commitment to deploy funds towards projects and activities in the Green Bond Principles use of proceeds categories. Compliance with the GBP is only on the use of the proceeds, of which 100 per cent needs to be aligned with green activities, which are consistent with GBP activities. Bloomberg does not, however, require additional reporting of proceeds for the bond to be included. Moreover, it observes specific exclusions for green bond use of proceeds, including, but not limited to, those involving coal and nuclear. Generally considered very reliable, at the time of this research there were some incorrectly marked securities in these data. For example, there are a number of securities identified as green prior to 2013, despite the fact that the first self-labelled green bond was marketed in June 2013 (S&P Global Ratings 2018).

Table 3.5: Sample breakdown of bonds by Bloomberg sector (Paper 3)

	Number of Bonds	Average Issue Size (M€)
Bank	319	338
Financial (non-bank)	44	285
Industrial	170	130
REIT	100	122
Utility	93	458
Others	45	316
Total	771	

3.5. Limitations

Both Bloomberg and Thomson Reuters software provide real-time financial data and news feeds; in fact, they are the top financial data sources available for researchers and investment professionals who seek to measure CSR (Scotti 2016). Hence, as measures, it is assumed that Bloomberg and Thomson Reuters financial and non-financial activity scores are suitable for this study. Limitations are uncontrolled issues representing threats to the validity of the study (Ellis and Levy 2009). This is therefore the first limitation: currently, there are more than 50 providers of corporate data and when it comes to environment, social and governance (ESG) ratings to benchmark performance, providers have different methods to calculate scores and typically created them to study supply chains, improve reporting, and build portfolios, not for research. The second assumption, and therefore limitation, is that the self-reported financial data, corporate performance measurements, and CSR data are accurate and honest. Although financial data for the companies observed from this study derive from publicly available financial performance measurements, are internationally accepted and have been accounting-based by external auditors, there is no strong consensus on the most suitable financial performance measurements for ESG scores, as useful

measures of CSR activities stem from records prepared and reported by each company; therefore, it is possible for errors or misrepresentations in the reporting to affect the findings of this study. Lastly, and linked to the above limitation, is the fact that data were obtained from large public companies listed in the Russell 1000 index, which excludes smaller businesses and medium-sized firms not listed in the Russell 1000 index that might contribute different data, which could affect the results of this study. The same limitation applies to the green bond market study where smaller companies that may be raising debt for sustainability may have neither the money nor the capacity to seek a green bond label on their debt transactions.

Does a higher degree and cost of leverage worsen corporate environmental performance?

4. 1. Introduction

The acceleration of climate change in recent years has increased the pressure on corporations to improve their environmental practices and key stakeholders expect to see an increased level of corporate environmental accountability (Buysse and Verbeke 2003; Delmas and Toffel 2008; Kassinis and Vafeas 2006). Corporate environmental performance (CEP) across company value chains presents great opportunities but comes with substantial costs (Economist Intelligence Unit 2008). Earlier examinations find that capital constraints assume critical roles in strategic decision making by influencing the firm's major investment decisions (Ducassy 2013; Stein 2003). The direct or indirect pressure for sustainability actions, either mandatory or voluntary, may require budgetary allocations or commitments that corporations cannot afford, or may fail to prioritize over financial returns. Therefore, sustainability concerns, like any other corporate action, require sufficient external or internal incentives.

Scholarly attention and managerial practices have made CEP a critical performance metric for corporations in recent years. This is particularly evident in the attempts of a growing body of literature to link CEP and corporate outcomes

from different vantage points (such as those of investors and lenders). Lenders view companies with poor environmental records as risky investments and, compared with their better performing counterparts, exposed to a higher risk of litigation. According to Derwall et al. (2011), exposure to higher risk drives lenders to demand higher interest rates for financing the debts of companies with poor environmental records. Earlier studies on environmental performance focused on the relationship between the CEP and financial performance of corporations from a lender's point of view (Dixon-Fowler et al. 2013; Endrikat et al. 2014). However, although there is little clarity over how lenders perceive the corporate cost of meeting higher environmental performance, it is evident that the cost of raising funding to pay for the strategies necessary to increase this performance may be a barrier as it is based on the market mechanism that guides the issuance of debt capital for environment-friendly investments (Luo et al. 2015). Regardless of whether CEP can explain, or is explained by, financial performance, neither the literature nor practitioners are adequately addressing the question of how the cost and structure of capital are influencing CEP.

The focus of this chapter is on how the cost of the corporate debt and capital structure (that is the degree of leverage) influences CEP. Debt financing has an important effect on how an organization implements its strategies, including environmental ones. However, a higher degree of leverage and/or a higher cost of debt could lead firms to deviate from their environmental objectives and prevent CEP. The urge to generate higher financial returns to service a debt could drive such a deviation. To examine the effects of the cost and degree of leverage on CEP, in addition to the other control variables, four key explanatory variables are considered – capital structure, total cost of debt, cost of long-term debt, and cost

of short-term debt. To capture CEP, the environmental pillar score from Thomson Reuters ESG data is used for selected publicly listed corporations from the USA, UK, Canada and Australia. The effects are estimated at three levels – (i) all companies as a whole; (ii) country-specific separate assessments; and (iii) sector/industry-wide estimations. Section 4.2 contains a review of the literature and an outline of the hypothesis to be tested; section 4.3 details the methodology followed; section 4.4 presents and discusses the results; and section 4.5 follows with a conclusion and a discussion about the implications of the findings.

4.2. Review of the literature and hypothesis

Definition and measurement of CEP

Over the last couple of decades, CEP has become a prominent field of research and several authors have tried to deliver a standard definition of it (Dahlsrud 2008; Poser et al. 2012; Trumpp et al. 2015), but there is still no agreed version (Yang Spencer et al. 2013). A key reason for this is that environmental issues cross complex fields of design, manufacturing, marketing, social responsibility, employees and the public at large (Etzion 2007).

Scholars across a wide range of research areas and disciplines have focused on the construct of CEP and examined its relationship with different organizational constructs or variables. Hart (1995) defines environmental performance as a combined approach of product stewardship, pollution prevention and sustainable use of resources.

A large body of literature suggests measuring environmental performance in terms of environmental impacts and outputs, such as toxic emissions/pollution (Cormier and Magnan 1997; Khanna and Damon 1999; Patten 2002a; Sam et al.

2009), emission volume (Porter and van der Linde 1995b), ratio of emission over output level (Arimura et al. 2008; Earnhart and Lizal 2007), and emission intensity (Jiang et al. 2014).

CEP can also be indirectly measured by the degree of compliances to environmental regulations (Dasgupta et al. 2000; Gangadharan 2006), chemical waste/recycled waste (Al-Tuwaijri et al. 2004; King et al. 2005; Theyel 2000), product life management score and ISO 14001 certifications (Lefebvre et al. 2003), level of energy usage (Cole et al. 2008), self-report surveys from managers (Judge and Douglas 1998; Dixon-Fowler et al. 2012), and a firm's emission reduction (Barba-Sánchez and Atienza-Sahuquillo 2016). Henri and Journeault (2010) argue that these 'single component focused' approaches limit the scope of environmental performance to operational outcomes and fail to consider further strategic elements of the construct (for example, product innovations or resource use).

Stakeholders are increasingly recognizing the importance of CEP and empirical studies show that analysts are considering environmental performance in their research recommendations (Ali 2017; Clark and Viehs 2014; Dahlsrud 2008; Eccles et al. 2011; Ioannou and Serafeim 2015). Particularly for large firms, greater environmental disclosure is found to be associated with an increase in analyst forecast accuracy (Dhaliwal et al. 2012). In this regard, many global corporations are paying increased attention to their environmental performance and, thus, increasing their resource allocations to environmentally friendly investments. Given that risk management is a key driver in superior economic performance (Oikonomou et al. 2014a), companies are increasingly considering

sustainability strategies to circumvent various risks, particularly any that might spoil their reputation.

In this research, CEP is measured in terms of the cumulative environmental pillar score measured by Thomson Reuters ESG database, which consists of weighted averages of three specific scores – resource use, product innovation, and emission reduction; this measurement is consistent with Hart's (1995) definition.

General determinants of CEP

The available literature identifies a wide range of factors that affect CEP. Many empirical studies employ theoretical arguments to define the components and underlying features of CEP, particularly stakeholder theory (Brammer and Millington 2008; Donaldson and Preston 1995; Freeman 2010; Jones 1995; Mitchell et al. 1997; Orlitzky et al. 2003) and resources dependency theory (Berman et al. 1999; Branco and Rodrigues 2006; Hillman and Keim 2001; McWilliams and Siegel 2001; Russo and Fouts 1997). González-Benito and González-Benito (2006) identify three features that often drive the environmental proactivity of firms: these are (i) company-specific factors (such as size and degree of internationalization), (ii) stakeholder pressure (primary-secondary, internal-external), and (iii) external factors (like location and sector of operation).

An environmental management system in a firm generally consists of internal policies, assessments and the implementation of actions that affect the entire enterprise and its relationship with the natural environment. Institutional theory suggests that regulatory, market and social pressures could constrain an organization's economic activities and/or create opportunities for strategic advantage with respect to the firm's environmental interactions (Hoffman 1999).

As customers become increasingly aware of the natural environment, market

pressures may encourage companies to engage in proactive environmental strategies (Darnall et al. 2005). Hoffman (1999) and King and Lenox (2000) found that environmental accidents have significantly increased social pressure from environmental and social groups, as well as from the relevant trade associations and labour unions.

The link between degree of leverage and CEP

The level of debt in a capital structure, that is the degree of leverage in a firm, is a significant determinant of the strategic choices made in an organization's financial management. An optimal debt level in the capital structure is a critical prerequisite for any business wanting to achieve sustained profitability, firm value and an increased ability to deal with market competition (Yazdanfar and Öhman 2015). According to Jensen (1986), if ownership and management are separated, as they usually are in large companies, debt financing has a disciplinary effect in that it increases the pressure on managers to perform more efficiently. According to Jensen (1986), if ownership and management are separated, as they usually are in large companies, debt financing has a disciplinary effect in that it increases the pressure on managers to perform more efficiently.

According to Magnanelli and Izzo (2017), when making issuance of debt decisions, lenders are likely to consider the post-cost-benefit tradeoff, which might include the expectations of future compensations for environmental investments. These considerations fall broadly in line with stakeholder theory (Miles 2017).

The relationship between the financing structure and a firm's performance is a frequently discussed topic in managerial finance. The presence of debt, either long or short term, in the balance sheet entails a periodic fixed cost in the form of

financial expenses. A higher degree of leverage would mean higher repayment burdens over the term or maturity of the debt; such burdens particularly of higher long-term debt could significantly constrain a firm's operating and investing abilities over a longer time period. In such cases, to meet higher repayment burdens, firms might be forced to prioritize financial returns over anything else, such as environmental concerns and using up some of the funds reserved for their CSR activities. Furthermore, firms might also decide to cut back some of their costs that do not provide immediate financial benefits, such as waste recycling, emission level reduction, and environmental resource efficiency. These consequences are eventually likely to reduce the CEP of firms. Schneider (2011) argues that poor CEP puts a firm at risk of future clean up and compliance costs, which may threaten the polluting firm's ability to pay creditors in the long term.

The prioritization of financial returns over environmental commitment could become more serious particularly in the cases of economic downturn. Pruitt and Gitman (1991) found that firms with a higher degree of leverage experience a higher volatility in investment and expenditure. In such a situation, managers lack strong incentives to invest in the environment and are likely to divert the debt capital to other profitable investments with higher short-term returns. To reduce the volatility, the firm's investment portfolio can be altered to sectors that provide higher rates of return but that generate higher environmental cost; such sectors could include coal and ore mining, cow ranching or non-renewable energy development. The inclinations towards financial returns over environmental performance could be further motivated by weak regulations and lack of incentives. Overall, the deviation from environmental towards financial objectives is likely to lower a firm's CEP.

The link between COD and CEP

The cost of a firm's capital originates from the cost of equity and debt utilized in its capital structure. Several studies suggest that CEP could have a significant association with COD. Ng and Rezaee (2015) found that firms engaging in environmental misconducts evoke negative reactions from lenders, because such behaviour is likely to affect the firm's default risk. This in turn could raise the cost of further financing for those firms. In other words, a firm's cost of debt could be prone to corporate social responsibility externalities. In an effort to negate lender reactions, firms often tend to publish information on their environmental performances. Kaymak and Bektas (2017) find that firms often produce useful environmental information for lenders, and more environmental disclosures tend to help lower the cost of capital removing the information asymmetry (Dhaliwal et al. 2011). Corporations are thus keen to leverage their environmental performance, which Martínez and Frías (2015) see as a way of reducing the cost of debt capital. In a study of the relationship between CEP and cost of debt, Eichholtz et al. (2019) point out that the cost of debt for commercial mortgages and corporate debt of property companies (REITs), is also affected by 'the crisis and post crisis period', especially in the post crisis period as lenders increasingly include environmental deliberations when determining their loan pricing.

Firms with poor CEP are more likely to risk litigation and clean-up costs, which could reduce their debt repayment abilities (Schneider 2011; Tse 2011). Lenders therefore charge more interests to companies that present poor CEP. Bauer and Hann (2010) find that companies with better environmental management have lower loan spreads, while Chava (2014) argues that firms with several pending environmental issues are likely to face significantly higher interest rates on their loans. Other studies suggest that companies that behave

irresponsibly in relation to environmental, social and governance (ESG) standards are likely to incur fines, penalties, government sanctions and other associated litigation costs, which in turn could result in a higher cost of capital financing and restrict access to finance (Bauer and Hann 2010; Dhaliwal et al. 2011).

Companies with good CEP records tend to be better placed to minimize risk (Chen et al. 2018). According to Yazdanfar and Öhman (2015), such risks are associated with an increase in debt covenants as the environmental performance of a company decreases (El Ghouli et al. 2011; Hong and Kacperczyk 2009). Oikonomou et al. (2014a) and Bauer and Hann (2010) show that firms with better corporate environmental management enjoy a lower cost of debt financing and recent studies provide further support for this relationship (Erragragui 2018; Fonseka et al. 2019; Jung et al. 2018).

Many studies suggest that firms with socially responsible and environmentally sustainable practices have a significantly lower cost of equity (Borghesi et al. 2014; Crifo and Forget 2015; Dhaliwal et al. 2011; El Ghouli et al. 2011; Mackey et al. 2007; Sharfman and Fernando 2008). Harrison and Wicks (2013) use agency theory to explain the conflicting interests between the shareholders and managers of corporations engaged in sustainable investments. They believe that shareholders expect managers to invest adequately in environment-friendly activities and projects to ensure that they are more stable and able to sustain themselves in the long term. Also, shareholders (owners) expect managers (agents) to deliver optimal returns and to ensure that there is an adequate cash flow to pay off debts and the interest on them over time (Engle 2007; Walls et al. 2012).

However, being environmentally responsible might interact with firms' operation performances. Several studies note a significant relationship between CEP and corporate performance, though they return different verdicts (Albertini 2013; Endrikat et al. 2014; García-Sánchez and García-Meca 2017; Hang et al. 2019; Herremans et al. 1993; Porter and Kramer 2006; Trumpp and Guenther 2017; Venturelli et al. 2018; Wiseman 1982). Goss and Roberts (2011), on the other hand, argue that some environmental investments tend to be very costly and might lower the company's profitability in the short run, though they find the returns in the long run to be unclear. Recent trends suggest that in an effort to leverage environmentally-friendly strategies in raising capital at an attractive cost, firms are increasingly considering using sustainable borrowing sources, such as green bonds (Barua and Chiesa 2019; Chiesa and Barua 2019). In this regard, corporations with good environmental credentials are likely to attract lenders and therefore lower the cost of debt.

Several studies have found a negative association between the cost of capital and financial and market performance (Gebhardt et al. 2001; Gode and Mohanram 2003; Lambert et al. 2012), which could also relate to a firm's environmental performance. Cost of debt capital could influence CEP, for Harrison and Wicks (2013) argue that the tendency of managers to pursue short-term objectives to lower their cost of debt could drive their decision and attention to divert away from environmental performances.

The literature on the link between COD and CEP does not offer much knowledge with respect to how COD could influence the CEP of firms, although the understanding is critical to put appropriate mechanisms in place to make corporations behave more responsibly. For example, if a higher cost of long-term

debt forces firms to prioritize financial benefits over environmental concerns to be able to repay the debt over a long period of time, it would eventually reduce the environmental performances of firms. Such a likelihood could also be evident across firms (for example, firms experiencing higher costs could have lower CEP). While the pressure of debt financing to a greater extent or to a higher cost could force firms to deviate significantly from environmental concerns, a lower degree of leverage or a lower cost of debt financing could also allow them to include environmental considerations in business and investment decisions. However, as specified before, no empirical study in the existing literature, to the best of my knowledge, has studied the potential effects of COD and the degree of leverage on CEP. In this chapter, I address this research gap by testing the following hypotheses:

Hypothesis 1. Cost of total debt does not influence CEP.

Hypothesis 2. Cost of long-term debt does not influence CEP.

Hypothesis 3. Cost of short-term debt does not influence CEP.

Hypothesis 4. Degree of leverage, that is capital structure, does not influence CEP.

In the next section, I detail the methodology of empirically testing the above hypothesis.

4.3. Data and methods

Variables and model specification

The exploration of the effects of the cost of debt and capital structure (namely the degree of leverage) on the environmental pillar (EP) score starts with the following functional relationship:

$$EP_i = \alpha_i + \beta_1 COD_i + \beta_2 CS_i + \beta_k X_i + \epsilon \text{ --- (1)}$$

$$i = 1, 2, 3, \dots, n$$

Where, EP is the environment pillar score, α denotes constant, COD is the cost of debt, CS stands for capital structure, X denotes control variables, k indicates the number of X vector, and ϵ is the error term. The intention is to examine the effects of the costs of long-term and short-term debt separately. Therefore, equation (1) can be expanded as follows by breaking down the cost of debt into the cost of short-term debt ($COSTD$) and the cost of long-term debt ($COLTD$):

$$EP_i = \alpha_i + \beta_1 COLTD_i + \beta_2 COSTD_i + \beta_2 CS_i + \beta_k X_i + \epsilon \text{ --- (2)}$$

$$i = 1, 2, 3, \dots, n$$

From the literature and available data, it is possible to identify a set of control variables. These are *firm size, business growth, market risk, age and experience, profitability, capital investment, and cash flow*. To operationalize equations (1) and (2), capital structure is captured by debt-equity ratio (DEQ), firm size by total assets (TA), business growth by revenue growth (GR) market risk by firm beta (Beta), age and experience by age of business (Age), profitability by return on assets (ROA), capital investment by annual capital expenditure (CAPEX), and cash flow by operating cash flow (OCF). Therefore, equations (1) and (2) can be expanded as follows for final estimations:

$$\begin{aligned} EP_i = & \alpha_i + \beta_1 \ln TA_i + \beta_2 Age_i + \beta_3 GR_i + \beta_4 Beta_{dum_i} + \beta_5 ROA_{dum_i} \\ & + \beta_6 \ln OCF_i + \beta_7 CoD_i + \beta_8 \ln Capex_i + \beta_9 DEQ_i + \sum_{j=1}^4 \beta_j C_j \\ & + \sum_{k=1}^{10} \beta_k S_k + \epsilon \text{ --- (3)} \end{aligned}$$

$$\begin{aligned}
EP_i = & \alpha_i + \beta_1 \ln TA_i + \beta_2 Age_i + \beta_3 GR_i + \beta_4 Beta_{dum_i} + \beta_5 ROA_{dum_i} \\
& + \beta_6 \ln OCF_i + \beta_7 CoLTD_i \\
& + \beta_8 CoSTD_i + \beta_9 \ln Capex_i + \beta_{10} DEQ_i + \sum_{j=1}^4 \beta_j C_j \\
& + \sum_{k=1}^{10} \beta_k S_k + \epsilon - - - (4)
\end{aligned}$$

In addition to the variables defined, equations (3) and (4) also control for country fixed-effects (C) and industry/sector (S) fixed-effects. A detailed definition of all variables specified in equations (3) and (4), alongside the justifications for their inclusions and their expected impacts, is discussed below.

In this analysis all the corresponding dependent variables are taken at the same point in time (t0) while CEP is taken at t+1. This because the corporate environmental score of a company is disclosed in the report published the year after.

Corporate environmental performance: this is measured CEP by using the Eikon ESG environmental pillar (EP). Following the definition provided by Eikon, the environmental pillar consists of the weighted average of three specific scores – resource use (32.35 per cent), product innovation (32.35 per cent), and emission reduction (35.30 per cent). These criteria are in line with Hart’s (1995) definition of environmental performance.

Thomson Reuters ESG scores are transparent, objective measures of the relative ESG performances of different companies with a weighted structure that guarantees the information is consistent and comparable across sources and companies.

Using company-reported data, the scores also capture the commitment and success of a company in addressing important environmental themes. Thomson

Reuters ESG scores, presented as either a percentage or as a letter grade, are simple to understand. According to Cho et al. (2013), they provide the best source of intelligent information, which is widely used by businesses and professionals alike. This is because Thomson Reuters ESG data are based on more than 250 key performance indicators and original data sources. Trained research analysts collect the data from a variety of sources, including but not limited to company reports, stock exchange filings and news agencies. After gathering the material, the analysts convert the qualitative data into easier-to-understand quantitative data units. Thus, professional and experienced evaluators achieve consistent and transparent Thomson Reuters scores. For this study, the cost of debt is a representation of the lender's marginal cost. It is the sum of the weighted costs of short- and long-term debt based on the one- and ten-year points of an appropriate credit curve. In the three selected countries, Thomson Reuters ESG scores applied indices of different levels of importance based on industry-specific, country-specific and regional operations.

The resource use score reflects a company's performance, as well as its capacity to reduce the use of materials, energy or water, and to find more eco-efficient solutions by improving supply-chain management. The innovation score reflects a company's capacity to reduce environmental costs and burdens on its customers by creating new market opportunities through the adoption of new environmental technologies and processes, or through eco-designed products. The emission reduction score measures a company's commitment to and success in reducing environmental emissions in its production and operational procedures.

Cost of debt: the cost of debt represents the marginal cost to the company of issuing a new debt. It is calculated by adding the weighted cost of the short-term

debt and the weighted cost of the long-term debt based on the one- and ten-year points of an appropriate credit curve. The costs of the short- and long-term debts are the marginal costs to the company of issuing new short- and long-term debts respectively.

Capital structure: the capital structure (or debt-equity ratio) is the proportion of debt and equity under a firm's control. In other words, it indicates the amount of leverage used in the firm's total capital investment. This is in line with Jensen and Meckling's (1976) argument that stringent debt covenants associated with the use of debt might confine a manager's ability to operate freely, which in turn affects the firm's performance. Moreover, the use of debt may decrease manager's share of equity and mitigate the loss that arises due to conflicts between managers and shareholders (Harris and Raviv 1991). The debt-equity ratio (*DEQ*) is used as a measure of capital structure and is expected to have a negative relationship with the EP.

Control variables: in addition to the key variables above, several measures commonly used in the analysis of financial performance as controls are included (Berger and Ofek 1995). The size of the firms (*Size*) is controlled because size affects the issuing of environmental reports, especially when large firms face pressure from the public or have adequate financial resources (Lang and Lundholm 1993). Size is also controlled because, generally, larger firms are considered safer and less risky than smaller ones. Firm size can be measured using some proxies, such as total assets, sales and number of employees (Berger and Di Patti 2006; Majumdar and Chhibber 1999; Sheikh and Wang 2011). Firm size is measured as the natural logarithm of total assets (*lnTA*) and is expected to be positively associated with CEP.

The proxy variable for firm age (Age) is the number of years since the firm's date of incorporation. Older firms are a priori more likely to benefit from a longer history of reporting (learning advantage), business experience, and more substantial pressure from investors and peers. Age is expected to be positively related to CEP.

There is also a control for a firm's growth rates (Growth) and this is compared with the three-year compound annual growth rate (CAGR) of EBITDA. The control for growth opportunities is necessary because, in an expansionary period, firms are more financially constrained and have fewer resources for environmental activities and disclosure. However, growing firms also tend to have higher levels of information asymmetry, which could encourage managers to make more disclosures to attract potential investors (Dhaliwal et al. 2011; Giannarakis et al. 2018). Growth is expected to be negatively related to CEP.

CEP often interacts with capital markets and investors. To capture the market reaction and risk, the firms' three-year monthly beta coefficient is used. Beta is the measure of movements in the firm's stock price, in response to the movements in the broad market index. Thus, it captures market and investor reactions to corporate actions and, as the literature shows, market and investor reactions often guide corporate actions. Hence, market and investor reactions primarily drive beta controls for the changes in the EP due to corporate actions. Although it is difficult to anticipate a direction, there is a naïve expectation that it will be positively related to CEP, that is, a higher market risk would possibly drive companies to become more environmentally responsible.

Return on assets (ROA) captures the influence of financial performance on CEP. As employed in previous studies (Margolis et al. 2003), ROA is a standard

accounting measure of financial performance commonly found in strategy research. There could be a positive association between financial performance and the EP, for higher profitability would give firms more financial resources for reinvestment. However, a negative association could emerge if, by prioritizing financial incentives over environmental concerns, firms sacrificed environmental performance in favour of higher profitability.

Capital expenditure (CAPEX) denotes the funds a company uses to acquire, upgrade and maintain physical assets such as property, industrial buildings and equipment. CAPEX is measured as the natural logarithm of capital expenditure ($\ln\text{CAPEX}$). As firms often use CAPEX to embark on new projects or investments, the expectation is that this type of financial outlay will affect environmental performance negatively, except when companies make investments to maintain or increase the sustainability of their operations.

The operating cash flow (OCF) is used to capture the firm's financial performance, strength and the availability of its liquid resources. Firms that can produce a higher level of cash flow from their operations can also generate greater financial returns from their regular business. Firms that generate higher OCF are generally regarded as having better financial health. In addition, a higher OCF means that more liquid financial resources are available to reinvest in the firm, including environmental resources. Therefore, greater cash generating firms are likely to be able to commit more resources to environmental concerns, which would yield a better CEP. The research uses natural log converted OCF values ($\ln\text{OCF}$) and a positive association between the OCF and CEP is expected.

In addition to the control variables identified above, the economic sector/industry fixed-effects (S) and the country fixed-effects (C) are included to

control for fixed regulatory, economic, and market-factor differences, for example demand, supply and prices, and the cyclical nature and average capital intensity of the industries under consideration.

Data

In estimating the cross-section equations (3) and (4), data are extracted on firms with ESG information from Thomson Reuters (TR) available through Eikon, which covers 3507 companies headquartered in the United States, the United Kingdom, Canada, and Australia. The environmental pillar (EP) score from the ESG framework is used to measure corporate environmental performance (CEP). The 2017 score values of the EP and the 2016 values for all the explanatory variables for all the firms are considered. This is because, to be reflected in the firms' EP scores, one would expect any effect of the explanatory variables considered to require a time lag. This time lag is considered to be one year, meaning that the effects of the explanatory variables on the EP score is considered after this time. The data are collected from Thomson Reuters to ensure that the information is standardized, comparable and reliable. All the ESG data are quality controlled and verified in a rigorous process to remove potential errors. Considering the cross-section data gathered, ordinary least squares (OLS) regressions are used to estimate the equations (3) and (4). Annex 1 provides detail on the calculation method of EP scores. Table 4.1 below shows the distribution of the companies available in the data across the four countries and the Thomson Reuters Business Classification (TRBC) sectors/industries. For more information on the definition of each industry please refer to Table A4.3.

The distribution shows that the data are heavily led by the United States. About 70 per cent of the companies are headquartered there, followed by the UK,

Australia and Canada. Given the distribution of the samples, a three-phase approach is adopted towards estimating equations (3) and (4). First, both equations are estimated for the whole sample combining all companies. Second, country-wide estimations of the equations are carried out for the four countries separately. Finally, sector/industry-wide estimations are run for both equations for the ten sectors/industries separately. However, considering the adequacy of the sample size, only run sector/industry-wide estimations are run for the USA.

Table 4.1: Sample breakdown by country and sector/industry

Name	Australia	Canada	UK	USA	Total
Basic materials	91	72	30	129	322
Consumer cyclicals	52	29	78	356	515
Consumer non-cyclicals	29	10	25	119	183
Energy	35	67	20	145	267
Financials	71	54	118	581	824
Healthcare	23	9	22	338	392
Industrials	47	30	75	342	494
Technology	20	14	17	315	366
Telecommunications services	5	6	5	27	43
Utilities	8	14	9	70	101
Total	381	305	399	2422	3507

Source: Thomson Reuters data.

Table A4.2 contains the descriptive statistics for the variables of the whole sample, including those for country and sector/industry, which show the broad characteristics of the data. Two common challenges involved in cross-section OLS estimations are multicollinearity and heteroskedasticity. To identify the potential biases, Breusch-Pagan/Cook-Weisberg and variance inflation factor (VIF) tests are run to detect heteroskedasticity and multicollinearity respectively.

Since Table A4.1 shows that some estimation samples display heteroskedasticity, robust estimations for them are carried out to minimize the biases. Two sectors – the USA sectoral samples of telecommunication and utilities – show significant multicollinearity mainly due to the very small sample size. In the detailed VIF estimates, the OCF variable is found to contribute greatly to multicollinearity, and, therefore, for these two sectors the equations are estimated after removing the

Table 4.2: Correlation matrix

	A	B	C	D	E	F	G	H	I	J	K	L
Environmental score	1											
Total assets	0.52	1										
Age	0.22	0.20	1									
Growth	0.02	0.03	0.00	1								
Beta	-0.09	-0.07	-0.06	-0.09	1							
ROA	0.14	0.25	0.12	0.01	-0.18	1						
Cost of overall debt	-0.02	0.23	-0.05	-0.02	0.19	-0.02	1					
Cost of LT debt	-0.20	-0.03	-0.15	-0.05	0.33	-0.25	0.77	1				
Cost of ST debt	-0.16	-0.06	-0.12	-0.07	0.23	-0.18	0.63	0.77	1			
Capex	0.40	0.79	0.18	0.03	-0.06	0.21	0.21	0.00	-0.03	1		
CF	0.31	0.49	0.13	0.02	-0.06	0.09	-0.03	-0.12	-0.10	0.43	1	
Debt to Equity	0.02	0.10	-0.03	0.01	0.03	-0.04	0.17	0.18	0.14	0.10	0.03	1

A = Environmental score; B = Total assets; C = Age; D = Growth; E = Beta; F = ROA; G = Cost of overall debt; H = Cost of LT debt;

I = Cost of ST debt; J = Capex; K = CF; L = Debt to Equity.

Source: Authors' calculation.

Table 4.3: Effects of cost of debt on EP: All sample (equations 3 and 4)

Variables	Equation (3)	Equation (4)
Firm Size (Intot_assets)	6.373*** (0.588)	6.446*** (0.585)
Age	0.094*** (0.014)	0.088*** (0.014)
Growth	-0.604 (0.498)	-0.596 (0.502)
Beta	0.373 (0.660)	0.823 (0.676)
ROA	0.056* (0.032)	0.037 (0.034)
CF (lnOCF)	1.146** (0.511)	0.922* (0.523)
COD	-1.053*** (0.254)	-
COLTD	-	-2.002*** (0.370)
COSTD	-	1.542** (0.660)
CAPEX (lncapex)	0.676** (0.344)	0.632* (0.345)
Leverage (Debt to Equity)	-0.000 (0.000)	0.000 (0.000)
Constant	-118.059*** (5.197)	-112.427*** (5.326)
R-squared	0.392	0.397
Prob>F	0.000	0.000
No. of obs.	2,147	2,146
Sector-FE	Yes	Yes
Country-FE	Yes	Yes
Multicollinearity [VIF test statistic]	2.30	2.46
Heteroskedasticity (Chi2 statistic) [Breusch-Pagan / Cook-Weisberg test]	7.46***	7.61***

Significance level: ***=1%, **=5%, *=10%.

Source: Authors' calculation.

OCF variable. All other samples, following the mean VIF cut-off value of ten (O'Brien 2007), show no significant multicollinearity. Table 4.2 shows the correlation matrix among the variables, which further supports the VIF results.

4.4. Results and discussion

Table 4.3 reports the results of the estimations of equations (3) and (4) for all firms included in the sample. Although the research began with a dataset on a total of 3507 firms, given the data availability of different variables considered, the estimations procedurally included a maximum of 2147 firms. The estimations controlled for both sectoral and country fixed effects.

Cost of debt

The estimates for equation (3) in Table 4.3 show that the cost of the total debt has a negative effect on a firm's environmental performance (CEP) and the result is significant at a 1 per cent level. The results suggest that a 1 per cent increase in the overall cost of a debt in a year (2016) is associated with a reduction of EP. Estimates suggest that a lower cost of debt increases environmental performance the following year (2017). This is further confirmed by the results of equation (4) on the separated effects of the costs (long and short) which have significant and negative effect on CEP. The result is significant at 1% level. The results suggest that a 1 per cent increase in the cost of a long-term debt in a year results in a decrease in environmental performance (CEP) by a score of 2.00 in the following year. This result indicates that the higher the cost of a firm's long-term borrowing, the lower its environmental performance is likely to be. However, this appears to be the opposite for the costs of short-term debt. The cost of a short-term debt shows a positive effect on CEP and it is significant at a 5 per cent level; a 1 per

cent increase in the cost of a short-term debt in a year is associated with a corresponding increase in CEP by a score of 1.54 in the following year.

The estimates could mean that long-term debt tends to be more expensive, possibly because of the greater uncertainty involved; it is likely to discourage corporations from making financial commitments to environmental investments. According to Palley (2013), a large long-term debt has the potential to create higher financial obligations, which may encourage managers to divert debts meant for environmental investments into alternative more profitable investments. In addition, since environmental performance has no short-term financial payoff, or cannot be translated into short-term financial returns, environmental investments may receive less consideration. This factor could be driving lower environmental performance.

The positive effect of the cost of short-term debt, however, offers a different insight. Generally, environmental performance requires time to reflect and a commitment to long-term funding. Firms only take out short-term loans to invest in the environment if they urgently need to improve their credentials to impress their stakeholders and stockholders (Clark et al. 2015). However, short-term borrowing can be used for environmental purposes, such as taking advantage of a premium price for more sustainable inputs, or paying off environment related fees, charges or lawsuits. In such cases, a firm could be incentivized to borrow short-term even if it carried a higher cost.

All in all, the findings suggest that greater long-term obligations and higher long-term costs can reduce corporate environmental investments and therefore influence environmental performance. Firms may be motivated towards short-term investment to drive immediate environmental performance. A higher cost of

short-term debt creates an obligation for a shorter period only; a desire to appear more responsible to the stakeholders in the short run could encourage firms to borrow at a higher rate.

Capital structure

The estimates of both equations confirm no statistically significant effect of degree of leverage on CEP. The results indicate that higher debt equity does not necessarily affect CEP, in particular negatively.

Considering the effects of both cost of debt and capital structure, the overall results indicate that it is the cost not the degree of leverage that significantly affects CEP. The ability of corporations to gain profit indicated by the degree of leverage has little effect on CEP. By contrast, the cost of debt determines how a loan can increase profits and in turn the amount of resources available for CEP.

Control variables

For the estimates, the most important control variables were selected from the literature. According to the estimates for both equations, firm size (total assets) has a significant positive effect on CEP. According to the estimates of equations (3) and (4), a 1 per cent increase in total assets in a year is associated with a corresponding rise of CEP by a large score of 6.373 and 6.446 respectively. These results indicate that the environmental performances of larger firms are likely to be better than those of their smaller counterparts. Furthermore, the estimates for both equations show that the age of a firm has a significant positive effect on it; according to equations (3) and (4), an extra year in age is associated with an increase in CEP by a score of around 0.09. This result could indicate that older firms are likely to perform better environmentally. This is consistent with earlier

studies indicating that older firms, potentially having been in the market for longer and with greater experience, are likely to be more environmentally responsible. This result is not surprising. Given that they have access to more resources, bigger firms are often at a more advanced stage of addressing environmental issues and, for many years, are likely to have incorporated environmental management into their environmental strategy. Furthermore, larger firms often have more knowledge of how to deal with multiple stakeholder pressures; also, due to their longer experience, they have been able to acquire the resources and skills they need to engage with the environmental activities of their business. An explanation for firm size is that it can be used to reflect firm visibility, and, since larger firms tend to be more susceptible to public scrutiny, they are more likely to be industry leaders on environmental performance.

Furthermore, there is a significant positive effect of return on assets on environmental performance, as evidenced by the equation (3) estimates. The results suggest that a 1 per cent increase in ROA in a year is associated with a corresponding increase in the CEP score by 0.06 points in the following year (in this case 2017). This result show that firms with a higher profitability are likely to have a better environmental performance. Profitability variables like ROA and ROS (return on sales) have an impact on CEP. The findings echo those of Qi et al. (2014) who found that a firm's financial performance affected its environmental performance.

Furthermore, the estimates of both equations consistently indicated a significant positive effect of operating cash flow (CF) on CEP. Those of equations (3) and (4) suggest that an annual increase of the EP score by 1.15 and 0.92 points respectively is associated with a 1 per cent increase in operating cash flow in the

preceding year. These estimates suggest that firms with a higher operating cash flow are likely to have a better environmental record. Firms with a higher operating cash flow have a greater potential for growth and therefore higher value price. According to Dragomir (2010), corporations with higher value price tend to have better environmental performances.

No significant effect of firm growth on CEP is found. An intuitive argument is that companies grow faster because they invest more in return-generating business opportunities to fulfil corporate objectives like expanding their production capacity or opening a new product line, but not because they invest in environmental practices or sustainability. Hence, growth may not have a relationship with CEP. However, although insignificant, the coefficients of the growth variable show a negative sign across the estimations, indicating a likely negative effect. A negative effect is likely when firms sacrifice environmental concerns to achieve a higher business growth, guided by purely business motives. Like growth, the other control variable, market risk, also shows no significant effect on the environmental performance of firms. It therefore confirms that corporate actions on the EP are not a response to the investor reactions or market movement in the stock prices. In other words, corporations do not factor in market reactions or movements while considering environmental issues in their business decision-making.

Country level investigation

Table 4.4 presents the estimations at a country level. When analysing the data at a country level, the results appear highly heterogenous. The significant and negative effects of the cost of the total debt (equation 3) on CEP can only be confirmed for the USA and the UK. Estimates for these countries are broadly consistent with all the sample estimations explained earlier; CEP declines by an annual score of 1.55

for the USA and 1.81 for the UK due to a 1 per cent increase in the overall cost of the debt in the previous year. However, when the cost of the debt is broken down (equation 4), the negative and positive effects of the cost of long-term and short-term debt respectively can only be confirmed for the USA. Consistent with all the sample effects observed earlier, a 1 per cent increase in the annual cost of long-term debt is associated with a corresponding decrease in CEP by a score of 2.31 for the US points. A similar increase in the cost of a short-term debt is associated with an increase in CEP by a score of 2.27 points. However, the breakdown estimates (equation 4) suggest that cost has no significant effect on either long- or short-term debt for the UK and no significant effect on any of the cost of debt variables for Australia and Canada.

In the last three years alone, environmental, social and governance (ESG)-related regulations have doubled across the UK, USA and Canada, which suggests that the ESG regulatory landscape is evolving fast (Datamaran 2018). While there are more discussions about CEP in the USA and UK, the long-term lending interest rates in these two countries over the last decade have been the second and third highest among the four in question. A possible link between the two countries in this respect is that, faced with a higher lending rate, firms perhaps fail to improve rather than lower their CEP standards. This result is consistent with the argument presented earlier that firms with a higher cost of debt, particularly long-term debt, are likely to bear the extra burden of having to secure the ability to repay it. That a significant portion of its income is being used for high-cost debt servicing would limit a firm's ability to pledge funds for environmental purposes. In such situations, corporations generally prioritize their finances over the environment.

Table 4.4: Country-wise effects of cost of debt on environmental performance (equations 3 and 4)

Variables	USA		UK		Canada		Australia	
	Eq. (1)	Eq. (2)	Eq. (1)	Eq. (2)	Eq. (1)	Eq. (2)	Eq. (1)	Eq. (2)
Firm size (assets)	6.569*** (0.769)	6.678*** (0.759)	4.303*** (1.494)	4.111*** (1.486)	8.436*** (2.302)	8.101*** (2.331)	6.281*** (1.548)	6.383*** (1.567)
Age	0.102*** (0.018)	0.096*** (0.018)	0.064** (0.030)	0.058* (0.031)	0.144* (0.080)	0.160* (0.082)	-0.004 (0.044)	-0.004 (0.044)
Growth	-0.654 (0.535)	-0.662 (0.555)	2.743* (1.482)	2.634* (1.479)	-1.310 (1.318)	-1.476 (1.357)	-1.494 (1.369)	-1.482 (1.370)
Beta	0.112 (0.882)	0.541 (0.899)	5.281** (2.351)	2.634** (1.479)	0.991 (1.667)	0.245 (1.780)	0.974 (2.296)	0.792 (2.340)
ROA	0.006 (0.057)	-0.034 (0.059)	0.041 (0.070)	0.041 (0.069)	0.065 (0.276)	0.157 (0.280)	0.012 (0.089)	0.019 (0.090)
OCF	1.552** (0.689)	1.294* (0.709)	-1.346 (1.422)	-1.319 (1.415)	-1.262 (2.155)	-1.414 (2.174)	1.817 (1.338)	1.883 (1.349)
COD	-1.054*** (0.307)	-	-1.806** (0.783)	-	-1.262 (2.155)	-	0.441 (0.846)	-
COLTD	-	-2.305*** (0.425)	-	-1.833 (1.455)	-	0.452 (1.727)	-	0.344 (1.595)
COSTD	-	2.271*** (0.811)	-	-0.404 (2.527)	-	-1.438 (2.158)	-	0.529 (2.557)
CAPEX	0.532 (0.486)	0.456 (0.486)	2.081** (0.834)	2.013** (0.824)	1.438 (1.262)	1.573 (1.274)	0.245 (0.840)	0.265 (0.844)
Leverage (debt to equity)	-0.000 (0.000)	-0.000 (0.000)	0.014** (0.006)	0.014** (0.006)	-0.002 (0.009)	-0.005 (0.009)	-0.008 (0.010)	-0.008 (0.010)
Constant	-136.887*** (6.916)	-129.707*** (6.872)	-51.517*** (15.364)	-43.401*** (15.820)	-134.562*** (22.019)	-131.746*** (22.832)	-121.226*** (15.384)	-126.718*** (18.524)
R-squared	0.388	0.395	0.296	0.251	0.421	0.414	0.418	0.418
Prob>F	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
No. of obs.	1433	1432	276	276	184	184	254	254
Sector-FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-FE	-	-	-	-	-	-	-	-

Significance level: ***=1%, **=5%, *=10%. ♣ = Multicollinearity tested by VIF statistic and heteroskedasticity (Chi2 stat) tested by Breusch-Pagan/Cook-Weisberg test.

Source: Author's calculation.

In Canada and Australia, a lack of significance can be explained by the real nature of the level of compliance. In Australia, despite increased debate on environmental regulations and their enforcements, poor CEP, whether intentional or unintentional, has become increasingly evident in recent years. In Australia mineral-based extractive industries such as coal, are very important for the economy. In the last decade, despite pressure from several green groups and community organizations, the country actually increased its reliance on pollutants. For example, while coal is considered the worst of the environmental pollutants, Australia is a major exporter of it. In fact, 77 per cent of its electricity comes from coal-based power plants and these create 27 per cent of the country's total carbon emissions (Commonwealth of Australia 2017). In 2016 alone, Australia produced about 6.9 per cent of world production (503 Mt out of a total of 7269 Mt). Its exports account for about 32 per cent of the world's total coal exports (389 Mt out of a total of 1213 Mt) from at least 405 coal mines, thus making the country the fourth highest producer and biggest net exporter of coal in the world (IEA 2017). Despite severe criticism of its contribution to emissions and climate change, Australia has shown flexibility and leniency towards its coal-based projects; it has agreed to expand Adani's Carmichael coal mine while 50+ applications are awaiting approval, which is about six times more than Canada's projected proposals (IEA 2016). Australia is also encouraging, rather than backing away from, more pollutant-based industries and, because of its relaxed regulatory climate, current policies are improperly enforced. CEP is likely to deteriorate because corporations tend to overlook environmental concerns and, regardless of the cost of capital, show no interest in improving CEP voluntarily. Furthermore,

the preference of firms in these two countries for internal sources to avoid the higher cost of whatever environmental investment they choose, is consistent with the pecking order theory stated by Myers and Majluf (1984), which could also play a role in the non-significant effect of the cost of debt.

The results show that, since a significant and positive effect is only found for the UK, capital structure has a limited effect. The result might indicate that higher leverage helps UK firms improve their CEP. This could be possible when the borrowed funds are invested in sustainability projects, or when debt covenants put direct or indirect compliance requirements in place. However, for the other three countries, there is consistent confirmation that capital structure has no significant effect on CEP.

The control variables provide broader confirmation of the positive effects of firm size and age across the countries. Growth and beta appear to have positive effects on CEP only in the UK, which means that firms that grow faster and take market reactions and movements into account are likely to have a better CEP. Higher growth can be linked to higher CEP when the growth is aligned with environmental considerations. The result on beta remains consistent with the expectation. Furthermore, CAPEX and OCD show positive effects on CEP in the UK and USA respectively, which is consistent with the arguments and general expectation cited earlier.

The results suggest that the effects of the variables on CEP are significantly heterogeneous at country level because there are wide-ranging differences in environmental and sustainability rules and regulations between countries. These differences may also exist between sectors in a given country, particularly since some sectors in a country may be well regulated, while others are less regulated or

not regulated at all. For example, most of the mandatory sector-specific regulations published after 2015 were aimed at the utilities, healthcare and pharmaceutical sectors (Datamaran 2018). Therefore, it is important to look into the sector-specific effects of the cost of debt on CEP. As specified in the methodology section, given the sample size limitations, this is applied only to the USA.

US industry-level

Because of the distribution of the samples across industries, a small number of observations were found for most industries/sectors for the UK, Australia, and Canada. To maintain the reliability of the estimates, only the sector/industry-wide estimation for the USA is considered because its sample sizes were larger. Tables 4.5 and 4.6 present the sector/industry-wide estimation results for equations (3) and (4) respectively for the USA.

CEP has mostly negative sensitivity to the cost of debt for five sectors in particular – consumer cyclical, financials, industrials, healthcare, and telecommunication. However, capital structure (namely degree of leverage) shows no significant effect on CEP in any of the sectors considered.

Consumer cyclical companies show very different results, for their cost of debt appears to have a negative and significant effect on CEP. Given the higher price of consumer cyclical goods and lumpier cash flows, this sector is defined by a presumed high-price elasticity of demand. As a result, these types of firms may need to prioritize using their cash flows to service debt financing at the expense of CEP. On the other hand, the cost of debt of non-cyclical companies shows no significance, perhaps because a presumed low-price elasticity of demand and therefore an overall lower cost of debt is characteristic of this sector. However,

Table 4.5: USA-sector-wise effects of overall cost of debt (equation 3)

	Basic materials	Consumer cyclicals	Consumer non-cyclicals	Energy	Financials	Healthcare	Industrials	Technology	Telecom	Utilities
Firm size (assets)	7.161* (4.156)	3.667* (2.184)	-1.327 (4.149)	9.443*** (2.903)	8.295*** (1.988)	6.016*** (2.077)	10.218*** (2.503)	8.752*** (2.799)	5.403 (5.389)	-1.416 (6.454)
Age	0.117** (0.051)	0.090** (0.046)	0.093 (0.065)	0.119 (0.073)	0.311*** (0.092)	0.018 (0.060)	0.070 (0.045)	0.138** (0.063)	0.039 (0.239)	0.061 (0.065)
Growth	-0.345 (1.263)	-3.217 (2.387)	-0.086 (5.508)	-7.253** (2.817)	-1.786 (1.561)	2.533 (1.620)	-0.829 (2.712)	0.591 (1.262)	-34.632 (39.373)	4.776 (8.910)
Beta	-2.244 (3.412)	-3.217 (2.387)	6.647 (4.504)	-0.128 (2.542)	-3.018 (3.698)	-0.799 (2.916)	-1.586 (2.344)	1.386 (2.334)	-5.340 (15.365)	-3.709 (7.829)
ROA	-0.027 (0.441)	-3.217 (2.387)	0.183 (0.367)	-0.479** (0.199)	0.181 (0.300)	-0.042 (0.113)	0.339 (0.297)	0.012 (0.135)	0.260 (0.368)	-0.632 (0.661)
OCF	0.564 (2.648)	3.809 (2.493)	6.485 (4.644)	1.503 (2.182)	-0.797 (1.994)	2.070 (1.806)	-0.067 (2.384)	0.746 (2.431)	Y	Y
COD	-1.294 (1.920)	-1.528* (0.791)	6.485 (4.643)	-0.268 (0.968)	-1.724* (1.036)	-1.913** (0.832)	-1.092 (0.820)	0.185 (0.860)	2.101 (7.051)	4.892 (3.544)
CAPEX	3.182 (3.200)	2.054 (1.423)	4.172* (2.311)	-3.054 (1.928)	0.026 (0.996)	-1.616 (1.144)	-0.315 (1.293)	-0.244 (1.430)	1.930 (5.109)	10.522* (6.145)
Leverage (debt to equity)	-0.001 (0.003)	0.000 (0.001)	0.008 (0.017)	-0.001 (0.002)	-0.002 (0.003)	-0.000 (0.001)	0.000 (0.002)	-0.008 (0.008)	-0.005 (0.004)	-0.036 (0.032)
Constant	-176.044*** (39.050)	-146.690*** (16.827)	-144.117*** (26.036)	-143.003*** (31.708)	-120.638*** (29.234)	-81.777*** (17.388)	-170.951*** (21.365)	-154.389*** (19.186)	-126.115** (53.199)	-137.445*** (49.951)
R-squared	0.382	0.395	0.477	0.508	0.272	0.407	0.370	0.462	0.730	0.456
Prob>F	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.015	0.000
No. of obs.	104	261	141	88	166	154	261	270	21	62

Y = OCF removed to mitigate the significant level of multicollinearity in the initial model. Significance level: ***=1%, **=5%, *=10%. Source: Authors 'calculation.

Table 4.6: USA-sector-wise effects of cost of long- and short-term debt (equation 4)

	Basic materials	Consumer cyclicals	Consumer non-cyclicals	Energy	Financials	Healthcare	Industrials	Technology	Telecom	Utilities
Firm size (assets)	6.376 (4.277)	4.252** (2.090)	-0.039 (4.155)	9.093*** (2.961)	8.171*** (2.003)	6.007*** (2.006)	10.602*** (2.211)	9.229*** (2.769)	-3.564 (5.811)	1.343 (5.860)
Age	0.115** (0.053)	0.090** (0.045)	0.083 (0.068)	0.115 (0.075)	0.296*** (0.0915)	0.002 (0.060)	0.070 (0.045)	0.138** (0.063)	0.103 (0.201)	0.045 (0.066)
Growth	-0.429 (1.271)	-3.458 (2.537)	2.334 (5.605)	-7.283** (2.836)	-1.592 (1.605)	2.101 (1.600)	-2.324 (1.884)	0.717 (1.264)	-33.147 (29.020)	5.321 (8.851)
Beta	-2.239 (3.513)	3.192 (2.188)	5.786 (4.522)	-0.333 (2.571)	-0.897 (3.795)	-0.598 (2.897)	-1.047 (2.060)	1.272 (2.365)	-8.322 (12.582)	-3.448 (7.819)
ROA	-0.051 (0.462)	-0.028 (0.195)	0.053 (0.365)	-0.464** (0.200)	0.196 (0.276)	-0.148 (0.116)	0.420 (0.269)	0.003 (0.134)	0.671 (0.539)	-0.910 (0.728)
OCF	0.447 (2.678)	3.117 (2.404)	5.009 (4.743)	1.558 (2.230)	-1.053 (1.914)	2.073 (1.756)	-0.846 (2.062)	0.384 (2.433)	γ (8.799)	γ (-2.747)
COLTD	-0.609 (1.714)	-2.263 (1.855)	-3.513 (3.710)	-1.005 (1.760)	-2.861** (1.310)	-4.639** (1.917)	-2.824*** (0.832)	-2.256 (1.815)	-8.799 (5.439)	-2.747 (4.432)
COSTD	-1.193 (1.770)	-0.205 (6.037)	11.858 (10.459)	1.735 (2.673)	0.686 (3.516)	6.119 (4.969)	4.339 (1.613)	4.534 (3.978)	20.977** (8.523)	5.882 (4.047)
CAPEX	3.904 (3.298)	1.909 (1.430)	4.598* (2.344)	-2.981 (1.934)	-0.039 (0.995)	-1.999* (1.132)	-0.245 (1.429)	-0.263 (1.429)	11.024* (5.497)	5.882 (4.047)
Leverage (debt to equity)	-0.000 (0.004)	0.001 (0.001)	0.015 (0.017)	-0.001 (0.002)	-0.002 (0.002)	0.000 (0.001)	0.000 (0.001)	-0.008 (0.008)	-0.004 (0.004)	-0.044 (0.035)

Constant	-168.267*** (43.338)	-135.558*** (17.323)	-147.393*** (28.485)	-136.337*** (36.414)	-107.205*** (33.396)	-67.974*** (16.812)	-164.810*** (18.766)	-154.328*** (18.540)	-89.371* (44.419)	-118.198** (52.870)
R-squared	0.363	0.405	0.528	0.510	0.281	0.427	0.390	0.466	0.825	0.466
Prob>F	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.004	0.000
No. of obs.	103	261	88	88	166	154	261	230	21	62

Y = OCF removed to mitigate the significant level of multicollinearity in the initial model. Significance level: ***=1%, **=5%, *=10%.

Source: Authors 'calculation.

capital expenditure shows a positive significance to the EP. This could signal that the larger the funds used by a company to acquire, upgrade, and maintain physical assets like property, industrial buildings, or equipment, the higher the EP.

The cost of overall debt has a significant and negative effect on CEP in the financial sector. A similarly significant and negative effect of the cost of long-term debt supports this result. These estimates confirm that a higher cost of debt, particularly long-term debt financing, reduces corporate environmental performance in this sector. The financial sector in the USA is regarded as a highly regulated industry subjected to a higher than average degree of competition and stakeholder surveillance, thereby putting constant pressure on profitability and cash flows. A higher cost of debt, particularly long-term debt, could force financial institutions to sacrifice their environmental performance to maintain a certain level of financial strength and stakeholder confidence. In fact, financial institutions seem to be more interested in discussing their role in influencing the environmental performances of borrowing institutions, for example green banking (Rahman and Barua 2016), than they are in their own environmental performance. Their tendency to overlook their own environmental behaviour could contribute towards lowering their CEP.

Unsurprisingly, the industrial sector's cost of long-term debt shows a significant and negative effect on CEP. Damages to the environment caused by industrial processes include, but are not limited to, a decrease in raw materials, a deterioration in the quality of the land, air and water, the extinction of species, human rights violations, and general environmental pollution. Thus, industrial firms often require important investments to upgrade their current facilities, treat

waste, and introduce prevention guidelines and training. Increasing industrial responsibility for ‘clean’ production processes is an important long-term material goal reflected in sensitivity towards the cost of the long-term debt.

The estimates show that a higher overall cost of debt has a significant and negative effect on CEP in the healthcare sector (equation 3). This result is supported by a significant negative effect of the cost of long-term debt (equation 4).

Healthcare companies are energy-intensive infrastructures, particularly in the USA where healthcare businesses are among the most energy-consuming of the sectors. Hospitals are also large waste producers, much of which is clinical waste. Given that consumers are failing to push these types of businesses towards sustainability, environmental initiatives could be very sensitive to the cost of financing. The results show that a higher cost of debt lowers the CEP of firms in this sector.

The cost of short-term debt has a further significant and positive effect on CEP in the telecommunications sector, where most environmental issues stem from the manufacturing process, particularly the disposal of electronic waste. Firms in this sector need to invest heavily to cover the costs of regular inspections and to keep their equipment functioning in line with environmental standards. The higher cost of a short-term debt could help telecom companies improve their CEP. Since this industry is sensitive to litigation lawsuits or other legal actions that may require short-term capital, the solution may perhaps lie in improving the sector’s CEP.

4.5. Conclusion

All other things being equal, this analysis suggest a main constraint on environmental investment is the cost of debt financing. If environmental investments are to achieve a high environmental performance, corporations must find ways of meeting the heavy initial costs and of ensuring that their investments generate sufficient revenue. When internal equity is not enough to finance such projects, firms use debt and face the risk of incurring higher costs. In fact, many environmental projects have high initial costs and therefore require long-term financing. While the literature includes discussions on accounting approaches to corporate environmental performance, it is evident that comparatively few studies explore how the cost of corporate debt and the structure of capital influence CEP. This study uses the environmental pillar score from Thomson Reuters ESG data firms drawn from the USA, UK, Australia and Canada to determine the effect of the cost of capital on environmental performance, thus discovering cost of debt to be the main constraint on sustainability investments. Most projects addressing corporate environmental performance have high initial costs and require significant long-term financing. Therefore, the availability and cost of financing are important factors in developing viable new environmental projects. Here, it is recognized that creditors who lend to corporations via loans, bonds, or other types of debt may create an additional impediment to environmental performance, particularly if they charge a high price in the form of interest and fees. A higher cost of financing could limit a firm's capacity to focus on environmental performance by hampering a manager's ability to address sustainability issues.

The effect of the cost of debt on CEP could happen in four main ways: (i) firms facing a higher cost of debt financing tend to invest their funds in projects that provide enough financial return to service the cost of debt, rather than in projects that are environmentally responsible or beneficial; (ii) firms raising debt finances at a higher long-term cost could experience significant pressure on their financial performance and financial strength for a long period of time; this prospect could motivate them to undertake projects that are financially attractive but not environmentally responsible; (iii) firms facing a higher cost of debt might need to use CSR-allocated funds in an attempt to service the cost of the debt, particularly during firm-specific crises and systemic downturns in the economy and the financial market; such a diversion of funds could eventually lead a firm to abandon its previously planned CSR or environmentally-related activities for one or several years, and thus reduce the firms' environmental performance; and (iv) lenders could impose a higher cost on firms that are currently environmentally-irresponsible, which could force them to deviate even further from their environmental goals. The likely effects of these four points could be the opposite in cases where firms face a lower cost of debt; in other words, a lower cost of debt would create lower cost burdens, thus allowing firms the flexibility they need to prioritize environmental objectives and thus encourage projects that are both environmentally and financially viable. Although this study covers an insufficient time to draw causality conclusions, findings are meaningful, particularly to managers and policy makers who are trying to find alternative ways to increase corporate sustainability.

From a managerial finance perspective, the association between firms' cost of debt, degree of leverage and environmental performance requires a thorough examination. In this chapter, empirical evidence of this link was provided by using reliable econometric techniques on a large data set of publicly listed corporations in the USA, UK, Australia and Canada. The overall findings indicate that a higher cost of total debt is likely to reduce the environmental performance of companies. In a further examination, using separate cost measures, it was found that it is particularly the cost of long-term debt that works as a deterrent, which suggests that long-term projects that may affect a corporation's sustainability performance in the long run may be set aside due to a lack of affordable financing.

Does a company's environmental performance influence its price of debt capital? Evidence from the bond market

5.1. Introduction

Economic activities are directly linked to environmental sustainability and, as such, firms play a crucial role in its promotion. Particularly, private sector firms or corporations need to play a more proactive role in fostering environmental protection and sustainable development (Barua 2019). As environmental and sustainability concerns continue to escalate around the world, there is an increasing demand on firms to disclose more information that is relevant to their corporate environmental performance (CEP). This disclosure demand is propelled by increased societal and corporate environmental awareness, as evidenced by the growth in socially responsible investment trends. Indeed, according to the US Forum for Sustainable and Responsible Investment (n.d.), sustainable, responsible and impact investing (SRI) assets have expanded to \$12.0 trillion in the United States, up by 38 per cent from \$8.7 trillion in 2016 and some \$2.1 trillion in 2000.

The increase in SRI investments and demand for disclosure captures stakeholders driven by both financial and non-financial motives. Those driven by financial motives are guided by the supposition that environmental information and sustainability are factors incorporated in risk and return profiles; thus, an

environmentally responsible company should enjoy financial benefits. Given these trends, a growing academic literature has developed the connection between environmental performance – including corporate social responsibility (CSR) more broadly – and the financial performance of firms (Albertini 2013; Cheng et al. 2014; Dhaliwal et al. 2011; El Ghouli et al. 2011; Goss and Roberts 2011; Cheng et al. 2014; Lee and Faff 2009). The empirical literature also shows the impact of CSR on the systematic (Oikonomou et al. 2012) or idiosyncratic (Luo and Bhattacharya 2009) risk of publicly traded firms.

Earlier studies have highlighted the difficulty of studying the link between CSR activities on security pricing (Christensen 2016; Christensen et al. 2017; Delis et al. 2018), with some providing contradictory empirical results on the research questions raised about the existence of an environmental and security pricing performance relationship and its sign (positive or negative) and magnitude (Anis and Utama 2016; Cooper and Uzun 2015; de Sousa Gabriel and Roceiro-Pazos 2018; Ge and Liu 2015; Menz 2010). In particular, evidence remains scarce on the impact of environmental performance, information, or, more generally, CSR variables on debt capital pricing per se on cost of debt (COD). As an attempt to address the literature gap, in this article, the effect of CEP on the COD is examined. Exploring this link is important because debt financing plays a crucial role in enhancing the growth and corporate sustainability of a firm (Betti et al. 2018).

This chapter is constructed around El Ghouli et al. (2011), who argue that the perceived risk of firms with high CEP is lower than that of those with low CEP. This is because CEP helps decrease firm risk by reducing the probability and impact of adverse events (such as environmental costs) while also creating

unforeseen opportunities (for example, new products or services, or better marketing of products and services).

While the rationality of the supposition that superior environmental performance (EP) might reduce financial risk could be established in both equity and debt markets, for a number of reasons the focus of this article is on debt markets (through cost of debt). First, due to the size and dynamic quality of bond markets across Europe and North America, the US corporate bond market is the largest in the world and accounts for approximately 44 per cent of the global market (Standard & Poor's 2018), while the European market accounts for 28 per cent of it (Blackrock 2016). Second, debt markets remain more institutional investor weighted than equity markets. Indeed, some 86 per cent of US corporate bonds are institutionally owned compared with about 64 per cent for US equities. This higher institutional weighting is advantageous in the context of this study because institutional investors are believed to be better informed than private actors and, as such, are better able to incorporate complex EP considerations into capital allocation decisions. Finally, given that debt is refinanced across different maturities, debt markets provide the opportunity to evaluate the potential time horizon impact of EP. This is significant given that the earlier literature suggests that the financial impacts of environmental performance are more likely to accumulate over the longer term (Cox et al. 2004; Hillman and Keim 2001).

The contribution of this study is that, although other academics (like Goss and Roberts 2011) have documented a significant association between CSR and the cost of debt, this study is one of the first to examine a direct link between the environmental dimension of ESG and the cost of the debt (coupon rates).

Moreover, it includes an analysis of the debt maturities that identifies the granularities of such an effect in the short, medium and long term.

This chapter is organized as follows. Section 5.2 contains a literature review and an outline of the hypotheses to be tested in this research, section 5.3 details of the methodology to be followed, section 5.4 a discussion of the results, section 5.5 an explanation of the interface between the cost of debt and environmental performance, and section 5.6 the conclusion.

5.2. Literature review

Corporate social responsibility and financial performance

A number of studies suggest that environmental information is a major concern for investors and other stakeholders, including regulators, in firms located in developed markets such as Europe and the USA (Bebbington et al. 2001; Cormier and Magnan 2003; Patten 2002b; Schmitz et al. 2019).

The literature provides substantial evidence of the relationship between CSR (and its sub-components), access to external finance, and cost of capital (Cheng et al. 2014; El Ghouli et al. 2011; Goss and Roberts 2011; Gupta 2018). Gupta (2018), who examines the relationship between environmental practices and the implied cost of equity, finds that an improvement in environmental practices leads to a reduction in the implied cost of equity. Similarly, El Ghouli et al. (2018) confirm that corporate environmental responsibility (CER) affects equity financing costs. Gao et al. (2019) also show how CSR reduces the costs of high leverage, while other studies find that better CSR environmental performance leads to lower yield spreads and better credit ratings (Attig et al. 2013; Ge and Liu 2015; Menz 2010; Oikonomou et al. 2014b). Furthermore, a number of recent

studies find that higher CSR levels are associated with lower costs of debt (Amal and Rim 2019; Bhuiyan and Nguyen 2019; Gong et al. 2018; Huang et al. 2018; Eliwa et al. 2019; La Rosa et al. 2018). Conversely, Magnanelli and Izzo (2017) report on a study showing a positive association between corporate social responsibility performance (CSP) and the COD, thus demonstrating that CSR is not a value driver with an impact on the firm's risk profile, while Erragragui (2018) finds that only a few constituents of CSP actually matter in a creditor's perception of firms' risks.

Broader research on the cost of capital supplements these conclusions. For example, several scholars (Christensen 2016; Christensen et al. 2017; Dhaliwal et al. 2011) uphold the suggestion of Servaes and Tamayo (2013) that there is growing evidence of an association between ESG and CSR activities on equity security pricing. Yet other studies show that banks include an assessment of environmental aspects in the credit risk assessments of their lending decisions (Aintablian et al. 2007; Cowton and Thompson 2000; Gray and Bebbington 2001; Jung and Jin 2014).

The general determinants of cost of financing through debt issuances

According to capital market theory, the expected return from a security is primarily a function of its risk. The price of the security reflects the present value of its expected future cash flow, which incorporates many factors (Clarke et al. 2001). As such, under the efficient market hypothesis (EMH), the price of a security should reflect all risk factors through various transmission mechanisms. With regard to the transmission of these risks into fixed income securities, there are a number of major elements, which affect the pricing of debt security such as coupon rates in the case of issuing bonds.

A bond issuer's choice of coupon rates could, in addition to other fundamental bond features such as maturity, be influenced by different factors. While the determinants of maturity have received wide attention in the literature (Körner 2007; Ozkan 2000; Stohs and Maurer 1996; Whited 1992; Yu 2005), studies on coupon rates remain relatively limited (Amiram et al. 2017; Jorion et al. 2009). Bahure and Singhal (2009) show that exchange rates, inflation rates, default rates, bond stability, bond maturity, and the liquidity adjustment facility (LAF) influence coupon rates. While default rates, stability, and inflation rates have a positive effect, maturity, exchange rates, and LAF show negative effects on annual coupon rates. Galil et al. (2014) consider a broad range of factors in examining the determinants of coupon payments alongside other control variables and find that the degree of leverage has a negative effect while proceeds from issuances (issue size), maturity, restrictive covenant features and redeemable features show positive effects on coupon payments. Accordingly, Owen et al. (2012) point towards a number of key factors influencing coupon rates that include the default risk of the issuer, current market interest rates and the maturity date of the bonds. On default risks, Elton et al. (2011) reported that the credit rating of an organization is a significant factor in influencing the pricing of fixed-income securities. Credit rating involves determining the ability of the firm to meet its obligations (Gourieroux et al. 2014) and the lower the rating, the more likely it is that the company will be unable to meet its debt obligations (Ortas et al. 2015). Given elevated levels of risk associated with lower credit ratings, issuers are required to offer a higher coupon rate than the prevailing interest rate to pay for the additional credit risk taken by the investors (Allen 2019; Ng and Ariff 2019).

The coupon rate of the security is also a function of the prevailing interest rate in the market. When the level of the market interest rate is higher than the coupon rate of the bond, the price of the bond is likely to decline compared with its face value because of rises and falls in investor demand (Weber et al. 2018). Hilscher et al. (2018) further report that high-interest rates lower the price of a bond, thus resulting in an increase in the yield to maturity.

The currency denomination of a coupon and the principal proceeds of bonds are also found to be critical elements, for currency exchange rates in the global market could reflect not only the macroeconomic stability and strength of the relevant countries but also the degree of credibility of the bond issued at the global level. Therefore, the currency of the denomination could help explain variations in coupon rates or yield levels arising from differences in country or market-specific fixed factors. Also, bonds denominated in US dollars or euros could have different levels of acceptance and credibility in the market for international finance.

With regards to maturity dates, Pescatori and Turunen (2016) report that bonds that have a longer-dated maturity are considered to have a higher risk than those of shorter duration. The relative elevated risk associated with longer duration bonds, predominantly a function of interest rate risk, is traditionally reflected through bonds with longer maturity offering higher yields than analogous shorter-dated maturity bonds.

Corporate environmental performance and cost of debt

Both financial and non-financial motives drive investors to seek environmental information from bond issuers (Tadros and Magnan 2019). Peters and Romi (2015) suggest that ethical overlays drive investors' non-financial motives,

whereas Pasewark and Riley (2010) link them to the investors' preference for investments that are consistent with their personal religious or political values. Furthermore, McCann et al. (2003) observe that many investors are pursuing a new form of ethical discourse in a move away from the 'hard-nosed form of capitalism' and globalization.

While initial assessments showed that only a subset of niche investors considered non-financial factors in their investment decisions, it is increasingly evident that there is considerable growth in CSR investing and that socially responsible investing has begun to 'enter the mainstream of investment practice' (Sparkes and Cowton 2004). However, much of this growth can be ascribed to overlap with investors driven by more explicitly financial motives. Graafland and Mazereeuw-Van der Duijn Schouten (2012) indicate that financial motives include acquiring environmental information with a view to reducing the risk of a company being unable to repay its debt obligations and thus enhancing its financial performance.

Nevertheless, while the literature linking environmental disclosure to financial outcomes is somewhat uncertain, Lyon and Shimshack (2012) identify several channels that may transmit this environmental risk into security pricing (with varying degrees of empirical magnitude). These channels include input market pressures (for example, investor preferences as they pertain to risk inferences); output market pressures (for example, consumer preferences); regulatory pressures (for example, an 'inevitable policy response' on climate change); and managerial information (for example, evidence of enhanced corporate governance procedures reducing risk).

As such, numerous studies highlight the link between financial motives and environmental information (El Ghoul et al. 2011; Gomes 2015; Kuzey and Uyar 2017), and they widely note that the disclosure of non-financial statement information allows users of the financial reports to acquire improved insights into the company's activities (Fonseka et al. 2019). For instance, Jung et al. 2018 demonstrate that companies exposed to carbon risks can mitigate the negative association between carbon risks and costs of debt (i.e. higher carbon risks are associated with higher costs of debt) by engaging in carbon-related disclosure. This reduction in information asymmetry reduces investment risk (Dhaliwal et al. 2011) because it enables investors to derive an improved understanding of a company's risk profile, thereby reducing a firm's cost of capital. Indeed, Bauer and Hann (2010), Erragragui (2018), Fernández-Cuesta et al. (2019), Schneider (2011) and Sharfman and Fernando (2008) show that proactive environmental risk management lowers the cost of debt and increases credit ratings.

In general, a firm exposed to material environmental performance factors carries a higher probability of negative event impacts, which leads to a higher cost of debt. Both explicit financial penalties and negative stakeholder (including investor) reactions may influence this higher cost of debt, and each of these could in turn influence default risk. There are many examples of such incidents, including the downgrading of BP's credit rating following the Deepwater Horizon oil spill in 2010 and the downgrading of the credit rating of Vale S.A. after the Brumandinho disaster in 2019.

Furthermore, as Bauer and Hann (2010) noted, considerable environmental liabilities can create intractable risks for a firm and can increase the likelihood of strategic bankruptcy. Examples of such bankruptcy filings are growing globally,

with the most notable recent case being that of the Pacific Gas and Electric Company's (PG&E) bankruptcy proceedings in response to the Camp Fire of 2019.

With specific reference to the incorporation of a material subset of environmental risks – climate change risks – into asset prices, Connaker and Madsbjerg (2019) report that climate change has become critical to the fixed income market in the USA. This is because of the materiality of the physical and transitional macroeconomic risks derived from climate change, as identified by Batten (2018).

All things considered, the likely increase in default probability and the loss of severity of investments in firms that are more exposed to environmental risks should influence credit ratings and thus, costs of debt financing.

Towards a theoretical framework on the link between CEP and COD

Given the available literature, to explain the possible effects of CEP on COD, it is expected that CEP would have an influence on a firm's pricing of debt financing, namely cost of debt financing. Companies with a higher CEP are better able to mitigate environmental risks and exploit environmental opportunities; alternatively, better management of environmental impacts (such as promoting positive and minimizing negative externalities) eventually drives up CEP for a firm (Erauskin-Tolosa et al. 2019; Hörisch et al. 2015; Melnyk et al. 2003; Testa et al. 2017). Firms that are known to be more environmentally responsible and sustainability oriented with a higher CEP would, therefore, have a better reputation in the society and communities (Bansal and Clelland 2004; Bansal and Roth 2000; Morales-Raya et al. 2017); therefore, society or communities would assign higher 'goodwill' values to those companies (Godfrey 2005; Godfrey et al.

2009). The reputational or goodwill advantage acquired through environmentally responsible behaviour, in turn, makes firms more acceptable to their stakeholders (for example, investors, lenders, suppliers) who in the end are members of the society and different communities (Kassinis 2012). While the improved levels of reputation and goodwill are more qualitative in nature, they could generate measurable and visible impacts on firms; for example, investors preferring securities or customers preferring products or services offered by environmentally responsible firms (Bansal and Clelland 2004; Flammer 2013; Lin et al. 2016; Lourenço et al. 2014). An increasing number of empirical studies suggest that securities issued by environmentally responsible firms are likely to have a higher demand (Bansal and Clelland 2014, Flammer 2013) and sometimes they could offer a higher return for investors (Khan et al. 2016). Higher demand for securities could enable such firms to raise large funds by issuing debt or equity securities at a relatively lower cost. For example, a firm known to be more environmentally responsible could raise the necessary funds by issuing bonds at a relatively lower coupon rate and take advantage of investors' greater degree of acceptance and demand created by an improved reputation or goodwill over a period of time. In such a case, the reputational advantage of being environmentally responsible is converted into cost-saving for a firm while raising long term funds; though the cost-saving could be regarded as compensation for offsetting the cost of becoming environmentally responsible. A lower coupon rate could still attract enough demand for bonds, given the increasing evidence that investors are increasingly denying polluting companies or companies that harm the environment and prefer investing in environmentally responsible companies (Busch et al. 2016; Global Sustainable Investment Alliance 2018; Hunt and Weber 2019).

Investors are increasingly eschewing companies with poor environmental performances since they carry a higher risk of environment-related liabilities and less ability to take advantage of environmental opportunities (Hart 1995; Sharma and Vredenburg 1998). Studies suggest that firms that persistently pollute the environment or create environmental hazards often face substantial financial and non-financial costs arising from environmental liabilities, for example, through the cost of litigation, settlements of environmental impact related claims, penalties imposed by courts or the government, loss of business due to declining reputation or goodwill, and the cost of settling community complaints (Buysse and Verbeke 2003; Hart and Ahuja 1996; King and Lenox 2002). In addition, such firms are likely to be unable to utilize any environment-related business opportunities since they are already following the opposite path; for example, a heavily CO₂-emitting firm is likely to be unsuccessful in a recycling or renewable energy-related business, since it has a negative image in the society and communities so long as it keeps harming the environment. Therefore, a persistently poor environmental performance could prove costly for a firm; and such firms could also incur higher costs while raising funds from the financial market, for example, through higher coupon rates while issuing debt securities like bonds or higher interest rates imposed on a firm's borrowing from a bank (Sharfman and Fernando 2008; Erragragui 2018; Weber 2012; Weber et al. 2008). Particularly on debt issuances like bonds, firms with a poor environmental performance will likely have to offer higher coupon rates to attract enough demand for their securities by offsetting their negative reputation. In such a case, firms will face an increased cost of bond issuance, which might be seen as a penalty to be paid for its negative image. This scenario is the opposite of that of an environmentally responsible firm.

The discussion above suggests that a firm's environmental performance could have an effect on its pricing or cost of debt issuance; in other words, a firm's CEP could have an influence on its COD. Considering this conceptual link, the following broad hypothesis can be developed for empirically testing purpose:

Hypothesis 1. EP score influences the cost of debt.

However, the CEP's effects on COD could vary depending on many firm or bond-specific factors; for example, bond maturities with a longer duration could allow a firm the time it needs to generate environmental returns by utilizing the funds and the firm's sector of operation, since firms in different sectors are likely to have a largely heterogeneous sensitivity to the environment (for example, financial institutions vs manufacturing). To capture the variations across sectors and bond maturities, this chapter addresses two further hypotheses under the broad hypothesis (1) specified above:

Hypothesis 1.1. EP score influences longer maturities rather than shorter maturities.

Hypothesis 1.2. EP score influences the cost of debt in sectors with higher environmental materiality.

The review of the existing body of literature suggests that no study so far has addressed the link between CEP and COD. This research tests the above hypotheses (1), (1.1), and (1.2) in an attempt to fulfil this research gap.

5.3. Methodology

A cross-section regression framework is utilized to examine the effects of corporate environmental performance (CEP) on the pricing of funds raised

through bond issuance. The coupon rates of bonds are used as the price for funds raised through bond issuance.

Specification of variables and econometric model

To begin, a simple econometric model is presented in the following form:

$$CR_i = \alpha + \beta CEP_i + \Gamma X'_i + \vartheta_i + \varepsilon \text{ ----- (1)}$$

where X' is a vector of the control variables. CEP is environmental performance, ϑ denotes the applicable controls for fixed effects, β and Γ are the coefficients to be estimated for CEP and the control variables, α denotes intercept or constant, ε defines the error term, and i denotes each bond issued by firms. It is expected that CEP and CR will be negatively associated, in other words, firms with higher EP are likely to be able to sell bonds at lower CR and vice versa. Since the influence of CEP on the choice of CR during bond issuances is unlikely to be contemporaneous and may take time, in estimating the effects, a one-year time lag is allowed between CEP and CR .

In equation (1), the dependent variable – coupon rate (CR) – is the annual (percentage) interest rate offered on a bond at its initial public offering; this rate is explicitly written down and offered when a bond is issued for the first time and generally does not change over its maturity. A set of control variables (X') is considered for equation (1). First, there are controls to be considered for bond-specific characteristics – size of bond issuances (AMT) and risk and quality of the bonds proxied by bond rating (BR). Second, there are controls for variations in issuer-specific factors that are to be incorporated by considering the size of the issuing firms, degree of leverage, and cash flow generation ability and financial health. In this research, the size of the issuing firm is proxied by the value of total

assets (TA) in USD, capital structure or degree of leverage of the issuing firms is captured by the debt-equity ratio (LEV), and cash flow generation ability and financial health is measured by free cash flow (FCF) to total assets ratio (FCFA).

The detailed measurement and rationale of considering these variables and their expected effects on coupon rates are presented in Appendix A5.1. In addition, since coupon rates could vary significantly across issuers' specific business sectors, currency of coupon denomination, maturity of bonds, and year of issuances, further controls are utilized to capture sector (S_i), currency (C_i), maturity (M_i), and issuance year (Y_i) fixed-effects in equation (1). These fixed-effects impose the use of dummies (1 or 0) for the variables to control for effects that are constant and specific to those variables and do not change over time. For example, in a year-wise fixed effect for 2016, the Year variable would take a dummy value of '1' for all bonds issued in 2016 and '0' for other years (2017 and 2018) to control for the effects specific to that particular year (2016); similarly, to control for fixed effects of 2017, the Year variable would use dummy of '1' for all bonds issued in 2017 and '0' for others. In a similar fashion, an industry-wise fixed effect would control for effects that are specific to and fixed for each of the economic sectors in which an issuer operates; in this process, the Sector variable would take dummy value of '1' for all issuers belonging to a particular sector and '0' for others. Following studies using cross-section bond datasets similar to this research (e.g., Barua and Chiesa, 2019; Elyasiani et al., 2002; Chiesa and Barua, 2019), issuer-wise fixed effects are not considered since including thousands of issuer company dummies makes the empirical modelling heavily complex and estimates unreliable. The maturity and currency fixed effects follow a similar mechanism.

Considering the variables, equation (1) can be re-written as follows for estimation purpose, where natural logarithms of *AMT* and *TA* are used to reduce the large value bias:

$$CR_i = \alpha + \beta_1 EP_i + \beta_2 \ln AMT_i + \beta_3 BR_i + \beta_4 \ln TA_i + \beta_5 LEV_i + \beta_6 FCFA_i + S_i + C_i + M_i + Y_i + \varepsilon \text{ ----- (2)}$$

Data

The Thomson Reuter fixed income database is extracted for the years 2016, 2017 and 2018 to generate data for all variables included in equation (2). Bonds issued in both the United States and Europe are included in the sample. Although Thomson Reuters ASSET4 provides financial data for every publicly listed corporation, the focus is only on the US and EU markets, for firms from these geographies have a higher ESG data reporting standard in the three dimensions ('pillars') of CSR – social, environmental, and corporate governance. Given the way in which ESG data are reported (for example, 2017 data are reported in 2018 and therefore financial markets in 2018 can only be aware of the performance in 2017) for each bond issued, the CEP score is taken for the year immediately before the bond issuance. Considering the data availability, this research uses two measures – EP score and ESG score – to capture CEP equation (2).

The Thompson Reuters total ESG rating score is derived by calculating total weighted average of scores assigned for ten categories under three broad pillars – environmental (three categories making up a total weight of 34 per cent for this pillar); social (four categories making up a total weight of 35.5 per cent for this pillar); and governance (three categories making up a total weight of 30.5 per cent for this pillar) (Thompson Reuters 2017). The environmental pillar's three

individual categories are resources use (11 per cent), emissions (12 per cent), and innovation (11 per cent); the weights of these categories make up the total weight of the environmental pillar (Thompson Reuters 2017). In line with the objectives, this chapter uses the total ESG score and the environmental pillar (EP) score as two measures of CEP of a firm. Hence, equation (2) is estimated in the following sections in two separate forms – one with an EP score as the CEP measure and the other with a total ESG score as the CEP measure.

As explained earlier, data on the total amount of funds in USD raised by issuing a bond is extracted to use for size of bond issuance (*AMT*) variable; value of total assets (*TA*) in USD is used as a measure for size of issuing firms. *BR* is measured by the credit rating assigned to a bond issued by Standard & Poor's, where categorical scores are assigned for each bond depending on the original rating assigned; higher rating is assigned with higher score value and vice versa, following appendix Table A3. Furthermore, data on debt-equity ratio (*LEV*) is procured to use as the capital structure or degree of leverage variable. To feed in the cash flow generation ability and financial health variable, free cash flow (*FCF*) data are extracted and the ratio of FCF to *TA* (*FCFA*) derived. In addition, the fixed effects in equation (2) are incorporated in the following manner: for sector fixed-effects (S_i), this research uses six TRBC (Thompson Reuters Business Classification) sector classifications as shown in Table 5.1, where each issuer is assigned with a specific sector of operation by Thompson Reuters; for currency fixed-effects (C_i), two currencies (dollars and euros) are included considering the currency denomination of coupon of all bonds; for maturity fixed-effects (M_i), three maturity clusters are imposed as shown in Table 5.1 following the IMF (1996) definition, in which each bond is assigned into a specific cluster

depending on its original maturity (in number of years); and, finally, year fixed-effects (Y_i) is incorporated for each of the years 2016, 2017 and 2018 for which data are considered in this research. Appendix Table A5.1 lists a detailed definition of the data for each variable considered above.

A total of 5620 bonds, 2168 in the EU and 3092 in the US market are analysed. Specifics on sector composition and maturities are displayed in Table 5.1.

Table 5.1. Sector and maturity composition

Name	Panel A: EU	Panel B: USA	Total
Financial products	1165	1075	2240
Consumer goods	73	147	220
Utilities and Transportation	168	525	693
Manufacturing	359	574	933
Services	275	608	883
Telecommunications	128	163	291
Total	2168	3092	5260

Name	Panel A: EU	Panel B: USA	Total
Short maturity (≤ 3 years)	343	552	1407
Medium maturity (> 3 to ≤ 10 years)	1472	1874	3194
Long maturity (> 10 years)	353	666	1019
Total	2168	3092	5260

Tables 5.2 and 5.3 present descriptive statistics and pairwise correlation coefficients, respectively.

Table 5.2 shows that average coupon rates offered by bond issuances in the USA (3.92 per cent) is larger than that in the EU (3.10 per cent); for both the USA and the EU, median coupon rates are smaller than their means, suggesting that the data are skewed to the right. On the other hand, the environmental performance of firms on average appears better in the EU compared with that in the USA; it is

suggested by larger mean EP and ESG scores for the EU (EP 67.88, ESG 64.49) compared with those in the USA (EP 65.67, ESG 63.88). The median scores for EP and ESG are higher than their means, which suggests that the EP and ESG data are skewed to the left. Among the control variables, maturity appears to be noticeably different in the two panels; on average, bonds issued in the USA appear to have longer duration (11.18 years) compared with those issued in the EU (8.86 years).

Table 5.2. Summary statistics

<i>Variable</i>	<i>Mean</i>	<i>Median</i>	<i>SD</i>
<i>Panel A: EU</i>			
Coupon Rate	3.1	2.88	2.19
EP	67.88	74.09	23.09
ESG	64.49	69.13	18.57
Log (Amount Sold)	20.23	20.03	0.78
Log (Assets)	25.02	24.83	2.29
Debt/Equity	3.43	2.33	3.92
FCF/Assets	0.01	0.01	0.06
Bond Rating	9.47	10	3.83
Maturity	8.86	8	7.64
<i>Panel B: USA</i>			
Coupon Rate	3.92	3.75	1.4
EP	65.67	68.93	22.19
ESG	63.88	67.42	16.61
Log (Amount Sold)	20.26	20.13	0.65
Log (Assets)	24.82	24.6	2.06
Debt/Equity	3.48	2.17	5.09
FCF/Assets	0.01	0.01	0.06
Bond Rating	9.98	10	3.74
Maturity	11.18	8	10.45

Source: Developed by author.

Table 5. 3 shows that coupon rates (CR) have a negative correlation with six of the independent variables included – EP, ESG, Log (AMT), Log (TA), FCFA

and BR. This would mean that coupon rates tend to go up when EP and ESG are lower

Table 5.3. Pairwise correlations

<i>Panel A: EU</i>	Coupon Rate	EP	ESG	Log (Amount Sold)	Log (Assets)	Debt/Equity	FCF/Assets	Bond Rating	Maturity
Coupon Rate	1								
EP	-0.5378	1							
ESG	-0.5209	0.9001	1						
Log (Amount Sold)	-0.1151	0.1278	0.094	1					
Log (Assets)	-0.3466	0.4864	0.474	0.1352	1				
Debt/Equity	0.038	0.0718	-0.0216	0.073	0.0593	1			
FCF/Assets	-0.1214	0.0944	0.084	0.0506	0.0294	-0.1218	1		
Bond Rating	-0.4475	0.3812	0.4123	0.1306	0.3436	-0.0735	0.112	1	
Maturity	0.2284	-0.0442	-0.0255	0.0998	-0.0467	0.0629	0.1313		1
<i>Panel B: USA</i>	Coupon Rate	EP	ESG	Log (Amount Sold)	Log (Assets)	Debt/Equity	FCF/Assets	Bond Rating	Maturity
Coupon Rate	1								
EP	-0.3593	1							
ESG	-0.3708	0.8883	1						
Log (Amount Sold)	-0.092	0.2214	0.1642	1					
Log (Assets)	-0.3502	0.5085	0.4779	0.259	1				
Debt/Equity	-0.0132	0.0882	0.04	-0.0016	0.0491	1			
FCF/Assets	-0.1311	0.1331	0.1039	0.1721	0.0276	-0.0024	1		
Bond Rating	-0.3875	0.3378	0.3522	0.1317	0.2838	0.0426	0.1302	1	
Maturity	0.2898	0.0163	0.0186	0.0543	-0.0563	0.0187	-0.0353	0.1779	1

and vice versa. This correlation supports the arguments presented earlier on the conceptual link between CEP and COD, stating that a higher CEP tends to enable firms to raise debt funds from the market at a lower cost. Table 5.3 suggests that coupon rates tend to go down as the size of issuance and the size of the issuer becomes larger and vice versa; similarly, better financial health and credit rating tend to be associated with lower coupon rates and vice versa. The correlations support the general expectation that bond issues from larger sized firms in better financial health generally have a greater demand compared with poorly performing issuers; this financial reputation driven excess demand enables them to sell out their issuances and raise necessary funds even when they offer a relatively lower coupon rate. Table 5. 3 also shows that bonds of better quality and with larger issue size tend to offer lower coupon rates; it is reasonable since high-quality investment grades bond tend to sell out even when they offer a lower coupon due to their quality advantages. On the other hand, firms aiming to obtain larger size of funds by bond issuances could offer lower coupon to reduce future pay-out burdens. Table 5.3 further shows that coupon rates tend to move in the same direction with degree of leverage and maturity, that is a higher degree of leverage and longer maturities tend to be associated with higher coupon rates and vice versa. Overall, the table suggests no sign of a multicollinearity problem.

Estimation process

Equation (2) is estimated using a cross-section OLS method in three phases as outlined below; in each phase, separate estimations are carried considering each of the two measures of CEP specified earlier – EP score and ESG score.

- (i) estimations including all bonds in the sample to realize the overall effects of EP and ESG scores separately on coupon rates during issuances;

- (ii) separate estimations of EP and ESG effects for each of the three maturity classes (short, medium and long) are carried out to explore the sensitivity of bonds across different maturity traits. Maturity classes are defined as following the IMF (1996) maturities definition – short (<3 years), medium (3 to 10 years), and long (>10 years); and
- (iii) a further examination of EP and ESG effects separately by issuer business sector to establish in which sectors the coupon rates of bonds are sensitive to CEP. Following Thompson Reuters economic sectors, the sample is clustered into the following categories – financial products, consumer goods, utilities and transportation, manufacturing, services, and telecommunications.

If not treated properly, multicollinearity and heteroskedasticity biases often affect cross-section regressions. Appendix Table A5.2 reports the VIF test and Breusch-Pagan/Cook-Weisberg test results for multicollinearity and heteroskedasticity, respectively. The significant Chi2 values for the Breusch-Pagan/Cook-Weisberg tests suggest the existence of heteroscedasticity for most panels; however, following O'Brien (2007), the mean VIF scores suggest no significant level of multicollinearity biases associated with this specific model. Considering these test results, there is a robust estimation of cross-section regressions for equation (2) for all phases specified above by clustering the standard errors by issuer and adjusted for heteroskedasticity.

5.4. Discussion of results

Tables 5.4, 5.5 and 5.6 present the results for 'all issuances', by 'maturity level' and by 'sector level', respectively.

The ‘all issuances’ results show that the estimation process has procedurally considered a total of 1934 issuances for the EU market and 2980 for the US market. All estimations control for sector, currency of coupon denomination, maturity class, and time (year) fixed effects. R-squared values across the estimations mostly appear to be in the 60 to 80 per cent range, indicating the higher explanatory power of the model specified in this chapter.

Results for Tables 5.4, 5.5, and 5.6 are discussed in the following subsections below.

All issuances

Table 5.4 presents the results for all issuances. In both the EU and US data, there is a negative and statistically significant effect of EP and ESG on the coupon rate. The magnitudes of the effects are large. The results show that a one-point increase in an EP score is associated with a decrease in coupon rates by 6.2 per cent in the EU and 4.8 per cent in the USA. These results suggest that firms with a higher environmental performance are likely to be able to offer, or sell, bonds at lower coupon rates. The results could have implications for both the demand (investors/lenders) and the supply (issuers/borrowers) sides of the financial market.

On the demand side, issuances at cheaper (compared with regular) coupon rates could be an indication that investors in the market are assigning better value to these issuers. This dynamic may be a function of ethical/social considerations, or it may derive from a more ‘conventional’ risk/return perspective.

In the case of the former, investors may sacrifice their return to encourage environmentally friendly behaviour among firms that raise debt financing. In the latter case, investors may simply be becoming increasingly confident that

Table 5.4. All issuances

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	EU				USA			
Dependent Variable	Coupon Rate							
EP	-0.006*** (0.002)	-0.006*** (0.002)			-0.005*** (0.002)	-0.005*** (0.002)		
ESG			-0.007*** (0.003)	-0.007*** (0.003)			-0.006*** (0.002)	-0.006*** (0.002)
Log (Amount Sold)	-0.173*** (0.065)	-0.174*** (0.065)	-0.173*** (0.065)	-0.174*** (0.065)	-0.058 (0.049)	-0.058 (0.049)	-0.066 (0.049)	-0.066 (0.049)
Log (Assets)	-0.048** (0.019)	-0.047** (0.019)	-0.049*** (0.019)	-0.049*** (0.019)	-0.016 (0.014)	-0.016 (0.014)	-0.017 (0.014)	-0.017 (0.014)
Debt/Equity	0.029*** (0.009)	0.029*** (0.009)	0.027*** (0.009)	0.026*** (0.009)	-0.002 (0.006)	-0.002 (0.006)	-0.003 (0.006)	-0.003 (0.006)
FCF/Assets	-0.424 (0.714)	-0.427 (0.714)	-0.465 (0.713)	-0.467 (0.713)	-0.384 (0.565)	-0.384 (0.565)	-0.461 (0.566)	-0.461 (0.566)
Bond Rating	-0.235***	-0.234***	-0.233***	-0.233***	-0.176***	-0.176***	-0.175***	-0.175***

	(0.025)	(0.025)	(0.025)	(0.025)	(0.015)	(0.015)	(0.016)	(0.016)
1 (Green Bond)		-0.102		-0.078	0.007			0.004
		(0.209)		(0.201)	(0.120)			(0.117)
Observations	1934	1934	1934	1934	2980	2980	2980	2980
R-squared	0.857	0.857	0.857	0.857	0.630	0.630	0.629	0.629
Mean VIF		13.22		17.9		13.69		21.72
Sector x Currency x Maturity x Issuance Year FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors are clustered by issuer and in parentheses *** p<0.01, ** p<0.05, * p<0.1.

environmental risk factors are likely to affect the generation of cash flows and thus the ability of the firm to service its debt. This therefore has an impact on security pricing and, accordingly, increases the chances of this score/factor being integrated into investment decisions.

On the supply side, improving environmental performance could involve significant long- and short-term costs for firms. While the opportunity to borrow at ‘cheaper’ coupon rates could help lower the cost of capital for the issuing firms, firms could use this ‘saving’ in the borrowing cost as a way of offsetting the potential cost of ‘going green’ or improving environmental performances. Furthermore, such cost savings could also serve as an economic rationale for the firms to go green. Alternatively, firms may decide to ‘go green’ as a strategy with new ‘green’ products or services that are attractive to customers and consumers. Debt investors may perceive this ‘green’ strategy in a positive light, and this could drive down borrowing costs.

Considering the other variables, issue size, firm size and degree of leverage appear to have a significant effect on coupon rates in the EU, while they show no significant effect in the USA. Issue size is found to have a significant negative effect in the EU, indicating that firms borrowing larger funds from the market are likely to offer bonds at a lower coupon rate, potentially due to an investor preference for higher liquidity.

Similarly, firm size has a significant negative effect on coupon rates in the EU, which suggests that larger firms are likely to offer bonds at lower coupon rates. Large firms are likely to offer fixed income investors higher asset liquidity and a longer track record of credit issuance, both of which reduce the perception of risk associated with investing.

On the other hand, the degree of leverage shows a significant and positive effect in the EU. This could indicate that firms with a higher level of existing leverage are likely to offer higher coupon rates to make further debt issuances attractive to the market and also, in severe cases, to improve financial flexibility in a situation of ongoing debt stress.

It is further found that bond rating has a consistently significant and negative effect on coupon rates in both the EU and USA. The result suggests that bonds with a higher rating are likely to accompany lower coupon rates; as such, higher rated bonds are likely to provide better safety and more security for investments. This is expected because junk bonds are likely to offer higher returns to investors than investment grade bonds.

Estimates for both the EU and USA suggest that the ability to generate cash flows and labelling coupon rates ‘green’ have no significant effect on the issuing of bonds.

Maturity level

Table 5.5 estimates the results for the three maturity classes defined – namely short-term (< 3 years), medium-term (5–10 years), and long-term maturity (> 10 years).

The results show that EP has a significant and negative effect on coupon rates for short- and long-term maturity in the EU, but on only medium-term maturity in the USA, which is in line with the negative effect found in the all-issuances estimates. These results indicate that firms with higher environmental performances are likely to offer lower coupon rates when issuing both short- and long-term maturity bonds in the EU and medium-term maturity bonds in the USA. The size of the bond market in relation to the corporate funding market is substantially different between the EU and USA. While the corporate bond market

occupies about 80 per cent of total corporate funding in the USA, it is almost the opposite in the EU, which makes the EU bond market significantly smaller as a source of corporate funding.

The results suggest that, although the bond market is markedly smaller, coupon rates offered during bond issuances are still very sensitive to environmental performances in the EU, for a significant effect is found for two of the three maturity buckets considered. Several factors may account for the European market appearing to integrate EP into coupon rates to a greater degree. These include the fact that the quantum of European funds that are managed under some form of sustainable investing mandate is higher and that European legislation on the integration of ESG factors into company and financial institution decision-making (as demonstrated by the European Commission's 'Action plan on financing sustainable growth')¹ is significantly more advanced.

The findings on US bonds are perhaps remarkable given that the importance accorded to environmental performance is significantly more recent. The integration of environmental factors into investment processes and decision-making is apparent along each maturity, thus showing that the majority of investors buying US debt securities seem to understand responsible investing.

Considering other variables, a consistently negative and significant effect of bond rating on coupon rates is found across all maturity buckets in both the markets. The green labelling of bonds shows a significant and positive effect on the coupon rates of long-maturity bonds, which could indicate that assigning bonds specifically to green projects or activities by firms may not necessarily

1. For more information, see https://ec.europa.eu/info/publications/180308-action-plan-sustainable-growth_en

Table 5.5a: Maturity (EU)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dependent Variable	Coupon Rate											
EP	-0.009 (0.007)	-0.008 (0.007)			-0.004* (0.002)	-0.004* (0.002)			-0.009** (0.003)	-0.007** (0.003)		
ESG			-0.007 (0.007)	-0.006 (0.007)			-0.005* (0.003)	-0.005* (0.003)			-0.013*** (0.004)	-0.012*** (0.003)
Log (Amount Sold)	-0.116 (0.140)	-0.106 (0.140)	-0.088 (0.165)	-0.079 (0.165)	-0.116* (0.069)	-0.118* (0.069)	-0.119* (0.069)	-0.121* (0.069)	-0.074 (0.150)	-0.043 (0.150)	-0.077 (0.151)	-0.045 (0.150)
Log (Assets)	-0.028 (0.027)	-0.031 (0.027)	0.025 (0. .025)	0.027 (0. .025)	-0.032 (0.022)	-0.032 (0.022)	-0.032 (0.022)	-0.033 (0.022)	0.032 (0.053)	0.035 (0.051)	0.038 (0.053)	0.041 (0.050)
Debt/Equity	0.038 (0.029)	0.038 (0.030)	-0.038 (0.030)	0.038 (0.030)	0.005 (0.003)	0.004 (0.003)	0.004 (0.003)	0.004 (0.003)	-0.002 (0.002)	0.002 (0.002)	-0.001 (0.002)	0.001 (0.002)
FCF/Assets	1.932 (1.969)	0.591 (1.810)	-1.887 (1.974)	0.514 (1.759)	-0.447 (0.550)	-0.446 (0.549)	-0.450 (0.550)	-0.448 (0.549)	2.442*** (0.870)	2.290*** (0.772)	2.361*** (0.878)	2.224*** (0.783)
Bond Rating	-0.025 (0. .015)	-0.021 (0. .014)	-0.028* (0.016)	-0.025* (0.015)	-0.333*** (0.026)	-0.333*** (0.026)	-0.331*** (0.027)	-0.331*** (0.027)	-0.146*** (0.027)	-0.144*** (0.028)	-0.131*** (0.029)	-0.129*** (0.028)
1 (Green Bond)		-2.150*		-2.104*		-0.178		-0.163		1.779***		1.807***

	(1.147)			(1.168)		(0.196)		(0.188)		(0. .660)		(0.646)
Observations	300	300	300	300	1350	1350	1350	1350	215	215	215	215
R-squared	0.877	0.881	0.876	0.879	0.865	0.865	0.865	0.865	0.878	0.882	0.880	0.885
Maturity Group	Short Maturity			Medium Maturity			Long Maturity					
Sector x Currency x Maturity x Issuance Year												
FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 5.5b: Maturity (USA)

	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
Dependent Variable	Coupon Rate											
EP	-0.009** (0.004)	-0.009** (0.004)			-0.004** (0.002)	-0.004** (0.002)			-0.003* (0.002)	-0.003* (0.002)		
ESG			-0.009** (0.006)	-0.009 (0.006)			-0.005* (0.003)	-0.005* (0.003)			-0.003 (0.003)	-0.003 (0.003)
Log (Amount Sold)	-0.458*** (0.100)	-0.459*** (0.100)	-0.455*** (0.101)	-0.455*** (0.101)	-0.055 (0.067)	-0.054 (0.067)	-0.064 (0.067)	-0.063 (0.067)	-0.016 (0.073)	-0.015 (0.073)	0.112 (0.074)	0.111 (0.074)
Log (Assets)	0.0108 (0.025)	0.011 (0.025)	0.004 (0.024)	0.004 (0.024)	0.004 (0.024)	0.004 (0.021)	0.002 (0.020)	0.002 (0.020)	0.029 (0.039)	0.030 (0.040)	0.023 (0.039)	0.024 (0.039)
Debt/Equity	0.036 (0.026)	0.036 (0.026)	0.035 (0.026)	0.035 (0.026)	-0.000 (0.001)	-0.000 (0.001)	-0.000 (0.001)	-0.000 (0.001)	-0.002*** (0.001)	-0.002*** (0.001)	-0.002*** (0.001)	-0.002*** (0.001)
FCF/Assets	-2.989** (1.458)	-2.990** (1.458)	-3.366** (1.468)	-3.366** (1.469)	0.564 (0.561)	0.573 (0.560)	0.541 (0.563)	0.549 (0.562)	-0.341 (0.654)	-0.335 (0.655)	-0.355 (0.656)	-0.351 (0.657)
Bond Rating	-0.052*** (0.015)	-0.052*** (0.015)	-0.055*** (0.015)	-0.055*** (0.015)	-0.240*** (0.021)	-0.241*** (0.021)	-0.241*** (0.021)	-0.241*** (0.021)	-0.129*** (0.024)	-0.129*** (0.024)	-0.131*** (0.025)	-0.131*** (0.025)
1 (Green Bond)		0.173 (0.217)		0.211 (0.246)		0.328*** (0.104)		0.325*** (0.099)		-0.141 (0.125)		0.119*** (0.140)

Observations	539	539	539	539	1814	1814	1814	1814	583	583	583	583
R-squared	0.413	0.413	0.408	0.408	0.642	0.642	0.641	0.641	0.726	0.726	0.724	0.724
Maturity Group	Short maturity				Medium maturity				Long maturity			
Sector x Currency x Maturity x Issuance												
Year FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 5.6: Sectors

Panel A: EU												
Coupon Rate	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
EP	-0.010*** (0.003)	-0.010*** (0.003)			-0.012 (0.009)	-0.012 (0.009)			-0.001 (0.005)	-0.001 (0.005)		
ESG			-0.014*** (0.003)	-0.014*** (0.003)			-0.035 (0.022)	-0.035 (0.022)			0.005 (0.007)	0.005 (0.007)
Log (amount sold)	-0.198** (0.083)	-0.200** (0.083)	-0.196** (0.084)	-0.197** (0.084)	-0.147 (0.240)	-0.147 (0.240)	-0.144 (0.219)	-0.144 (0.219)	0.122 (0.203)	0.122 (0.203)	0.109 (0.199)	0.109 (0.199)
Log(assets)	-0.066*** (0.021)	-0.066*** (0.021)	-0.065*** (0.021)	-0.065*** (0.020)	0.119 (0.177)	0.119 (0.177)	0.130 (0.139)	0.130 (0.139)	-0.091 (0.070)	-0.091 (0.071)	-0.099 (0.068)	-0.099 (0.068)
Debt/equity	0.029*** (0.009)	0.029*** (0.009)	0.025*** (0.009)	0.025*** (0.009)	0.082 (0.162)	0.082 (0.162)	0.149 (0.166)	0.149 (0.166)	0.054 (0.034)	0.054 (0.034)	0.052* (0.031)	0.052* (0.031)
FCF/assets	-0.791 (0.976)	-0.791 (0.977)	-0.891 (0.972)	-0.891 (0.973)	5.813 (8.182)	5.813 (8.182)	7.720 (9.058)	7.720 (9.058)	0.267 (0.667)	0.270 (0.670)	0.019 (0.714)	0.017 (0.717)
Bond rating	-0.174*** (0.026)	-0.175*** (0.026)	-0.169*** (0.026)	-0.169*** (0.026)	-0.445*** (0.122)	-0.445*** (0.122)	-0.369*** (0.126)	-0.369*** (0.126)	-0.361*** (0.067)	-0.361*** (0.068)	-0.366*** (0.069)	-0.366*** (0.069)
1(green bond)		-0.101 (0.242)		-0.049 (0.224)						-0.043 (0.281)		0.035 (0.280)
Observations	1090	1090	1090	1090	36	36	36	36	176	176	176	176
R-squared	0.845	0.845	0.847	0.847	0.910	0.910	0.929	0.929	0.885	0.885	0.886	0.886
Sector	Financial products				Consumer goods				Utilities and Transportation			
	Sector x Currency x Maturity x Issuance											
Year FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors are clustered by issuer in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Table 5.6: Sectors (continued)

Panel A: EU												
Coupon rate	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
EP	-0.002 (0.004)	-0.002 (0.004)			-0.006* (0.003)	-0.006* (0.003)			-0.013 (0.008)	-0.013 (0.008)		
ESG			0.000 (0.005)	0.000 (0.005)			-0.007* (0.004)	-0.007* (0.004)			-0.013 (0.012)	-0.013 (0.012)
Log (Amount Sold)	-0.371*** (0.137)	-0.364*** (0.134)	-0.376*** (0.135)	-0.369*** (0.132)	0.169 (0.161)	0.169 (0.162)	0.161 (0.163)	0.161 (0.163)	-0.131 (0.169)	-0.1309 (0.169)	-0.159 (0.161)	-0.159 (0.161)
Log (Assets)	0.017 (0.055)	0.014 (0.053)	0.008 (0.056)	0.005 (0.054)	-0.035 (0.040)	-0.035 (0.040)	-0.034 (0.042)	-0.034 (0.042)	0.155*** (0.041)	0.155*** (0.041)	0.149*** (0.046)	0.149*** (0.046)
Debt/Equity	0.004 (0.023)	0.004 (0.023)	0.005 (0.023)	0.005 (0.023)	0.017 (0.026)	0.017 (0.026)	0.017 (0.026)	0.017 (0.026)	-0.005 (0.063)	-0.005 (0.063)	-0.005 (0.078)	-0.005 (0.078)
FCF/Assets	1.940 (1.795)	2.054 (1.843)	1.864 (1.789)	1.985 (1.843)	-2.911** (1.277)	-2.911** (1.282)	-2.861** (1.233)	-2.859** (1.237)	1.509 (2.493)	1.509 (2.493)	0.992 (2.735)	0.992 (2.735)
Bond Rating	-0.327*** (0.056)	-0.328*** (0.057)	-0.328*** (0.056)	-0.330*** (0.057)	-0.265*** (0.036)	-0.265*** (0.036)	-0.261*** (0.036)	-0.261*** (0.036)	-0.415*** (0.052)	-0.415*** (0.052)	-0.411*** (0.053)	-0.411*** (0.053)
1 (Green Bond)		0.544 (1.146)		0.569 (1.154)		-0.030 (0.257)		-0.090 (0.280)				
Observations	323	323	323	323	239	239	239	239	70	70	70	70
R-squared	0.847	0.847	0.847	0.847	0.884	0.884	0.884	0.884	0.920	0.920	0.917	0.917
Sector	Manufacturing				Services				Telecommunications			
Sector x Currency x Maturity x Issuance												
Year FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors are clustered by issuer in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Table 5.6: Sectors (continued)

Panel B: USA		(1)	(2)										(12)
Dependent Variable	Coupon	Rate	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	)	
EP	-0.009*** (0.002)	-0.009*** (0.002)			-0.002 (0.008)	-0.002 (0.008)			-0.000 (0.003)	0.000 (0.003)			
			0.014*** (0.004)	0.014*** (0.004)			-0.004 (0.008)	-0.004 (0.008)			0.003 (0.004)	0.003 (0.004)	
ESG													
	-0.077 (0.055)	-0.078 (0.055)	-0.084 (0.055)	-0.084 (0.055)	-0.421* (0.233)	-0.421* (0.233)	-0.408* (0.227)	-0.408* (0.227)	0.124 (0.094)	0.127 (0.095)	0.120 (0.093)	0.124 (0.094)	
Log (amount sold)													
	-0.003 (0.014)	-0.003 (0.014)	0.001 (0.016)	0.001 (0.016)	0.119 (0.099)	0.119 (0.099)	0.126 (0.109)	0.126 (0.109)	-0.161*** (0.061)	-0.165*** (0.063)	-0.168*** (0.061)	-0.173*** (0.062)	
Log (assets)													
	0.020** (0.009)	0.020** (0.009)	0.015 (0.009)	0.015 (0.009)	-0.006 (0.032)	-0.006 (0.032)	0.003 (0.043)	0.003 (0.043)	-0.009 (0.006)	-0.009 (0.006)	-0.009 (0.006)	-0.009 (0.006)	
Debt/equity													
	1.377 (0.928)	1.376 (0.930)	1.275 (0.943)	1.276 (0.945)	0.101 (2.633)	0.101 (2.633)	0.059 (2.593)	0.059 (2.593)	0.249 (1.046)	0.241 (1.045)	0.133 (1.034)	0.130 (1.033)	
FCF/assets													
	-0.139*** (0.022)	-0.139*** (0.022)	-0.134*** (0.022)	-0.134*** (0.022)	-0.1827** (0.087)	-0.183** (0.087)	-0.181** (0.081)	-0.181** (0.081)	-0.236*** (0.039)	-0.237*** (0.039)	-0.2382*** (0.040)	-0.239*** (0.040)	
Bond rating													
		-0.044 (0.180)		0.057 (0.184)						0.283 (0.216)		0.319 (0.223)	
1 (green bond)													
Observations	1051	1051	1051	1051	130	130	130	130	618	618	618	618	
R-squared	0.642	0.642	0.647	0.647	0.736	0.736	0.737	0.737	0.659	0.660	0.660	0.661	
Sector	Financial products				Consumer goods				Utilities and Transportation				
Sector x Currency x Maturity x Issuance													
Year FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	

Robust standard errors are clustered by issuer in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 5.6: Sectors (continued)

Panel B: USA	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
Coupon Rate												
EP	-0.004 (0.005)	-0.004 (0.005)			-0.005* (0.003)	-0.005* (0.003)			-0.012 (0.012)	-0.012 (0.012)		
ESG			-0.002 (0.007)	-0.002 (0.007)			-0.011*** (0.004)	-0.011*** (0.004)			0.010 (0.011)	0.010 (0.011)
Log (amount sold)	-0.090 (0.164)	-0.090 (0.164)	-0.094 (0.160)	-0.094 (0.160)	-0.073 (0.092)	-0.073 (0.092)	-0.098 (0.087)	-0.099 (0.088)	-0.161 (0.442)	-0.161 (0.442)	-0.189 (0.427)	-0.189 (0.427)
Log (assets)	0.069 (0.049)	0.068 (0.049)	0.055 (0.048)	0.0542 (0.048)	-0.054 (0.040)	-0.053 (0.041)	-0.040 (0.041)	-0.039 (0.042)	0.014 (0.051)	0.014 (0.051)	-0.032 (0.056)	-0.032 (0.056)
Debt/equity	-0.007 (0.008)	-0.007 (0.008)	-0.008 (0.009)	-0.008 (0.009)	0.013 (0.009)	0.013 (0.009)	0.012 (0.009)	0.012 (0.009)	0.285*** (0.077)	0.285*** (0.077)	0.338*** (0.113)	0.338*** (0.113)
FCF/assets	-1.103 (1.607)	-1.123 (1.615)	-1.094 (1.597)	-1.112 (1.604)	-2.011* (1.153)	-1.959* (1.179)	-2.103* (1.138)	-2.052* (1.163)	-1.693 (4.229)	-1.693 (4.229)	2.103 (4.272)	2.103 (4.272)
Bond rating	-0.219*** (0.037)	-0.220*** (0.037)	-0.225*** (0.037)	-0.225*** (0.037)	-0.113*** (0.025)	-0.113*** (0.025)	-0.105*** (0.023)	-0.105*** (0.023)	-0.098 (0.104)	-0.098 (0.104)	-0.117 (0.108)	-0.117 (0.108)
1 (green bond)		0.320 (0.319)		0.324 (0.329)		0.309 (0.213)		0.302 (0.202)				
Observations	558	558	558	558	578	578	578	578	45	45	45	45
R-squared	0.577	0.577	0.575	0.575	0.644	0.645	0.652	0.652	0.911	0.911	0.905	0.905
Sector	Manufacturing				Services				Telecommunications			
Sector x currency x maturity x issuance												

Year FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
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Robust standard errors are clustered by issuer in parentheses *** p<0.01, ** p<0.05, * p<0.1

lower the cost of borrowing, but rather that it could raise it. The other variables have differential affects across the maturity buckets in the two markets.

Sector level

In Table 5.5, the sample is split by the six sector classes and produce estimates for each sector class. The coefficients on EP are negative and significant for the financial and service sectors for both the EU and the USA data. Following the effects of EP, the impacts of the other variables, particularly issue size, firm size, and degree of leverage, are found to be dominant in the financial and services sectors. While the direction of the effects of the other variables remains consistent with the previous estimates, the magnitudes and occurrences of significance are different between the two sectors. No significant effect of ‘green’ labelling was found on any of the sectors considered.

Kotsantonis et al. (2016) highlight the importance of identifying the ‘material’ environmental, social and governance (ESG) issues that are critically tied to the operations of each industry. These issues are embedded in any firm’s corporate strategy and business model and are therefore no different from the many other issues considered in investment research and regarded as financial. According to the Global Reporting Initiative (GRI), material issues are those that have ‘a direct or indirect impact on an organization’s ability to create, preserve or erode economic, environmental and social value for itself, its stakeholders and society at large’. The results obtained, however, present no major differences between industries.

At first glance, this could be a positive result, meaning that investors may accord the same value to low or high environmental performance regardless of specific sector materiality. However, the process of labelling environmental

material topics in a company requires a comprehensive framework that can methodologically identify and prioritize issues, risks and opportunities. This process often entails comparing industry peers across significant themes based on company-reported data. As such, given that the availability of environmental data and their integration into the decision-making process are still relatively restricted, the ability of investors adequately to discern the idiosyncratic set of risks pertaining to an individual company or industry may be compromised.

Nevertheless, different environmental practices have different effects on environmental degradation and climate stabilization objectives. In fact, as investors' analyses of environmental issues become more sophisticated, their ability to evaluate environmental scores should actively improve and they should therefore expect differences in sectorial significance to appear across industries.

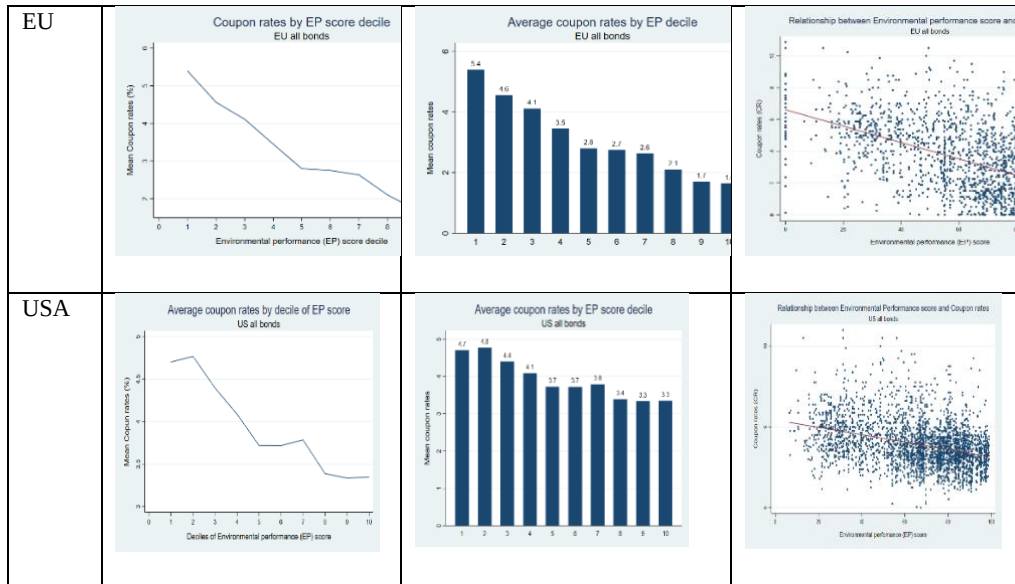
5.5. The interface between cost of debt and environmental performance

The lower cost of debt for companies with good environmental performances could predominantly be related to a lower level of financial risk through intangible asset creation (Ambec and Lanoie 2008; Flammer 2015; Hart 1995; Jones 1995; Porter and van der Linde 1995a) and better risk management and mitigation (Ambec and Lanoie 2008; Bauer and Hann 2010).

The time when sustainability was relevant only to a few niche markets has long gone. The research shows that investors are becoming increasingly interested in sustainability, which includes environmental information, both when purchasing corporate shares and financing a corporation's debt. Investors play a crucial role by rewarding corporations for their positive environmental impact

with a lower cost of debt. This chapter contains empirical evidence that CEP influences cost of debt, as illustrated in the figure below:

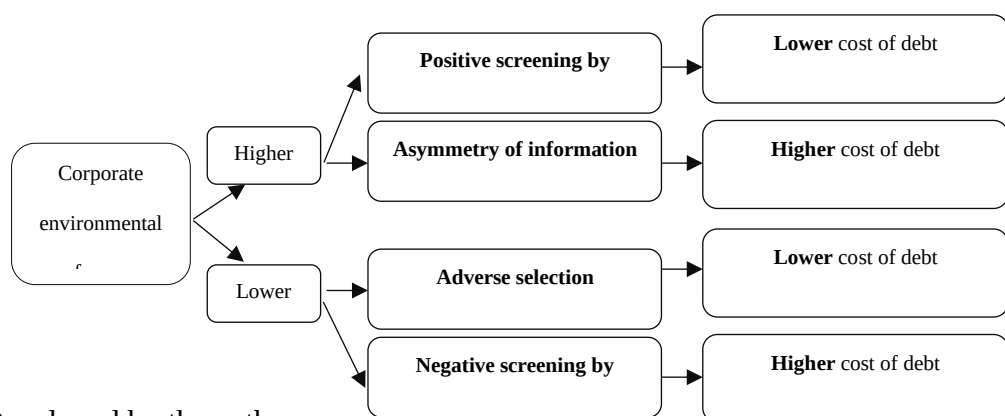
Figure 5.3. Relationship between coupon rates and environmental performance for EU and US bonds



Source: Developed by the author.

Based on this empirical finding, the following framework is developed:

Figure 5.4. Conceptual framework on the relationship between CEP and COD including outliers



Source: Developed by the author.

Positive screening by investors

This study supports the supposition that when investors buy bonds from firms identified (because of their high CEP scores) as environmentally responsible,

these firms are predicted to carry a lower default risk than their sector specific peers. The converse is also true in that investors need to be compensated for higher sectoral environmental risk scores, which are increasingly understood to affect financial risk because of their higher coupon rates.

As previously noted, a number of factors are likely to cause this lower environmental risk. These include a firm's superior ability to sustain key stakeholders, customers, investors and suppliers; improved investor confidence in the ability of firm-specific corporate governance procedures to reduce risk; and a lower likelihood of negative events creating 'one-off' environmentally related events that might affect the default risk, or the eventuation of intractable risks, leading to an increased likelihood of strategic bankruptcy.

These factors translate into increased confidence in, or at least the reduced probability of a deterioration of, a given firm's ability to generate current and long-term cash flows, thus reducing the risk of default.

Accordingly, environmentally responsible firms are often regarded as economically lower risk and thereby better able to present lower risk premia. Investors are thus motivated to offer a pricing advantage to corporations with higher environmental performance metrics.

This becomes more pronounced because the balance-sheet debt of European and American companies is generally much higher than their equity. On the assumption that the capital structure of a given firm reflects this market weighting, this in turn will impact disproportionately on its cost of capital.

Fixed income investors, therefore, have both the incentive (via reduced risks on improved EP scores) and the potential to influence companies to exercise environmentally responsible behaviour (Scholtens 2006). For example, many

banks now view environmental and social issues as ‘real’ risk variables that may affect their creditors’ default risk as well as their own performance (Menz 2010). By decreasing the cost of debt, investors allow companies to raise more money to invest in environmental sustainability, therefore decreasing the overall risk of the company. Bondholders can engage with issuers by influencing investments decisions for example by asking to provide a minimum standard for due diligence to support responsible risk decision-making. An example is the creation and adoption of the Equator Principles, which aim to incorporate environmental and social standards into the project lending practices of banks (Esty et al. 2005).

Furthermore, since companies rely on debt markets for refinancing, rewarding a company for a good environmental score at least incentivizes it to maintain its score constant over time. Indeed, through a lower performance, a company risks being exposed to market discipline and jeopardizing refinancing at the same rates.

Asymmetry of information

Some investors have less access to, or access to lower quality, ESG and environmental information (Barber and Odean 2000; Locke and Mann 2005). Indeed, this information asymmetry may be a factor in the ability of some investors to take complex issues such as environmental performance, or more generally corporate sustainability, into account efficiently in investment decisions.

It could also be that, while some investors recognize the importance of environmental sustainability, they could also believe that environmentally oriented investment may have a negative impact on financial returns. Such an ambivalent, or indeed negative, attitude towards EP might be logical if one believes that environmental issues produce unnecessary costs, which conflict with

the target of an increase in cash flows, so therefore undermines the capacity of a given firm to pay back its debt.

Finally, from a climate stabilization viewpoint, other investors may be aware of environmental risks and the potential ‘tragedy of the horizon’ (Carney 2015), but feel that the horizon is sufficiently far away to accept that arbitrage mechanisms to ‘burst the bubble’ are very risky and too challenging to effect.

Accordingly, such investors might be prepared to ride the bubble for as long as feasible, knowing that the market will ultimately collapse but that returns might be surrendered in the interim and that they will have sufficient skill to ‘beat the gun’ (Keynes 1936).

Indeed, Abreu and Brunnermeier (2003) note that asset price bubbles can endure despite the presence of rational arbitrageurs. They note that ‘the resilience of the bubble stems from the inability of arbitrageurs temporarily to coordinate their selling strategies. This synchronization problem, together with the individual incentive to time the market, results in the persistence of bubbles over a substantial period’ (Abreu and Brunnermeier 2003).

Adverse selection

Adverse selection problems arise when investors fail to identify high-risk borrowers, potentially in cases where a firm carries a significantly underestimated default/bankruptcy risk stemming from environmental performance factors.

One can attribute this to a knowledge gap between the possible interaction of variables such as environmental disclosures and whether investors actually use such information to their advantage. A lack of understanding about how environmental disclosures affect investors could theoretically seriously impede the integration of ESG issues into mainstream investment decision-making,

particularly since there is limited research on the potentially different roles of less-informed investors in mobilizing against climate change.

Negative screening

Environmental issues affect portfolio companies and their investors in several ways. First, corporations that fail to include sustainability in their business strategy miss opportunities for growth through new market segments, innovation and attracting new customer segments.

Furthermore, companies that fail to engage in the environmental aspects of their footprint may also fail either to reduce their use of resources or to manage their use of constrained resources properly. As such, they may be exposing shareholders and other stakeholders (including fixed income investors) to the risk of stranded assets or asset devaluation.

This may also be compounded by lower brand value, for social licences to operate may be compromised, which is particularly relevant for corporations with high exposure to intangibles and for those exposed to consumer facing industries. For this reason, such firms may find it difficult to attract investors and partners. This not only increases the risk to business operations and the licence to operate but also exposes the firm to legal and financial risk and thus to a higher cost of capital.

When analysing such corporations and adjusting their investment offers, investors tend to focus on negative screening, on highlighting exposure to environmental liabilities and on including risk mitigation factors. By making it more expensive for these companies to raise debt for general purposes, investors can still facilitate a corporate transition to the green economy by supporting green

projects at lower interest for those that put their proceeds to environmental use, thus unlocking the full potential of the green bond market.

However, when financing a green bond, investors must be confident that the transition efforts of the firm associated with issuing that bond address the company's environmental risk/score position. If a firm with poor EP issues a green bond at a low coupon rate, and if the issuance of that bond does nothing to address the firm's environmental risk, then the investors have unnecessarily exposed themselves to a higher default risk.

5.6. Conclusions

The question of whether corporate environmental performance has a positive effect on firm value has been almost exclusively analysed from the perspective of equity markets. In this chapter, the relationship between the valuation of CEP on EU and US corporate bonds is, therefore, being investigated. Of late, a number of studies have reported a positive association between corporate ESG and the COD (Attig et al. 2013; El Ghouli et al. 2018; Gao et al. 2018; Gupta 2018). Having built on these findings and analysed a sample of 5260 bonds issued in the EU and USA market over the last three years (2016–18), here it is suggested that there is a negative association between environmental performance and the COD, proxied as coupon rates – in other words, a higher CEP helps reduce the cost of debt financing through bond issuance.

A limitation of this study is that, typically, highly profitable firms require no external financing because they can finance their activities and projects with internally generated resources (Gomes 2015). Another limitation arises from the quality of the EP data. Not only are firms with better CSR performance more

likely to disclose their CSR activities to the market (Dhaliwal et al. 2011), but in both equity and credit markets, people continue to view the quality of EP and ESG data as restricting the integration of this type of information into investment decision making.

While banks provide traditional lending services and act as intermediaries between the supply and demand of capital by size and maturity transformation, investment companies, insurance firms and pension funds play an essential role as buyers in the market for corporate bonds. Therefore, credit market players can influence corporate environmental behaviour both in the short and long term. Moreover, even non-public companies (partnerships, companies without a public stock listing) take on debt. For this reason, the potentially disciplining effect of the credit market reaches far more companies than the equity market.

Not every credit market actor is properly able to include environmental information into credit analysis and/or investment decisions. This could be because corporations fail either to communicate appropriately or to report their corporate environmental performance. An alternative explanation for a higher COD despite good CEP could be that some credit market actors continue to disregard environmental performance as an important factor in their investment process or return analysis. Changing these practices is likely to require heightened investor awareness of the importance of environmental performance to investment returns. Given the increased sophistication of publicly available corporate environmental data, this could also be done via standardized environmental reporting, which can be used as a factor in the analysis of historic returns, as well as in the provision of more environmental literacy courses based on corporate case studies for credit market actors.

In this study, it has been shown that since debt market forces do not penalize companies that score well in corporate environmental performance, managers can afford to be responsible. If investment managers believe that CEP is a precursor to a lower cost of debt, they may begin to pursue it actively as an investment strategy on the grounds that the market will reward them for doing so. To deliver outperformance, managers should view CEP scores as a risk leveller and use them to their advantage when negotiating debt financing. Furthermore, market financing should see the lower cost of debt capital as endorsing a reduced perceived risk that can benefit corporations in other capital market spheres, thus incentivizing firms to pursue higher CEP as part of their strategy to attain a lower cost of capital for the firm.

6

The surge of impact borrowing: the magnitude and determinants of green bond supply and its heterogeneity across markets

6.1. Introduction

The nexus between finance and environmental sustainability has recently gained much attention from both researchers and practitioners. Although corporate activity has well-known benefits for society, there is an increasing demand for more sustainable management of companies' operations. The Group of Twenty's (G20) Green Finance Synthesis Report forecast that investment of some US\$ 90 trillion is needed in the next 15 years to achieve global sustainable development and climate objectives (Green Finance Study Group 2016). Over US\$ 800 billion needs to be invested every year to 2020 in renewable energy, energy efficiency, and low-emission vehicles alone, according to OECD estimates (S&P Global 2017). To put all this in perspective, global investment in clean energy in 2016 was only US\$ 287.5 billion.

Green finance is a broad term that can refer to financial investments flowing into sustainable development projects and initiatives, environmental products and policies that encourage the development of a more sustainable economy (Höhne et al. 2012). The emerging idea of investing for 'blended value', a business model

that combines profitability with social benefit (Emerson 2003), includes coupling financial returns with the improvement of social and environmental conditions. By contrast, traditional ‘profit investment’ would produce financial returns only, while social and environmental issues would improve via donations or government policies. The idea behind blended value investment, be it in the form of *debt* or *equity*, is that corporations, organizations, and funds raise capital to fund mission-driven or other projects with the intention of using the proceeds to generate measurable social or environmental impacts alongside financial returns.

For the banking sector, green finance is defined as financial products and services, which take environmental factors into consideration throughout the lending decision making, ex-post monitoring, and risk management processes. Green financing, while supporting financial objectives, permits investments in actions that best support social mission objectives as well promote environmentally responsible investments and to stimulate low-carbon technologies, projects, industries and businesses PwC (2009).

As Reichelt (2010) has argued, to make an impact through financing, investment products must appeal to investors with a substantial asset base. Globally, there has been a surge in the use of such corporate debt financing, particularly that which utilizes one very promising financial instrument – the green bond.

The green bond, a debt instrument issued to raise capital specifically to support climate-related environmental projects (World Bank 2015), made its first appearance in 2007 and since then has expanded at more than 50 per cent compounded annual growth rate, providing an opportunity to fund environmental projects all over the world (Kochetygova and Jauhari 2014). In the first quarter of

2018, sales of green bonds rose to US\$ 25.8 billion, according to the Green Bonds Market Summary (CBI 2018a). A green bond is differentiated from a regular bond by its label, which signifies a commitment to use the funds raised exclusively to finance or refinance ‘green’ projects, assets, or business activities.

Given the potential environmental and economic benefits of green bonds, it is crucial to understand the nature of green bond supply and its determinants globally. Although the volume of academic and practitioner publications on green bonds has increased lately, much of it focuses on the drivers of the market and the demand (investor) side (OECD 2015; Wood and Grace 2011; Wulandari et al. 2018; Zerbib 2017). The aim of this chapter is therefore to address the supply side of the market, which is equally vital in creating and shaping the market for green bonds and can serve as a low-cost financing tool toward a green economy (Caldecott 2015; Mathews and Kidney 2012).

Within this context, and given the dearth of literature on the supply side of the green bond market, this chapter is one of the first attempts to answer three particular research questions: (i) what factors influence the supply side of the green bond market? (ii) How do the factors affect the issue size, that is supply of green bonds? and (iii) do the effects of the factors differ across emerging and non-emerging markets? In answering these questions, a large sample of corporate bonds labelled ‘green’ from the Bloomberg platform over the years 2010 to 2017 is utilized in this chapter. To address the first question, conversations were held with key practitioners in the green bond market to understand the potential variables that could influence the supply of green bonds, in particular the size of green bond issuance. To explore the effects of the potential variables on issue size, cross-sectional ordinary least square (OLS) regressions were carried out, first

on all bond samples, and then separately by ‘emerging’ and ‘non-emerging’ markets to identify the heterogeneity of the effects. Further, the Blinder-Oaxaca Decomposition was used to verify the nature and significance of the heterogeneity across the two markets (emerging and non-emerging).

There is no study yet available in the literature that examines the determinants of supply or related dimensions of green bonds. The contribution of this chapter to the literature is that it focuses on the green fixed-income market and provides empirical evidence of what factors affect the supply side of this new market segment, which is believed to have significant growth potential. Further contributions are made by examining the heterogeneity of the effects across ‘emerging’ and ‘non-emerging’ markets.

This chapter proceeds as follows: section 2 contains a discussion of the relevant literature and theoretical background; section 3 outlines the materials and methods used; section 4 presents the results of the analysis; section 5 presents a discussion of the results; and finally, section 6 is dedicated to policy implications and conclusions.

6.2. Literature and theoretical background

Three main strands of the literature, which are addressed in turn, are important to this chapter. These are studies on impact investing and sustainable finance, traditional theories of long-term corporate borrowing, and works on the role of the bond market as a vital platform for long-term capital supply, namely impact borrowing. There are several attempts in the current literature to define both the concept of impact financing and impact investing, but a clear definition on impact borrowing is missing. There is a definite need for a definition of impact borrowing

as a subfield of impact financing; the one proposed here defines it as ‘debt financing by corporations, organizations and funds to fund mission-driven or other projects with the intention of using the proceeds to generate a measurable social or environmental impact alongside financial returns. Impact borrowing may happen through different avenues, for example, through green bank financing and issuing green bonds.’ Defining impact borrowing could help all stakeholders understand the link between a firm’s debt financing activities and its environmental performance in a more specific manner.

Sustainable financing and investing

The transition to a low-carbon, climate-resilient economy requires a shift of financial capital towards greener solutions (Clark 2013). It has been shown that the more society shows environmental awareness, the more organizations will be required to have a better environmental performance (Jabbour 2013). However, adopting environmental management practices in companies necessitates mobilizing a wide range of organizational resources (Caldecott 2015). The relationship between finance and sustainability links the environmental, social and governance (ESG) criteria, concerns on climate change, and the need for social responsibility, with the financing and investments made by economic agents like corporations (Alm and Sievänen 2013; Hebb 2013; Nikolakis et al. 2012). The public image of a company can translate into real value for that company, which is why making strategic choices to gain and maintain a ‘green image’ can be value enhancing for a business (Hamilton and Eriksson 2011).

According to a survey by Morgan Stanley of high net worth investors in 2016, sustainable investing is becoming more popular among investors, with 55 per cent reporting that they are interested in sustainable investing and 32 per cent viewing

sustainable investing as a good investment approach for the future (Morgan Stanley 2016). Yet, regardless of the growing interest of investors in sustainable investing, there is still a large funding gap for low-carbon projects, which cannot be supported by public sources alone (World Bank 2015). This suggests a potential role for private funding in the transition to a low-carbon economy.

Long-term borrowing: theories and determinants

Access to long-term capital, especially long-term debt financing at an affordable rate, is essential for firms to grow. Equity and long-term debt financing can be either complementary or substitutes for each other, depending on the financial and business status and needs of the firm. There is no consensus on an optimal debt-equity mix, that is capital structure, in corporations. However, long-term borrowing remains a favourite mode of raising capital as an alternative to equity financing for several practical reasons, including tax advantages, cheaper cost, convertibility feature, less regulatory scrutiny, and reporting requirements. Having an optimal capital structure is pivotal for the survival and growth of a firm, and thereby maximizing stakeholders' benefits, particularly shareholder value.

Academic attention to capital structure and its role in a firm's value maximization escalated after the publication of Modigliani and Miller's (1958) seminal article, which shows that a firm's value is independent of its capital structure, that is debt to equity ratio. Later, a number of other significant theories emerged, for example, on the firm preference for capital sources in minimizing information asymmetry between the insiders and outsiders of a firm (the pecking order theory that Myers and Majluf (1984) popularized), the role of different and conflicting stakeholder interests, for example between managers and shareholders, in creating agency costs that influence decisions about a firm's capital structure

(Jensen and Meckling 1976: 2001), and the importance of market timing in maximizing shareholders' wealth or firm value (Baker and Wurgler 2002).

The capital structure question is often related to the extent of a firm's long-term external financing needs. Firm characteristics are perhaps the most important factors to affect long-term financing decisions. For example, the financial condition of a firm determines whether it can access long-term external financing and if so what kind and how much (Leland and Pyle 1977; Myers and Majluf 1984; Pagano et al. 1998); firms with high leverage could have higher fund roll-over needs, and therefore may have more significant demand for debt financing, for example selling bonds. Myers and Majluf (1984) theorized that firms prefer internal sources first, then debt, and finally equity to finance their long-term financing needs. As a result, both growing and large firms often find their internal sources inadequate, and hence opt for long-term debt financing (namely issuing bonds and debentures); they will consider equity issuance as a last resort. Denis and Mihov (2003) argue that bond financing should be more viable for firms with high profits. In addition to financial condition, firm size also has a positive impact on access to public finance and is expected to increase the probability of bond issuance (Calomiris and Hubbard 1995; Datta et al. 2005). Growing firms are also more likely to issue bonds than firms that have fewer opportunities for expansion because they have a greater demand for external funding (Datta et al. 2005; Pagano et al. 1998).

Specific studies on the determinants of traditional bond issue size and green bond issue size appear to be non-existent. However, some studies argue that an increase in the government's borrowing (Folkerts-Landau 1985), recent quantitative easing (QE) programmes in the United States (D'Amico and King

2013; D’Amico et al. 2012; Gagnon et al. 2011; Krishnamurthy and Vissing-Jorgensen 2011) and the United Kingdom (Greenwood et al. 2015; Joyce et al. 2011), business-cycle expansions and inflation (Campbell et al. 2009) may influence bond supply decisions. Moreover, several papers measure supply effects by analysing the behaviour of bond yields around specific policy events such as Operation Twist (Modigliani and Sutch 1966; Bencivenga et al. 1995; Swanson et al. 2011; Wallace 1967) and the US Treasury’s 2000–2002 buybacks (Garbade and Rutherford 2007; Greenwood and Vayanos 2010).

Although issuing bond works as a lifeline for long-term borrowing, the global bond market appears skewed towards developed economies. Burger et al. (2015) suggest that the financial markets in developing countries are different from those in developed ones, with a revealed preference for the banking sector relative to the bond market. As a result, the supply and demand dynamics of the bond market are highly likely to be different across developing and developed, or emerging and non-emerging, economies. Emerging economies are the fast-growing developing countries, such as China, which are considered to be the drivers of global economic development.

While the literature on green financial instruments has been well-developed, most of the emphasis so far has been on analysing the performance of the equity sector of the market. To the best of my knowledge, this is one of the first attempts to characterize the behaviour of the supply side of the world’s green fixed-income market.

Green bonds: evolution and market size

A bond is a type of loan or IOU that companies, governments and banks use to finance projects. The issuer of the bond (the borrower) owes the holder (the

creditor) a debt and, depending on the terms to which they agree, is obliged to pay back the amount lent within a certain amount of time and with a certain interest. A green bond is differentiated from a regular bond by its commitment to using the funds raised to finance or refinance projects, assets or business activities that deliver environmental benefits. A green bond can be either 'labelled' or 'unlabelled'. Labelled green bonds are formally marketed as 'green' by the issuers, who define the types of environmental projects they plan to support with the bond proceeds and report back to investors on a regular basis (Pham 2016). Unlabelled green bonds do not have a formal green tag but are issued by firms whose businesses are naturally aligned with environmental causes, for example, bonds issued by wind or solar energy companies.

Green bonds can be issued by either public or private actors and be bought by institutional investors like pension funds and fund managers; the range of projects supported by green bonds is very diverse, with low-carbon transport and clean energy projects being the two largest beneficiaries (Shankleman 2016).

Green bonds, like most bonds, receive a credit rating from agencies like Standard & Poor's and Moody's and are no cheaper than regular ones. They do offer the same returns as other bonds, but with the added benefit that funds are only going to climate change solutions (CBI 2017).

The identification and labelling of green bonds typically follow the Green Bond Principles (GBPs), a set of voluntary standards established by participants in industry including major banks and non-profit organizations (ICMA 2015). The GBPs consist of four elements. First, to be labelled 'green', a bond's proceeds must be used for environmentally beneficial capital expenditures, such as investments in alternative energy, energy efficiency, pollution prevention and

control, or sustainable water and green buildings. Second, the green bond documentation must include specific criteria and processes for determining eligible projects or investment. Third, a formal process that regulates the use of net proceeds must be disclosed in the bond prospectus or supporting document. Fourth, issuers of green bonds should report at least annually on the specific investments made from the green bond proceeds and document the environmental impacts of the specific investments.

Among different market players, the terminology to promote the environmental benefits of issued bonds varies. For example, multilateral development banks use a variety of titles, such as ‘Climate Awareness Bonds’ (European Investment Bank), ‘Environmental Support Bonds’ (Nordic Investment Bank), and simply ‘Green Bonds’ (World Bank 2015). Further, there are several labels for green bonds, including the GBPs, the Climate Bond Initiative’s Climate Bond Standards (CBS), and various national definitions (such as the green bonds endorsed catalogue in China). Table 6.1 presents the different labelling of green bonds per the widely accepted Climate Bond Initiative.

As the Climate Bond Initiative argues, apart from its environmental aspect, green bonds and standard bonds are conceptually almost similar. There are, however, two practical differences between them. First, green bonds use flat pricing with no additional costs, while the standard bonds often carry extra expenses. This is because the credit profile of green bonds is the same as other vanilla bonds from the same issuer, regardless of the complexity of their features. Additional features (that is callable or convertibility features) could introduce an extra cost for traditional bonds, thus increasing their price.

Second, green bonds have the same recourse to the issue, which means that they are a debt obligation for which the proceeds are tracked by the issuer and attested to by a formal internal process that will be linked to the issuer's lending and investment operations for projects.

Table 6.1. The green bond market with a focus on the various types of bonds

Type	Proceeds raised by bond sale are	Debt recourse	Example
Green 'use of proceeds' bond	Earmarked for green projects.	Standard/full recourse to the issuer; therefore, same credit rating applies as to issuers other bonds.	EIB 'Climate Awareness Bone' (backed by EIB)
Green 'use of proceeds' revenue bond	Earmarked for green projects.	Revenue streams from the issuers though fees or taxes are the collateral for the debt.	Hawaii State (backed by fee on electricity bills of the state utilities)
Green project bond	Ring-fenced for the specific underlying green project(s).	Recourse is only to the project's assets and balance sheet.	Alta Wind Holdings LLC (backed by the Alta Wind project)
Green securitized bond	Either (1) earmarked for grand project or (2) go directly into the underlying green prefects.	Recourse is to a group of projects that have been grouped together (that is covered bond or other structures).	(1) Northland Power (backed by solar farms) or (2) Soler City (backed by residential solar leases)

Source: Climate Bonds Initiative (<https://www.climatebonds.net/market/explaining-green-bonds>, accessed 14 December 2017).

The green bond market, while still relatively small compared with the total outstanding bond universe, has experienced steady growth since its inception in 2007. Initially driven by multilateral development, or supranational banks such as

the World Bank and the European Investment Bank, recent market growth has been driven by corporate and municipal bond issuance. In 2014, two-thirds of all new green bonds came from issuers that were not multilateral development banks, attracting a broad group of investors such as asset managers, pension funds, companies, foundations and religious organizations (Kochetygova and Jauhari 2014).

The climate-aligned bond market now stands at US\$ 895 billion, a jump of US\$ 201 billion from the 2016 figure; this total is comprised of unlabelled climate-aligned bonds at US\$ 674 billion and labelled green bonds at US\$ 221 billion (CBI 2017). Yet, it does not reflect the full potential for labelled green bond market growth (Kidney 2015). Ehlers and Packer (2016) provide another account of the available green bond market, showing that emerging market issuers, most of whom are from China, have taken the majority share in the global green bond market. The global green bond market has been largely driven by China in recent years, especially since 2015. China experienced a record-breaking green bond issuance of about US\$ 35.50 billion, which reached US\$ 37.1 billion in 2017, up by 4.5 per cent. Of this 2017 total, a US\$ 22.9 billion issuance aligns with international green bond definitions. Standing at 15 per cent of global green bond issuance, this makes China the world's second largest green bond market (CBI 2017).

Ridley (2016) has determined four forces that would stimulate green bond market growth: (1) the standardization and uniform adoption of the architecture for green bond issuance throughout the world; (2) the success of Moody's initiative to offer green bond assessments for new green bonds; (3) the successful CoP-21 held in Paris, which should prompt agencies, banks, and corporations to identify further green projects to fund, much of which will be financed by green

bonds; and (4) the successful performance of many green bonds – particularly ‘agency’ green bonds – in the secondary market. Contrary to the general perception, liquidity for the green bond is ample and, as a result, issuers may find it attractive for large-scale financing (Della Croce et al. 2011). However, demand may not be sustained if investors receive inadequate yield compensation; the average green bond premium is negative, especially where the issue size is greater than US\$ 100 million. Based on the overall evolution of the green bond market, it is understandable that the supply side plays the leading role in making and shaping the market. This is also because financing needs and intended projects are the outputs of corporations, which create the supply of green bonds, namely investment opportunities for investors.

While there is academic and practitioner evidence for the overwhelming demand for green bonds (HSBC 2017; Kidney 2017), empirical studies examining the factors that affect the supply of corporate green bonds and their heterogeneity across different markets remains unavailable. The aim here is to help address this research gap by drawing from the literature on the traditional long-term borrowing determinants presented above, extending the nature and type of the determinants based on practitioner opinions, and then applying the appropriate methodological tools with which to examine their effects on green bond issue size.

Based on this needs, the hypothesis of this Chapter reads as follows:

HP1: The size of green bond issuance is influenced by factors that differ across emerging and non-emerging markets

6.3. Materials and Methods

The decision here is to opt for research methods that prioritize open-minded investigation and observation, yet retain rigour and reduce inadvertent or unintended biases. Thus, the method of assembly, a ‘close dialogue’ approach that has found success in studies in the fields of financial and economic geography (Clark 1998), is adopted. More specifically, a three-pronged approach is followed. First, based on the existing literature and close dialogue discussions with leading practitioners who are high-ranking members of the Green Bond Principles Initiative hosted by the International Capital Market Association (ICMA), critical variables have been selected that affect a firm’s bond issuance size (supply of bonds). Second, a cross-sectional OLS estimation is used to explore the effects of the selected issuer-specific, bond-specific, and market-specific factors on green bond supply measured by issue size. Further evaluations are made to compare two different markets, namely emerging and non-emerging markets, as defined by Bloomberg.¹ Finally, Blinder-Oaxaca decomposition is applied to identify whether a significant difference exists in issue size between emerging and non-emerging markets, and to explore the contributions of the factors utilized in creating such difference.

To allow for a replicable dataset and standardized approach, a green bond list was chosen from Bloomberg’s existing ‘green labelled’ bonds. Bloomberg defines green bonds as ‘instruments for which the proceeds are exclusively applied (either by specifying use of proceeds, direct project exposure, or securitization) towards

1. The geographic breakdown of green bonds in Bloomberg’s analysis is based on ‘country of risk’ (= country providing the largest single source of sales, operations or cash flow for an issuer – that is not market of distribution of the bond, but market of sales of the issuers products/services).

new and existing green projects, defined as projects and activities that promote climate or other environmental sustainability purposes.’ The four types of green bonds are the Green Use of Proceeds Bond, the Green Use of Proceeds Revenue Bond, the Green Project Bond, and the Green Securitized Bond.

Identification of factors

To measure the supply of green bonds, the amount of funds raised through the sale of the bonds (amount issued), measured in US dollars, is considered. To identify the determinants of green bond supply, the following variables based on the literature and consultation with the market stakeholders have been defined. The key parties consulted are leading green bond issuers and underwriters as well as professional organizations and NGOs working primarily on this topic.

Variables, econometric model design and data

To estimate the effects of the factors identified in the supply of green bonds, the following functional form is first developed using the above terminology:

$$\text{Issue Size} = f(\text{Bond Characteristics, Issuer Characteristics, Economic and Market Characteristics});$$

hence,

$$\begin{aligned} \text{Issue Size} = f(\text{Coupon rate, Maturity, Bond rating, Pari passu, Security, Risk} \\ \text{premium, Denomination currency, Firm size, Business growth, Capital structure,} \\ \text{Issuer credit rating, Profitability, Alternative financing cost, Sector of issuer,} \\ \text{Market interest rate, Market type, Market of distribution});^2 \end{aligned}$$

therefore,

2. For a detailed definition of each variable please refer to Appendix.

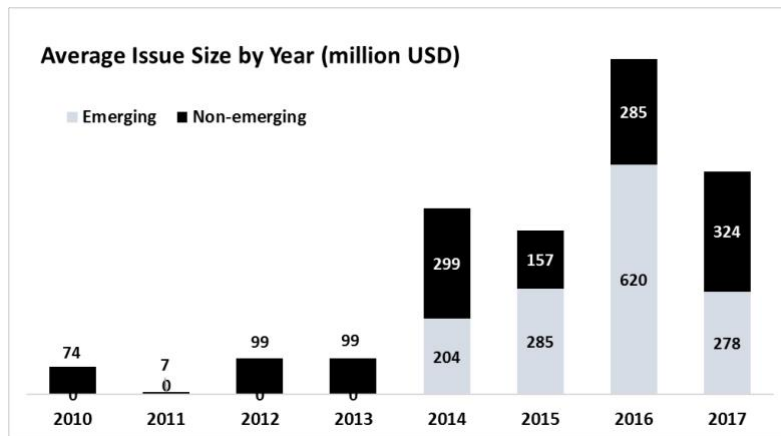
$$\text{Amount Issued} = f(\text{CR}, \text{Mat}, \text{BR}, \text{PP_dum}, \text{Sec_dum}, \text{RP}, \text{Curr_dum}, \text{TA}, \text{RG}, \\ \text{CS}, \text{IR}, \text{ROA}, \text{MIR}, \text{Sect_dum}, \text{MT_dum}, \text{MD_dum});$$

Using all the variables, the following equation is formulated:

$$\begin{aligned} \ln \text{amt_issued}_i &= \alpha_i + \beta_1 \text{CR}_i + \beta_2 \text{Mat}_i + \beta_3 \text{BR}_i + \beta_4 \text{PP_dum}_i \\ &+ \beta_5 \text{SEC_dum}_i + \beta_6 \text{RP}_i + \sum_{j=7}^9 \beta_j \text{CUR_dum}_i + \beta_{10} \text{TA}_i \\ &+ \beta_{11} \text{RG}_i + \beta_{12} \text{CS}_i + \beta_{13} \text{IR}_i + \beta_{14} \text{ROA}_i + \beta_{15} \text{MIR}_i \\ &+ \sum_{j=15}^{19} \beta_j \text{SECT_dum}_i + \beta_{20} \text{MT_dum}_i + \sum_{j=21}^{23} \beta_j \text{MD_dum}_i \\ &+ \sum_{j=1}^n \beta_j Y_j + \epsilon \end{aligned} \quad (1)$$

Where α is the constant, ϵ is the error term, i denotes for each bond, β measures the coefficients of the variables, and $\sum_{j=1}^n \beta_j Y_j$ captures the year dummies. Our model ensures robustness by controlling issuer sector of operation, the currency of denomination, market targeted, and time fixed effects.

Figure 6.1. Mean issue size, 2010–17: classified by emerging and non-emerging markets



Source: Author calculations.

Bloomberg data are considered for 771 green bond issuances from 2010 to 2017. Data obtained for all variables are the latest available as of the issue date of each bond. Figure A6.1 in the Appendix shows the mean issue size of green bonds over the period considered at the aggregate level and classified by emerging and non-emerging markets. Figures A6.2 and A6.3 in the Appendix show further distribution of green bond issuances by currency, sector and major source countries.

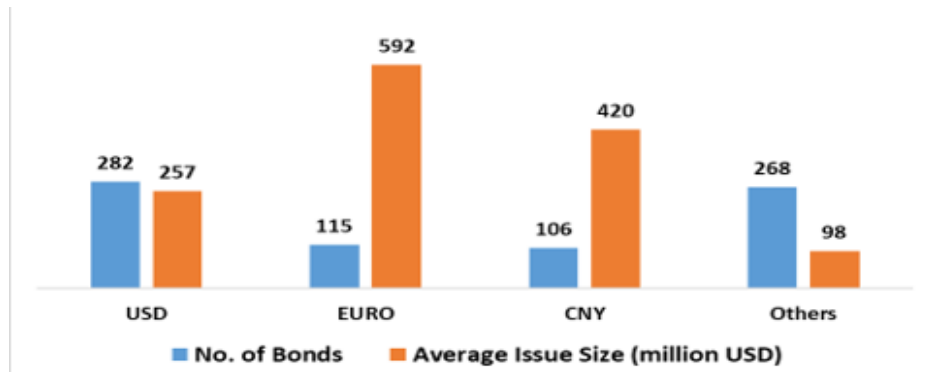
Using equation (1) above, two types of estimations are run: (a) ordinary least square (OLS); and (b) Blinder-Oaxaca decomposition.

OLS estimation: with the data set obtained from the Bloomberg terminal, the parameters of the linear model equation (2) are first estimated for all bonds together via the OLS method (Breusch-Pagan/Cook-Weisberg test). In a second stage, since the aim of the study is to explore the differential effects of the supply determinants between emerging and non-emerging markets, another OLS was run to estimate the parameters of equation (2) for emerging and non-emerging markets separately. Since different bonds are issued in different years but do not contain any time series information – that is only information at the time of issue is considered – the dataset behaves like repeated cross-section data. To capture the different year fixed effects, equation (1) uses the dummies for each issue year of each bond from 2010 to 2017. Cross-sectional data often carry an inherent heteroscedasticity problem. Diagnostics are run for heteroscedasticity and multicollinearity in the data; the results are reported in Table 6.2.

The findings show significant levels of heteroskedasticity for all three sets of data. Therefore, the OLS for all three sets is estimated with robust standard errors. Also, a variance inflation factor (VIF) test suggests no significant

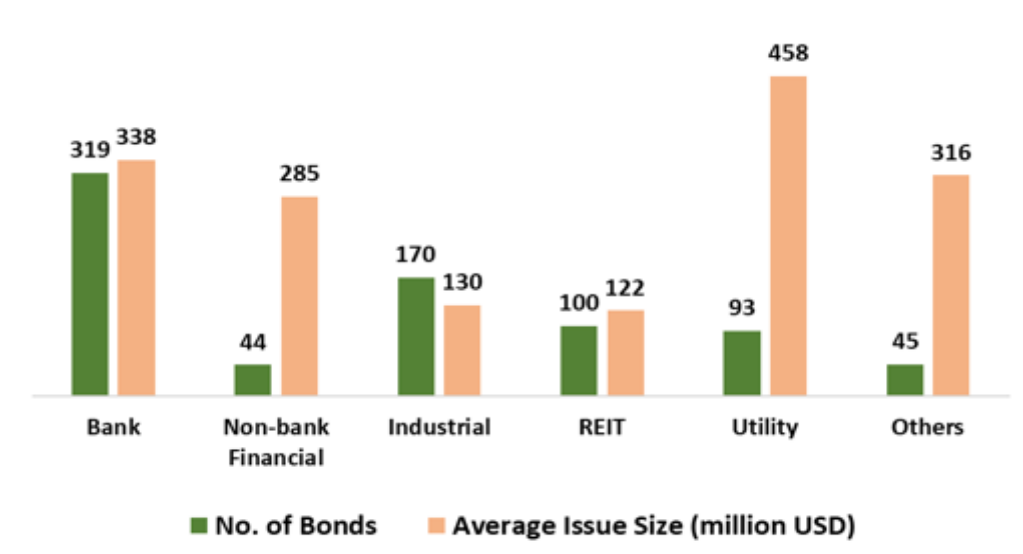
multicollinearity problem. To further validate the nullification of multicollinearity prevalence, the correlation matrices of the variables for all three datasets are provided in the Appendix separately.

Figure 6.2. Distribution of bond issuances by currency



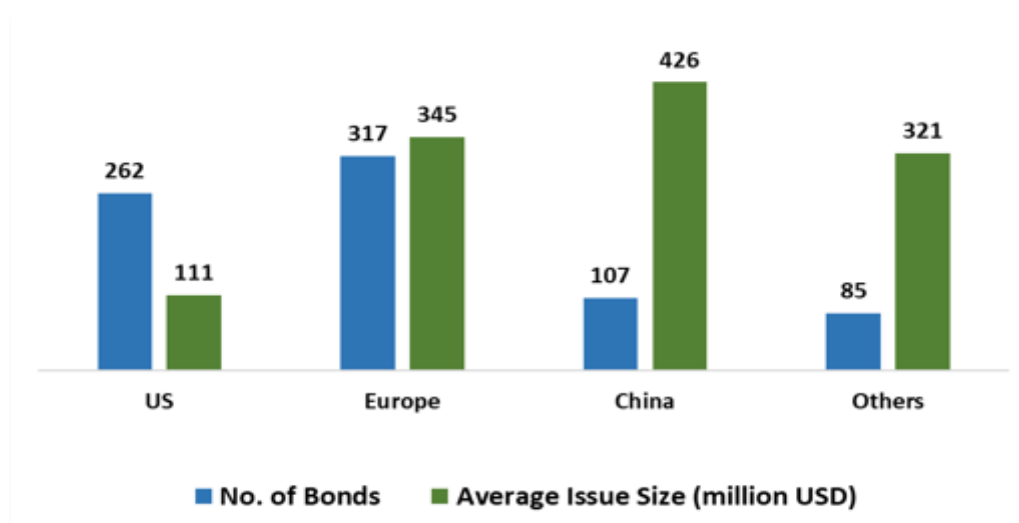
Source: Bloomberg data.

Figure 6.3. Distribution of bond issuances by sector



Source: Bloomberg data.

Figure 6.4. Distribution of bond issuances by country



Source: Bloomberg data.

Table 6.2. Factors/variables used

Determinant categories	Variables considered	Variable description	Rationale	Expected effects
(1) Bond Characteristics	Coupon Rate (CR) = (YTM)	% rate of coupon interest per annum	Cost of financing	Higher cost would discourage issue size
	Maturity (Mat)	Total original maturity in years	Cash flow repayment timing	Longer maturity would encourage issue size
	Bond Rating (BR)	Numerical codes for rating either by Standard & Poor's or Moody's; lower in case of both	Creditworthiness and riskiness of the bond	Having bond rating would encourage issue size

Risk premium (RP)	Excess return above risk-free rates (%)	Excess return for the credit risk; indirect proxy for riskiness	Higher risk premium would discourage issue size as cost rises
Pari Passu (PP_dum)	Dummy; 1 = yes, 0 = no	Equivalence with conventional bonds	Increase in equal debt class should discourage issue size
Security (SEC)	Dummy; 1 = secured, 0 = unsecured	Security for repayment ability	Having security would help raise larger fund
Currency (CUR_dum)	Dummies for three major currencies: US\$, EUR, CNY and others	Control for currency reliability and preference of markets	More internationally accepted currencies should be associated with larger size

Table 6.2 continued

Determinant categories	Variables considered	Variable description	Rationale	Expected effects
(2) Issuer Characteristics	Total asset (TA)	Value of total assets in million US\$	Firm size	Larger firms would have more significant financing needs
	Revenue growth (RG)	% growth in revenue year- on-year of the issuing company	Business performance and potential of the issuers	Better business performance would require

				less external financing
	Capital structure (CS)	Debt to capital ratio	Degree of leverage	Higher existing leverage would discourage issue size
	Return on assets (ROA)	Return on assets (annual %)	Firm profitability	Higher profitability would depress external fund needs
	Issuer Credit Rating (IR)	Numerical codes for rating either by Standard & Poor's Moody's; lower in case of both	Creditworthiness and risk profile of the issuer	Having credit rating would encourage greater issue size
	Sector (SECT_dum)	Dummy for each sector: bank (BNK), financial (FIN), industrial (IND), real estate (REIT), utilities (UTI), and others	Control for the sector where the raised finance is flowing in	Some sectors may attract more funds than others
(3) Economic and market characteristics	Market interest rate (MIR)	Lending interest rate charged by the financial institutions	Alternative cost of financing for companies	Higher alternative financing cost would encourage issue size, but

			the lower market value may discourage.
Market Type (MT_dum)	Dummy for market of sales; emerging = 1, others =0	Control for if issued in the emerging market; also controls for economy size	Emerging markets would be associated with higher issue size, given the market trend
Market of distribution (MD_dum)	Four Dummies for Domestic (DOM), Foreign (FOR), international (INTL) and global (GLOB)	Control for the primary market segment targeted and sold to	More internationalized target would enable issuance of larger bond size

Blinder-Oaxaca Decomposition: the Blinder-Oaxaca decomposition analysis (Blinder 1973; Oaxaca 1973) is carried out to see whether the two groups of bonds, namely emerging market and non-emerging market bonds, differ significantly. Both twofold and threefold decomposition analyses are run to understand the differences of issue size, that is supply of green bonds, between emerging and non-emerging markets. This analysis also explores the magnitude effect of each determinant defined in the methodology section.

6.4. Discussion

Table 6.3 shows the OLS estimation results for all bonds, with emerging market and non-emerging market listed separately. After first discussing the results for all

the bonds, the emerging and non-emerging markets are then compared following the three major categories of the variables utilized – bond characteristics, issuer characteristics, and economic and market characteristics.

Table 6.3. Diagnostic tests (p-values reported)

Test for	Test name		All bonds	Emerging markets	Non- emerging markets
Heteroskedasticity	Breusch-Pagan/	chi2(1)	21.15	10.76	19.40
	Cook-Weisberg test				
		Prob > chi2	0.000	0.001	0.000
Multicollinearity	VIF Test	3.90	4.82	4.79	

Source: Author calculations.

All Bonds Results

Bond Characteristics

The results of the OLS suggest that the coupon rate is a highly significant factor in explaining the issue size differences in the ‘all bonds’ data set (at the 1 per cent level). It has a negative effect on issue size, which indicates that issues with

Table 6.4. OLS estimations results of equation (1)

Dependent variable: amount issued in US\$ (lnamt_issued) independent variables	All Bonds	Emerging markets	Non-emerging markets
Coupon rate (CR)	−0.126*** (0.031)	0.268*** (0.095)	−0.137*** (0.032)
Maturity (Mat)	−0.023 (0.016)	−0.061* (0.033)	−0.023 (0.0190)
Security dummy (SEC_dum)	0.757*** (0.271)	−0.285 (0.910)	0.617** (0.287)
Bond rating (BR)	0.223*** (0.032)	0.214 (0.168)	0.220*** (0.034)
Risk premium (RP)	0.020 (0.034)	−0.021 (0.050)	0.024 (0.048)
Pari passu (PP_dum)	0.052 (0.162)	−1.458** (0.570)	0.193 (0.169)

Total Asset (lnTA)	0.081*(0.048)	0.385*** (0.100))	0.009(0.057
Revenue Growth (RG)	−0.001**(0.000)	0.000(0.002)	−0.001**(0.000)
Debt to asset ratio (CS)	−0.777* (0.444)	− 0.558(1.358)	−0.962**(0.485)
Issuer rating (IR)	−0.042(0.041)	0.053(0.087)	−0.014(0.050)
Return on assets (ROA)	0.155*** (0.029)	−0.125(0.136)	0.151*** (0.032)
Market interest rates (MIR)	−0.017(0.066)	−0.082(0.058)	0.092(0.083)
US\$ currency dummy	−0.233(0.232)	2.861*** (1.005)	−0.357(0.245)
EURO currency dummy	1.617*** (0.267)	4.340*** (1.201)	1.434*** (0.296)
CNY currency dummy	0.432(0.524)	2.133*** (0.490)	−
EM ¹ dummy (MT_dum)	1.280*** (0.455)	−	−
Foreign market dummy	0.645* (0.360)	−0.656(0.691)	0.458(0.428)
Global market dummy	1.573*** (0.408)	−	1.554*** (0.439)
International market dummy	−0.984*** (0.275)	−0.288(0.956)	−1.173*** (0.334)
Bank sector dummy	−0.732(0.591)	−0.327(0.944)	−1.569** (0.784)
Financial sector dummy	−1.595** (0.694)	−0.643(1.110)	−2.778*** (1.066)
Industrial sector dummy	−2.353*** (0.634)	0.909(1.204)	−3.478*** (0.822)
REIT sector dummy	−2.273*** (0.588)	0.352(1.086)	−3.232*** (0.768)
Utility sector dummy	−0.351(0.599)	0.018(0.989)	−1.131(0.769)
Constant	17.535*** (0.988)	11.878*** (1.958)	18.827*** (1.093)
<i>R Squared</i>	0.633	0.679	0.628
<i>Prob > F</i>	0.000	0.000	0.000
No. of Observations	577	79	498

Notes: ¹EM = emerging market. Significance level *** = 1%, ** = 5%, and * = 10%. Figures within parenthesis indicate robust standard errors. Estimates for year dummies not reported. Global market dummy automatically dropped by estimation because of collinearity as no emerging market bond had global market reach. Similarly, CNY currency dummy dropped by estimation because of collinearity as no non-emerging market bond is issued with CNY currency as a denomination.

higher coupon rates are likely to be smaller in size. This finding is practically consistent with the principle that a higher coupon or yield usually implies a higher cost of financing (hence, a higher interest payment to the investors). A lower cost of financing would create incentives for the issuers to raise the maximum possible funds against their needs through selling the bond. The findings show that bond maturity has no significant impact on the issue size.

Pari passu shows a significant and negative effect on green bond issue size, suggesting that issuers that are ranked or rated equally with other traditional long-term debts are of smaller size, namely borrowers with differential debt status are higher in issue size. This effect may indicate that issuers have an appetite for a diversified debt portfolio approach, and that those holding a particular class of securities are less likely to raise further debt financing classified with equal status.

Bond credit rating appears to be a highly significant factor, positively influencing issue size. It means that bonds with a higher credit rating by either S&P or Moody's are likely to be more creditworthy and secured, and therefore the size of a bond issued is expected to be larger. Having a higher bond rating often not only encourages the issuers to raise larger fund but also creates a natural avenue for that. Issuers intending to sell bonds with higher credit ratings would have more demand in the market than those with a lower rating, enabling and incentivizing the issuers to finance big. The encouragement and opportunity to raise large funds can be further validated from the results of the security dummy variable. The OLS results suggest that bonds secured via collateral are likely to be larger. Having collateral makes the bonds secure, which increases investor acceptance of the bond in the market, so thus helps the issuers to raise more funds.

Three currency dummy variables were used (USD, EUR, CNY) to explore the effects of the bonds' original currency of denomination. The logic is that bonds that are denominated in more widely accepted international currencies (for example, USD, EUR) are likely to have a bigger market with higher investor confidence globally. The OLS results partially confirm this hypothesis, for they indicate that bonds denominated in EUR currency are more significant in issue size relative to other currencies that are excluded from the regression (for example

AUD, BRL, SEK). Interestingly, the USD currency dummy appears insignificant. This might reflect the fact that the global bond market has seen more substantial financing through EUR denominated bonds in the investigated period of 2010–2017, and that investors welcome them. We also do not find any significant influence of the Chinese currency (CNY) dummy on issue size.

Issuer characteristics

The OLS results suggest that both debt-to-capital ratio (a proxy for a company's capital structure) and annual revenue growth rate (a proxy for business performance) have a significant and negative effect on the issue size. The negative influence of 'revenue growth' on bond issue size may indicate that issuers with a better business performance are likely to generate higher cash flows, thereby creating availability of higher internal funds and less appetite for external borrowing. The result is consistent with the Pecking Order theory of Myers and Majluf (1984). Further, the findings regarding a negative impact of the debt-to-asset ratio may suggest that issuers who already have higher leverage in their capital structure would have less flexibility (either to avoid increased risk of default through excessive leverage or because of restrictions from current lenders) to raise further funds by issuing debt instruments. As a result, a higher degree of leverage would perhaps result in the lower size of new debt issuance.

The result on the sectoral dummies indicates the sensitivity of the issue size concerning the sector that absorbs the fund. For example, the industrial and real estate (REIT) sector dummies show a significant and negative impact on issue size, suggesting that green project finance in these sectors is likely to be smaller relative to the 'other' sectors. The opposite argument applies to the utility sector

dummy. Banking and financial sector dummies show no significant effect on the issue size.

Market characteristics

The results of the OLS suggest that emerging market dummy is highly significant (at 1 per cent level) and has a positive impact on the amount issued, meaning that bonds sold in the emerging market are larger in issue size relative to those sold in the non-emerging market. The result is suggestive of higher liquidity and demand for green bonds in the emerging market. Furthermore, the variable carries the highest coefficient value among all the variables, which means that, whether the green bonds are sold in emerging or non-emerging markets, it has the largest influences on their issue size.

The results indicate that the issue size of green bonds linked with the ‘foreign’ and ‘global’ markets is higher than of those targeting the ‘domestic’ market. ‘Foreign’ means bonds are intended for domestic investors issued by foreign issuers, while ‘global’ means that a sovereign or supranational entity issues the bonds. The results confirm, at least partially, that the effect of issuing bonds under a ‘foreign’ or ‘global’ regime is relatively larger on issue size than for purely ‘domestic’ bonds. Surprisingly, bonds categorized as having ‘international’ target market are likely to have a smaller effect on issue size than the purely domestic ones. ‘International’ means that the bonds are intended for both domestic and non-domestic investors.

Emerging vs non-emerging: a deeper investigation

Two separate regressions are carried for each of the two markets to explore their differences. The significant and positive effects of bond credit rating and the EUR currency dummies are confirmed, while there are negative effects of revenue

growth and capital structure on the green bond issue size in the separate estimations, similar to all bonds results.

However, while the coupon rate/YTM shows a negative effect for ‘all bonds’ and ‘non-emerging markets’ (interpretation see under ‘all bonds’, in ‘emerging markets’), it shows a positive effect in the emerging market, suggesting that the larger the coupon rate in emerging markets, the larger the bond’s issue size. It perhaps reflects the overwhelming issuance of Chinese bonds, which dominate emerging markets, combined with a higher coupon rate and larger issue size. Similar to all bond results, the findings confirm that maturity does not affect issue size in either of the markets. Pari passu shows negative and significant effect only in non-emerging markets, confirming that the negative effect of pari passu in the ‘all bond’ regression arises solely from non-emerging markets. A similar argument is applicable for the security dummy. The findings suggest that whether the bond is secured or not matters primarily in the non-emerging markets. Regarding the currency dummies, the effect of EUR currency on green bond issue size remains significant and positive across both the markets. Bonds issued in USD, EURO and CNY enable the issuers to finance at high levels in emerging markets while in non-emerging markets, a similar effect arises only from EURO. Contrary to the ‘all bond’ results, both USD and CNY currency dummies appear to have significant and positive effects on issue size in emerging markets.

It is apparent that fundamental characteristics of the issuers (revenue growth and capital structure) matter only in non-emerging markets, that is for emerging markets, these characteristics show no significant effect on green bond issue size. Therefore, their significance in the ‘all bonds’ result appears to arise only from non-emerging markets. Interestingly, issuer credit rating shows a significant and

positive effect in emerging markets while in non-emerging markets the variable has a negative effect on the green bond issue size, that is a higher credit rating induces larger bond issue size in emerging markets only. All sector dummies except utilities show adverse effects on issue size in the non-emerging market while no sectoral sensitivity is found in emerging markets. Further, there is no significant sensitivity of issue size to the type of distribution market in emerging markets. However, in emerging markets, bonds targeted to global and international investor markets are likely to have a larger issue size for the former and a smaller one for the latter, respectively. It appears that the results of the market of distribution dummies in the ‘all bond’ estimation arise purely from non-emerging markets. It is worth noting that emerging markets are dominated by China, and hence many of the findings could be attributed to the green bond supply from China to the global market.

Overall, R-squared values suggest that the determinants used can explain 65 per cent of the variations in the issue size across issuers when all bonds are considered together. However, this power of explanation appears to be 65 per cent for non-emerging markets and 41 per cent for emerging markets, as the separate estimations suggest. Based on the data available concerning the model designed, a total of 614 bonds (135 emerging and 419 non-emerging market bonds) have been used in the estimations.

Decomposition analysis: the Blinder-Oaxaca decomposition analysis is carried out to see whether the two groups of bonds, namely, emerging market and non-emerging market bonds, differ significantly. Twofold and threefold decomposition analysis was run to form a rigorous understanding of the differences. The results suggest that the size of the mean issue (in natural log

terms) for emerging market bonds is 19.37 and for non-emerging market bonds it is 17.51, indicating a difference of 1.86.

Table 6.5. Blinder-Oaxaca decomposition

Inamt_issued	Coef.	Robust Std. Err.	z	P > z	[95% Conf. Interval]	
Pooled (threefold) decomposition						
Differential						
Prediction_1	19.37	0.09	206.54	0.00	19.18	19.55
Prediction_2	17.51	0.11	154.79	0.00	17.29	17.73
Difference	1.86	0.15	12.63	0.00	1.57	2.14
Decomposition						
Explained	0.66	0.29	2.26	0.02	0.09	1.23
Unexplained	1.20	0.30	3.99	0.00	0.61	1.78
Twofold decomposition						
Differential						
Prediction_1	19.37	0.10	196.27	0.00	19.17	19.56
Prediction_2	17.51	0.11	153.35	0.00	17.29	17.74
Difference	1.86	0.15	12.29	0.00	1.56	2.15
Decomposition						
Endowments	0.78	0.22	3.49	0.00	0.34	1.21
Coefficients	1.35	0.50	2.71	0.01	0.38	2.33
Interaction	-0.27	0.51	-0.53	0.60	-1.28	0.73

1. Emerging market = 1; 2. non-emerging market = 0; no. of observations = 614.

The findings show that the difference is statistically significant and that emerging market bonds have a higher mean issue size relative to non-emerging market bonds. Endowments carry a value of 0.66 in threefold and 0.78 in twofold decomposition. This result suggests that the differences in all characteristics utilized in the regression estimations account for about $(0.66/1.86)$ 35 to 42 per cent $(0.78/1.86)$ of the differences in the issue size, that is a larger mean bond issue size in emerging markets compared with non-emerging markets.

6.5. Conclusion

Given the global focus on environmental sustainability and a growing awareness of environmental issues among investors and the general public, the need to study the factors influencing the size of the green bond market is stronger than ever.

Using Bloomberg data from 2010 to 2017 with an OLS estimation and Blinder-Oaxaca decomposition analysis, this is one of the first studies on the supply side of the market to identify the relevant dependent factors that can provide issuers and investors with an extra insight into this growing and favourable environment. The OLS estimation led to a few interesting conclusions, namely that green bond issuance has shown the most growth in emerging markets and in non-traditional currencies such as CNY. The Blinder-Oaxaca analysis found a statistically significant difference in the size of emerging market green bonds versus developed market green bonds, indicating that the market may be more mature or accepted by investors in emerging markets as opposed to developed markets.

The main challenge for issuers as the green bond market continues to grow, is to introduce stronger differentiation strategies between green bonds and conventional bonds in order to keep attracting investors towards both green and conventional bonds. The function of green bonds is to couple the allocation of financial resources with non-financial outcomes (namely environmental performance). This functionality, in principle, could potentially be incorporated into any other financial instrument, including corporate bonds that could function in the same way. Functionality (coupling financial resource allocation with environmental outcomes) is therefore the critical factor and whether bonds are called green or something else is perhaps secondary. Or, perhaps it is not, because

market participants might react differently to bonds labelled ‘green’ than to those with other labels, which could make room for further research.

Nevertheless, investors can use this estimation results to construct the optimal risk-minimizing portfolio mix between green and conventional bonds as well as between the bonds of emerging and non-emerging countries.

Moreover, the findings appear to carry policy implications at both national and international levels. As EURO denominated bonds already appear to have an important effect on supply, more attention should be given to markets that raise USD debt capital, to incentivize the issuance of green bonds. Furthermore, the finding that CNY denomination influences are only apparent in emerging markets could suggest a failure to utilize the international market potential of Chinese bonds. Making US and CNY denominated green bonds more attractive would not only help mobilize more green financing, but it might also encourage more US and Chinese firms to adopt environmentally friendly practices, particularly in the industrial, financial and REIT sectors. This, combined with the findings across markets, suggests that while countries with rapidly-growing emerging markets, primarily led by China’s large and fast-expanding economy, show much greater room to finance further via green bonds, policies should also focus on enhancing the growth of green bonds in non-emerging markets. A final implication of the findings is that the determinants of a supply of green bonds in emerging and non-emerging markets are significantly heterogeneous, which calls for market-specific policies and efforts instead of a ‘one size fits all’ approach towards expanding the size and outreach of the global market for green bonds.

The analysis in this chapter suggests several directions for future research. First, it would be interesting to compare and investigate the main differences and

commonalities between the supply side of the market for green and conventional bonds. Second, depending on the availability of data, it would be interesting to examine the supply of green bonds in China to identify what accounts for this enormous growth. Third, future research could study how issuers are redefining well-known financial products for environmental purposes (for example, green insurances).

It is likely that issuers, having shown that green bonds are an attractive security to investors, can scale the concept and diversify it, thereby creating new markets towards other ESG specific issues in the immediate future.

The determinants of green bond spread and the influence of issuance order

7.1. Introduction

Fuelled by a growing appetite for environmental and social benefits on the part of investors, green bonds have enjoyed strong investor demand. Green bonds are debt finance instruments used to raise long-term capital for environmentally friendly projects, while offering returns that are similar to those of conventional bonds (BNP Paribas 2017; Ehlers and Packer 2017; Weber and Saravade 2018, 2019). As innovative financial instruments, they enable issuers to diversify their investor base by attracting a new type of socially responsible investors, namely institutional investors (Banga 2019; Breen and Campbell 2017; Buttin 2016; Martín 2019). One of the main characteristics of green bonds is that, in contrast to conventional bonds, there is transparency about the use of their proceeds, which are earmarked for green projects or products, thus generating a win–win outcome for both issuers and investors. Green bonds labelled by the Green Bond Initiative are considered transparent by the international investor’s community as, to be certified, they go under a structured scrutiny and must report on use of proceeds every few months. Several other international initiatives, like the Green Bonds Transparency Platform launched at COP 25, help bringing greater transparency to the green bond market. Moreover, as investors are active supporters of the green

bond market, they are becoming more interested in the way funding are allocated. As such, they demand higher quality of information, improving transparency and data availability. This transparency, however, comes at a cost, for it requires the setup of specific sustainability committees and expensive certifications and third-party reviews (Martín 2019). For this reason, many issuers may issue green bonds without an official label, thus making it harder for investors to defend the sustainability investment proposition.

Although the annual issuance of green bonds has increased extensively over the last few years from about US\$ 3 billion in 2011 to US\$ 155.5 billion in 2018 (CBI 2018b), the green bond market to date represents only 2 per cent of the global fixed-income market (Reuters 2018b). This limited market size has been the focus of many recent discussions, for the growth of North American corporate green bond issuances has been slow (S&P Global 2019), despite the willingness of most issuers to consider sustainable financing in the capital mix (Clark 2017). Since a number of corporate sectors have had reasonable success issuing green debt, the focus of this chapter is on identifying the major determinants of green bond spread to help us to understand why, despite many companies wishing to issue or reissue them, they still feel unsure about market acceptance (S&P Global 2019). In particular, the focus of this chapter is on observing the influence of the order of issuance, that is the bond issued by the same company at different times to see whether it has an effect on spread that could justify the slowness of the market. In fact, if issuers find that the cost of debt becomes higher over issuances, they may be disincentivized to reissue green bonds. If potential issuers see interest rates growing over time, they may be discouraged from issuing their first green

bond, given the high initial cost of issuance plus the added complexities of, for example, having to set up a corporate sustainability commission, as well as provide a business plan with specific environmental features and certification. On the other hand, it may be difficult for first-time green bond investors to evaluate properly all the risks associated with green investments (Buttin 2016). Therefore, the overall perceived risk may increase as the market increases by including issuers who come from many different sectors and geographies (Lin et al 2019).

Finding an increase in spread over issuances would suggest that the cost of finance might rise for new issuances. It could also mean that the market demand for subsequent issuances is slowing down, suggesting that fewer investors are interested in buying the bonds, thus causing prices to plunge and yields to rise. The factors that could discourage further investments in green bonds are associated with their risk-return potential, environmental commitments and a request to fund projects that have an unclear association with positive environmental change (Tolliver et al. 2019; Zerbib 2019).

In fact, as the company proves that the proceeds are having a positive environmental effect while also being able to generate a profit or savings to return the debt, the perceived risk associated with green bond issuances should decrease over time, thus translating into lower interest rates and helping the world move towards a greener economy.

If investors feel confident about this type of investment, their perceived risk associated with subsequent issuances should decrease, which should reduce the cost of financing later environmental issuances compared with the first. As a

result, the higher the number of issuances, the lower the likely cost of financing and the higher the environmental performance of a company in the long term.

As the green bond market continues its growth and the market supply tends to exceed demand, primarily due to increased corporate and institutional environmental commitment (Morel and Bordier 2012), it becomes relevant to investigate the determinants of green bond pricing, including the learning curve effect.

One important aspect of evaluating the market-based cost of bond financing is its reference to the market interest rates, in particular Treasury yields (Cavallo and Valenzuela 2010; Durbin and Ng 2005; Garay et al. 2019).

In general, the difference between yields offered on corporate bonds and those offered on government bonds is often defined as yield spread and can be influenced by the market, issuer and project characteristics (Choudhry and Lizzio 2015; Elton et al. 2001). Bonds trading at a larger spread could reflect the investor's scepticism about this new security, since the market is still establishing international standards and showing the first signs of a positive use of the proceeds and a capacity for repayment. A lower spread on the other hand, would suggest that there is enough demand in the market for the issuances and that the project is considered more valid and less risky, at least compared with other issuances.

As Zerbib (2019) has already investigated the pricing differences between green bonds and conventional bonds (with the same characteristics and from the same issuer), the aim of this chapter is to further develop academic understanding of green bond pricing, examining empirically how green bonds characteristics may influence it, with a particular focus on order of issuance. To isolate the macroeconomic effects that could

influence the green bond price over time, this analysis takes the spread between green bonds and its corresponded treasury bond with the same currency and maturity. This investigation also includes other bond and market characteristics that could ultimately effect pricing.

The empirical examination involves the application of two different panel data estimation techniques on a dataset of more than 600 bonds issued in dollars, euros, Swedish krona, Chinese yuan and Japanese yen. The analysis covers daily spread data for the last five years and it considers a set of control variables in addition to the order of issuance. Estimates are produced for the whole set of determinants for all bonds, and across currencies and maturities.

This study is original and differs from previous ones in at least three respects. First, to the best of our knowledge, it is one of the first research that investigates what effect issuance experience has on green bond yield spread, which drives the pricing of green bond issuances. Second, while most studies define and analyse spread by matching green bond yields to those of conventional bonds issued by the same issuer, this study rather considers the difference between green bond yields and the Treasury bond of the issuer's home country. Lastly, it makes it easier to understand how investors consider credit risk for green bonds and how they price green bonds in relation to risk-free Treasury bonds, the Treasury yield curve being a benchmark for pricing bonds and setting yields in other areas of the debt market.

The remainder of this chapter proceeds as follows. In section 7.2 there is a review of the literature on the learning curve and the determinants of corporate bond spreads. Section 7.3 contains a description of the methods and data used in the study. Section 7.4 consists of a presentation of and a discussion about the key

findings. Section 7.5 concludes the chapter while exploring possible areas of future research.

7.2. Literature review

In this section, the literature on green bond pricing and on the determinants of the yield spreads on corporate bonds is reviewed. Investors, especially the so-called socially responsible ones, have been showing growing confidence in green bonds as a mainstream investment tool (CBI 2017; Pham 2016). Unlike conventional bonds, green bonds have unique features, and their issuance follows a special process (Li et al. 2019). Moreover, a growing number of studies show that investment in green bonds is beneficial to shareholders (Tang and Zhang 2018) and that it reduces investors' exposure to environmental risks (Ehlers and Packer 2017).

There is a consensus that the proceeds of green bonds are earmarked for green infrastructural projects (Baker et al. 2018; CBI 2018b; ICMA 2017; OECD 2017) that contribute towards achieving a low-carbon transition (Kidney and Boulle 2015). However, the literature on the determinants of green bond pricing is barely nascent and has so far been mixed (Horsch and Richter 2017). Over the last few years, several scholars have attempted to investigate various dimensions of the green bond market, including its volatility (Pham 2016), its portfolio diversification benefits (Banga 2019; CBI 2016; Reboredo 2018), and the determinants of the issue size (Barua and Chiesa 2019; Chiesa and Barua 2019). Siswantoro (2018) argues that certification by a second opinion has an effect on green bond prices. Partridge and Medda (2019) investigate the US green

municipal bonds and conclude that indexes comprised of green municipal bonds outperform their conventional counterparts. In their investigation of the pricing and ownership patterns of the US corporate and municipal bonds, Baker et al. (2018) found that municipal green bonds are traded at a premium to otherwise conventional bonds, while the pricing and ownership effects are stronger for bonds certified as green by an independent review. Similar results were documented by Kapraun and Scheins (2019), who found a significantly negative premium of 20–30 bps for green bonds across currencies and issuer types. Furthermore, Bloomberg (2015) found that green bonds are traded at lower yields compared with their non-green peers, due to the shortage of supply. Likewise, GRESB (2015) found that investors require higher coupons for green bonds compared with conventional bonds from the same issuer, and price green bonds with respect to their buy and hold strategies. However, a study from Barclays (2015) suggests that, to decarbonize their portfolios, some green bond investors are ready to pay a 20 basis-point premium over conventional bonds in the secondary market.

Meanwhile, other studies document that there are no pricing differences between green and conventional bonds (BMO Global Asset Management 2017; BNP Paribas 2017; Hachenberg and Schiereck 2018; Tang and Zhang 2018). A study of thirty-four green bonds, of which eight are from repeat issuers, shows that, on average, EUR green bonds achieve larger book cover and slightly lower spread compression than their vanilla equivalents, while USD green bonds on average achieve a slightly lower book cover and the same spread compression as their vanilla equivalents (CBI 2018b). The same study shows that seven days after

pricing, green bonds had tightened more than vanilla benchmarks, while twenty-eight days after pricing, green bonds had, on average, tightened by more than matched indices. In some cases, where corporate green bond spread is higher, this may be due to imbalances between supply and demand (CBI 2016).

While investigating the relationship between the initial public offering (IPO) price of green bonds and the probability of issuer defaults, Weber et al. (2018) find that subjects learn to price the bonds well after only a few repetitions, thus suggesting an experience curve effect on green bond pricing. By analysing the determinants of sovereign bond issuances by developing countries, Grigorian (2003) looked at the differences between first and subsequent issues and found that, in general, investors require a lower interest rate from repeated issuers (that is issuers with at least one outstanding bond), while the interest rates on the bonds of debut issuers are usually higher. Because of the debut issuer's new experience with the market, which does not allow for the immediate incorporation of all information into the bond's price, investors display risk-averse behaviour (Loncarski and Szilagyi 2012).

With respect to corporate bond spread in general, it is commonly agreed that the yield spread is a proxy for default risk (Andersen 2018; Chen et al. 2007). Since corporate bonds are riskier than government ones, investors could ask for a higher yield spread over risk-free Treasury bonds to compensate for the risks taken (Choudhry and Lizzio 2015; Durbin and Ng 2005; Garay et al. 2019). In other words, the higher the spread over Treasury bonds, the riskier the bond for investors and the costlier the bond for the issuer (Cavallo and Valenzuela 2010). Such spread could again vary across maturity, sectors, or market of issuances. For

example, Garay et al. (2019) explain that, provided that the economic conditions remain constant, the yield spreads of short-term bonds are significantly lower than those of long-term bonds.

In their study of the impacts of liquidity risks on green bond spread, Wulandari et al. (2018) found that, after controlling for bond-specific characteristics, macroeconomic conditions and credit risk, liquidity risk has a higher explanatory power for the yield spread of green over conventional bonds. Corporate bond yield spreads generally depend on a variety of factors. These include issuer characteristics (Bachelet et al. 2019), the liquidity of the bond (Abudy and Raviv 2016; Chen et al. 2007; Huang 2016; Lin et al. 2011, 2019; Wulandari et al. 2018), maturity (Huang and Huang 2012), size and currency (Zerbib 2019), credit risks (Duffee 1998; Huang and Huang 2012), credit rating (Krylova 2016), the sophistication of the issuer (Rodin and Bland 1986), as well as the environmental preferences of the investors (Zerbib 2019). Ge and Liu (2015) assert that firms with favourable corporate social performance in the US primary market enjoy lower bond spreads.

Based on the above literature, many factors may influence the spread of green bonds, including interest rates, inflation, the yield curve and economic growth. Corporate bond yields are also influenced by a company's own metrics such as credit rating and industry sector. At this stage, based on the above conceptual framework and the naivety of the green bond market, which requires issuers and investors to put efforts into understanding and developing this security, the purpose of this chapter is to test the impact of the order of issuance and other bond and market characteristics on green bond spread.

HPI: 'The price of green bonds is influenced by issuance order

7.3 Methodology and data

Model and variables specification

To examine the learning curve effects on green bond spread, the following formula is used to calculate spreads of corporate green bond yields over Treasury yields.

$$Spread_{it} = Y_{it} - Y_{gt}$$

Where Y stands for yield, i indicates a green bond, g indicates a government bond (Treasury bond), and t indicates a date in a particular year. Since risk-free rates reflect government bonds with no credit risk, and are used as a benchmark for other risky assets (ECB 2014), the excess yield of a corporate green bond over a comparable government bond shows the premium required by the investors for the risks associated with the issuer of the bond. Therefore, green bond spread was considered over government bonds rather than conventional corporate bonds because it can capture the risk factor involved with the green bonds issued.

Testing the experience curve effects begins with the following specification.¹

$$Spread_{it} = \alpha_i + \beta_1 order_{it} + \beta_i X_i + \beta_i Z_{it} + \epsilon - - - - - (1)$$

Where α is constant, $order_{it}$ is the order of issuance of a bond from the same issuer, β_i indicates coefficients, X_i represents factors that are time-invariant but vary across bonds, and Z_{it} indicates factors that vary both across bonds and over time. A set of control variables are introduced in place of X_i and Z_{it} that are based

1. For more information on the description of the variables, see Table A7.1 in Annex 3.

on the literature and that consider the bond, issuer and market characteristics. The variables chosen are listed and defined in Table 7.1.

Table 7.1: Variable description

Variable	Measurement
Spread	The difference of yields between green bond and Treasury bond
Lag of spread (l_spread)	One period lag of spread
Order of issuances ($order$)	Order of issuances
Coupon rates (cpn)	Original coupon rates of the bonds
Tenor ($tenor$)	Original total maturity of the bond
Call feature ($call$)	Dummies for call option feature availability
Put feature (put)	Dummies for put option feature availability
Exchange listing ($exlist$)	Dummies for exchange listed or not (yes or no)
Company type ($cotype$)	Dummies for type of original issuer (private or public)
Guarantee feature ($grnte$)	Dummies for the availability of guarantee feature (yes or no)
Instrument type ($instr$)	Dummies for EIKON classification of the instrument (note, bonds, or debentures)
Coupon frequency ($cpnfrq$)	Dummies for five coupon frequency type: zero/discount, fixed, floating, variable, range
Coupon class ($cpncls$)	Dummies for four coupon class: annual, monthly, quarterly, semi-annually
Currency	Dummies for five currencies – USD, EURO, Chinese YUAN, Japanese YEN, Swedish KRONA
Issuer sector	Dummies for nine sectors: financials (banking, leasing, mortgage banking, property and casualty insurance, and other financials); manufacturing (automotive manufacturer, conglomerate/diversified mfg, electronics); real estate (home builders, building products, lodging, real estate investment trust); utilities (oil and gas, gas utility - local distrib, utility – other); transports (railroads, transportation – other); industrials (machinery, metals/mining, industrials – other); food processors; health care; and all others (publishing, retail stores – other, service – other)
Market of distribution	Dummies for market of distribution – domestic; global; Eurobond (including Masala and Uridashi); Group of Dimsum, Panda, Samurai, and Yankee; and other foreign bonds

Using the variables chosen, the following equation for estimation is specified:

$$Spread_{it} = \alpha_i + \beta_1 l_spread_{it} + \beta_2 order_{it} + \beta_3 cpn_i + \beta_4 tenor_i + \beta_5 call_i$$

$$\begin{aligned}
& +\beta_6 put_i + \beta_7 exlist_i + \beta_8 cotype_i + \beta_9 grnte_i + \beta_{10} instr_i \\
& + \beta_{10} cpnfrq_i + \beta_{10} cpncls_i \\
& + \sum_{j=1}^p C_i + \sum_{j=1}^q \beta_j S_i + \sum_{j=1}^f \beta_j M_i + \sum_{j=2014}^{2018} \beta_j Y_j + \epsilon \text{-----} (2)
\end{aligned}$$

Where,

Spread = yield differences between Green and Treasury bond

l_spread = one period lag of spread

order = Order of issuance

cpn = Coupon rates

tenor = Total maturity of the bond

call = Dummy for call option feature availability

put = Dummy for put option feature availability

brat = Scores assigned for bond rating by different agencies (following
Appendix Table A7.1)

cotype = Type of original issuer (Patent or subsidiary)

grnte = Dummy for availability of guarantee feature

instr = Classification of the instrument (note, bonds, or debentures)

We further control for coupon currency fixed effects ($\sum_{j=1}^p C_i$), issuer sector fixed effects ($\sum_{j=1}^q \beta_j S_i$), market of distribution fixed effects ($\sum_{j=1}^f \beta_j M_i$), and time (year) fixed effects ($\sum_{j=2014}^{2018} \beta_j Y_j$).

Data

Panel data from the Thomson Reuters Fixed Income Database were used to examine how corporate green bond yields vary with changes in the level of the

Treasury term structure. This database contains the daily price and other characteristics of corporate and government bonds. The initial bond dataset consisted of a total of 819 bonds issued over the five-year period from September 2013 to December 2018. Since there is still no universally agreed definition of a ‘green bond’, the sample used here is compiled from the ‘green bond’ tag in the TR database. This excludes all so-called ‘green bonds’ that are not clearly aligned with the Climate Bonds Initiative Standards. A subset of the data in this database is used in this study. First, all bonds that were issued in minor currencies (that did not provide a significant sample for observation) were eliminated from the sample. This left five main currencies – US dollars, the euro, the Swedish krona, the Chinese yuan and the Japanese yen. Next, we eliminated zero-coupon bonds, dual currency bonds, bonds issued by corporations with headquarters in fiscal paradises and corporations that filed for bankruptcy. The data left after the elimination process pertained to 614 bonds for the period from 1 January 2014 to 31 December 2018.

The weekly spread for each of the bonds is calculated for the whole period, which results in a panel data set. To ensure consistency during spread calculation, comparable Treasury bonds are matched against each green bond by matching bond maturity, coupon currency, and market of issuance. To determine the order of issuance, each issuance from the same issuer is ranked starting from 1 onwards, which gives an overall order of issuance of all bonds ranging from 1 to 33.

Equation (2) is estimated in three steps – (i) all bonds combined; (ii) currency level and (iii) maturity bucket segregation (shorter, longer and medium maturity bonds) separately.

Table 7.2: Summary statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Spread	197,278	1.37	1.66	-0.19	9.16
Coupon	197,399	2.33	1.88	0	9.63
Tenor	197,399	6.82	4.28	2	31
Order	197,399	2.12	3.03	0	33
Call	197,399	1.22	0.41	1	2
Put	197,399	0.04	0.19	0	1
Rating code	197,399	7.81	5.73	0	16
Company type	197,399	1.59	0.49	1	2
Instrument type	197,399	1.56	0.50	1	3
Guarantee	197,362	1.15	0.36	1	2
<i>Market type</i>					
Domestic	197,399	0.48	0.50	0	1
Global	197,399	0.05	0.22	0	1
Eurobond	197,399	0.41	0.49	0	1
DimSum-Panda-Samurai	197,399	0.02	0.14	0	1
Other Foreign	197,399	0.04	0.19	0	1
<i>Coupon class</i>					
Discount/Zero	197,399	0.01	0.10	0	1
Fixed	197,399	0.81	0.39	0	1
Floating	197,399	0.17	0.38	0	1
Range	197,399	0.00	0.00	0	0
Variable	197,399	0.01	0.10	0	1
<i>Coupon frequency</i>					
Annual	195,541	0.57	0.50	0	1
Monthly	195,541	0.00	0.00	0	0
Quarterly	195,541	0.18	0.38	0	1
Semi-annual	195,541	0.26	0.44	0	1
<i>Sector</i>					
Financial	197,399	0.54	0.50	0	1
Manufacturing	197,399	0.02	0.12	0	1
Real Estate	197,399	0.16	0.36	0	1
Utilities	197,399	0.17	0.38	0	1

Transport	197,399	0.01	0.08	0	1
Industrial	197,399	0.01	0.10	0	1
Food processing	197,399	0.01	0.09	0	1
Healthcare	197,399	0.00	0.07	0	1
Others	197,399	0.08	0.28	0	1

Table 7.2 continued

Variable	Obs	Mean	Std. Dev.	Min	Max
<i>Year</i>					
2014	197,399	0.02	0.13	0	1
2015	197,399	0.05	0.22	0	1
2016	197,399	0.13	0.33	0	1
2017	197,399	0.28	0.45	0	1
2018	197,399	0.52	0.50	0	1

Table 7. 3: Bond distribution by currency, maturity and order

By currency		By maturity		By order	
Yuan	116	Shorter (<3 years)	16	1	349
Euro	192	Medium (3–10 years)	483	2	111
Yen	57	Longer (>10 years)	115	3	44
Krona	119			4	23
USD	130			5	10
				>5	77
Total Bonds	614	Total Bonds	614	Total Bonds	614

Estimation techniques

To choose the suitable panel data estimation technique for equation (2), it is necessary first to examine the diagnostics of the data across all five levels specified above. A modified Wald test and Breusch-Pagan/Cook-Weisberg test are used to check for heteroskedasticity, a Pesaran (2004) CD test to check cross-section dependence, a variance inflation factor (VIF) test to check for multicollinearity, a Wooldridge test to check for serial correlation (AR1) and a

Cumby–Huizinga (1992) test to check for moving average (MA) autocorrelation. Table A7.2 in the Appendix presents the diagnostic checks showing that data at all levels contain significant heteroskedasticity, cross-section dependence, multicollinearity and serial correlation.

Furthermore, the test results show the existence of MA autocorrelation for most of the panels at different lag orders (see Table A7.3 in Appendix for autocorrelation matrixes). The persistence of serial correlation and MA autocorrelation is common in financial time series data such as yield. To deal with serial correlation, the one period lag of spread (l_spread) is initially included in the model; however, the diagnostic check indicates the persistence of serial correlation even after including the lag. Considering the diagnostic checks, two different panel data estimators are chosen to estimate equation (2), namely the Prais-Winsten Panel Corrected Standard Errors (PCSE) and the Driscoll-Kraay standard errors (DKSE). The PCSE regression can mitigate the biases of heteroskedasticity, Cross-section dependence, multicollinearity and serial correlation. On the other hand, DKSE can mitigate the biases of heteroskedasticity, Cross-section dependence, multicollinearity and MA autocorrelation at different lag orders. The use of two different estimators helps us not only to mitigate the biases identified in the diagnostic checks but also to check the reliability of our estimates across estimation techniques. While implementing both the estimation techniques identified, the estimation process procedurally includes 521 out of 614 bonds to produce the results. Since the actual number of bonds included in the estimation differs from that of the initial dataset considered, in the section in which the results are discussed, we present the distribution of the

total number of bonds by the currency of the coupon denomination, maturity, sector and order of issuance.

7.4. Regression results and discussion

Table 7.4a shows the effects of the actual order of issuance and other determinants on spread for all bonds. Table 7.4b presents the effects of determinants by currency and Table 7.4c represents the effect by maturity. The discussion focuses first on the order of issuance effect before proceeding to shed light on the other determinants.

Table 7.4a Determinant of green bond spreads (all bonds)

Variable	All Bonds	
	DKSE	PCSE
Coupon	0.003*** (0.001)	0.002*** (0.000)
Tenor	-0.000** (0.000)	-0.000* (0.000)
Order of issuance	0.000*** (0.000)	0.000** (0.000)
Call option	0.001 (0.001)	0.000 (0.000)
Put option	0.003** (0.001)	0.002* (0.001)
Rating	-0.000** (0.000)	-0.000* (0.000)
Company type	-0.000 (0.000)	-0.000 (0.000)
Guarantee feature	-0.001 (0.001)	-0.001 (0.001)
Instrument type		
<i>Bonds (1)</i>	—	—
<i>Notes (2)</i>	-0.001** (0.001)	-0.001 (0.001)-
<i>Debenture (3)</i>	-0.003 (0.004)	-0.002 (0.004)
Spread (L1)	0.997*** (0.001)	0.998*** (0.000)
Constant	—	-0.006 (0.002)
R squared	0.799	0.799
No. of Observations	188,738	188,738
No. of Bonds	521	521
Currency x Market x Coupon Class x Coupon	Yes	Yes
Frequency x Sector x Year fixed effects		

Figures inside and outside parentheses indicate robust standard errors and coefficients, respectively. Significance levels: ***=1%, **=5% and *=10%

Table 7.4b Determinants of green bond spreads (by currency)

Variable	YUAN		EURO		Japanese YEN		KRONA		USD	
	DKSE	PCSE	DKSE	PCSE	DKSE	PCSE	DKSE	PCSE	DKSE	PCSE
Coupon	0.006*** (0.002)	0.005*** (0.001)	0.001 (0.001)	0.001 (0.001)	0.005** (0.003)	0.004** (0.002)	0.002** (0.001)	0.001 (0.001)	0.005*** (0.002)	0.004*** (0.001)
Tenor	0.000 (0.001)	0.000 (0.001)	-0.000 (0.000)	.000 (0.000)	.000 (0.000)	0.000 (0.000)	0.001 (0.000)	0.001* (0.000)	-0.000*** (0.000)	-0.000*** (0.000)
Order of issuance	0.001** (0.001)	0.001** (0.001)	0.000 (0.000)	.000 (0.000)	-0.000 (0.000)	0.000 (0.000)	0.001 (0.000)	0.000*** (0.000)	0.000* (0.000)	0.000* (0.000)
Call option	—	—	0.001 (0.000)	0.001 (0.000)	—	—	0.070 (0.011)	0.042*** (0.008)	-0.001 (0.002)	-0.001 (0.001)
Put option	0.001 (0.001)	0.000 (0.001)	—	—	—	—	—	—	—	—
Rating	-0.000 (0.000)	—	0.000 (0.000)	.000 (0.000)	0.001 (0.000)	0.001 (0.000)	0.002*** (0.001)	0.001*** (0.000)	0.000 (0.000)	0.000 (0.000)
Company type	-0.001 (0.001)	-0.001 (0.002)	0.001 (0.001)	0.001 (0.000)	-0.010 (0.004)	-0.008** (0.004)	-0.011*** (0.001)	-0.007*** (0.001)	-0.002 (0.001)	-0.002 (0.001)
Guarantee feature	—	0.0000	—	—	—	—	—	—	—	—
	-0.000 (0.001)	(0.000)	0.000 (0.000)	0.000 (0.000)	0.006 (0.024)	0.004 (0.020)	0.006** (0.003)	0.004 (0.003)	-0.000 (0.001)	-0.000 (0.001)
Instrument type										
Bonds (1)	—	—	—	—	—	—	—	—	—	—
Notes (2)	0.002 (0.002)	0.001 (0.003)	-0.001 (0.001)	-0.001 (0.001)	—	—	-0.006*** (0.001)	-0.004*** (0.001)	-0.004*** (0.001)	-0.003** (0.001)
Debenture (3)	—	—	—	—	—	—	—	—	-0.008** (0.004)	-0.006 (0.004)
Spread (L1)	0.991*** (0.004)	0.992*** (0.002)	0.997*** (0.002)	0.998*** (0.001)	0.997*** (0.001)	0.997*** (0.001)	0.978*** (0.003)	0.986*** (0.002)	0.996*** (0.002)	0.997 (0.001)
Constant	-0.011 (0.009)	-0.010 (0.008)	0.003 (0.002)	0.001 (0.002)	0.012*** (0.004)	0.010 (0.004)	-0.036*** (0.008)	-0.022 (0.007)	-0.013 (0.011)	-0.005 (0.005)
R squared	0.794	0.795	0.799	0.799	0.810	0.810	0.786	0.791	0.798	0.799
No. of Observations	24,886	24,886	71,316	71,316	6,905	6,905	43,515	43,515	42,351	42,351
No. of Bonds	96	96	173	173	25	25	117	117	112	112
Currency x Market x Coupon Class x Coupon										
Frequency x Sector x Year fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Figures inside and outside parentheses indicate robust standard errors and coefficients, respectively. Significance levels: ***=1%, **=5% and *=10%

Table 7.4c Determinants of green bond spreads (by maturity)

ALL AND BY MATURITY

Variable	Shorter Maturity		Medium Maturity		Longer Maturity	
	DKSE	PCSE	DKSE	PCSE	DKSE	PCSE
Coupon	0.081** (0.039)	0.062*** (0.004)	0.002*** (0.001)	0.002*** (0.001)	0.003* (0.001)	0.002** (0.001)
Tenor	—	—	-0.000* (0.000)	-0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Order of issuance	0.004** (0.002)	0.003*** (0.000)	0.000*** (0.000)	0.000** (0.000)	0.001** (0.000)	0.001 (0.000)
Call option	—	—	0.000 (0.000)	0.000 (0.001)	-0.000 (0.001)	-0.000 (0.001)
Put option	—	—	0.002* (0.001)	0.001 (0.001)	0.027 (0.034)	0.021 (0.038)
Rating	- 0.001*** (0.000)	- 0.003*** (0.000)	0.000** (0.000)	0.000** (0.000)	0.000 (0.000)	0.000 (0.000)
Company type	-0.043** (0.020)	- 0.033*** (0.003)	0.000 (0.000)	-0.000 (0.000)	-0.000 (0.001)	-0.000 (0.001)
Guarantee feature	-0.269* (0.145)	—	0.000 (0.001)	0.000 (0.001)	-0.001 (0.001)	-0.001 (0.001)
Instrument type						
<i>Bonds (1)</i>	—	—	—	—	—	—
<i>Notes (2)</i>	—	—	-0.001** (0.001)	-0.001 (0.000)	- 0.003*** (0.001)	- 0.003*** (0.001)
<i>Debenture (3)</i>	—	—	—	—	-0.004 (0.004)	-0.003 (0.004)
Spread (L1)	0.904*** (0.046)	0.926*** (0.005)	0.998*** (0.001)	0.999*** (0.000)	0.995*** (0.002)	0.996*** (0.001)
Constant	0.064** (0.031)	0.057*** (0.008)	- 0.016*** (0.006)	-0.006** (0.003)	0.005 (0.009)	0.002 (0.005)
R squared	0.799	0.799	0.799	0.799	0.797	0.798
No. of Observations	2,402	2,402	142,714	142,714	43,622	43,622
No. of Bonds	14	14	149	149	96	96
Currency x Market x Coupon Class x Coupon Frequency x Sector x Year fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes

Figures inside and outside parentheses indicate robust standard errors and coefficients, respectively.

Significance levels: ***=1%, **=5% and *=10%.

The data show that the order of issuance is positive and significant for all bonds – Yuan, Swedish krona and US dollars, which means that the higher the issuance ranking the higher the spread, thus confirming that order is an important factor in determining green bond interest rates. As investors familiarize themselves with green bonds in certain markets, the demand to buy these instruments decrease and therefore investors are only willing to buy them at a higher interest rate. This investor attitude is not confirmed for the bonds that are issued in euros and yen, but it is consistent for all maturity levels.

Although investors are behaving more responsibly with respect to long-term sustainable investment (Clark 2016), and their appetite for environmental projects is increasing exponentially (Clark et al. 2018), the results show that they are unwilling to do so at a reduced price, despite all the work that the International Capital Market Association (ICMA) has undertaken to increase investor trust by strengthening the structure and definition of green bonds. In China, despite a commitment by policymakers to transform the market into a fully-fledged green finance system, Chinese green bonds face three challenges that are of concern to global investors. These are the definition of what constitutes a ‘green’ project, in particular the inclusion of what is known as ‘super critical’ (clean) coal-fired stations; transparency; and the use of green bond proceeds as working capital. This may explain why, after the first issuance, investors may increase their risk perception on subsequent issuances offering higher interests that translate into higher spreads to Chinese treasury bonds. In the US and Swedish market, this phenomenon can also be explained by the type of companies able to issue green bonds and the way projects are monitored to ensure that they finance either new or ongoing projects for which the green bonds were issued. If corporations do not

prove these systems reliable, it can increase investor scepticism and therefore lower their willingness to facilitate environmental projects with lower interest rates. These findings complement the available literature on green bond supply and issuance (Chiesa and Barua 2019: 149; Demary and Neligan 2019; Glavas and Bancel 2018).

Among the other determinants considered, coupon rates have a significant and positive effect on spread when estimated for all bonds together, for all currencies save the euro and for all maturities. Coupons are often used to leverage the value of green bonds to investors; hence, higher coupons are likely to result in higher spreads. Although there is no direct literature on the effects of coupon rates on green bond spreads, studies on interest rates and personal taxes (Hachenberg and Schiereck 2018; Liu et al. 2009; Sarig and Warga 1989: 1355), especially those regarding conventional and corporate bonds, support the findings (Duffee 1998: 2225; Helwege and Turner 1999: 1873).

The results further show that tenor has a significant negative effect on all bonds, which is driven by bonds issued in US dollars with medium maturity. The effects of tenor are insignificant for all other estimations. This is supported by the literature on the question of tenor and green finance (Chang 2019; Madan and Schoutens 2012).

The effects of the option features embedded in green bonds are tested on their spread. The call option feature is found to have a positive effect only on Swedish krona bonds. This is an expected result because companies that can afford to put a call option on their bonds are already in the lower risk category. The results here are consistent with the literature on call options and option valuations (D'Halluin et al. 2001: 56; Edwards et al. 2007: 1433; Hachenberg and Schiereck 2018). By

contrast, the results in Table 7.2 suggest that spreads in green bonds with put options are likely to be higher. This may be because bonds for which investors require a put option, namely the ability to sell the bond back to the issuer before maturity, may be considered riskier so have higher spreads.

Except for Swedish bonds, the bond rating was also found to be significant with negative effects on green bond spread. This is entirely consistent with market trends because the riskier the bond, the higher the spread. Riskier green bonds, in fact, have lower liquidity and prices, thus leading to higher spreads compared with the less risky ones. This is likely to be driven by the higher demand from investors for higher rating securities because of their higher liquidity. This result is in line with the available literature on issuer characteristics associated with going green and with green bond volatility (Bachelet et al. 2019; Bethune et al. 2017: 15; Clapp and Pillay 2017; Pham 2016: 271).

Company type, the other determinant in this analysis, shows a significant and negative effect on green bond spreads for Japanese yen, Swedish krona and shorter maturity bonds. These results indicate that the yield spread of bonds issued by parent companies is likely to be lower compared with those issued by subsidiary companies. In other words, investors could earn a yield relative to treasury bonds by investing in bonds issued by subsidiary companies rather than parent companies.

The results show that the availability of a guarantee feature has a significant and negative effect only for short maturity bonds. Most investors are expected to opt for guaranteed but smaller gains rather than to take major risks for higher gains; hence, guarantee features mean lower spreads for risk-averse investors. This is backed by the relevant literature on government guaranteed bonds and the

concept of risk acceptance (Chygryn et al. 2019: 1448; Levy and Zaghini 2010: 753; Pagano and Von Thadden 2004: 536; Ratha et al. 2018: 69; Sanchez et al. 2017).

Another factor is the type of instrument. The results suggest that issuing notes has a strong negative affect on a euro green bond market and has a serious impact on green bond spreads, provided that they fall within the medium to longer term maturity bucket. This is in line with the available literature on issuing financial instruments and the different characteristics of bonds, notes and debentures (Amihud and Mendelson 1991: 1412; Febi et al. 2018: 53) A positive effect of the lag of spread variable across all estimations is consistently found, indicating that the previous day's level of spread positively affects the current day's spread.

The findings, however, are subject to some limitations encountered in this research. First, although this study is based on Thomson Reuters green bond labelling, it does not include all the bonds issued for which the proceeds are intended for environmental use, for many companies prefer not to label their environmental related bonds officially. Second, this dataset does not include other minor currencies and therefore fails to incorporate growing markets that could be potentially important issuers in the coming years. Finally, despite utilizing the best possible estimation methods available, the five-year weekly dataset used in this research could have a long autocorrelation structure that could still source some biases.

7.5. Conclusion

Green bonds are unique financial instruments because they are mainly issued with the aim of financing projects geared towards encouraging a green economy and a

healthy environment through anti-climate change policies. The use of green bonds to finance projects has, given their tendency to attract investors from both local and foreign markets, been on the rise in recent years. Many investors now have a green investment mandate, which creates a market for green bonds and, as a result, green bonds have been received with great enthusiasm. Accountability for such projects should be highly traceable and green investors should have full confidence in the projects to be undertaken.

The players of the markets in which a green bond is issued are expected to determine the risks associated with it, thus affecting the green bond spreads for that market. In addition, the market in which the green bond is issued is also expected greatly to affect the determination of the risk-free rates and the certainty of yields, further creating differences in spread.

In this chapter, a linear regression analysis was conducted to determine the differences in the levels of significance and the reasons why some factors are highly significant for green bond spreads while others are less so. Criticisms of the factors under analysis included coupon, tenor, options, company type, a guarantee of feature and instrument type while controlling for currency, market sector and year fixed effect. Throughout the analysis, the findings were based on both the DKSE and the PCSE techniques for all five currencies (US dollar, euro, Swedish krona, Chinese yuan and Japanese yen) and the three bond categories (general, shorter, medium and longer maturity bonds). The study found that, beside the regular factors, order of issuance has an effect on the spread that is significant and negative for all bonds and across all maturities. This means that further issuances of the same issuers are perceived as riskier from investors who

are only willing to offer higher interest rates. There could be three main reasons for these results.

First, subsequent green bond issuances could reflect a reduction in green project quality and an increase in green project risk. As companies grow and seek access to additional debt liquidity, they may propose more controversial green projects over time, thus signalling greenwashing attitudes to investors. Investors, as part of the green bond investment analysis, are likely to see new projects as riskier and price them appropriately at a wider spread.

Second, the large 2011–2018 increase in green bond issuance may have outstripped green bond demand. While investors have ‘poured’ into the green bond market, the demand may still be lower than the overall supply of new issuances. As a result, investors presented with an abundance of green bond choice may be more discerning towards second, third, fourth and fifth issuances from existing companies. In addition, investors are likely to have a diversification bias, where they are only willing to hold one issuance from each issuer to avoid concentration, which would increase the sale and exit liquidity risk.

Third, green bonds may be showing higher spreads over subsequent issuances due to increased market risk. The period of the sample, from 2014 to 2018, saw rises in economic and political, as well as climate risks, which could have influenced the perceived risk that investors anticipated in the market and in individual green bond issuances. These market risks could be driving wider spreads independent of individual green bond projects.

In order to flatten the spread faced by green bond issuers and to guarantee a good and stable market for them, to reissue, it might be advisable to set a common taxonomy for green bond certification. Such a taxonomy is likely to increase

transparency, reduce the transaction costs associated with green bond issuance, improve the overall funding strategy of the issuers, while attracting new types of investors, including small ones from developing countries. Furthermore, doing so could help not only to predict the future growth of the market, but also to counter greenwashing forms of behaviour, where issuers spend a considerable amount of time claiming to be green rather than acting in accordance with their claims.

8

Conclusion

The nexus between finance and environmental sustainability has recently gained much attention from both researchers and practitioners. Although traditional finance theories prioritize the maximization of shareholder value, society is becoming increasingly insistent that companies incorporate ethical concerns into their management and operations. Addressing climate change is one of the greatest challenges that human society has ever faced. Corporations have the potential needed to change the way in which they produce and ‘what’ they produce to facilitate the transition towards a greener economy. This is particularly important, given that supranational accords such as the Paris Agreement are currently struggling to ensure that these commitments are respected.

The main thrust of this thesis has been to examine the relationship between debt financing and corporate environmental performance through a financial geographical framework incorporating stakeholder theory. Most theories on the relationship between corporate environmental performance (CEP) and corporate financial performance (CFP) assume that the current evidence is too fractured, or too variable, to draw any generalizable conclusions about whether the availability of debt influences environmental performance or vice versa (Orlitzky et al. 2003). The empirical evidence in this study, derived from analysing corporate information and conducting interviews with several financial market players, demonstrates that the relationship works both ways, albeit at different levels. First, an attempt was made to establish if the cost of debt presented a barrier to investing in environmental related initiatives. Lenders in fact play a critical role in

constructing the market to finance sustainability, for their ability to lend at lower rates influences the decision making of managers on the allocation of capital, thus shaping corporate environmental performance levels. There was then an investigation into whether debt capital markets understand the importance of corporate environmental sustainability and if they reward corporations for positive environmental behaviour. An attempt was also made to study a particular kind of debt financing, namely green bonds, which are designed to enable the raising of capital and investment for both new and existing projects that will bring environmental benefits. Moreover, the role of the green bond market was recognized, with the main drivers of its supply and performance (spread) over time being identified.

In this concluding chapter, the findings and comments on the broader implications of the thesis are drawn, the main findings of the four substantive chapters (chapters 4, 5, 6 and 7) highlighted, suggestions made about how each chapter contributes to the existing literature, and the implications for the various stakeholders spelled out. The limitations of the findings and suggestions for possible future directions for research are also addressed.

The subject of Chapter 4 is whether a higher degree and cost of leverage worsens corporate environmental performance. The literature has long debated the role of individuals, governments and other stakeholders, including financial ones, in achieving appropriate outcomes. In line with stakeholder theory, in this chapter it becomes clear that debt capital markets do in fact play a role in both influencing corporate environmental strategies and facilitating corporate transition to a greener economy; indeed, lenders are identified as central stakeholders in increasing corporate environmental performance and achieving higher

environmental protection. Following consultations with corporate decision makers to establish that the availability of financing indeed affects environmental decision making, an attempt was then made to prove this empirically by testing the impact of the cost of corporate debt on corporate environmental performance (CEP). The results indicate that the higher the cost of a firm's long-term borrowing, the lower its environmental performance is likely to be, thus recognizing that creditors who lend to corporations via loans, bonds, or other types of debt may create an additional impediment to environmental performance, particularly if they charge a high price in the form of interest and fees.

A higher cost of financing could limit a firm's capacity to focus on environmental performance by hampering a manager's ability to address sustainability issues. This proposition is corroborated by experts who expressed concern when interviewed that corporations are being discouraged from making financial commitments to environmental investments when the cost of debt is high, for the benefit derived from the majority of environmental projects comes from long-term efficiency related savings rather than cash flows. This finding that a main constraint to environmental investment is the cost of debt financing has important implications.

First, it corroborates the position in stakeholder theory vis-à-vis the role of financial stakeholders in corporate performance. The implication of this is that business leaders and lenders should together seek ways to promote corporate environmental initiatives because a lack of engagement on this front (namely a willingness to lend money at a lower price) has a negative effect on corporate environmental performance.

Second, establishing that the cost of debt financing is a deterrent to investing in environmentally responsive practices has vital implications for regulators. It is important to recognize that conventional sustainability and environmental policy tools usually depend on rigid legislation and regulations, which must be observed irrespective of the cost, and that they require standard process implementation. These results should be considered when future policies and regulations are being formulated. Since the dynamics of environmental liability and accountability are constantly changing, many regulatory solutions become outdated. There is thus a clear need to introduce new debt instruments, or debt features with discounted pricing, that would be able to facilitate the transition to a greener economy. Thinking about what such instruments might look like and what governments could do to incentivize them suggests a promising avenue for future research.

Finally, given that capital constraints are important in strategic decision making in that they influence a firm's major investment decisions (Stein 2003), the findings derived from Chapter 4 are valuable insofar as they explain why certain companies may fail to invest in sustainability. Insufficient financial resources should not act as a barrier to a healthier world, and financial stakeholders, in collaboration with governments and corporations, should create new systems to facilitate these urgent investments. Finding the resources with which to finance environmental solutions is a challenge and further research is needed to test whether collaborating with these investors to finance solutions to the impacts of climate damage may be facilitated through the financial tool of green bonds.

The quality and quantity of the available data have imposed a serious limitation on this study. For a start, there is still no consensus on how ESG

criteria, particularly the environmental performance of a company, needs to be calculated, for CEP is a valid theoretical construct, though admittedly a meta one, that can be measured in a variety of ways. Given the large number of CEP measures and measuring methods, the use of Thomson Reuters ESG data preclude generalizing about all the CEP measures and all the assumptions underlying them, quite apart from the fact that not all countries require ESG reporting. In addition, the first part of this thesis has been restricted to a limited selection of publicly listed corporations in the USA, UK, Australia and Canada, due also to limited data available for other countries. Further research is therefore required, first on the EU countries but also on developing economies, which may face the greatest difficulty accessing finance while being low performers on environmental parameters.

The purpose of Chapter 5 was to establish whether a company's environmental performance influenced the price of its debt capital. Based on evidence from the bond market and building on the literature about how lenders assess corporate risk (Cheng et al. 2014; El Ghouli et al. 2011; Goss and Roberts 2011; Oikonomou et al. 2012), this chapter produces strong evidence that corporate environmental performance (CEP) is negatively associated with the cost of debt financing; in other words, a higher CEP helps to reduce the cost of debt financing through bond issuance.

The findings show that debt markets have started to address sustainability and environmental issues, which suggests that higher environmental scores improve risk management and protect a firm's capital, all things being equal. Moreover, this chapter contains a framework in which to explain outliers. This is done by recognizing that environmental performance does not always achieve the financial

outcomes expected, and by considering the role of debt in establishing how market players process environmental information and outcomes before applying them to their financial decisions. The finding that a better ESG performance improves access to finance makes a contribution to the CSR literature (Cheng et al. 2014; El Ghouli et al. 2011), as well as to the emerging literature on investor preferences for ESG criteria (Dimson et al. 2015; Dyck et al. 2018; Starks et al. 2017).

The study also contributes to our understanding of the impact of corporate environmental performance on risk reduction, for it shows that debt market forces generally do not penalize companies that are high in corporate environmental performance; thus, managers can afford to be responsible. If managers believe that CEP is an antecedent to a lower cost of debt, they may eventually actively pursue it because they think the market will reward them for doing so. Top managers must learn to operate their CEP score as a risk leveller and use it to their advantage when negotiating debt financing.

It would be helpful to conduct further research into how managers can influence the risk perceptions of third parties by using environmental scoring. It would also be useful to establish whether savings made from a lower cost of debt could justify the initial investment. A lower cost of financing by the debt capital market could be seen as public endorsement of a perceived risk. This in turn might also benefit corporations in other capital markets, for it would encourage managers to pursue higher CEP as part of their strategy for attaining a lower cost of capital, which would have implications for regulators and policy makers alike.

Since environmental performance has a negative impact on a firm's financial risk, the benefits of market-based measures like firm risk and downside risk may

be promulgated to the market participants so that, irrespective of the legislation, they will adopt environmentally responsive behaviour merely because it gives the firms strategic advantages. Regulators would thus be able to rely on a market-based enforcement mechanism, which would be more efficient and encourage greater environmental improvement than through the direct intervention of conventional laws and regulations (Salama et al. 2011).

Finally, this finding is important when advancing theories about the social aspects of corporate strategy and their practical implications for firm management. A limitation, however, is that due to a lack of financial and environmental data for private companies, the focus of the chapter is confined to publicly listed corporations. Although at the time of the research, data were available on EU companies, thus making it possible to gain wider insights into their corporate environmental performance and cost of debt financing, the findings are nonetheless still based on research in specific markets in the EU and USA. This means that not only developing economies but also the transition economies, like China, currently changing from a centrally planned to a market economy yet playing a major role in increasing international environmental commitments, have been neglected. Future research that relaxes these limitations would be valuable as would studies that can assess which environmental information might affect risk profiling more than others.

The next substantive chapter, Chapter 6, which is on the surge of impact borrowing, looks at what determines the supply of green bonds and their heterogeneity across markets. Since debt finance is providing a growing opportunity to fund environmental solutions, the investigation in this chapter centres on the impact of bond, corporate and market attributes on the size of green

bonds. While, in practice, the use of corporate green bonds is become increasingly prevalent, very little is known about their determinants. These types of securities are meant to create long-term value for corporate issuers and to reduce their environmental footprint, thus making them a powerful tool for addressing climate change (Flammer 2015).

The market for green corporate bonds, which are designated for financing environmentally friendly projects and businesses, has undergone a boom in the past five years. From an issuance of just \$3 billion in 2013, by 2018 the market had ballooned to 249.5 billion. However, despite a rapid recent increase in the literature on green bonds, much of it is on the demand (investor) side, thus leaving the supply side mostly unaddressed. Since supply is equally (or perhaps even more) crucial to creating and shaping the market for green bonds, the focus of this chapter is on understanding the nature of the green bond supply and its determinants globally.

The results show how differences in issue size, or in the amount borrowed, may be attributed to differences in the bond, in the issuer and in the characteristics of the market. Importantly, and in line with Chapter 1 of this thesis, the data show that coupons have a negative effect on issue size, which indicates that issues with higher coupon rates are likely to be smaller in size. This is yet more proof that the cost of debt could be a deterrent to sustainability investments. A lower cost of financing would create incentives for issuers to raise larger funds against their needs through selling the bond. Moreover, the results show how a higher bond rating often encourages issuers to raise larger funds, while it may very well be that corporations with lower ratings are also performing worse in environmental terms

and therefore are companies that need to increase the size of their financing to transform their operations, but are unable to do so.

Deepening this analysis would be an interesting and valuable avenue for future research. An interesting spinoff from this chapter, which is one of the first attempts to study the supply side of the market in green bonds, might be to deepen the investigation into emerging markets. This is because, quite unexpectedly, these markets show a higher liquidity and demand for green bonds followed by a positive effect on coupons, which means that the larger the coupon rate in emerging markets, the larger the issue size of the bond.

Although the data for this study include all the geographical places that issue green bonds, that corporate green bonds are a new phenomenon means that the results are based on a relatively small number of observations and this is a serious drawback. As more data become available, new research could provide broader evidence and a more refined characterization of the main drivers. Given the merits of the findings, controls for the country of issue and regulations are excluded from this chapter. However, they may be of interest to future researchers wishing to study the national and international policy implications of increasing the supply of green bonds in the market.

Finally, the discussion in this chapter relies on the Bloomberg and Thomson Reuters definition of a ‘green bond’, which is mostly linked to obtaining expensive certification. There may be many other non-labelled bonds whose proceeds are directed towards meeting environmental goals that are unfortunately not captured in this study. Being able to include such bonds in the analysis is yet another research project worth undertaking.

The focus of the last of the substantive chapters, Chapter 7, is on the learning curve effect and other determinants of green bonds spread. Investors in green bonds often benefit from the spreads realized over risk free rates whenever they invest in them. The determinations of these spreads will vary from time to time depending on certain factors related to either the issuers, the bonds themselves, or the markets in which they are traded. Here, the determinants of the spread between a green bond and the equivalent treasury bond are investigated, thus complementing the literature already available on green bond spread (Demary et al. 2019; Glavas and Bancel 2018; Wulandari et al. 2018; Zerbib 2019).

A first main finding is that in most markets the order of issuance, namely the time lapse between issuing one green bond and the same issuer's previous green bond, has a positive effect on spread, which means that the more progressive the issuance, the lower the spread. The results thus indicate that multiple issuances from the same issuer are likely to have lower yield spread. This could reflect a higher demand, alongside a lower risk to investors, for environmental projects that are financed with bonds issued later compared with those issued earlier. This suggests that investors grow increasingly comfortable about both the corporation's use of the proceeds for environmental purposes and the outcomes of the environmental projects funded through green bonds. Moreover, investor attitudes towards the environment are moving towards more responsible behaviour with regard to long-term sustainable investment (Clark 2016).

In addition, investors are growing increasingly concerned about their brand image and reputation and therefore their appetite for environmental projects is growing exponentially (Clark 2016). As more bonds are released, this confidence should be further studied, which includes an analysis of the hurdle rate, which is

the minimum rate of return on an investment required by an investor in environmentally friendly projects. Given that the cost of debt, as analysed in this thesis, presents a serious deterrent to corporate environmental sustainability, it is extremely important to understand this number and to create market mechanisms around it to push for further investments in corporate environmental transformation. Understanding the effect of the order of issuance also helps one to explore the comparative spread performance between green bonds issued by the same issuer. This would enable corporations to learn how to set up and manage a project in the most sustainable and efficient way from a financing point of view.

Moreover, the results given on Chinese bonds show a very important trend. For some markets, the spread is actually wider over issuances, which suggests that unless accountability for such projects is highly traceable, green investors may lose confidence in the projects to be undertaken. Subsequent green bond issuances could reflect a reduction in green project quality and an increase in green project risk. As companies grow and seek access to additional debt liquidity, they may propose more controversial green projects over time. Investors, as part of the green bond investment analysis, would likely see new projects as riskier and price them appropriately at a wider spread.

Furthermore, the large increase in green bond issuances between 2011 and 2018 may have outstripped green bond demand for some markets or coupon/principal currencies. While investors have ‘poured’ into the green bond market, the demand may still be lower than the overall supply of new issuances. As a result, investors presented with an abundance of green bond choices may be more discerning towards second, third, fourth and fifth issuances from existing companies. In addition, investors are likely to have a diversification bias, where

they are only willing to hold one issuance from each issuer to avoid concentration, which would increase the sale and exit liquidity risk.

Last but not least, green bonds may be showing higher spreads over subsequent issuances due to increased market risk. The period of our sample (2014–2018) saw rises in economic, political and climate risks, which could have had an effect on the perceived risk that investors anticipated in the market and on individual green bond issuances. These market risks could be driving wider spreads independently of individual green bond projects.

Given the results of the four substantive chapters of this thesis, a natural progression of the argument would be to study what economic mechanisms, guided by fiscal policy making and corporate regulations, might optimally be imposed on investors to dedicate a fixed percentage of their total investments (possibly less than 1 per cent) towards financing corporate environmental sustainability. The first step in such a study would be to establish how much money a corporation would need to become sustainable, then to ascertain how much investment would be expected over the next ten years to find that rate.

Having established that rate, a dialogue would need to be started with investors and the structure of incentives outlined. Given the possible risks associated with such ventures, governments would need to have a plan to support such investments, either through mechanisms to secure cash flows to repay the debt, or by offering tax-free rates on this percentage of the fundamental investments. Of course, such a project would not be the main focal point of a corporate business, for companies wholly dedicated to green technology are already well backed by subsidies in both the debt and equity markets. Rather, the study should focus on non-core corporate environmental needs, which may go

beyond greenhouse emissions but are still crucial to business continuity in the longer term (Clark 2016); the study could thus focus on an overall transformation of the corporate supply chain from the perspective of a circular economy. Many investors now have a green investment mandate, so they need to encourage firms to respond to climate change through not only lobbying, activism and legal frameworks, but also through the actions of financial mechanisms (Clark 2016). Clearing the ground for such ideas presents an exciting avenue for future research.

Appendix 1:

List of people interviewed at PepsiCo headquarters between 2017 and 2018 *(position as of December 2018)*

Code	Company	Department
Professional 1	PepsiCo	C-suite
Professional 2	PepsiCo	C-suite
	PepsiCo	Global Public Policy and Government
Professional 3		Affairs
	PepsiCo	Global Public Policy and Government
Professional 4		Affairs
Professional 5	PepsiCo	Sustainability
	PepsiCo	Global Sustainable Agriculture &
Professional 6		Responsible Sourcing
Professional 7	PepsiCo	R&D
Professional 8	PepsiCo	Global Procurement
Professional 9	PepsiCo	R&D
Professional 10	PepsiCo	Global Business Services Program
Professional 11	PepsiCo	Finance & Operations
Professional 12	PepsiCo	Global Citizenship & Sustainability
Professional 13	PepsiCo	Sustainability
Professional 14	PepsiCo	Global Operations
Professional 15	PepsiCo	Human Capital
Professional 16	PepsiCo	Global Operations
Professional 17	PepsiCo	Human Capital
Professional 18	PepsiCo	Sustainability
Professional 19	PepsiCo	Insights and Analytics

Appendix 2:

Affiliation of professionals engaged in the open dialogues

Code	Company	Cluster
Professional 1	ABInbev	Corporate
Professional 2	Accenture	Consulting
Professional 3	Bain and Company	Consulting
Professional 4	Bain and Company	Consulting
Professional 5	Bain and Company	Consulting
Professional 6	Bank of America	Finance
Professional 7	B-Lab	Other
Professional 8	BlackRock	Finance
Professional 9	Blackrock	Finance
Professional 10	Bloomberg	Other
Professional 11	Bocconi	Other
Professional 12	Bridgepoint	Finance
Professional 13	Bridgepoint	Finance
Professional 14	Carbon Tracker Initiative	Other
Professional 15	Centerview Partners	Finance
Professional 16	Climate Bonds Initiative	Other
Professional 17	Credit Swisse	Finance
Professional 18	Danone	Corporate
Professional 19	Deutsche Bank	Finance
Professional 20	Diageo	Corporate
Professional 21	EBRD	Finance
Professional 22	EBRD	Finance
Professional 23	EBRD	Finance
Professional 24	Hogan Lovells	Other
Professional 25	HSBC	Finance
Professional 26	IMF	Finance
Professional 27	Infinox Capital	Finance
Professional 28	Intesa San Paolo	Finance
Professional 29	Johns Hopkins	Other
Professional 30	JP Morgan	Finance
Professional 31	JP Morgan	Finance

Professional 32	KKR	Finance
Professional 33	Lazard	Finance
Professional 34	London Stock Exchange	Finance
Professional 35	Marks and Spencer	Corporate
Professional 36	McKinsey and Company	Consulting
Professional 37	MIO Partners	Consulting
Professional 38	Nestle	Corporate
Professional 39	Nestlè	Corporate
Professional 40	OECD	Other
Professional 41	One Ocean Foundation	Other
Professional 42	Oxford	Other
Professional 43	Oxford	Other
Professional 44	PRI	Other
Professional 45	PwC	Consulting
Professional 46	PwC	Consulting
Professional 47	Rotschild	Finance
Professional 48	UNDP	Other
Professional 49	UNDP	Other
Professional 50	Unilever	Corporate
Professional 51	Unilever	Corporate
Professional 52	USGOV	Other
Professional 53	Walmart	Corporate
Professional 54	We mean business	Consulting
Professional 55	World Bank	Other
Professional 56	World Bank	Other

Appendix 3: Additional tables for Chapters 4, 5, 6 and 7

Table A4.1: Diagnostic tests (p-values reported)

Panel A: Country level

Test for	Test name	All		USA		UK		Canada		Australia	
		Eq. (3)	Eq. (4)	Eq. (3)	Eq. (4)	Eq. (3)	Eq. (4)	Eq. (3)	Eq. (4)	Eq. (3)	Eq. (4)
Heteroskedasticity	Breusch-Pagan/ Cook-Weisberg chi2(1)	7.46***	7.61***	9.14***	9.95***	0.03	0.06	0.65	0.32	1.82	1.69
Multicollinearity	VIF [#]	2.30	2.46	2.65	2.75	2.27	2.67	2.33	2.60	1.94	2.11

Significance level: ***=1%, **=5%, *=10%. [#]VIF means Variance Inflation Factor. Source: Authors 'calculation

Panel B1: USA Industry Level Eq. (3)

Test for	Test Name	Basic materials	Consumer cyclicals	Consumer non-cyclicals	Energy	Financials	Healthcare	Industrials	Technology	Telecom	Utilities
Heteroskedasticity	Breusch-Pagan/ Cook-Weisberg chi2(1)	0.66	4.66**	0.26	0.76	11.73***	0.22	1.85	1.64	1.67	0.17
Multicollinearity	VIF [#]	2.54	3.50	5.88	2.87	1.94	3.26	3.30	4.73	6.55 [15.20 ^r]	8.63 [15.44 ^r]

Significance level: ***=1%, **=5%, *=10%. [#]VIF means Variance Inflation Factor. Source: Authors 'calculation

Panel B2: USA Industry Level Eq. (4)

Test for	Test Name	Basic Materials	Consumer Cyclicals	Consumer Non-cyclicals	Energy	Financials	Healthcare	Industrials	Technology	Telecom	Utilities
Heteroskedasticity	Breusch-Pagan/ Cook-Weisberg chi2(1)	0.56	4.67**	0.73	0.45	9.79***	0.73	3.20*	1.66	0.08	0.00
Multicollinearity	VIF [#]	2.49	4.71	6.69	3.55	1.95	4.09	3.38	5.10	11.11 [17.02 ^r]	8.13 [15.41 ^r]

Significance level: ***=1%, **=5%, *=10%. [#]VIF means Variance Inflation Factor. Source: Authors 'calculation

Table A4.2: Descriptive statistics of the variables

Variable	Obs	Mean	Std. Dev.	Min	Max
All firms					
Environmental score	3508	44.93	21.37	5.19	98.88
Total assets (million USD)	3503	19800.00	125000.00	0.40	3290000.00
ln total_asset	3503	21.48	1.90	12.89	28.82
Capital expenditure (CAPEX) (million USD)	2630	359.00	1220.00	0.00	22400.00
ln capex	2619	17.78	2.15	7.76	23.83
Operating cash flow (CF) (million USD)	3498	748.00	3030.00	-16400.00	69000.00
ln_OCF	3032	19.03	1.71	11.87	24.96
Age	3507	26.26	26.35	-1.00	201.00
Growth	3364	-0.01	0.83	-12.46	14.40
Beta	3290	1.12	0.69	-5.11	7.81
ROA	3486	0.16	22.36	-439.54	259.28
Cost of debt	3290	2.95	1.74	0.00	12.10
Cost of long-term debt	3289	5.04	1.84	0.74	12.23
Cost of short-term debt	3289	2.20	1.06	-0.75	9.44
Debt to equity	3347	170.48	1322.27	0.00	53736.06
USA					
Environmental score	2,423	42.45	20.91	5.19	98.88
Total assets (million USD)	2,420	18900.00	126000.00	0.40	3290000.00
ln total_asset	2,420	21.61	1.83	12.89	28.82
Capital expenditure (CAPEX) (million USD)	1,754	408.00	1360.00	0.00	22400.00
ln capex	1,752	17.94	2.10	8.87	23.83
Operating cash flow (CF) (million USD)	2,420	802.00	3080.00	-16400.00	64200.00
ln_OCF	2,111	19.15	1.67	12.85	24.89
Age	2,423	25.72	24.65	-1.00	201.00
Growth	2,311	0.01	0.84	-12.46	14.40
Beta	2,266	1.16	0.62	-2.43	5.04
ROA	2,409	-0.61	22.63	-439.54	259.28
Cost of debt	2,266	3.03	1.78	0.00	12.10
Cost of long-term debt	2,265	5.27	1.86	0.74	12.23
Cost of short-term debt	2,265	2.23	1.02	-0.30	9.44
Debt to equity	2,291	198.33	1509.33	0.00	53736.06
UK					
Environmental score	399	59.25	19.11	12.70	98.36
Total assets (million USD)	399	31500.00	171000.00	41.70	2370000.00
ln total_asset	399	21.80	1.72	17.54	28.49
Capital expenditure (CAPEX) (million USD)	313	358.00	1290.00	0.11	16700.00
ln capex	313	17.78	2.04	11.56	23.54
Operating cash flow (CF) (million USD)	393	870.00	3970.00	-4500.00	69000.00
ln_OCF	362	19.03	1.71	12.40	24.96
Age	399	35.25	36.75	0.00	160.00
Growth	385	-0.01	0.72	-8.75	3.26
Beta	382	0.91	0.51	-0.34	3.64
ROA	395	5.64	18.03	-119.32	233.81

Cost of debt	382	2.41	1.62	0.00	12.05
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Table A4.2 continued

Variable	Obs	Mean	Std. Dev.	Min	Max
Cost of long-term debt	382	3.77	1.72	0.89	12.23
Cost of short-term debt	382	1.36	0.95	-0.75	6.81
Debt to equity	388	96.14	188.59	0.00	1671.71
Canada					
Total assets (million USD)	303	23100.00	98700.00	5.12	880000.00
ln_total_asset	303	21.59	1.87	15.45	27.50
Capital expenditure (CAPEX) (million USD)	240	318.00	637.00	0.00	5010.00
ln_capex	238	18.06	2.12	8.57	22.33
Operating cash flow (CF) (million USD)	304	701.00	2490.00	-1970.00	32900.00
ln_OCF	262	19.12	1.62	12.35	24.22
Age	305	18.90	22.66	-1.00	200.00
Growth	297	-0.13	0.90	-9.53	3.15
Beta	276	1.39	1.15	-0.82	7.81
ROA	303	1.48	16.16	-47.69	190.13
Cost of debt	276	3.26	1.61	0.00	9.12
Cost of long-term debt	276	5.03	1.78	2.84	12.23
Cost of short-term debt	276	2.27	1.23	0.90	6.81
Debt to equity	296	94.38	151.32	0.00	1324.98
Australia					
Environmental score	381	43.67	20.90	7.37	97.56
Total assets (million USD)	381	11000.00	70900.00	0.44	750000.00
ln_total_asset	381	20.23	2.07	12.99	27.34
Capital expenditure (CAPEX) (million USD)	323	124.00	381.00	0.00	4250.00
ln_capex	316	16.66	2.27	7.76	22.17
Operating cash flow (CF) (million USD)	381	313.00	1550.00	-4350.00	18800.00
ln_OCF	297	18.08	1.79	11.87	23.66
Age	380	26.18	24.04	0.00	132.00
Growth	371	-0.04	0.84	-7.26	3.14
Beta	366	0.91	0.75	-5.11	3.68
ROA	379	-1.70	27.60	-326.88	62.24
Cost of debt	366	2.79	1.58	0.00	8.73
Cost of long-term debt	366	4.98	1.23	1.39	12.23
Cost of short-term debt	366	2.82	0.76	-0.09	6.81
Debt to equity	372	137.04	1278.86	0.00	24471.87
Basic Materials					
Environmental score	129	44.64	22.04	6.68	95.84
Total assets (million USD)	129	5170.00	6590.00	163.00	37300.00
ln_total_asset	129	21.73	1.13	18.91	24.34
Capital expenditure (CAPEX) (million USD)	117	269.00	441.00	9.37	2810.00
ln_capex	117	18.62	1.25	16.05	21.76
Operating cash flow (CF) (million USD)	129	453.00	727.00	-311.00	5610.00
ln_OCF	123	19.24	1.33	12.85	22.45
Age	129	31.81	34.45	0.00	135.00

Growth	124	0.04	1.39	-2.86	14.40
Beta	121	1.43	0.60	0.16	3.13

Table A4.2 continued

Variable	Obs	Mean	Std. Dev.	Min	Max
ROA	129	3.72	6.91	-15.41	50.21
Cost of debt	121	3.89	1.28	0.00	8.97
Cost of long-term debt	120	6.00	1.65	1.02	12.23
Cost of short-term debt	120	2.72	1.22	-0.06	6.81
Debt to equity	123	232.95	500.56	0.00	3544.00
Consumer Cyclicals					
Environmental score	356	43.72	21.05	6.08	93.73
Total assets (million USD)	356	7600.00	22900.00	48.60	238000.00
Intotal_asset	356	21.51	1.48	17.70	26.20
Capital expenditure (CAPEX) (million USD)	313	343.00	1040.00	0.27	9540.00
Incapex	313	18.27	1.60	12.50	22.98
Operating cash flow (CF) (million USD)	356	783.00	2270.00	-1380.00	19800.00
ln_OCF	335	19.27	1.50	14.57	23.71
Age	356	26.08	25.02	-1.00	121.00
Growth	344	0.08	0.54	-4.77	3.53
Beta	334	1.10	0.53	-0.66	3.32
ROA	356	5.85	8.72	-47.60	46.29
Cost of debt	334	3.20	1.62	0.00	8.31
Cost of long-term debt	334	5.43	1.69	1.49	12.23
Cost of short-term debt	334	2.00	0.63	-0.17	6.81
Debt to equity	320	151.72	431.68	0.00	6410.52
Consumer non-cyclicals					
Environmental score	119	46.07	22.90	7.88	95.71
Total assets (million USD)	119	12900.00	27800.00	16.60	199000.00
Intotal_asset	119	21.80	1.80	16.63	26.02
Capital expenditure (CAPEX) (million USD)	101	451.00	1210.00	0.96	10600.00
Incapex	101	18.52	1.79	13.77	23.09
Operating cash flow (CF) (million USD)	119	1300.00	3500.00	-45.90	31700.00
ln_OCF	116	19.52	1.73	15.68	24.18
Age	119	35.75	31.18	0.00	115.00
Growth	114	0.05	0.35	-2.11	1.71
Beta	114	0.80	0.51	-0.42	3.10
ROA	119	6.51	9.32	-56.72	36.81
Cost of debt	114	2.81	1.42	0.00	7.76
Cost of long-term debt	114	4.83	1.66	0.74	12.23
Cost of short-term debt	114	1.80	0.68	-0.30	6.81
Debt to equity	109	110.61	127.66	0.00	640.75
Energy					
Environmental score	145	42.69	19.96	5.19	97.61
Total assets (million USD)	145	12800.00	37200.00	0.40	330000.00
Intotal_asset	145	21.69	1.92	12.89	26.52
Capital expenditure (CAPEX) (million USD)	117	976.00	2350.00	1.92	18100.00
Incapex	117	19.35	1.75	14.47	23.62

Operating cash flow (CF) (million USD)	145	802.00	2350.00	-1700.00	22100.00
ln_OCF	118	19.23	1.87	14.35	23.82

Table A4.2 continued

Variable	Obs	Mean	Std. Dev.	Min	Max
Age	145	22.45	22.01	0.00	135.00
Growth	129	-0.48	0.95	-8.06	1.11
Beta	124	1.58	0.80	-2.43	3.50
ROA	143	-6.99	26.72	-59.50	259.28
Cost of debt	124	4.47	2.28	0.00	12.10
Cost of long-term debt	124	7.23	2.77	3.24	12.23
Cost of short-term debt	124	3.18	1.77	1.16	6.81
Debt to equity	131	329.55	1296.14	0.00	11740.74
Financials					
Environmental score	581	37.73	19.34	7.92	98.87
Total assets (million USD)	579	50800.00	251000.00	8.69	3290000.00
ln_total_asset	579	22.58	1.66	15.98	28.82
Capital expenditure (CAPEX) (million USD)	185	179.00	278.00	0.00	1740.00
ln_capex	183	17.79	2.02	9.39	21.28
Operating cash flow (CF) (million USD)	579	718.00	3220.00	-16400.00	53900.00
ln_OCF	537	19.03	1.58	12.97	24.71
Age	581	22.58	19.95	-1.00	183.00
Growth	554	0.05	0.93	-12.46	7.12
Beta	545	1.01	0.49	-0.06	4.03
ROA	577	2.76	6.21	-17.43	92.54
Cost of debt	545	3.03	1.49	0.00	8.33
Cost of long-term debt	545	4.84	1.21	1.23	12.23
Cost of short-term debt	545	2.42	0.52	0.13	6.81
Debt to equity	573	298.81	2794.54	0.00	53736.06
Healthcare					
Environmental score	338	46.68	16.82	9.95	98.26
Total assets (million USD)	338	5700.00	18700.00	5.71	172000.00
ln_total_asset	338	20.17	1.97	15.56	25.87
Capital expenditure (CAPEX) (million USD)	275	138.00	381.00	0.01	3230.00
ln_capex	275	16.29	2.49	8.87	21.89
Operating cash flow (CF) (million USD)	338	532.00	2100.00	-342.00	18800.00
ln_OCF	180	18.90	1.95	13.86	23.66
Age	338	20.33	17.89	-1.00	130.00
Growth	322	0.09	0.98	-5.69	3.80
Beta	318	1.26	0.74	-2.06	5.04
ROA	336	-21.45	46.86	-439.54	78.57
Cost of debt	318	2.46	2.00	0.00	8.33
Cost of long-term debt	318	5.39	1.84	3.24	12.23
Cost of short-term debt	318	2.01	0.85	1.16	6.81
Debt to equity	316	138.61	919.24	0.00	15447.93
Industrials					
Environmental score	342	40.21	22.07	7.09	96.70
Total assets (million USD)	342	7050.00	23000.00	35.30	365000.00
ln_total_asset	342	21.47	1.42	17.38	26.62

Capital expenditure (CAPEX) (million USD)	288	349.00	1040.00	0.52	11100.00
Incapex	288	18.03	1.69	13.16	23.13

Table A4.2 continued

Variable	Obs	Mean	Std. Dev.	Min	Max
Operating cash flow (CF) (million USD)	342	601.00	1290.00	-244.00	10500.00
ln_OCF	328	19.14	1.47	14.64	23.07
Age	342	33.83	27.62	0.00	127.00
Growth	332	0.00	0.46	-4.33	1.33
Beta	332	1.27	0.58	-0.19	4.72
ROA	339	4.73	9.99	-134.89	26.44
Cost of debt	332	3.23	1.79	0.00	9.89
Cost of long-term Debt	332	5.50	2.18	0.85	12.23
Cost of short-term Debt	332	2.38	1.23	-0.22	6.81
Debt to equity	330	162.18	449.84	0.00	5611.31
Technology					
Environmental score	315	44.44	22.57	6.70	98.88
Total assets (million USD)	314	8780.00	31900.00	16.10	375000.00
Intotal_asset	314	21.12	1.70	16.60	26.65
Capital expenditure (CAPEX) (million USD)	267	309.00	1330.00	0.24	12500.00
Incapex	267	17.42	1.81	12.40	23.25
Operating cash flow (CF) (million USD)	314	1130.00	5180.00	-1470.00	64200.00
ln_OCF	281	18.87	1.89	13.21	24.89
Age	315	20.63	19.42	-1.00	141.00
Growth	295	-0.09	0.94	-7.86	3.56
Beta	285	1.28	0.52	-1.02	3.85
ROA	312	-0.05	15.57	-112.40	48.58
Cost of debt	285	2.21	1.66	0.00	8.33
Cost of long-term debt	285	4.50	1.46	3.24	12.23
Cost of short-term debt	285	1.68	0.63	1.16	6.81
Debt to equity	294	88.46	249.98	0.00	3074.36
Telecommunication					
Environmental score	27	30.00	23.14	11.42	82.70
Total assets (million USD)	27	34600.00	88900.00	245.00	404000.00
Intotal_asset	27	22.05	2.06	19.32	26.72
Capital expenditure (CAPEX) (million USD)	25	2280.00	5460.00	7.96	22400.00
Incapex	25	19.38	2.23	15.89	23.83
Operating cash flow (CF) (million USD)	27	2820.00	8610.00	-3290.00	39300.00
ln_OCF	24	19.59	2.11	15.99	24.40
Age	27	21.63	17.35	3.00	82.00
Growth	26	0.21	0.50	-0.39	2.33
Beta	27	1.04	0.51	0.27	2.15
ROA	27	-3.46	15.07	-73.95	7.93
Cost of debt	27	3.96	1.36	0.00	8.09
Cost of long-term debt	27	6.43	2.06	3.24	12.23
Cost of short-term debt	27	2.53	1.27	1.26	6.81

Debt to equity	24	697.21	1700.18	0.00	6534.81
Utilities					
Environmental score	70	50.97	22.22	9.73	90.73
Total assets (million USD)	70	22300.00	28700.00	320.00	133000.00
Intotal_asset	70	22.99	1.44	19.59	25.61

Table A4.2 continued

Variable	Obs	Mean	Std. Dev.	Min	Max
Capital expenditure (CAPEX) (million USD)	65	1640.00	2050.00	2.26	8570.00
Incapex	65	20.16	1.88	14.63	22.87
Operating cash flow (CF) (million USD)	70	1430.00	1820.00	-166.00	8450.00
ln_OCF	68	20.29	1.44	16.78	22.86
Age	70	39.63	39.74	-1.00	201.00
Growth	70	0.11	0.30	-0.15	2.45
Beta	66	0.48	0.44	0.00	2.46
ROA	70	4.41	17.81	-12.99	147.21
Cost of debt	66	3.17	1.56	0.97	9.53
Cost of long-term debt	66	4.86	2.04	1.49	12.23
Cost of short-term debt	66	2.54	1.94	-0.04	9.44
Debt to equity	70	151.82	124.22	33.23	807.10

Source: Author calculation.

Table A4.3: Industries' Definitions

Basic Materials:	The Basic Materials economic sector consists of companies engaged in the extraction and primary refinement of chemicals, metals, non-metallic and construction materials; forest, wood and paper products; and containers and packaging products.
Consumer Cyclical:	The Cyclical Consumer Goods and Services economic sector consists of companies engaged in the production of automobiles, homebuilding, household goods, textiles and apparel, as well as hotel, casino, leisure, media and retail operations and services.
Consumer Non-cyclical:	The Non-Cyclical Consumer Goods and Services economic sector consists of companies engaged in fishing and farming operations; the processing and production of food, beverages and tobacco; manufacturers of household and personal products; and providers of personal services.
Energy:	The Energy economic sector consists of companies engaged in the exploration, extraction and refining of coal, oil and natural gas.
Financials:	The Financials economic sector consists of companies engaged in the operation of retail and commercial banks, insurance companies, real estate operations, investment trusts and other financial service providers.
Healthcare:	The Healthcare economic sector consists of companies engaged in manufacturing medical equipment, supplies and pharmaceuticals, as well as operating healthcare facilities and provision of managed healthcare.
Industrials:	The Industrials economic sector consists of companies engaged in providing industrial and commercial supplies and services, diversified trading, distribution operations and transportation services.
Technology:	The Technology economic sector consists of companies engaged in manufacturing semiconductors, communications equipment, computer hardware and technology-related office equipment, as well as providers of consulting and IT services.
Telecom:	The Telecommunications Services economic sector consists of companies engaged in fixed-line and wireless telecommunication networks for voice, data and high-density data.
Utilities:	The Utilities economic sector consists of companies engaged in producing and delivering electric power, natural gas, water and other utility services, such as steam and cooled air.

Source: Global Industry Classification Standard - S&P Global.

Table A5.1: Key explanatory variables and their expected association with coupon rates (CR)

Variable	Measure	Hypothesized/Expected effects on Coupon Rates (CR)	Rationale
Environmental Performance (<i>EP</i>)	EP score assigned in Thompson Reuters' ESG rating	-VE	Firms with higher EP are likely to be able to sell bond issuances at a lower CR, since they are better valued by investors in the market, and firms could use the less than regular CR to offset their cost of going green.
Size of issuances (<i>AMT</i>)	Total amount of funds raised in USD by a bond issuance	-VE	Larger issue size is likely to be associated with lower coupon rates, for this is a way of reducing the issuing firm's future interest cost burden.
Bond rating (<i>BR</i>)	Categorical score assigned in relation to the credit rating of a bond given by Standard & Poor's; higher rating gives higher score and vice versa, following appendix Table A3.	-VE	Bonds with higher quality and lower risk are likely to offer lower coupon rates because they provide better safety and security of investments made in them.
Issuing firm size (<i>TA</i>)	Value of total assets in USD	+VE	Larger issuing firms can offer higher coupon rates because they are financially stronger and better able to repay their debts.
Leverage (<i>DER</i>)	Debt-equity ratio; calculated by the standard formula: value of total long-term debt divided by value of total equity	+VE/-VE	Issuing firms with a higher degree of leverage can offer lower coupon rates to avoid an extra interest burden in the future; however, many firms with significantly higher existing leverage might be forced to offer higher a coupon rate to make their offer saleable or attractive to the market.
Cash flow (<i>FCFA</i>)	Free Cash Flow to Total Assets ratio; calculated by dividing value of total FCF in USD by value of total assets in USD	+VE/-VE	Issuing firms with a higher ability to generate cash flows can offer a higher coupon rate; however, many such firms may also be able to issue bonds at a lower coupon rate, since, because of their superior cash flow generation ability, investors in the market already see them as financially stronger and safer.

Source: developed by authors.

Table A5.2: Test results for multicollinearity and heteroskedasticity

Name	Panel A: EU		Panel B: USA	
	With GB	Without GB	With GB	Without GB
Multicollinearity (VIF test)				
All issuances	1.18	1.16	1.19	1.17
By maturity sub-samples				
Short maturity (<=3 years)	1.15	1.15	1.14	1.12
Medium maturity (>3 to <=10 years)	1.29	1.25	1.28	1.24
Long maturity (>10 years)	1.11	1.10	1.23	1.21
By sector sub-samples				
Financial products	1.12	1.10	1.19	1.16
Consumer goods	1.32	1.32	1.29	1.27
Utilities and Transportation	1.36	1.13	1.22	1.22
Manufacturing	1.27	1.26	1.40	1.35
Services	1.46	1.39	1.30	1.27
Telecommunications	1.22	1.22	1.25	1.22
Heteroskedasticity (Breusch-Pagan/Cook-Weisberg test p values)				
All issuances	50.95***	50.54***	400.72***	400.89***
By maturity sub-samples				
Short maturity (<=3 years)	88.35***	88.98***	90.12***	91.31***
Medium maturity (>3 to <=10 years)	39.60***	42.15***	613.18***	614.48***
Long maturity (>10 years)	2.45	1.74	186.04***	185.76***
By sector sub-samples				
Financial products	29.53***	30.71***	25.84***	25.89***
Consumer goods	14.71***	14.71***	7.30***	7.30***
Utilities and Transportation	0.13	0.83	28.25***	28.35***
Manufacturing	12.25***	13.13***	112.06***	112.04***
Services	0.77	0.68	17.99***	17.59***
Telecommunications	10.22***	10.22***	58.33***	58.33***

*** p<0.01, ** p<0.05, * p<0.1.

Table A5.3: Scores assigned ratings given by Standard & Poor's

Rating	Score for EU bonds	Score for USA bonds
AAA	17	18
AA+	16	17
AA	15	16
AA-	14	15
A+	13	14
A	12	13
A-	11	12
BBB+	10	11
BBB	9	10
BBB-	8	9
BB+	7	8
BB	6	7
BB-	5	6
B+	4	5
B	3	4
B-	2	3
CCC+	1	2
CCC	Not available	1
Not Rated	0	0

Source: developed by authors.

Table A6.1: Variable definitions as defined by Bloomberg

ISSUE SIZE	Cumulative amount issued from the original security pricing date through to the current date for debt securities. The amount will include taps/increases or reopenings.
COUPON RATE	Current interest rate of the security. <i>Corporates:</i> Floating rate securities that have not settled will return a projected rate. This is calculated by adding the spread to the current index rate. For Brazil Taxa DI-Over linked securities [identifiable by Calculation Type (DS138, CALC_TYP) values of '1368' and '1401'], returns the calculated interpolated rate without the spread.
MATURITY	Date the principal of a security is due and payable. <i>Fixed Income:</i> Perpetual securities will not return a value, as they do not have a 'true' maturity date.
BOND RATING	Issue level rating assigned by rating agencies,
PARI PASSU: IS_PARI_PASSU	Indicates if the obligation ranks equal to other debt.
SECURITY	Description of the specific instrument type within its market sector. <i>Corporates:</i> This returns the market issue type (DS061, MARKET_ISSUE) of the bond.
RISK PREMIUM	Average additional return required by an investor as compensation for investing in equities rather than a risk-free instrument. Risk premium is the product of Country Risk – Premium (VM109, COUNTRY_RISK_PREMIUM) and applied beta
DENOMINATION	Currency in which the security was issued.
CURRENCY	<i>Fixed Income:</i> Provides the currency in which the bond was issued, not necessarily the currency in which the bond trades or pays its coupons. Use Trade Currency (DX028, TRADE_CRNCY) if values differ.
SECTOR OF ISSUER	The industry classification of the issuer of the security.
MARKET OF DISTRIBUTION	Identifies the type of market the security is intended to be distributed to at the initial issuance. The possible returns are: Domestic, Local, Foreign, International and Global. <i>Corporates:</i> Returns 'Domestic' if the initial issuance of the security is issued by a domestic issuer and the distribution is intended for domestic investors and where data is not available to be conclusive. Returns 'Foreign' if the initial issuance of the security is issued by a non domestic issuer and the distribution is intended for domestic investors. Returns 'International' if the

initial issuance of the security is intended for domestic and non-domestic investors. Returns 'Global' if the initial issuance of the security is issued by a sovereign or supranational entity, greater than or equal to USD 500 million or greater than or equal to EUR 500 million.

A6.2: Summary statistics of variables

Variable	Obs	Mean	Std. Dev	Min	Max
Amount issued (issue size)	770	17.88	2.26	9.21	22.09
Coupon rate (CR)	767	3.45	2.38	0.00	11.75
Maturity (mat)	766	7.08	4.57	1.01	32.81
Security dummy (SEC_dum)	771	0.18	0.38	0	1
Bond rating (BR)	771	2.38	2.90	0	7
Risk premium (RP)	623	9.69	3.17	3.02	15.71
Pari passu (PP_dum)	771	0.55	0.50	0	1
Total asset (lnTA)	613	11.32	2.13	2.21	19.51
Revenue growth (RG)	598	35.78	131.40	−93.38	1415.83
Debt to asset ratio (CS)	613	0.48	0.22	0.00	0.93
Issuer rating (IR)	771	3.13	3.08	0.00	7.00
Return on assets (ROA)	606	0.83	2.79	−5.09	20.45
Market interest rates (MIR)	771	4.64	1.84	0.5	20.94
Emerging market dummy (MT_dum)	771	0.22	0.41	0	1
Foreign market dummy	771	0.07	0.25	0	1
Global market dummy	771	0.03	0.17	0	1
International market dummy	771	0.43	0.50	0	1
USD currency dummy	771	0.37	0.48	0	1
EURO currency dummy	771	0.15	0.36	0	1
CNY currency dummy	771	0.14	0.34	0	1
Bank sector dummy	771	0.41	0.49	0	1
Financial sector dummy	771	0.06	0.23	0	1
Industrial sector dummy	771	0.22	0.41	0	1
REIT sector dummy	771	0.13	0.34	0	1
Utility sector dummy	771	0.12	0.33	0	1

Source: Author calculations.

A6.3: Correlation matrix

	lnamt_issued	CR	Mat	SEC_dum	BR	RP	PP_dum	lnTA	RG	CS	IR	ROA	MIR	MT_dum
lnamt_issued	1													
CR	-0.32	1												
Mat	0.00	-0.05	1											
SEC_dum	0.25	-0.05	0.02	1										
BR	0.38	-0.31	0.15	0.19	1									
RP	-0.35	0.10	0.16	-0.11	-0.31	1								
PP_dum	-0.20	0.12	0.07	-0.02	0.11	0.36	1							
lnTA	0.38	-0.07	-0.18	-0.02	0.25	-0.52	-0.15	1						
RG	-0.11	-0.03	-0.03	-0.04	-0.20	0.02	-0.11	-0.12	1					
CS	-0.02	0.03	-0.12	0.12	0.37	-0.16	0.14	0.23	-0.19	1				
IR	0.17	-0.14	-0.02	0.02	0.61	-0.52	-0.01	0.50	-0.14	0.51	1			
ROA	0.29	-0.24	-0.11	0.03	0.04	-0.42	-0.27	0.13	-0.03	-0.11	-0.02	1		
MIR	0.27	0.04	-0.13	0.02	0.03	-0.29	-0.12	0.33	-0.05	0.10	0.06	0.19	1	
MT_dum	0.31	0.15	-0.09	0.04	-0.21	-0.16	-0.33	0.30	-0.06	-0.26	-0.30	0.14	0.27	1
FOR_dum	0.19	-0.02	0.05	0.10	0.19	-0.07	0.07	0.20	-0.06	-0.01	0.05	-0.01	0.12	0.08
GLOB_dum	0.25	-0.14	0.09	0.12	0.26	-0.09	0.01	0.09	-0.06	0.22	0.20	-0.03	0.00	-0.08
INTL_dum	-0.10	0.03	-0.09	-0.10	0.34	-0.37	0.03	0.35	-0.07	0.51	0.69	-0.07	0.06	-0.23
USD_dum	-0.28	-0.02	0.24	-0.01	-0.02	0.46	0.33	-0.39	0.01	-0.18	-0.28	-0.30	-0.37	-0.17

EURO_dum	0.38	-0.33	0.18	0.16	0.30	-0.04	-0.07	0.02	-0.10	0.01	0.15	0.04	0.23	-0.09
CNY_dum	0.27	0.11	-0.15	-0.02	-0.25	-0.05	-0.33	0.21	-0.04	-0.22	-0.29	0.10	-0.01	0.80
BNK_dum	0.21	0.05	-0.16	0.00	0.20	-0.38	-0.04	0.67	-0.08	0.39	0.55	-0.18	0.24	0.04
FIN_dum	0.08	-0.03	-0.10	-0.01	-0.04	-0.05	-0.14	0.06	-0.04	0.08	-0.13	0.25	0.05	0.18
IND_dum	-0.43	0.14	0.19	-0.06	-0.38	0.78	0.37	-0.67	0.05	-0.32	-0.63	-0.27	-0.35	-0.13
REIT_dum	-0.09	-0.17	-0.08	-0.04	0.14	-0.27	-0.21	-0.07	-0.03	0.01	0.07	0.36	-0.04	-0.09
UTI_dum	0.28	-0.08	0.13	0.08	0.07	-0.11	-0.07	-0.13	0.13	-0.22	-0.01	0.11	0.14	0.09

Source: Author calculations.

Table A7.1. Summary statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Spread	249,840	2.35	3.31	-1.61	11.38
Coupon	942,420	2.91	2.19	0	15.50
Tenor	949,200	6.79	4.64	2	31
Order of issuance	949,200	4.63	7.16	0	38
Call feature	949,200	1.17	0.37	1	2
Put feature	949,200	0.05	0.21	0	1
Exchange listing	949,200	1.79	0.40	1	2
Company type	949,200	1.62	0.49	1	2
Guarantee feature	947,844	1.14	0.34	1	2
By currency:					
CNY	158,652	1	0	1	1
EURO	260,352	2	0	2	2
YEN	78,648	3	0	3	3
KRONA	161,364	4	0	4	4
USD	290,184	5	0	5	5
By market:					
Domestic	560,028	1	0	1	1
Global	28,476	2	0	2	2
Eurobonds	306,456	3	0	3	3
DimSum-Samurai-Panda-Yankee	18,984	4	0	4	4
Other foreign	35,256	5	0	5	5
By instrument type:					
Bonds	433,920	1	0	1	1
Notes	513,924	2	0	2	2
Debenture	1,356	3	0	3	3
By sector:					
Financial	489,516	1	0	1	1
Manufacturing	10,848	2	0	2	2
Real Estate	131,532	3	0	3	3
Utilities	221,028	4	0	4	4
Transport	17,628	5	0	5	5
Industrial	16,272	6	0	6	6
Food processing	2,712	7	0	7	7
Healthcare	2,712	8	0	8	8
Other sectors	56,952	9	0	9	9

Table A7.2: Diagnostics for the estimations (P-values reported)

	Heteroskedasticity	Hetero skedasticity	Cross-section dependence	Autocorrelation (AR1)	Moving Average (MA) Autocorrelation	Multicollinearity
<i>Test Name</i>	<i>Modified Wald</i>	<i>Breusch-Pagan/Cook- Weisberg test</i>	<i>Pesaran CD test</i>	<i>Wooldridge</i>	<i>Cumby–Huizinga</i>	<i>VIF Test</i>
All bonds	0.000	0.000	#	0.000	0.019 (lag 6)	5.06
Shorter maturity	0.000	0.000	#	0.000	0.027 (lag 6)	3.86
Medium maturity	0.000	0.000	#	0.000	0.059 (lag 6)	7.05
Longer maturity	0.000	0.000	0.000	0.000	0.018 (lag 7)	8.18
CNY	0.743	0.000	#	0.000	0.000 (lag 8)	1.98
EURO	0.000	0.000	#	0.000	0.019 (lag 6)	3.01
YEN	0.000	0.000	#	0.000	ns (lags 1 to 20)*	8.38
SWEDISH KRONA	0.000	0.000	0.000	0.000	0.083 (lag 6)*	2.85
USD	0.000	0.000	#	0.000	0.001 (lag 6)	3.69
Financials	0.000	0.000	#	0.000	0.094 (lag 5)	3.29
Real estate	0.000	0.000	#	0.000	0.006 (lag 6)	6.92
Utilities	0.000	0.000	#	0.000	0.000 (lag 5)	8.33
All other sectors	0.000	0.000	#	0.000	0.083 (lag 5)	6.21
All bonds (Binary)	0.000	0.000	#	0.000	0.019 (lag 6)	5.83
Order 1	0.000	0.000	#	0.000	0.033 (lag 5)	4.76
Order >1	0.000	0.000	#	0.000	0.021 (lag 7)	5.30
Order 2	0.000	0.000	#	0.000	ns (lags 1 to 20)*	4.33
Order 3	0.000	0.000	0.000	0.000	0.002 (lag 1)	8.07
Order 4	0.000	0.000	0.000	0.000	0.027 (lag 6)	9.03
Order 5	0.000	0.000	0.000	0.000	0.050 (lag 6)	9.03

*not significant any lag tested between 1 to 20; # statistic cannot be produced as data in the panel are highly unbalanced.

Table A7.3: Correlation matrix

	spread	coupon	tenor	order	call	put	exlist	cotype	grnte	CNY	EURO
spread	1.00										
coupon	0.54	1.00									
tenor	0.14	0.32	1.00								
order	0.41	0.33	0.18	1.00							
call	-0.06	0.06	0.26	-0.19	1.00						
put	-0.02	0.16	-0.07	-0.09	-0.08	1.00					
exlist	-0.45	-0.41	-0.31	-0.64	0.15	0.09	1.00				
cotype	0.20	0.19	0.09	0.32	-0.05	0.06	-0.30	1.00			
grnte	-0.01	0.15	0.00	-0.17	0.25	0.00	0.10	0.22	1.00		
CNY	-0.07	0.27	-0.24	-0.16	-0.16	0.52	0.18	-0.16	-0.06	1.00	
EURO	-0.25	-0.47	0.02	-0.29	0.21	-0.12	0.33	-0.21	0.00	-0.22	1.00
YEN	0.21	0.06	-0.05	0.05	-0.08	-0.03	-0.32	0.04	-0.07	-0.06	-0.12
KRONA	-0.21	-0.46	-0.31	-0.12	-0.21	-0.08	0.23	-0.09	-0.09	-0.16	-0.30
USD	0.37	0.61	0.39	0.46	0.09	-0.14	-0.49	0.36	0.13	-0.27	-0.51
Domestic	0.09	0.05	-0.07	0.33	-0.30	0.12	-0.24	0.04	-0.34	0.27	-0.32
Global	-0.06	0.07	0.11	-0.10	0.26	-0.04	0.11	0.02	0.14	-0.07	-0.13
Eurobond	-0.09	-0.14	-0.03	-0.26	0.15	-0.12	0.22	-0.03	0.26	-0.24	0.40
DimSum-Panda-Samurai	-0.03	-0.01	0.01	-0.05	-0.06	0.10	-0.07	0.04	-0.03	0.05	-0.08
Other foreign	0.06	0.16	0.14	-0.09	0.19	-0.03	0.01	-0.08	0.13	-0.06	0.02
Fixed	0.11	0.31	0.25	0.14	0.10	0.08	-0.13	0.04	0.02	0.14	0.20

Table A7.3 continued

	spread	coupon	tenor	order	call	put	exlist	cotype	grnte	CNY	EURO
<i>Floating</i>	-0.18	-0.38	-0.26	-0.13	-0.15	-0.07	0.19	-0.06	-0.07	-0.14	-0.19
<i>Range</i>	0.33	0.14	-0.03	-0.02	-0.03	-0.01	-0.12	0.04	-0.02	-0.02	-0.04
<i>Variable</i>	0.04	0.16	0.05	-0.05	0.19	-0.02	-0.15	0.05	0.22	-0.03	-0.04
<i>Quarterly</i>	-0.17	-0.36	-0.22	-0.13	-0.15	-0.07	0.20	-0.08	-0.08	-0.14	-0.19
<i>Semi-annually</i>	0.48	0.62	0.35	0.46	0.12	-0.15	-0.61	0.37	0.13	-0.28	-0.49
<i>Bonds</i>	-0.27	-0.33	-0.22	-0.25	-0.09	0.23	0.30	-0.22	-0.18	0.40	-0.04
<i>Notes</i>	0.27	0.33	0.22	0.25	0.09	-0.23	-0.30	0.22	0.18	-0.40	0.04
<i>Debenture</i>	-0.01	0.01	0.01	-0.01	0.04	0.00	0.01	0.01	-0.01	-0.01	-0.01
<i>Financial</i>	-0.14	-0.08	-0.20	-0.34	0.11	-0.08	0.25	-0.06	0.29	0.14	0.20
<i>Manufacturing</i>	-0.05	0.02	-0.02	-0.05	0.06	0.18	0.06	-0.07	-0.04	0.11	-0.07
<i>Real estate</i>	-0.15	-0.34	-0.22	-0.06	-0.07	-0.06	0.18	-0.06	-0.09	-0.13	-0.19
<i>Utilities</i>	0.29	0.33	0.33	0.51	-0.05	0.06	-0.47	0.25	-0.25	-0.10	-0.12
<i>Transport</i>	-0.03	-0.05	-0.01	-0.04	-0.03	0.07	0.00	0.02	-0.02	0.03	-0.01
<i>Industrial</i>	0.11	0.14	-0.08	-0.05	0.06	0.01	0.04	-0.07	0.12	0.11	0.03
<i>Food processing</i>	0.02	0.00	-0.01	-0.05	-0.04	-0.02	0.04	-0.12	-0.03	-0.03	0.13
<i>Healthcare</i>	-0.01	0.04	0.00	-0.03	0.04	0.19	0.03	-0.03	0.06	0.09	-0.04
<i>Others</i>	-0.09	-0.08	0.11	-0.13	-0.06	-0.02	0.09	-0.19	-0.01	-0.05	0.08

Table A7.3 continued

	<i>YEN</i>	<i>KRONA</i>	<i>USD</i>	<i>Domestic</i>	<i>Global</i>	<i>Eurobond</i>	<i>DimSum-Panda-Samurai</i>	<i>Other Foreign</i>	<i>Fixed</i>	<i>Floating</i>
<i>YEN</i>	1.00									
<i>KRONA</i>	-0.09	1.00								
<i>USD</i>	-0.14	-0.37	1.00							
<i>Domestic</i>	-0.14	0.24	-0.01	1.00						
<i>Global</i>	-0.04	-0.10	0.26	-0.25	1.00					
<i>Eurobond</i>	0.13	-0.17	-0.14	-0.83	-0.14	1.00				
<i>DimSum-Panda-Samurai</i>	0.16	-0.06	0.03	-0.15	-0.03	-0.08	1.00			
<i>Other foreign</i>	-0.03	-0.07	0.09	-0.21	-0.04	-0.12	-0.02	1.00		
<i>Fixed</i>	0.01	-0.64	0.23	-0.11	0.07	0.06	0.05	0.04	1.00	
<i>Floating</i>	-0.06	0.68	-0.25	0.13	-0.06	-0.08	-0.05	-0.04	-0.96	1.00
<i>Range</i>	0.33	-0.03	-0.05	-0.07	-0.01	0.09	-0.01	-0.01	-0.15	-0.02
<i>Variable</i>	-0.02	-0.04	0.10	-0.01	-0.02	0.03	-0.01	-0.02	-0.21	-0.03
<i>Annual</i>	-0.16	-0.08	-0.70	-0.04	-0.19	0.18	-0.07	-0.12	0.38	-0.36
<i>Quarterly</i>	-0.07	0.67	-0.23	0.12	-0.06	-0.08	-0.05	0.00	-0.94	0.98
<i>Semi-annually</i>	0.22	-0.39	0.87	-0.04	0.23	-0.12	0.10	0.12	0.28	-0.33
<i>Bonds</i>	0.00	0.35	-0.50	0.45	-0.10	-0.40	0.02	-0.09	-0.21	0.23
<i>Notes</i>	0.00	-0.35	0.50	-0.45	0.10	0.40	-0.02	0.09	0.21	-0.23
<i>Debenture</i>	0.00	-0.01	0.02	0.01	0.00	-0.01	0.00	0.00	0.01	-0.01
<i>Financial</i>	0.10	-0.19	-0.16	-0.46	-0.05	0.45	0.07	0.10	0.05	-0.08
<i>Manufacturing</i>	-0.02	0.01	0.00	0.01	0.18	-0.08	-0.01	-0.02	-0.02	0.03
<i>Real estate</i>	-0.03	0.68	-0.27	0.30	-0.07	-0.25	-0.05	-0.07	-0.45	0.48
<i>Utilities</i>	-0.09	-0.30	0.44	0.36	0.00	-0.33	-0.02	-0.11	0.28	-0.26
<i>Transport</i>	0.07	0.03	-0.06	0.03	-0.02	-0.01	-0.01	-0.01	-0.02	0.02
<i>Industrial</i>	0.00	-0.05	-0.06	-0.02	-0.02	0.00	-0.01	0.10	0.04	-0.04
<i>Food processing</i>	-0.02	-0.04	-0.07	-0.10	-0.02	0.03	-0.01	0.23	0.04	-0.03
<i>Healthcare</i>	-0.01	-0.03	0.01	0.05	-0.01	-0.04	-0.01	-0.01	0.03	-0.02
<i>Others</i>	0.01	0.06	-0.10	-0.15	0.13	0.10	-0.02	0.01	-0.04	0.04

Table A7.3 continued

	<i>Range</i>	<i>Variable</i>	<i>Annually</i>	<i>Quarterly</i>	<i>Semi-annually</i>	<i>Bonds</i>	<i>Notes</i>	<i>Debenture</i>	<i>Financial</i>	<i>Manufacturing</i>
<i>Range</i>	1.00									
<i>Variable</i>	-0.01	1.00								
<i>Annual</i>	-0.05	-0.08	1.00							
<i>Monthly</i>										
<i>Quarterly</i>	-0.02	-0.03	-0.36	1.00						
<i>Semi-annually</i>	0.07	0.10	-0.75	-0.34	1.00					
<i>Bonds</i>	-0.04	-0.05	0.32	0.22	-0.48	1.00				
<i>Notes</i>	0.04	0.05	-0.32	-0.22	0.48	-1.00	1.00			
<i>Debenture</i>	0.00	0.00	-0.01	-0.01	0.02	-0.01	-0.02	1.00		
<i>Financial</i>	0.07	0.09	0.20	-0.10	-0.14	0.00	0.00	-0.01	1.00	
<i>Manufacturing</i>	-0.01	-0.01	-0.01	0.02	-0.01	0.05	-0.05	0.00	-0.10	1.00
<i>Real estate</i>	-0.02	-0.03	-0.06	0.47	-0.28	0.39	-0.39	-0.01	-0.33	-0.04
<i>Utilities</i>	-0.04	-0.06	-0.22	-0.27	0.42	-0.29	0.29	0.02	-0.62	-0.08
<i>Transport</i>	0.00	-0.01	0.02	0.02	-0.03	0.04	-0.04	0.00	-0.06	-0.01
<i>Industrial</i>	-0.01	-0.01	0.00	-0.04	0.03	-0.04	0.04	0.00	-0.08	-0.01
<i>Food processing</i>	-0.01	-0.01	0.09	-0.03	-0.07	-0.06	0.06	0.00	-0.07	-0.01
<i>Healthcare</i>	0.00	-0.01	0.01	-0.03	0.00	0.08	-0.08	0.00	-0.05	-0.01
<i>Others</i>	-0.02	0.00	0.06	0.09	-0.12	0.02	-0.02	0.00	-0.23	-0.03

Table A7.3 continued

	<i>Real estate</i>	<i>Utilities</i>	<i>Transport</i>	<i>Industrial</i>	<i>Food processing</i>	<i>Healthcare</i>	<i>Others</i>
<i>Real Estate</i>	1.00						
<i>Utilities</i>	-0.27	1.00					
<i>Transport</i>	-0.03	-0.05	1.00				
<i>Industrial</i>	-0.04	-0.07	-0.01	1.00			
<i>Food processing</i>	-0.03	-0.06	-0.01	-0.01	1.00		
<i>Healthcare</i>	-0.02	-0.04	0.00	-0.01	-0.01	1.00	
<i>Others</i>	-0.10	-0.19	-0.02	-0.03	-0.02	-0.02	1.00

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