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The impact of ESG score on firm´s cost of capital and riskiness

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Abstract

This paper investigates the relationship between a firm´s Thomson Reuters ESG score and its weighted average cost of capital & implied credit default swap spread. The research is conducted on the Swedish stock exchanges and uses all available firms with an available ESG score. The effect is measured from 2017 to 2019. The paper uses a random effects regression in combination with a pooled OLS regression to determine the relationships. There is no evidence that ESG score affect a firm´s weighted average cost of capital. There is evidence at 5% significance that ESG have a positive effect on a firm´s implied CDS spread with a coefficient of .2081717 or .2368187, depending on the modelling. The findings stand in contrast to some previous literature which finds that ESG has a significant effect on a firm´s cost of capital.

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1.0 Introduction

1.1 Background

It seems mankind is living beyond its means. There are threats of global warming, social dividing and economic injustices, (United Nations (UN), 2019). With these issues, firms must satisfy both demands from its stakeholders, whilst battling in the marketplace to make a profit for their shareholders, (Freeman & McVea, Working paper).

Sustainability has gained major importance and the number of institutions concerned by it likewise. Today all firms on the OMXS30 index either provide an annual sustainability report or provide it in combination with their annual reports, *appendix table 15.* Firms on the OMXS30 are not alone in providing sustainability reports as this pattern shows in their American counterpart where more than 85% of all firms on the S&P500 index disclose sustainability information, (Market Watch, 2018). There are no doubt firms are aware of the importance of sustainability and the role it plays in the firm´s equation for longevity and prosperity. For instance; recently the CEO of the world's largest investor, BlackRock inc, communicated in his annual letter to his employees to consider more than financial profits. (Fink, 2019). Fink told the employees to also consider leaving a better world for their children. This raises the question if leaving a better world for the children stands in contrast to a firm to operate efficiently and profitably. It is not certain if a firm can gain a competitive advantage when it means a firm will be internalize costs which it would otherwise not be concerned with.

There are several conceptual ways to gain a competitive advantage through sustainability which include a better corporate image or reputation (Bauer & Hann, 2010) which may lead to higher demand from the public or incorporating sustainability as a means of reducing future potential sustainability related costs. For instance, a firm which decides not to invest in customer safety but continued to sell unsafe products, might face higher uncertainty for future unexpected legal fees thus increasing its financial risk.

There is no single definition of corporate sustainability, but it is sometimes defined as a paradigm under which firms achieve a competitive advantage, through sustainable business operations, (Wilson, 2003). This competitive advantage is part of the rationale for investment funds whose goal it is to invest sustainably, and those funds can expect to achieve advantages for investing in firms that are more sustainable in form of lower cost of capital, (Attig, Ghoul, Guedhami, & Suh, 2013). They can therefore invest in projects which are sustainable whilst

also providing financial returns for their investors. This investment strategy is however not uncontroversial and the idea that firms should act sustainably was criticised in 1970 by economist Milton Friedman.

Friedman argued there is nothing inherently wrong with a person acting for the greater good or in this case sustainably. However, when a manager intends of contributing to a greater good despite it contradicting the shareholder´s goals of e.g. profit maximization, that is when the altruistic behaviour becomes unethical, (Friedman, 1970). Friedman´s statements were made in an era different from today´s and his stance is being challenged. As stated, all firms on the OMXS30 index provide annual sustainability information, see *Table 15* in appendix.

The marketplace is a tough place. Firms want to maximize profits and if a firm fails to make a profit long enough, that firm will not be able to survive. Firms are aware of the circumstances regarding their survivability, and the fierce competition has historically been a major source of innovation (Philippe Aghion et al., 2005). With survival and competition in mind, one might see the sustainability reporting and sustainability efforts in another light. Sustainability could also be a means of innovation and increased sustainability might be a medium for firms to both reduce future legal and judicial risk whilst potentially increase transparency for its stakeholders, (Cheng, Ioannou, & Serafeim, 2013). With this in mind, it might also be in the interest of the shareholders to increase its sustainability efforts. If this is the case, it could help explain the disruption of corporate sustainability and sustainability reporting that has shifted the large firm´s focus from a shareholder to a stakeholder perspective, (Freeman & McVea, Working paper).

1.2 Purpose

The purpose of this thesis is to evaluate if there exists a relationship between a firm´s sustainability efforts and both its riskiness and cost of capital. The thesis aims at researching the Swedish stock exchange. The results will be the foundation for both the discussions and the analysis´ on how ESG scores affect a firm´s riskiness and its cost of capital. There is previous literature on the subject but most research focuses on the American stock exchange, (Bauer & Hann, 2010), (Oikonomou & al, 2014), (Attig, Ghoul, Guedhami, & Suh, 2013). Thus, data on the relationship on the Swedish stock exchange will provide further insights on the subject. The thesis is limited to the Swedish stock exchange to isolate the effect to this market and not that of the e.g. European market or U.S market.

1.3 Research questions and expected results

The paper is divided in two hypotheses. The first one will measure if ESG has any effect on a firm´s cost of capital whilst the second will measure if ESG has any effect on a firm´s riskiness. Riskiness will be measured by the implied CDS spread a company faces in the market

Hypothesis I
$H1_0$: There is no relationship between a firm´s ESG score and its cost of capital.
$H1_A$: There is a significant relationship between a firm´s ESG score and its cost of capital.

From previous literature (El Ghoul & al, 2011), (Oikonomou & al, 2014) (Goss & Roberts, 2011), a firm´s ESG score should have a negative impact on its cost of capital. The results are intuitive from certain effects. The first and the most obvious is that when a firm increases its sustainability reporting and the details of it, the firm also increases both financial and non-information about itself to the market, (Cheng, Ioannou, & Serafeim, 2013). When the information increases, uncertainties decrease. Uncertainties have a negative effect on cost of capital since investors are assumed to be risk averse, (Berk & DeMarzo, 2013). The increased information aspect explained (Cheng, Ioannou, & Serafeim, 2013)´s findings when they concluded ESG scores increased a firm´s access to capital. The second effect ESG score could have on a firm´s cost of capital is the effect which (Bauer & Hann, 2010) discovered; that preventive ESG efforts could lead to less uncertainties of future cashflows and thus decrease the probability of sustainability related incidents. In conclusion should a firm with good ESG score hypothetically have a lower cost of capital.

Hypothesis II
$H2_0$: There is no relationship between a firm´s ESG score and its riskiness
$H2_A$: There is a statistical relationship between a firm´s ESG score and its riskiness

The hypothesis how a firm´s ESG score affects its riskiness is not as well studied as the cost of capital. Although there should theoretically be a direct relationship between risk and capital cost, at least according to classic finance theories such as CAPM, (Berk & DeMarzo, 2013), there could be differences between the results in capital cost and a firm´s implied riskiness. If one decides to follow the evidence provided by (Cheng, Ioannou, & Serafeim, 2013), that

there is a negative relationship between a firm´s ESG score and the riskiness that the market expects of the firm. It is however important to understand the difference between the true riskiness of the firm´s operations and the riskiness which the market assesses the firm. As the true riskiness is hard to determine and could face subjectivity, a proxy is used. The proxy is a firm´s implied CDS spread. More on this in part *4.1 random effects regression*

Just like in hypothesis I, when a firm increases the amounts of disclosed financial and non-financial information, the uncertainty that the investors face reduces and so should also the riskiness for the investors (Cheng, Ioannou, & Serafeim, 2013). This is the rationale so that firms which have higher ESG score should have lower riskiness.

2.0 Result of literature

This section discloses previous literature and its conclusions. This section also includes an exposition of glossaries which helps understand financial terms.

2.1 Glossary

Basis points (BP): 1/100th of a percentage. (Berk & DeMarzo, 2013).
Market risk: The market risk is also called systemic risk and is risk that an investor is unable to reduce through diversification, (Berk & DeMarzo, 2013). This is due to market risk affecting the market and is therefore affecting all entities within given market.
Credit risk: The risk of a bond which is due to the borrower is facing a possibility of default, (Berk & DeMarzo, 2013).
Cost of capital: The required return a project must yield, given its riskiness. A project or a firm with greater risk must also yield a higher return for its investors, (Berk & DeMarzo, 2013).
Agency cost: Costs which arise because of a principal and an agent working towards different goals. (Berk & DeMarzo, 2013)

2.2 Previous studies on corporate sustainability´s effect on cost of capital

There is plenty research on the topic. Whilst most of prior research focuses on the American market; this thesis will focus on solely the Swedish. These previous studies generally conclude having a high ESG score will lower the firm´s cost of capital. Not all studies have studied the effect ESG had on the bond pricing. Some studies measured the effect on equity

financing or bank financing, but the sign of conclusion remained equal, but with different amplitude i.e. better ESG rating lead to lower cost of capital.

How ESG affects cost of capital

There are previous literature which examine the relationship between a firm´s ESG score and its cost of capital. In 2011, Sadok El Ghoul, Omrane Guedhami, Chuck C.Y. Kwok, and Dev R. Mishra measured the effect corporate social responsibility had on a firm´s cost of equity. (El Ghoul & al, 2011) measured the relationships on the U.S. market and could conclude there was a significant relationship between a firm´s ESG score and the cost of equity with an effect of 200bp lower cost of equity for more sustainable firms. The group is not alone, and similar conclusions have been made by other researches. In 2014, Ioannis Oikonomou, Chris Brooks, and Stephen Pavelin measured the impact that different dimensions of ESG had on the pricing on corporate debt. Just like El Ghoul et al., this study focused on the U.S. market. (Oikonomou & al, 2014) could also conclude that there was a significant relationship between ESG scores and the pricing of corporate debt. The measured effect was up to 100bp less spread on their corporate bonds for firms with high sustainability ratings in contrast to firms with low rating.

The effect of ESG ratings have also been studied on how it affects a firm´s pricing of bank loans. In 2011, Alles Goss and Gordon S. Roberts studies the relationship between ESG ratings and the cost of bank debt. (Goss & Roberts, 2011) conducted its research on the U.S. equity market. The duo concluded that depending on how they structured their models, the estimated effect that better ESG ratings had on the price of bank debt was between 7 to 18bp lower for firms with higher ESG ratings.

ESG and the relationship to credit ratings

The relationship between ESG and credit ratings have research in the literature. Using credit ratings is a good tool to determine the riskiness of a firm.

Rob Bauer and Daniel Hann analyses environmental management how it affects bond investors. The thesis was initiated in 2010 and is still a working paper but the duo has concluded that environmental incidents tend to lead to higher cost of dept and lower credit ratings and that proactive environmental work tends to lead to lower cost of debt. The duo assessed the effects to that firms which put efforts in environmental proactive work mitigate legal, reputational, and regulatory risks that are associated with environmental incidents.

In 2013, Najah Attig, Sadok El Ghoul, Omrane Guedhami, and Jungwon Suh researched how corporate social responsibility affected credit ratings for firms. (Attig, Ghoul, Guedhami, & Suh, 2013) studied the relationship on the U.S. equity market and their research covered the period 1991 to 2010. The group observed 1585 unique firms over this period. The study provides evidence that there is a positive relationship between a firm´s ESG score and its credit ratings. A firm with good ESG score tends to have a better credit rating. The positive effect was attributed to information gains, where firms which provided more non-financial information indirectly provided information which was beneficial from the credit rating´s perspective and thus for the firm´s overall creditworthiness.

Corporate social responsibility and access to capital

In 2013 Beiting Cheng, Ioannis Ioannou and George Serafeim researched how corporate social responsibility affected a firm´s ability to get financing. (Cheng, Ioannou, & Serafeim, 2013) researched the effect from 2002 to 2009 and researched firms from different continents and in different industries. The trio concluded that increased corporate sustainability performance lead to lower capital constrains and in extension better access to capital. The effect was attributed to two main factors. The first factor being higher stakeholder engagement. The trio explained that better sustainability performance leads to a higher stakeholder engagement. When stakeholders are more engaged, the likelihood of the firm to undertake short term behaviour decreases and asymmetrical information likewise. Secondly, the trio concludes an increased sustainability performance leads to better transparency and increased accountability. This in extent also reduces asymmetrical information and mitigates risk for an investor.

3. Data

This section will provide information on how and when all data has been collected. It also includes brief short comings such as missing values and timing issues. There are three different types of data which will be separated in their respective group: interest, control and response variables.

Control variables

All control variables are collected primarily from Bloomberg Terminal per 2019-05-03. In cases where Bloomberg is unable to provide all firm´s values, the values will be taken from that firm´s 2018 annual report. In cases where 2018´s annual report is yet to be announced, the latest interim report is used to collect the most recent data and avoid timing issues. The

firms which data has been collected from annual or interim reports are shown in appendix, *Table 14*.

Not all firms have equity and debt which are applicable to determine its leverage ratio. Two firms, Swedish match AB and Lundin Petroleum AB have negative equity. (Avanza AB, 2019), (Avanza AB, 2019). The fact that their equity is negative renders their leverage ratios unreliable and unusable. These numbers have therefore been nullified but not been excluded to fulfil the full rank assumption of regressions, this is further discussed in part *6.1 Critical Discussion*

Response variables

There are two response variables in this study, weighted average cost of capital (WACC) and implied CDS spread (IMP_DEF). All data regarding the firm´s *WACC* is collected from Bloomberg Terminal per 2019-05-03 and there are no missing values. All data regarding the implied CDS default rate of firms are collected from Bloomberg Terminal per 2019-05-03. There are no missing values in this category either.

Interest variables

This study uses one interest variable and that is the Thomson Reuters ESG score. This interest variable is collected from Thomson Reuters Eikon per 2019-05-03. The datapoints are from 2017, 2018, and 2019. Since these values are calculated only once per year (Thomson Reuters, 2019) there is no timing issue with the data not being specified further than yearly basis. In cases where ESG data is totally missing, there is no viable substitute since there is no similar ESG score with the same methodology. Therefore, any firm without a Thomson Reuters ESG score will be excluded from the data set and likewise the study. In total there are 71 firms listed on any Swedish stock exchange which Thomson Reuters provide ESG data on. All firms have data from both 2019, 2018, and 2017 except 8 firms which are listed in *Table 12* in appendix.

All missing ESG values have been replaced by the latest previous, available values. This is done since the distribution of the missing values not being completely random. Why this is reasonable is further discussed in part *6.1 Critical discussion*.

4. Method

To evaluate if there exists a relationship between a firm's ESG score and its weighted average cost of capital and implied CDS spread, there will be a series of statistical tests. The results

are divided into two parts: descriptive and inferential statistics with the first part being descriptive statistics.

Initially there is a correlation matrix. The matrix describes the relationship between *all* variables i.e. interest, control, and response variables. The correlation matrix is a great tool to determine the correlations between variables and understanding these correlations helps the reader grasp the data. There is also a panel summary which describe the data both a cross-sectional and time component. The descriptive statistics is presented to help the reader easier grasp the inferential statistics.

For the inferential statistics, the focus is regression. Since there are two response variables, WACC and IMP_DEF, there will always be double tests, one for each variable. As the data is panel, the primarily focus will be on random effects regression. To determine that a random effects test is more efficient than a fixed effects regression (Greene, 2012), there is also a Hausman test. This is done in the robustness section and is an important tool to support the choice of random effects regression.

There is also a pooled OLS regression. A pooled OLS regression does not control for the data being panel data but rather pools all observations as if the test were cross-sectional. Therefore, this test could have lower efficiency than the random effects test, (Greene, 2012). Since there might in fact be a time component to the data, a variable for time trend will be included in both the pooled OLS models. There is also a test to determine if it is appropriate to include a time variable in the pooled OLS model. The time test is done for both pooled OLS regression, but not for the random effects regression since it is per construction accounted for in this model, (Greene, 2012)

4.1 Random effect regression

The main source of statistical inference will be random effects regression. The random effects regression is suitable to use when the individual effects are strictly uncorrelated with the regressors (Greene, 2012). The random effects model assumes that the regressors are uncorrelated and treats the constants as randomly distributed, cross-sectionally. The random effects model is efficient when dealing with dataset which contains relatively many individual observations (n), but with few time dependent data points (t), (Greene, 2012). This is the case for this data set and to make sure it is statistically viable there is a Hausman test in *section 5.3.1*. To make sure the Random effects regression does not suffer from endogeneity or omitted variable bias, there are several control variables included, which are taken from the

literature, (Bauer & Hann, 2010). The tests will result in two different measurements which both will describe how ESG relates to WACC and implied CDS spread.

$$WACC_{it}\ , IMP\_DEF_{it} = \beta_1 * ESG_i + \beta_2 * \ln\_size_{it} + \beta_3 * LEV_{it} + \beta_4 * PXTB_{it} + \beta_5 \text{CAP\_INTit} + \varphi_1 * BANK_{it} + u_t$$

Where: β_k is the regression coefficient of every individual random variable and the letter k represents nominal values for respective beta and:

i represents every individual firm and

t represents the time in which any data point is collected.

Interest variables

This thesis focuses on one single interest variable and it is the Thomson Reuters ESG rating.

ESG score- Thomson Reuters have one of the largest ESG information collections worldwide, (Thomson Reuters, 2019). The index processes publicly available data with the goal of providing timely and objective coverage. The index collects more than 400 ESG measurements which are individually standardized so that for the information to be comparable between different firms and industries. In most cases, the ESG score is updated yearly in line with the firms´ own ESG disclosure through e.g. sustainability reporting. The data is sourced in combination of human an algorithmic sourcing to achieve as accurate scoring as possible, (Thomson Reuters, 2019). The index has existed since 2003 and has since expanded to cover more than 7000 firms worldwide and of that, more than 1200 being European.

The Thomson Reuters ESG scores are designed to measure firm´s relative ESG performance and divides a firm´s performance into 10 categories. Thomson Reuters provides two different ESG scoring systems but only one measurement will be used in this thesis – the ESG score. The other scoring system is the Combined ESG scoring system. The combined ESG scoring system takes a firm´s ESG scoring and discounts it when a firm has had any recent sustainability controversies. The 400 company specific measures that are recorded are further grouped into 178 subsets of relevant groups. These 178 subsets are then grouped into 10 categories. These 10 categories are: Resource use, Emissions, Innovation, Management, Shareholders, CSR strategy, Workforce, Human Rights, Community, and Product Responsibility. Further description: see *Table 13* in the appendix.

The 10 categories are then weighted proportionally, meaning categories with more data gets a greater weight, and the result are three fundamental scores of ESG ratings: Environmental, Social and Corporate Governance. These three together is a firm´s Thomson Reuters ESG

score. The scores can take the values from 0 to 1 with 0 being the poorest performing company and 1 being the best, (Thomson Reuters, 2019).

Response variables

Implied CDS spread (IMP_DEF) **–** The implied credit default swap (CDS) spread is derived from measuring the spread an investor requires to invest in a company specific CDS with 5-year maturity, (Bloomberg terminal, 2019). If the likelihood of a firm defaulting is higher, then the implied CDS spread will increase. Since the probability of any firm in the sample to default is miniscule, the CDS spread is measured in basis points, (Bloomberg terminal, 2019). The Implied CDS is a measurement of risk that the market indirectly assesses to a firm. A firm with higher implied CDS spread is henceforth implied to have higher risk and the measurement therefore acts as an indicator of how risky a firm is.

WACC- WACC is a measurement of a firms weighted average cost of capital. WACC is a tool get a precise picture of the real cost of capital, since debt payments often are tax deductible. The WACC is collected from the Bloomberg Terminal and all estimates are from the latest annual or interim report the firms have reported, (Bloomberg terminal, 2019). If a firm has no preferred equity and no debt, its WACC will equal the firm´s cost of equity, which is the required return an investor would require from the firm to undertake the financial risk of investing in the firm. (Berk & DeMarzo, 2013)

$$WACC = \left[KD * \left(\frac{TD}{V}\right)\right] + \left[KP * \left(\frac{P}{V}\right)\right] + \left[KE * \left(\frac{E}{V}\right)\right]$$

Where:

KD= cost of debt

TD= total debt

V =total capital

KP=cost of preferred equity

P= preferred equity

KE= cost of equity

E= equity capital

Source: Bloomberg terminal, (2019)

Control variables

Multiple control variables are included in all regressions to make sure no regression model suffer from endogeneity. The control variables are collected from the literature, (Bauer & Hann, 2010) and (Oikonomou & al, 2014).

Ln_size- Size is the number of total assets on a firm´s balance sheet. Size is measured in millions SEK which is later translated into its natural logarithmic form. All firm´s values are in SEK, so no exchange rates must be applied. Previous literature has found a significant coefficient telling larger firms should have a higher lower cost of capital and be less risky. (Oikonomou & al, 2014)

$$\ln\_size = \ln(total\ assets)$$

Capital intensity- The value is calculated by subtracting the number of current assets from the total assets. The numbers are normalized and can take the values from 0 to 1. This number implies how much of a firm´s assets are fixed and/or illiquid. Firms whom have low margins of current assets could potentially find it harder to find liquidity in case of an urgent short coming of liquidity and have a harder time to repay its liabilities than a firm which is not. Firms which all their assets are financial, are not applicable to such a measurement and all therefore their values are assumed to be 0. Both total and current assets are collected from every individual firm´s latest report, either being latest annual or interim report.

$$capital\ intensity = 1 - \frac{current\ assets}{total\ assets}$$

Leverage ratio- Leverage is defined as an individual firm´s total liabilities divided by its equity. The measurement shows whether a firm is in large debt or if it has financed its operation by equity from its shareholders or retained earnings, (Berk & DeMarzo, 2013). Since debt have a senior claim to cashflow, a large leverage could render a firm´s equity riskier, hence increasing its cost of equity.

$$leverage\ ratio = \frac{\boldsymbol{total\ liabilities}}{\boldsymbol{equity\ of\ firm}}.$$

BANK - This is a dummy variable to make sure there is no omitted variable bias in the *leverage* control variable. This variable is necessary since banks tend to have a different, more leveraged capital structure than other firms, see *Table 2 Correlation matrix*. The BANK variable is derived from the Global Industry Classification Standard (GICS), an industry index made by Morgan Stanley in collaboration with Standard & Poor, (GICS Global Industry Classification Standard, 2019). The industry assesses industry information worldwide and classifies firms according to their main business activity, (Bloomberg terminal, 2019)

The index classifies firms into 24 different industries, (GICS Global Industry Classification Standard, 2019). All firms which have banking as their main business will obtain a BANK score of 1 whilst all other firms will have their BANK score 0.

Price to book-ratio (PXTB)- Also called market to book-ratio. The price to book-ratio is defined as the valuation the market puts on a firm´s equity divided by the value of equity the firm accounts in its books, (Berk & DeMarzo, 2013). The ratio can depend on within which industry a firm is operating. Firms with large off-balance sheet assets tend to have a higher *PXTB*-ratio since the value of the assets still are accounted for by the market but not the company itself. The ratio could also have explanatory power for a firm´s riskiness and WACC since a firm which is the subject for low PXTB-ratio, has the market valuing its equity lower than the firm value it itself. This could be a sign of financial distress.

$$Price\ to\ book - ratio = \frac{market\ value\ of\ equity}{book\ value\ of\ equity}$$

5.0 Empirical Results

This section provides the results of the thesis. The section is divided into two parts, starting with descriptive statistics. This is followed by inferential statistics which is where all tests are displayed.

5.1 Descriptive Statistics

This part will help the reader understand the underlying data. This is done by a panel summary and a correlation matrix.

Table 1 *Panel summary*

Variable			Mean	Std. Dev.	Min	Max	Observations
WACC	overall		7.537905%	2.826566%	1.6777%	15.98241%	N = 213
	between			1.56556%	6.469496%	9.334985%	n = 71
	within			2.519481%	.3257467%	14.18533%	T = 3
IMP_DEF	overall		62.60563bp	25.455bp	16 bp	157bp	N = 213
	between			6.962777bp	54.64789 bp	67.57746bp	n = 71
	within			24.80896bp	14.02817bp	154.0141bp	T = 3
ESG	overall		59.47549	16.80276bp	19.05864	86.19053	N = 213
	between			1.141468	58.48711	60.72484	n = 71
	within			16.77677	19.44162	87.17891	T = 3
CAP_INT	overall		.6453453	.2435439	.0103642	1	N = 213
	between			.0008695	.6444408	.646175	n = 71
	within			.2435429	.0111028	1	T = 3
ln_size	overall		10.39276	1.656269	5.490177	14.95793	N = 213
	between			.0612743	10.3256	10.44562	n = 71
	within			1.65551	5.557335	14.96823	T = 3
LEV	overall		3.266728	3.837586	1	22.596	N = 213
	between			.1294576	3.140517	3.399204	n = 71
	within			3.836123	.867524	22.60226	T = 3
PXTB	overall		2.839771	2.533508	.5000365	21.80897	N = 213
	between			.1660484	2.688211	3.017258	n = 71
	within			2.52986	.32255	21.63149	T = 3
BANK_FIN	overall		.0422535	.2016409	0	1	N = 213
	between			0	.0422535	.0422535	n = 71
	within			.2016409	0	1	T = 3

The panel summary sums all variables and presents their values. Since the data is panel data, there is both a cross-sectional and a time-series component present.

The Table 1 *Panel Summary* shows all the variables and presents them descriptively. There are no underlying tests present, the data is only presented. The mean describes the average of all observations. The standard deviation (Std.Dev) is split into 3 parts; an overall, a between, and a within component. These different measurements describe how the data differs between different firms, within different firms (since the data is also time-series data), and these two measurements combined effect. The min shows the smallest value the data take, the max shows the largest. Observations is divided into 3 parts which tells the total number of observations and how the observations are divided into different firms and in different time. N is the total number of observations, T is the time component and n is the total number of firms.

Table 2 *Correlation matrix*

Variables	WACC	IMP_DEF	ESG	CAP_INT	ln_size	LEV	PXTB	BANK
WACC	1.0000							
IMP_DEF	-0.1451	1.0000						
ESG	-0.1142	0.0720	1.0000					
CAP_INT	-0.1788	0.0931	0.0513	1.0000				
ln_size	-0.1624	-0.2625	0.4544	-0.1854	1.0000			
LEV	-0.4477	0.0134	0.2583	-0.3918	0.5473	1.0000		
PXTB	0.2787	-0.1490	-0.2380	-0.1761	-0.4223	-0.1016	1.0000	
BANK	-0.3876	-0.1272	0.2024	-0.4113	0.5620	0.93 10	-0.1177	1.0000

The correlation matrix shows all correlations between interest variables, control variables and response variables.

Since the data is both time series and cross sectional, one should be careful to draw any conclusions from this simple correlation effect. The matrix is mere an instrument to further understand the data. There are correlations which are important to notice and understanding them will help comprehend the results.

LEV & BANK: The correlation between LEV and BANK is important to notice since increased leverage leads to higher equity beta of a firm (Berk & DeMarzo, 2013) and therefore increases the riskiness of the equity. This in combination with banks having a negative correlation with WACC results in BANK being an important variable to include into the regression to reduce potential omitted variable bias in the LEV variable so that the effect of BANK is not included in the LEV variable.

WACC & LEV: Of all the correlations with the WACC, the leverage (LEV) is the strongest. With a correlation coefficient of -0.4477, one must understand that the higher a firm has

leveraged its equity, the lower that firm´s WACC is expected to be. This is important to know when interpreting the results in part *6.2 Discussion Hypothesis I*

5.2 Inferential statistics

This part is where the hypothesis´ are tested. The tests are done twice. One for each interest variable and its hypothesis.

5.2.1 Hypothesis I – ESG score has no effect on firm´s WACC

In this part, Hypothesis I is tested by running a random effects regression. The results from the regression will be divided into two parts. The first part is a descriptive part of the wald chi^2 output, which explains the model over all. This part also shows the number of cross-sectional and time dependent observations. The second part is where the coefficients are tested, which renders a specific z and thus a p-value for each coefficient.

Table 3 *Random-effects GLS regression output*

Group variable: t		Number of obs	213
		Number of groups	3
R^2		Obs per group:	
within	0.4756	min	71
between	0.9705	avg	71.0
overall	0.4117	max	71
Wald chi2(6)	144.16	Prob > chi2	0.0000
corr(u_i, X)	0 (assumed)	theta	0

WACC	Coef.	Std. Err.	z	P>z	[95% Conf. Interval]	
ESG	.0065476	.0103993	0.63	0.529	[-.0138345	.0269298]
CAP_INT	-3.692827***	.6178943	5.98	0.000	[-4.903878	-2.481777]
ln_size	.4205347***	.1323824	3.18	0.001	[.16107	.6799994]
LEV	-.5569979***	.1103534	5.05	0.000	[-.7732867	-.3407092]
PXTB	.2864056***	.0688818	4.16	0.000	[.1513997	.4214115]
BANK	.699559	2.138846	0.33	0.744	[-3.492502	4.89162]
_cons	5.773708***	1.437253	4.02	0.000	[2.956744	8.590672]
sigma_u			0			
sigma_e			1.855498			

rho	0 (fraction of variance due to u i)

The results from the tables above describe the output from the random effects regression and shows how the independent variables affect the interest variable i.e. the weighted average cost of capital (WACC).

* Significant at 10% level

** significant at 5% level

*** significant at 1% level

The Table 3 *Random-effects GLS regression output* shows the Wald chi^2 value of the test is 144.16. This tells us that random effects regression is an appropriate model to estimate the effects that is tested. The model has a within R^2 of 0.4756, a between R^2 of 0.9705, and an overall R^2 of 0.4117. The R^2 shows how good the model is at predicting the values of the independent variables by comparing the expected values to the standard errors.

The random effects regression shows that the ESG variable is insignificant. With a z-value of 0.63 and a p-value of 0.529, there are no evidence that ESG scores have any effect on a firm´s WACC. At least not in this sample and sample space.

Whilst ESG is not significant, other variables show significance on the WACC. The capital intensity (CAP_INT) has a negative coefficient of -3.692827***. This implies that a firm which have proportionally more fixed assets would also tend to have a lower WACC. The size which is measured in its natural logarithmic form to prevent skewness in the data (Bauer & Hann, 2010) also has a significant effect on the firm´s WACC. Ln_size have a coefficient of .4205347***. This tells that larger firms tend to have a higher cost of capital than smaller firms. The effect cannot be interpreted linearly since the size variable is measured in logarithmic form. The model also tells that leverage (LEV) has a negative impact on a firm´s WACC. The variable has a coefficient of -.5569979***. PXTB which measures how much the market values a firm´s equity divided by how the firm´s books value the equity has a positive coefficient on a firm´s WACC. With a coefficient of .2864056*** the conclusion can be drawn that firms which the market values its equity higher than the firm´s books tend to have higher cost of capital. BANK have a coefficient of .699559 but this variable is insignificant at all relevant significance levels.

In conclusion, there are no evidence from the random effects model that ESG score has any significant effect on a firms WACC.

5.2.2 Hypothesis II - ESG score has no effect on firm´s implied default spread

In this part, hypothesis II is tested by a random effects regression model.

Table 4 *Random-effects GLS regression output*

Group variable: t		Number of obs	213
		Number of groups	3
R^2		Obs per group:	
within	0.3750	min	71
between	0.7224	avg	71.0
overall	0.3346	max	71
Wald chi2(6)	103.57	Prob > chi2	0.0000
corr(u_i, X)	0 (assumed)	theta	0

IMP_DEF	Coef.	Std. Err.	z	P>z	[95% Conf. Interval]
ESG	.2368187**	.0996012	2.38	0.017	[.0416039 .4320334]
CAP_INT	-2.681669	5.918019	0.45	0.650	[-14.28077 8.917434]
ln_sizE	-8.85822***	1.267921	6.99	0.000	[-11.3433 -6.37314]
LEV	6.83941***	1.056934	6.47	0.000	[4.767857 8.910963]
PXTB	-3.571731***	.659731	5.41	0.000	[-4.86478 -2.278682]
BANK	-107.1633***	20.48527	5.23	0.000	[-147.3137 -67.01288]
_cons	134.3767***	13.76561	9.76	0.000	[107.3966 161.3568]

sigma_u	0
sigma_e	19.985718
rho	0 (fraction of variance due to u i)

The results from the random effects regression are shown in the three tables above. Each table with its specific information. The tables show how the independent variables affects the interest variable, the implied CDS spread. The implied CDS spread is measured in basis points (bp).

* Significant at 10% level

** significant at 5% level

*** significant at 1% level

The Table 4 *Random-effects GLS regression output* shows that the model has a Wald-chi^2 value of 103.57*** which tells us the model is significant. When this number is high, it is more relevant to use this model over a fixed effect model, see *part 5.3.1 Hausmantest.* for further explanation. The model has a within R^2 value of 0.3750, a between R^2 value of 0.7224

and an overall R^2 value of 0.3346. These R^2 values hint that the random effects model has some forecasting ability.

The random effects model on IMP_DEF has a coefficient on ESG of .2368187**, which is significant at 5% significance level. The significant coefficient implies it can be concluded that higher ESG score will lead to higher implied CDS spread, i.e. a firm with good ESG score will have a higher probability of default. This conclusion can be drawn with the risk for type I error at 0.05 or 5%.

There are more significant variables that affects the IMP_DEF. The capital intensity (CAP_INT) is insignificant at all relevant significance levels. The total assets measured in its logarithmic form (ln_size) has a coefficient of -8.85822***. This implies that size has a negative effect on the implied CDS spread i.e. the bigger a firm is, the less risk the market perceives the firm to default. The leverage (LEV) has a positive coefficient of 6.83941***. The coefficient implies that the higher the firm has leveraged its equity, the riskier the market perceive the firm to be. Furthermore, price to book-ratio (PXTB) has a negative effect on the IMP_DEF. The coefficient is -3.571731***. The BANK dummy variable has a major effect on the implied CDS spread. Firms which are banks have a dummy coefficient i.e. an intercept change of -107.1633***. This effect means that firms that have banking as their main business operation are expected to have 107.1633 basis points lower spread on their 5-year CDS than firms which are not.

In conclusion, a firm´s ESG score have a positive effect on its implied CDS spread. This effect is significant at 5% significance level.

5.3 Robustness tests

The following part will contain robustness tests. The robustness parts are crucial to make sure the results from previous tests are reliable. There are two more regressions, but these regressions will be pooled OLS regression model. This is done to get a more nuanced picture of the relationships between the ESG score and the response variables.
Since the data is collected over time, there is also a test for a time trend, both in the WACC and in the implied CDS spread (IMP_DEF). The time trend component is only included in the OLS regression, but not the random effects model, since it is already accounted for in that type of model. There is also a test for making sure random effects test is more appropriate than a fixed effects test, a Hausman test, (Greene, 2012).

5.3.1 Hausmantest

To determine weather to use a random effect or a fixed effects model, a Hausman test is conducted, (Greene, 2012). The Hausman test tests which of the two tests that are the most efficient, given the sample and sample space. The Hausman test uses a chi^2 distribution with 1 degree of freedom. The null hypothesis of a Hausman test is to use the random effect regression and discard the fixed effect. The alternative hypothesis of a Hausman test states the fixed effects regression is more appropriate and should be used instead of the random effect. Generally, if there is a sample with large n and small t, then the random effect is more efficient. (Greene, 2012)

5.3.1.1 Hausman test for WACC

This part includes a Hausman test to test if random effects regression or fixed effects regression is more efficient for estimating the underlying data on the WACC.

Table 5 *Hausman test WACC*

Coefficients ----				
WACC	(b)	(B)	(b-B)	sqrt(diag(V_b-V_B))
	re	fe	Difference	S.E
ESG	.0065476	.0013093	.0052383	.0055536
CAP_INT	-3.692827	-3.705935	.0131082	.3317199
ln_size	.4205347	.3836783	.0368564	.0709532
LEV	-.5569979	-.4834564	-.0735415	.0586102
PXTB	.2864056	.2463601	.0400455	.0367161
BANK	.699559	-.4117335	1.111292	1.140878

Where:

b = consistent under Ho and Ha; obtained from xtreg

B =inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(6) = (b-B)'[(V_b-V_B)^(-1)](b-B) = 3.38

Prob>chi2 = 0.7594

The Table 5 *Hausman test WACC* shows that the prob>chi^2 is 0.7594 there is no evidence that the null hypothesis for the Hausman test can be rejected. Therefore, the most efficient test to use for testing the panel data between fixed and random effects is the random effects model. This is the basis for using the random effects model.

5.3.1.2 Hausman test for IMP_DEF

This part includes a Hausman test to test if random effects regression or fixed effects regression is more efficient for estimating the underlying data on the IMP_DEF.

Table 6 *Hausman test IMP_DEF*

Coefficients ----				
IMP_DEF	(b)	(B)	(b-B)	sqrt(diag(V_b-V_B))
	re	fe	Difference	S.E
ESG	.2368187	.2103843	.0264344	.0308552
CAP_INT	-2.681669	-2.624395	-.0572739	1.869477
ln_size	-8.85822	-9.060421	.2022015	.3981181
LEV	6.83941	7.283478	-.444068	.3206434
PXTB	-3.571731	-3.716682	.1449513	.202929
BANK	-107.1633	-113.8341	6.670807	6.31811

Where:

b = consistent under Ho and Ha; obtained from xtreg

B =inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(6) = (b-B)'[(V_b-V_B)^(-1)](b-B) = 3.27

Prob>chi2 = 0.7749

From the Table 6 *Hausman test IMP_DEF* the results show that there is no evidence for the null hypothesis for this Hausman test can be rejected with Prob>chi2 of 0.7749. Which is insignificant at all relevant significance levels. The most appropriate model to use for testing the IMP_DEF is the random effects model.

5.3.2 Pooled OLS: Hypothesis I

In this part Hypothesis I *(There is no relationship between a firm´s ESG score and its cost of capital.)* will be tested by running a pooled OLS regression. The results from the regression will be divided into two parts. The first part is a descriptive part of the summary output, which explains the model over all. This part also shows the number of observations and the forecast ability of the tested model. The second part is the ANOVA part which provides the ANOVA results and explains all individual regressors, their coefficients, and their p-values. All output is shown in Table 7 *Pooled OLS for WACC.*

Table 7 *Pooled OLS for WACC*

Summary output	
Number of obs	213
F(7, 205)	36.51***
Prob > F	0.0000
R-squared	0.5549
Adj R-squared	0.5397
Root MSE	1.9177

Anova			
Source	SS	df	MS
Model	939.890547	7	134.270078
Residual	753.878361	205	3.67745542
Tota	l 1693.76891	212	7.98947598

WACC	**Coef.**	**Std. Err.**	**t**	**P>t**	**[95% Conf. Interval]**
ESG	.0018897	.0090855	0.21	0.835	[-.0160232 .0198027]
CAP_INT	-3.692094***	.5387558	-6.85	0.000	[-4.754307 -2.629881]
LN_SIZE	.3861347***	.1155048	3.34	0.001	[.158405 .6138644]
LEV	-.484282***	.0966353	-5.01	0.000	[-.6748084 -.2937556]
PXTB	.256532***	.0601721	4.26	0.000	[.1378965 .3751676]
BANK	-.3952888	1.869773	-0.21	0.833	[-4.08174 3.291162]
t	1.31692***	.1621458	8.12	0.000	[.9972331 1.636608]
_cons	-2651.244***	327.1477	-8.10	0.000	[-3296.249 -2006.238]

The results from the pooled OLS regressions shows how the independent variables affect the interest variable, the weighted average cost of capital (WACC)

* Significant at 10% level

** significant at 5% leven

*** significant at 1% level

The Table 7 *Pooled OLS for WACC* shows that the f-value which is a measurement for the combined robustness of the regression is 36.51*** which renders a p-value of 0.0000. This hints the model is highly significant. The model has a R-squared of 0.5549 which implies the model has moderate forecasting power. The adjusted R^2 is a bit lower than the unadjusted R-squared. With an adjusted R-squared of 0.5397 the model hints it does not suffer from over fitting which could become a problem if too many regressors are included in the model.

The pooled OLS regression shows that ESG is highly insignificant. With a p-value of only 0.835, there can be no conclusions, at any relevant significance level that ESG score would have any effect on a firm´s weighted average cost of capital (WACC). At least not in this sample and this sample space.

Whilst ESG is not significant, other variables have great significance of a firm´s weighted average cost of capital. The capital intensity (CAP_INT) has a negative coefficient of -3.692094*** on WACC. This tells us that a firm which have proportionally more fixed assets would also tend to have a higher WACC. The size which is measured in its natural logarithmic form to prevent skewness in the data (Bauer & Hann, 2010) also has a significant effect on the firm´s WACC. Ln_size have a coefficient of .3861347***. This implies that firms with larger balance sheets have higher cost of capital than firms with smaller. The effect cannot be interpreted linearly since the size variable is measured in logarithmic form. The model also tells leverage (LEV) has a negative impact on a firm´s WACC. The variable has a coefficient of -.484282***. The negative coefficient implies that firms which are more leveraged have lower cost of capital. Price to book-ratio (PXTB) which measures how much the market values a firm´s equity divided by how the firm´s books value the equity has a positive coefficient on a firm´s WACC. With a coefficient of 0.256532*** the conclusion can be drawn that firms which the market values its equity higher than the firm´s books tend to have higher cost of capital. BANK have a coefficient of -.3952888 but is insignificant. This implies that the fact a firm being a bank does not affect its cost of capital and that these effects must be attributed to other factors. Lastly the variable time (t) influences the firms´ cost of capital. With a coefficient of 1.31692*** it implies that overall the firms´ WACC has increased by approximately 1.3% annually. This effect can be due to external factors such as macroeconomic variables which are not firm specific and affects the whole economy but will not be discussed further than this. The time variable is tested separately to verify its relevance in part *5.4.3 Time tests*.

In conclusion, there are no evidence from the pooled OLS regression that ESG score has any significant effect on a firms WACC, therefore the null hypothesis cannot be rejected with evidence from this model.

5.3.3 Pooled OLS: Hypothesis II

In this section hypothesis II, *(There is no relationship between a firm´s ESG score and implied CDS spread.)* is tested. This part will test the hypothesis using a Pooled OLS

regression on the implied CDS spread (imp_def) variable. All output is shown in Table 8 *Pooled OLS for imp_def.*

Table 8 *Pooled OLS for imp_def*

Summary output	
Number of obs	213
F(7, 205)	19.64***
Prob > F	0.0000
R-squared	0.4014
Adj R-squared	0.3809
Root MSE	20.028

Anova			
Source	SS	df	MS
Model	55134.5092	7	7876.35845
Residual	82232.3641	205	401.133483
Total	137366.873	212	647.956949

IMP_DEF	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]
ESG	.2081717**	.0948894	2.19	0.029	[.0210874 .3952561]
CAP_INT	-2.67716	5.626815	-0.48	0.635	[-13.77101 8.416689]
ln_size	-9.069785***	1.206343	-7.52	0.000	[-11.44822 -6.691355]
LEV	7.286625***	1.009268	7.22	0.000	[5.29675 9.276501]
PXTB	-3.755458***	.6284433	-5.98	0.000	[-4.994499 -2.516417]
BANK	-113.8968***	19.52808	-5.83	0.000	[-152.3984 -75.39512]
t	8.099279***	1.693466	4.78	0.000	[4.760435 11.43812]
_cons	-16206.72***	3416.761	-4.74	0.000	[-22943.22 -9470.225]

The results from the pooled OLS regressions shows how the independent variables affect the interest variable implied CDS spread (IMP_DEF) which is measured in basis points(bp).

* Significant at 10% level

** significant at 5% leven

*** significant at 1% level

The Table 8 *Pooled OLS for imp_def* shows the values for the pooled OLS on the implied CDS spread(imp_def). The table shows that the regression model is based on 213

observations spanning over 3 years. The model has a f-value of 19.64***. The model has a R^2 value of 0.4014 and an adjusted R^2 value of 0.3809. These metrics combined hints that the model has moderate forecasting power and it does not suffer from over fitting since its adjusted R-squared is only slightly lower than its unadjusted value.

This model shows that ESG score has a coefficient of .2081717. This positive coefficient implies that it can be concluded that higher ESG score will lead to higher implied CDS spread, i.e. a firm with good ESG score will have a higher probability of default. This conclusion can be drawn and the risk for type I error being 0.05 or 5%

Furthermore, there are more significant variables which all affect the implied CDS spread (IMP_DEF). Capital intensity (CAP_INT) has an insignificant effect on IMP_DEF, with a p-value of 0.635. The size measured in its natural logarithmic form (LN_SIZE) has a negative effect on IMP_DEF with a coefficient of -9.069785***. This is intuitive as larger firms is often more financially sound and having a lower risk to default, (Bauer & Hann, 2010). Leverage also have a significant effect on IMP_DEF. With a coefficient of 7.286625***, the regression model hints that increased leverage will lead to a firm having a larger probability to default. For each time the leverage multiplies, the IMP_DEF will increase by 7.28662 bp. Price to book (PXTB) has a negative coefficient on the IMP_DEF. With a coefficient of -3.755458***, the IMP_DEF will decrease if the price to book ratio increases. This may be due to the market valuing a firm's equity better in case of default and thus if the market values the firm's equity higher, the firm is seen less likely to default.
For firms that are banks are expected to have a large advantage relative to not being a bank. The dummy variable has a coefficient of -113.8968***, implying a firm which is a bank will, ceteris paribus, have 113.8968 bp lower spread on its credit default swaps.

In conclusion, there are evidence that ESG score have a significant and positive effect on a firm´s implied CDS spread. This is basis for rejecting the second null hypothesis.

5.3.4 Time tests

This part is incorporated to test whether it is relevant to include a time variable in the pooled OLS regressions. If there is evidence that there exists a time trend present in the data, it has to be included in the Pooled OLS regression to avoid omitted variable bias. The output from the time test for WACC is shown in Table 9 *Time test WACC.*

Table 9 *Time test WACC*

Summary output					
Number of obs			213		
F(1, 211)			43.86		
Prob > F			0.0000		
R-squared			0.1721		
Adj R-squared			0.1682		
Root MSE			2.578		
Anova					
Source	**SS**		**df**	**MS**	
Model	291.491566		1	291.491566	
Residual	1402.27734		211	6.64586418	
Total	1693.76891		212	7.98947598	
WACC	**Coef.**	**Std. Err.**	**t**	**P>t**	**[95% Conf. Interval]**
T	1.432745***	.2163374	6.62	0.000	[1.006285 1.859204]
_cons	-2883.741***	436.5689	-6.61	0.000	[-3744.336 -2023.14]

Where:

SS – sum of squares

DF – Degrees of freedom

MS – Mean of squares

* Significant at 10% level

** significant at 5% level

*** significant at 1% level

The results for testing if there exist a trend in all the firms´ WACC are shown in Table 9 *Time test WACC*. There exists a time trend (t) and this will skew the results if this variable is not included. When this variable is included, it explains factors which have affected all firms the tested years. Since the trend is upwards sloping with a coefficient of 1.432745***, it can be concluded that the WACC has increased the recent years. Since there exists a trend in the data, the time term must be included in the pooled OLS regressions to test the effect on the WACC, or the model will suffer from omitted variable bias. The conclusion is: in the sample space, each year passing, the firms have seen their WACC increase by an estimation of 1.432745%. It is appropriate to include a time variable in the Pooled OLS regression on WACC.

Table 10 *Time test imp_def*

Summary output						
Number of obs			213			
F(1, 211)			9.53			
Prob > F			0.0023			
R-squared			0.0432			
Adj R-squared			0.0387			
Root MSE			24.958			
Anova						
Source	**SS**		**df**	**MS**		
Model	5934.67606		1	5934.67606		
Residual	131432.197		211	622.901408		
Total	137366.873		212	647.956949		
IMP_DEF	**Coef.**	**Std. Err.**	**t**	**P>t**	**[95% Conf. Interval]**	
T	6.464789***	2.094428	3.09	0.002	[2.336104	10.59347]
_cons	-12983.34***	4226.557	-3.07	0.002	[-21315.02	-4651.651]

Where:

SS – sum of squares

DF – Degrees of freedom

MS – Mean of squares

* Significant at 10% level

** significant at 5% level

*** significant at 1% level

The Table 10 *Time test imp_def* shows that the implied CDS spread has increased the three recent years for all the firms in the tested data. With a coefficient of 6.464789***. This implies it can be concluded with a chance of a type I error of only 0.002 that there has been an increasing spread for the implied CDS. These results imply that the riskiness of all firms in aggregation have increased the recent years. This can be due to unknown macro factors or anything of its sort. The fact that the implied CDS spread have increased the recent years hints that the marketplace has become riskier. And it is appropriate to include a time variable in the Pooled OLS regression on imp_def.

6.0 Discussion

This section is where the discussion is due. There will be four types of discussions- a critical discussion, a general, and a specific discussion regarding each of the hypothesis´. The critical discussion will have its focus on the shortcomings of the results and the structure of the thesis.

6.1 Critical discussion

Since there are missing data in some of the variables, especially data from 2018 and 2017, there are some assumptions that had to be made. This is done to be able to execute the regressions and to satisfy the full rank assumptions of the regressions. Without the full rank assumption, there can be no regressions made. Therefore, it is crucial to determine how to handle the missing values and in a case of missing values one can choose between some possibilities. Either the observation can be fully dismissed, and the regression is done without its participation. This can be wise to consider if there are many observations or the missing data is completely random, (Allison, 2001). But in cases where there are fewer observations, each observation has an increasing importance for the accuracy of the results. To dismiss an observation could be wise if the data is completely random. But in cases where the data is not completely random, it is better to include the missing values by predicting it, (Allison, 2001). In cases with missing ESG scores, all data which were missing, which summed to 8 companies with either one or two missing values. All data which was missing was replaced by the most recent available data from the missing date. This makes sense since the correlation between the recent years have been very high. The correlation between the ESG scores the recent years are shown in *Table 11* in the appendix and is above 0.9 for all time differences.

Regarding the missing data concerning leverage, there are two cases where assumptions had to be made. This regards Lundin Petroleum AB and Swedish Match AB. Both firms have negative equity and their leverage therefore becomes negative. To have negative leverage would essentially mean a firm either is bankrupt since equity must be positive or that the firm has negative liabilities. To make sure the leverage measurement was not corrupted by these outliers and their unreliable observations, their leverage observations was assumed to be 0. These replacements were done with a few alternatives in mind. Either the values could be 0, it could be 1 or they could fully be dismissed. Since there are relatively few observations in the dataset, to exclude observations which otherwise were correct, would not increase the accuracy of the testing. So, the decision is to count the values as 0 or 1, both equally arbitrary. But since 0 is closer to the actual negative values, it makes more sense to use it rather than 1.

There is also an issue regarding timing of the data points. The data which regards the previous years are measured per the dates being exactly one and two years back from the data which 2019´s data regards. Therefore, the data is intended to be of 2019-05-03, 2018-05-03, and 2017-05-03. Since no firm had their annual or interim reports published on any on these dates; the data is collected for the dates which is the closest in time. This resulted in the data being captured for the dates 2018-06-30 and 2017-06-30. However, this should not be a problem since the interest variable data, the Thomson Reuter´s ESG score is measured and updated annually so this uneven timing should not corrupt the data. For the values presented for 2019, no values suffer from timing issues and all data are collected per the same date.

There is also an issue regarding the sample size for both hypothesis´. The paper is intended to measure how the ESG score affects a firm´s WACC and implied CDS spread. To make the hypothesis´ comparable to previous literature and especially international literature that use the same methodology, (Bauer & Hann, 2010), the most relevant measure of ESG score must be one which is internationally recognised. The Thomson Reuters ESG score is there for used as ESG measure. This paper uses all 71 Swedish firms which have a reported Thomson Reuters ESG score and uses all observations for 2019, 2018, and 2017.

Lastly, there are concerns regarding the Thomson Reuters ESG score. The score itself is amongst the world´s leading ESG scores with over 8000+ firms which are evaluated, (Thomson Reuters, 2019). Although the score itself has a thorough methodology and a wide coverage, there are concerns with ESG scores overall and its usage as a metric. To determine each firm´s ESG score, Thomson Reuters must use self-reported data which the firms themselves publish, (Thomson Reuters, 2019). There could be real incentives for firms to some extent enhance their ESG reporting. Especially since previous literature stipulate that increased ESG scores lead to better access to finance, (Cheng, Ioannou, & Serafeim, 2013), increased credit ratings, (Attig, Ghoul, Guedhami, & Suh, 2013), and lowered cost of capital, (El Ghoul & al, 2011). This is certainly troubling since the scores themselves could be misrepresentative and in extension skew the results for this thesis. However, no matter how troubling this might be, there is no evidence to suggest that one or another firm is more inclined to cheat or manipulate their ESG scores *more* than anyone else. Therefore, if there is manipulation, it can not be assumed to be not random nor systematic in a way that would skew the results.

6.2 Discussion Hypothesis I

The first hypothesis regards if there are any statistical evidence that Thomson Reuters ESG score has any effect on a firms WACC. The findings from both tests suggests that there is no evidence at any significance level (1%, 5% or 10%) that a firm´s ESG score should have any effect on its WACC. This is true for both the pooled OLS regression and the random effects regression that are used to test the WACC. In neither of the regressions, the ESG score had any significant effect. This contrasts the findings of previous literature, (El Ghoul & al, 2011), (Goss & Roberts, 2011), (Oikonomou & al, 2014).

The results could have been different, had the number of observations increased and thus the standard error decreased to receive a greater t- and z-value for the different regressions. This effect should however not be overestimated. One must consider that the reported p-values are 0.529 for the random effects regression and 0.835 for the pooled OLS regression, so for these p-values to decrease to a maximum of 0.10 or preferably 0.05 or even 0.01, there would have to be a great increase of observations, which just is not present on the used sample space. Even if the results would remain equal but the standard error decrease, and the coefficient gets significance, the estimated coefficient is still .0018897 which is interpreted as: if the ESG score increased by 1, then the firm´s WACC would increase by 0.0018897% or 0.18bp. To put this in perspective, the difference between performing the worst and best is 99 points, so the absolute maximum estimated effect would be 0.187% or 18bp, for calculation see *Equation I* in appendix. This is a moderate effect since the WACC usually being measured in percentage but can be compared to previous literature: 100bp lower spread on corporate bonds, (El Ghoul & al, 2011) and 7-18 bp lower interest rate for bank loans, (Goss & Roberts, 2011).

6.3 Hypothesis II

The second hypothesis regarding how a firm´s Thomson Reuters ESG score affects its implied CDS spread. In both the random effects and the pooled OLS regression, the ESG score has a significant effect on the implied CDS spread. For the random effects, the coefficient is .2368187**, which is significant at 5% significance level and for the pooled OLS the coefficient is .2081717**, also significant at 5%. The coefficients are not equal but similar. The result stand in contrast to those of the first hypothesis. Here there are evidence that ESG score do in fact affect a firm´s implied CDS spread and the null hypothesis that ESG does not affect the implied CDS spread can be rejected at 5% significance level from both the tests. The results can be interpreted as when ESG scores increase, so does the implied CDS spread.

This result is somewhat unexpected and by looking a previous literature which studied another proxy for riskiness, the credit rating. There is evidence that higher ESG lead to higher credit ratings, (Attig, Ghoul, Guedhami, & Suh, 2013).

6.4 General discussion

The results from the two hypotheses´ are somewhat unexpected. Since the hypothesis I (*There is no relationship between a firm´s ESG score and its cost of capital.)* could not be rejected whilst hypothesis II (*There is no relationship between a firm´s ESG score and its riskiness)* could, on both the random effects and pooled OLS regression. This hints that ESG have a statistically significant effect on the implied CDs spread but not the WACC. At first glance this is unintuitive. It would not be an unreasonable assumption to make that the variables WACC and implied CDS spread would be correlated, since the cost of capital theoretically should increase when the risk increases. However, this is not the case and the correlation coefficient between the variables have in this sample space been *-0.1451*, (see Table 2 *Correlation matrix*) so the results are not unreasonable.

The results are robust, since different models have been used to test the relationship between a firm´s ESG score and the response variables. When several models are used, and the result remains, it relieves uncertainties regarding the efficiency of the specific model.

When comparing the results on WACC with those of the results from previous literature, there are slight differences. Whilst (Oikonomou & al, 2014) measured the effect ESG had on corporate debt, (El Ghoul & al, 2011) measured the cost of equity, and (Goss & Roberts, 2011) measured the cost of bank loans. None of these studies studied the effect ESG had on a firm´s total cost of capital, but rather only how it affected components of it. There could therefore be an effect which compensated other factors of capital cost, that are not obvious when studying only components of the total cost of capital. If there in fact exists an effect like this, it would help explain why the results from the literature differ from those of this paper. The more obvious explanation for why the results differs is that the sample and sample spaces are not the same. When dealing with different sample spaces, it could be the case that there is in fact an effect that ESG have on cost of capital on the U.S. equity market which is not present on the Swedish equity market. There could also be the case that the true effects of ESG on WACC are the same but due to sampling bias in either previous literature or in this paper, which skew the results.

7.0 Conclusion

This is a study conducted exclusively on the Swedish market and examines the relationship between a firm´s ESG and its WACC and implied CDS. The study uses data from 2019, 2018, and 2017.

Regarding hypothesis I, *(There is no relationship between a firm´s ESG score and its cost of capital)* which tests how ESG relates to a firm´s weighted average cost of capital, there can be no rejection of the null hypothesis. This is the case no matter how the tests are structured. It can therefore not be concluded that ESG have any significant effect on a firm´s weighted average cost of capital. At least not on the Swedish market the years 2019, 2018, and 2017. This contrasts with previous literature, which may be due to different modelling or different sample spaces.

Regarding hypothesis II, (*There is no relationship between a firm´s ESG score and its riskiness)* which measures how a firm´s ESG score affect the implied CDS spread. The hypothesis can be rejected at 5% confidence level. This is the case no matter how the models are structured, and the estimated marginal effects differs between .2081717 and .2368187. This implies that increasing a firm´s ESG score will, ceteris paribus, increase the implied CDS spread.

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Appendix

Table 11

Correlation between the ESG scores for 2019, 2018, and 2017

	2019	*2018*	*2017*
2019	1		
2018	0,952282	1	
2017	0,906941	0,938548	1

The correlation has been over 0.9 for all years, rendering a high accuracy of the predictability for an ESG score a given year. The correlation matrix was made by excluding the missing values and all other assumptions from the model. All observations are collected per the date given in section *3.0 Data*

Equation I

This is the maximum estimated effect the ESG score would have on the WACC given a firm performs worst compared to best

$$99 * .0018897\% = 0.187\% = 18.7bp$$

Table 12

Missing Thomson Reuters ESG values

Firm	Year 2019	Year 2018	Year 2017
DOMETIC GROUP AB	Not missing	Missing	Missing
DUSTIN GROUPAB	Not missing	Not missing	Missing
EPIROC AB	Not missing	Missing	Missing
INDUTRADE AB	Not missing	Missing	Missing
LOOMIS AB	Not missing	Missing	Missing
MEKONOMEN AB	Not missing	Missing	Missing
NOBINA AB	Not missing	Not missing	Missing
SECTRA AB	Not missing	Not missing	Missing

These are all firms which have at least one missing value for its Thomson Reuters ESG score. There are in total 8 firms which have at least one missing value.

Table 13

Thomson Reuters ESG score assessment

Pillar	Category	Indicators in rating	weights	Pillar weight
Enviromental	**Resource Use**	**19**	**11%**	**34%**
	Emissions	**22**	**12%**	
	Innovation	**20**	**11%**	
Social	**Workforce**	**29**	**16%**	**36%**
	Human rights	**8**	**5%**	
	Community	**14**	**8%**	
	product response	**12**	**7%**	
Governance	**management**	**34**	**19%**	**31%**
	Shareholders	**12**	**7%**	
	CSR strategy	**8**	**4,5%**	
Total		**178**	**100%**	**100%**

Source: Thomson Reuters ESG methodology 2019

This table is provided by Thomson Reuters and describes how the collected measurements are further grouped and weighted to determine the values of the environmental, social, and governance scores.

Table 14

Firms with information gathered from annual reports

Firm	Information gathered	Year
Balder AB	Leverage	2017,2018
Mekonomen AB	Leverage	2017, 2018
Clas Ohlsson AB	Leverage	2017, 2018
Fingerprint cards AB	Leverage	2017, 2018
Skanska AB	Leverage	2017, 2018
Sectra	Leverage	2017/16, 2018/17

Table 15

Compilation on OMXS30 sustainability reportinng

Firm	Provides annual sustainability report	Comments
ABB Ltd	yes	
Alfa Laval	yes	
Assa Abloy B	yes	
AstraZeneca	yes	
Atlas Copco A	yes	
Atlas Copco B	yes	
Autoliv SDB	yes	

Boliden	yes	
Electrolux B	yes	
Ericsson B	yes	
Essity B	yes	
Getinge B	yes	in combination with annual report
Hennes & Mauritz B	yes	
Hexagon B	yes	in combination with annual report
Investor B	yes	in combination with annual report
Kinnevik B	yes	
Nordea Bank	yes	”sustainable investment report”
Sandvik	yes	in combination with annual report
SCA B	yes	
SEB A	yes	
Securitas B	yes	
Skanska B	yes	
SKF B	yes	
SSAB A	yes	
Swedbank A	yes	
Swedish Match	yes	
Svenska Handelsbanken A	yes	
Tele2 B	yes	
Telia Company	yes	
Volvo B	yes	in combination with annual report

Source: All individual firm´s latest annual report

Collection of all firms on the OMXS30 index and whether they provide an annual sustainability report. All data is collected manually from the individual firm’s latest sustainability report or annual report