ESG Performance and Firm Market Risk

Evidence from the Nordic market

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Abstract

The thesis investigates the relationship between CSR performance and firm market risk in the Nordics for a data set of 1,561 firm-year observations over the period of January 2004 to December 2019. A linear multivariate OLS regression model was estimated, with methodological challenges and data limitations common to similar studies about ESG performance and firm market risk. The relationship between ESG performance and firm risk is not confidently supported in the data for the full sample of firms in the period of 2004-2019. There are, however, insignificant, weak risk-reducing effects for ESG performance with stronger effects for the systematic risk measure. When limiting the time-period to data between 2010-2019, there is a significant risk-reducing impact from ESG performance for the total and idiosyncratic risk measures. The discrepancy between the periods may be due to different characteristics of the ESG performance – firm market risk relationship over time, due to improved reporting and measurement of ESG, or derive from random differences between the periods. The findings are in line with previous research that suggests a risk-reducing impact of ESG performance on firm market risk. Further research is needed to explore the relationship between the ESG factor dimensions and firm market risk.

Keywords: ESG factors, CSR, idiosyncratic risk, systematic risk, firm market risk
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Contents

1. Introduction

Environmental, social, and governance (ESG) activities have, over the past years, received increased attention among investors, companies, and society (Strand, Freeman et al. 2015). There is a large portion of research on sustainability performance's impact on financial performance; however, the research on sustainability performance's impact on firm risk is limited and to my knowledge non-existent in a Nordic context. The Nordics stand out in terms of strong corporate sustainability performance and are therefore interesting to study (Strand, Freeman et al. 2015).

The main purpose of this thesis is to empirically test if ESG factors performance impact a Nordic company's total, idiosyncratic and systematic market risk. The impact on total firm risk, and of its components, idiosyncratic and systematic risk will be studied separately. The thesis adds to the current literature by examining the ESG performance-firm market risk relationship for companies within the Nordic context with recent data. It thereby fills an important research gap that will be of interest to firm managers and investors since lowered firm risk creates a strong business case for CSR investments.

The CSR firm risk relationship is examined with a multivariate regression model for a data set of 1,561 firm-year observations between 2004-2019. Previous research within the field is inconclusive, but several theories suggest an impact from ESG factors on the three risk measures (Sassen, Hinze et al. 2016). Despite the proposed effects, the relationship between ESG performance and firm risk is not confidently supported in the data for the full sample of firms in the period of 2004-2019. However, when limiting the time-period to data between 2010-2019, there is a risk-reducing impact from ESG performance for the total and idiosyncratic risk measures.

The next section, section 2, provides a background on CSR and firm risk. Section 3 examines existing literature within ESG performance and risk, and introduces the theories in support of an impact on firm market risk from ESG. The theoretical framework that is the foundation for the hypotheses is thus introduced. Afterward, section 4 introduces the setting of the study as well as describes the research question and present the hypotheses. Section 5 introduces the linear regression methodology and gives the rationale behind the measurement methods, and section 6 describes the data as well as the selection process and data limitations. In section 7, the results, and the robustness checks, are presented. Section 8 discusses the results and conclusions from the findings. Section 9 is a concluding chapter.

2. Definitions and Measurement

2.1 CSR

Sustainability or Corporate Social Responsibility (CSR) have had different definitions over time in different studies and are often interchangeable as general terms for all ESG activities (Strand, Freeman et al. 2015).

A paper from 2015 aims to find a definition of CSR and arrives at "*private business regulation*" (Sheehy 2015). Most CSR practice is self-regulation, but CSR has, during recent years, had an increasingly important role in public regulation (Sheehy 2015). A paper from 2008 analysing 37 definitions of CSR by examining the frequency of search words from Google finds that these definitions always refer to five dimensions (environmental, social, economic, stakeholder, and voluntariness). The study argues that the issue when examining CSR lies in the differences that appear from how CSR is constructed in different contexts and not in the lack of a definition (Dahlsrud 2008). A review from 2015, summarises CSR into the following different dimensions: "*obligation to the society, stakeholder involvement, improving corporate image and reputation, economic development, ethical business practice, law-abiding, voluntariness, human rights, environmental protection, transparency and accountability"* (Hamidu, Haron et al. 2015).

ESG factors are widely accepted to describe CSR within both the research and investor community (Eccles, Ioannou et al. 2014), (Friede, Busch et al. 2015). The PRI Association defines the separate ESG factors as follows. Environmental issues are *"issues relating to the quality and functioning of the natural environment and natural systems."* Social issues are *"issues relating to the rights, well-being, and interests of people and communities,"* and governance issues are "*issues relating to the governance of companies and other investee entities"* (PRI Association 2018).

Previous research uses numerous different methods of measuring ESG performance. The assessment of ESG performance is affected both by the measurement method through the scoring approach (Dorfleitner, Halbritter et al. 2015) and by the social origin of different data vendors (Eccles, Stroehle 2018). Hence, it is essential to perform studies with ESG data from different data vendors to be able to understand the real impact of CSR.

2.2 Firm market risk

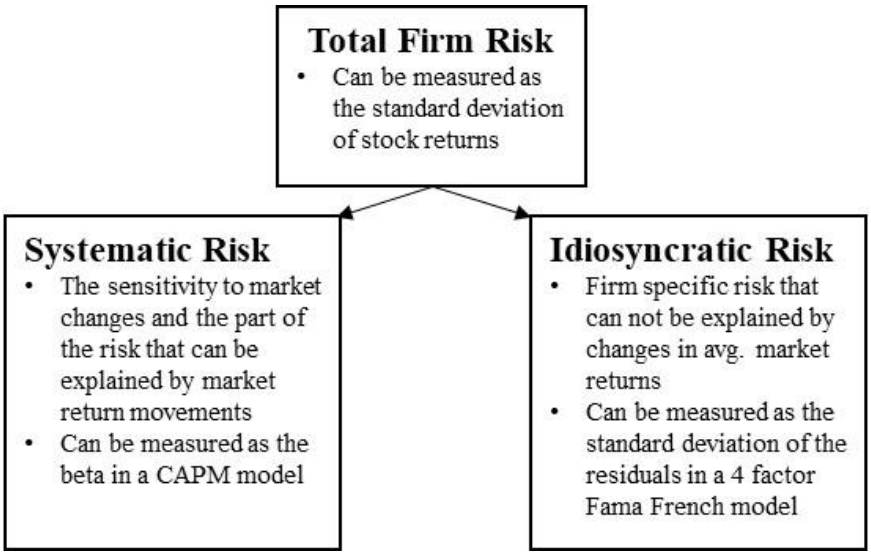
The traditional view of the CAPM, that risk is correlated with return, has been questioned repeatedly in empirical studies, (e.g. (Bowman 1982)). Bowman's risk-return paradox is based on the finding that companies with higher average profit have less variable profit over time. McNamara et al. examine managerial decision making and assessments of risk and expected return (McNamara, Bromiley 1999). The risk-return relationship turned out to be negative in the study, and it argues that measurement methods is the reason that previous research finds a positive risk-return correlation. Since financial performance includes both return and risk, it is important to not only establish the link between return and sustainability but also study the impact on firm risk (Orlitzky, Benjamin 2001).

From a firm perspective, a company's valuation depends on its cash flows discounted by its cost of capital, and the cost of capital reflects the company's risk (Miles, Ezzell 1980). Lower risk reflected in the cost of capital leads to a higher valuation. Following the assumptions in the studies mentioned above, this paper considers the risk of itself and not only as an adjustment factor to return.

Risk measurement can be based on accounting or market factors such as volatility of ROA or volatility of stock prices. Market risk has been shown to be more related to corporate social performance than accounting risk (Orlitzky, Benjamin 2001). Beaver et al. also find that accounting measures of risk are included in the market risk measure (Beaver, Kettler et al. 1970). In accordance, the paper focuses on market risk factors.

Against the assumptions of the CAPM, investors bear firm-specific idiosyncratic risk due to a lack of diversification (Chatterjee, Lubatkin, et al. 1999), (Merton 1987). Total firm market risk can be measured as the standard deviation of stock returns (Bae, Chan et al. 2004). Total risk includes both systematic and idiosyncratic risk. Systematic risk is the variations that follow the overall market portfolio, whereas idiosyncratic risk is the risk that is not correlated with the overall market movements (Luo, Bhattacharya 2009). Figure 1 presents an overview of the risk measures. Luo et al. find that <20% of total risk can be explained by systematic risk.

Figure 1. Flow chart of firm stock risk (Luo, Bhattacharya 2009)



3. Literature Review

3.1 Previous empirical studies

3.1.1 CSR performance and financial performance

Previous research indicates that CSR performance has a positive impact on financial performance. A paper from 2015 reviewing studies from a period of over 40 years and combining findings of 2,200 individual studies, finds that around 90% of the reviewed research conclude a non-negative relationship between ESG performance and financial performance (Friede, Busch et al. 2015). Most of the studies also find a positive relationship. The review concludes that the relationship holds across assets, geographical regions, and over time. Several other earlier reviews have come to similar conclusions (Orlitzky, Schmidt et al. 2003), (Margolis, Walsh 2003), (Van Beurden, Gössling 2008).

At the same time, several academics have questioned the empirical methods used to study the relationship between financial performance and CSR performance (Quazi, Richardson 2012). In a study by McWilliams et al., there is no positive correlation found between CSR performance and financial performance when controlling for R&D investments (McWilliams, Siegel 2000). The study, which includes 524 US firms, argues that methodologies used in previous studies show upwardly biased estimates since they mostly omit R&D investments. Besides, a study by Cavaco et al. explains the contradicting empirical evidence within the field by trade-offs and synergies between the different components of CSR activities (Cavaco, Crifo

2014). In their study of 300 firms from over 15 countries during 2002-2007, they only find that performance in certain dimensions (human resources and business behaviour dimension) leads to improved performance.

3.1.2 CSR performance and cost of capital

Prior studies about CSR performance and cost of capital mainly focus on accounting-based risk measures or credit ratings. For instance, El Ghoul et al. find a lower cost of equity for good performers within the CSR dimensions of environmental policies, product strategies, and employee relationships in a study of 2,809 firms between 1992-2007 (El Ghoul, Guedhami, et al. 2011). Other studies find that firms with better CSR scores have a lower cost of equity (Sharfman, Fernando 2008), and debt (Eliwa, Aboud et al. 2019), (Bauer, Derwall, et al. 2009). A study by Stellner et al. finds weak evidence that superior corporate social performance impacts a company's credit rating and zero-volatility spreads (Stellner, Klein et al. 2015).

3.1.3 CSR performance and firm market risk

Most studies indicate that CSR performance affects firm market risk and that the impact is risk-reducing. In Orlitzky et al.'s meta-analysis of 18 US-based studies between 1978-1995, they find a risk-reducing relationship between CSR performance and total firm market risk (Orlitzky, Benjamin 2001).

There are a few studies that examine systematic risk. A recent study with 15,328 firm-year observations from S&P's public firms 2004-2012 and CSR scores from MSCI's ESG database (former KLD) finds less systematic risk and higher firm performance for firms engaging in CSR. The study also finds that firm reputation has a positive relationship with CSR performance, and argue that the reason for lower risk is improved reputation (Albuquerque, Koskinen et al. 2019). Benlemlih et al. present similar findings after they investigate changes in KLD scores on 1,621 individual US firms from 1996-2011 and find that improved performance reduces systematic risk and generates higher firm value (Benlemlih, Jaballah et al. 2018).

A few studies have examined CSR performance and its impact on idiosyncratic risk. Luo et al. focus on the role of social performance and marketing in a study of 541 companies from 2002-2003 (Luo, Bhattacharya 2009). They utilise Fortune's Most Admired Companies and find that higher social performance reduces idiosyncratic risk. This effect is greater for firms with higher advertising expenses. Lee et al. focus on socially responsible investment in an international

study of 400 firms between 1998-2002 and find lower idiosyncratic risk for leading CSR performing firms measuring corporate social performance with the Dow Jones Sustainability Index (Lee, Faff 2009).

Only a few studies find no correlation between CSR performance strengths and firm market risk. For instance, a study of 167 European firms finds no evidence of influence on total firm market risk (Gramlich, Finster 2013). Another study with data from 1992-2009 shows insignificant results for the relationship between social performance strengths and systematic firm risk; however, it observes a significantly positive relationship between environment, employment, and community factor concerns and systematic risk (Oikonomou, Brooks et al. 2012). Humphrey et al.**,** using data from Sustainability Asset Management Group GmbH for 256 firms in the UK, find no impact of corporate social performance on idiosyncratic risk (Humphrey, Lee et al. 2012).

3.1.4 CSR dimensions and their impact on firm market risk

There is limited and inconclusive research about the different factors of ESG (environmental, social, governance) and each dimension's effect on firm market risk.

Sassen et al. investigate the impact of the three pillars of ESG on total, idiosyncratic and systematic risk 2002-2014 through 8,752 firm-year observations in Europe (Sassen, Hinze et al. 2016). They find that the "society" dimension of the social pillar of ESG reduces both idiosyncratic and systematic risk. The "society" dimension relates to a company's ability to generate loyalty and trust for the society as a whole. The customer dimension of the social pillar score and environmental pillar scores only impact idiosyncratic risk and not total or systematic risk. If controlled for environmentally sensitive industries, the environmental pillar impacts systematic and total risk. They do not find any impact from the corporate governance pillar score on any of the risk measures.

Bouslah et al. find different effects from the different dimensions of ESG examined in the study (Bouslah, Kryzanowski, et al. 2013). Firm risk is increased by environmental strengths for S&P500 firms and reduced by employee relations, corporate governance, and community strengths. For non-S&P500 firms, the dimensions of employee relations, community, and environment reduce risk. They find no impact from human rights, diversity and product dimensions. The study includes 16,599 firm-year observations over the period 1991–2007.

Finally, there has been some research about specific topics within the corporate governance dimension. Better board governance structures such as board composition, leadership structure, and the quality of board processes have shown to reduce firm risk (Mathew, Ibrahim et al. 2018). Ferreira et al. investigate the relationship between corporate governance and firm risk for an average of 1,248 firms per year between 1990-2001 in the context of takeover measures and find that companies with less such provisions have higher levels of idiosyncratic risk (Ferreira, Laux 2007).

3.2 General factors that affect firm market risk

There has been a lot of research about the different factors that affect firm risk. Some of the factors relate to the company's size, dividend cash flow record (Ben-Zion, Shalit 1975), funding liquidity (Perez-Quiros, Timmermann 2000), investment opportunity (Benlemlih, Girerd-Potin 2017), leverage (Ben-Zion, Shalit 1975) and stock trading liquidity (Brogaard, Li et al. 2017).

Size reduces firm risk due to the marketability of securities to investors, which makes them more liquid (Ben-Zion, Shalit 1975). Size could also lower the risk of bankruptcy if it proves past performance. Firms tend to grow over time, and larger firms are thus the survivors, among other already bankrupt firms. Past performance may, in this sense, suggest future performance. Economies of scale and diversification benefits that come with size would also lower firm risk. The dividend record shows the stability of earnings, and dividend-paying firms should have lower firm risk (Ben-Zion, Shalit 1975). Higher liquidity of a firm’s assets would reduce firm risk since more liquid assets have lower volatility in their earnings (Beaver, Kettler et al. 1970). Liquid assets can also be sold in times of shocks (Beaver, Kettler et al. 1970). Firms with better investment opportunities and growth prospects should be less exposed to earnings volatility and thus have lower firm risk (Benlemlih, Girerd-Potin 2017).

Leverage increases risk since it consists of more senior securities compared to equity, both in terms of a firm's earnings and the claims on the firm's assets in case of bankruptcy (Ben-Zion, Shalit 1975). Therefore, the risk of default increases, which increases the risk of the company’s equity (Ben-Zion, Shalit 1975).

Stock trading liquidity also impacts firm risk (Brogaard, Li et al. 2017). The impact could be both positive and negative. High trading liquidity could lead to mispricing due to noise trading or reduce internal firm monitoring. Alternatively, it could decrease default risk by greater price

efficiency or improved corporate governance giving investors the option to exit bad investments (Brogaard, Li et al. 2017).

3.3 Should ESG performance impact firm market risk?

3.3.1 Systematic and idiosyncratic risk

If CSR reduces the sensitivity to market downturns, CSR performance will reduce the systematic risk (Sharfman, Fernando 2008). For example, improved reputation from better CSR performance could make the firm less sensitive in market downturns since it could lower the risk of losing customers in weaker markets (Albuquerque, Koskinen et al. 2019).

In the case of a non-diversifiable common risk factor from CSR risks, it would be reasonable to think that CSR performance should impact the idiosyncratic risk (Benlemlih, Jaballah et al. 2018). For instance, random shocks occurring due to poor CSR performance would impact idiosyncratic risk. Such a shock for the company could, for example, be unexpected criminal legal proceedings, among others (Benlemlih, Jaballah et al. 2018).

Some studies argue that the most important implications from CSR performance should be for idiosyncratic risk, e.g. (Benlemlih, Girerd-Potin 2017), (Sassen, Hinze et al. 2016). First, the idiosyncratic risk measure can hide a common risk factor ignored in traditional models, and secondly, the impact from adverse events on changes in stock value can be avoided (Benlemlih, Girerd-Potin 2017). Sassen et al. assume that systematic risk from CSR performance is driven by industry-specific characteristics and therefore argue that company ESG scores would primarily impact idiosyncratic risk (as these scores measure relative company performance within an industry) (Sassen, Hinze et al. 2016).

The above theories suggest that total risk, systematic and idiosyncratic risk should be affected by CSR performance, and a few studies suggest a weaker relationship for the systematic risk factor.

3.3.2 Arguments for decreased risk from ESG performance

CSR engagements within all dimensions could be a way to avoid stranded assets (Silver 2017). Stranded assets are assets that suffer from unexpected losses and write-downs due to environmental damage, lack of resources, regulations, or change in societal norms (Silver 2017). Good CSR performance would reduce the likelihood of unexcepted losses due to depletion of the natural environment, regulatory issues, or public opinion and thus lower the risk.

ESG performance, mainly within the social dimension, would reduce firm risk according to instrumental stakeholder theory (Jones 1995). The theory builds on the idea that ethical principles characterized by trust, cooperation, and information sharing lead to competitive advantage. These ethical principles ensure that implicit stakeholder claims are taken into consideration today, which reduces the likelihood of future explicit claims and thus decrease the risk for the company. Such future claims that have an impact on the firm risk today could be but are not limited to, for example, criminal legal proceedings (Orlitzky, Benjamin 2001). Concerning the different stakeholders, CSR performance can for instance help attract talent due to signalling effects and social identity theory (Greening, Turban 2000), improve firm reputation (Albuquerque, Koskinen et al. 2019), increase brand value (Luo, Bhattacharya 2009) and customer satisfaction (Saeidi, Sofian et al. 2015).

Besides, stakeholder theory suggests that all dimensions of ESG performance may lead to an increased focus on other stakeholders than shareholders (Cheng, Ioannou et al. 2014). This removes informational asymmetry since it leads to more interactions with these stakeholders, which reduces agency costs. The increased interactions between stakeholders and the firm also lead to increased transparency, which leads to better access to capital (Cheng, Ioannou et al. 2014).

Further, the corporate governance performance dimension of CSR should reduce firm risk if it improves a company's ability to reduce its agency costs between shareholders and managers. There is a principal-agency problem between firm managers and shareholders as the owners of a company can not control or know if managers behave in their best interest (Shleifer, Vishny 1997). Corporate governance is a combination of rules and processes that addresses this issue, often by legal protection and through ownership of the influence of large stake owners (Shleifer, Vishny 1997).

Finally, risk management theory introduces the concept of moral capital, which comes from good CSR performance (Godfrey 2005). Moral capital protects the firm's relationships with different stakeholders in difficult times. The strengthened relationships due to CSR engagements can thus be viewed as intangible assets. The insurance that CSR performance in this way generates will, therefore, have positive effects for shareholder wealth and result in lower firm risk. Risk management theory can also explain lower firm risk through increased customer loyalty and brand value (Luo, Bhattacharya 2009).

Another aspect of risk management theory is that investors are less sensitive to the negative performance of socially responsible investment funds compared to other funds. The moral capital generated by good CSR performance is important to investors as they care about nonfinancial attributes (Renneboog, Ter Horst, et al. 2011).

3.3.3 Arguments for increased risk from CSR performance

Managerial opportunism theory would explain increased firm risk from CSR performance since management tends to pursue their own goals (Preston, O'bannon 1997). This leads to underinvestment in times when there already is high CSR performance and overinvestment in bad times since managers focus on short term objectives and not consider long-term risks. Barnea et al. argue that the managers and other "insiders" of firms that invest in CSR overinvest due to personal benefits (Barnea, Rubin 2010). These actors will get a "warm glow" effect since they will be viewed by society as good global citizens. In their study, the theory is supported by testing the insiders' ownership and leverage in the company vs. other institutional ownership, and they find that ownership and leverage are correlated with better CSR performance, indicating that there is overinvestment in CSR.

CSR performance, through the governance dimension, could also increase firm risk if it would encourage risk-taking behaviour (John, Litov et al. 2008). Better investor protection may lead to less excess risk-avoidance due to self-interest.

Cespa et al. suggest that inefficient CEOs pursue relationships with social activists in an "entrenchment strategy" by trying to gain stakeholder support to reduce the likelihood of being replaced (Cespa, Cestone 2007).

4. Research Design

4.1 Setting of the study

The study includes companies within Sweden, Denmark, Finland, and Norway, as previous research has suggested that these countries have superior sustainability performance compared to other countries (Strand, Freeman et al. 2015). Besides, stakeholder engagement and the concept of shared value is essential in the Nordics (Strand, Freeman et al. 2015). The Nordic countries have many similarities when it comes to their institutional environments, such as their cultural, ideological, political, and economic environments (Gjølberg 2010). For instance, characteristics such as a high level of state intervention and social welfare awareness. Also, the

role of the state as an investor and owner in the private sector is essential in the Nordic countries (Gjølberg 2010). The differences compared to the rest of the world makes it an exciting area to study.

Also, the Nordic countries are civil law countries (Strand, Freeman et al. 2015). A large international study of 1,169 firms in 25 countries 2001-2011 focuses on differences in institutional environments and examines both systematic and idiosyncratic risk (Benlemlih, Girerd-Potin 2017). They find that better CSR performers have lower idiosyncratic and systematic risk in civil law countries only. The different components of CSR are also tested, and there is lower idiosyncratic and systematic risk for all dimensions except for the governance score that reduces firm risk in common law countries only. The different outcomes in different institutional environments makes it important to study ESG performance and firm market risk in different contexts.

4.2 Contribution and research focus

As discussed in section 3, most previous research focuses on CSR performance and financial performance, and there is less research on the CSR impact on firm market risk. Many studies that focus on firm risk use American, European, and international samples. There is no study to my knowledge focusing on the Nordics. Previous studies have proved the importance of institutional environment and context, e.g. (Benlemlih, Girerd-Potin 2017), (Dahlsrud 2008). Therefore, it is essential to fill this research gap and extend the research into a Nordic setting.

The paper will answer the following research question:

Does corporate social performance affect Nordic companies' total, systematic and idiosyncratic risk?

Most prior studies are focused on other measurements of risk than market risk and only examine total risk. A lot of them also utilise aggregated ESG scores. Some evidence shows different impact from different ESG dimensions, e.g. (Bouslah, Kryzanowski, et al. 2013), (Sassen, Hinze et al. 2016), (Benlemlih, Girerd-Potin 2017), and there is no academic consensus of an impact from CSR performance on firm market risk. This paper aims to address this ambiguity.

There are several ways to measure ESG performance, and several studies are conducted with the Kinder, Lydenberg and Domini (KLD) database scores as CSR measures, e.g. (Sharfman, Fernando 2008), (Oikonomou, Brooks, et al. 2012), (Jo, Harjoto 2014), (Bouslah, Kryzanowski,

et al. 2013), (Jo, Na 2012). Previous research has shown that different databases assess ESG differently (Dorfleitner, Halbritter et al. 2015), (Eccles, Stroehle 2018). CSR measurement also tends to vary over time due to differences in reporting (Van Beurden, Gössling 2008). With recent data from 2004-2019 and ESG measures from Refinitiv's database, the hope is to contribute to the current literature by providing new insights into different CSR dimensions and its importance for firm risk management. More evidence within this area is important when investment decisions in CSR activities are made since lowered firm risk creates a strong business case for CSR investments.

4.3 Hypotheses

Based on the literature review, the following hypotheses are presented:

1 Hypothesis: *In the Nordics, a company's corporate social performance affects its total risk.*

2 Hypothesis: *In the Nordics, a company's corporate social performance affects its systematic risk.*

3 Hypothesis: *In the Nordics, a company's corporate social performance affects its idiosyncratic risk.*

Support for hypothesis 1-3 indicates that ESG performance impacts firm risk, systematic risk, and idiosyncratic risk and that stakeholder theory, theories about stranded assets and risk management theory, or managerial opportunism theory may apply. Lower risk could, for example, be due to the avoidance of stranded assets for firms who engage in CSR activities. Higher risk could, for example, be due to underinvestment in CSR in times of high CSR performance and overinvestment in times of low CSR performance, which would increase the risk.

Rejection of hypotheses 1-3 would mean that there is no confident support for a relationship between CSR and firm risk in the findings. It could mean that corporate social performance is of low importance as a determinant of firm market risk.

This thesis uses ESG scores measured by Refinitiv as estimates for a firm's corporate social performance to test the hypotheses. The next section describes the methodology and defines these scores.

5. Methodology

To test if ESG factor performance impacts firm market risk, the methodology of Sassen et al.'s paper "*Impact of ESG factors on firm risk in Europe"* will be replicated (Sassen, Hinze et al. 2016). Section 5.1 specifies the tested relationship as well as describes the linear regression model. The variables will also be specified, and the method used to estimate the dependant variables will be described. Section 5.2 discusses methodological considerations. It presents limitations of the model along with possible methods for improving the quality of the results. Afterward, section 5.3 summarises the different diagnostics and methodological adjustments performed based on these considerations.

5.1 Regression model

5.1.1 Model specification

The thesis follows previous research and employs an OLS multivariate panel regression model with numerous control variables for firm characteristics, e.g. (Sassen, Hinze et al. 2016), (Bouslah, Kryzanowski, et al. 2013), (Luo, Bhattacharya 2009), (Oikonomou, Brooks et al. 2012), (Benlemlih, Girerd-Potin 2017). The specification of variables follows Sassen et al.'s methodology with one exception; in their paper, they exclude the current ratio due to lack of data; it was, however, included here. The three relationships in Figure 2 were estimated to test the hypotheses.

Figure 2. Linear regression model (Sassen, Hinze et al. 2016)

$$TOTRisk_{it} = \alpha_{it} + \beta_1 ESG_{it} + \beta_2 Size_{it} + \beta_3 ROA_{it} + \beta_4 CuRatio_{it} + \beta_5 MBV_{it} + \beta_6 Lev_{it} + \beta_7 Liq_{it} + \beta_8 Div_{it} + \beta_9 SDROA_{it} + \epsilon_{it}$$

$$Beta_{it} = \alpha_{it} + \beta_1 ESG_{it} + \beta_2 Size_{it} + \beta_3 ROA_{it} + \beta_4 CuRatio_{it} + \beta_5 MBV_{it} + \beta_6 Lev_{it} + \beta_7 Liq_{it} + \beta_8 Div_{it} + \beta_9 SDROA_{it} + \epsilon_{it}$$

$$IR_{it} = \alpha_{it} + \beta_1 ESG_{it} + \beta_2 Size_{it} + \beta_3 ROA_{it} + \beta_4 CuRatio_{it} + \beta_5 MBV_{it} + \beta_6 Lev_{it} + \beta_7 Liq_{it} + \beta_8 Div_{it} + \beta_9 SDROA_{it} + \epsilon_{it}$$

where β represents the associated coefficients, and *ESG* is an estimate for a company's corporate social performance. *TOTRisk* is the firm total market risk, *Beta*, an estimate for firm systematic risk and *IR*, an estimate for a company's firm idiosyncratic risk. *Size* is the natural logarithm of total assets in US dollars, and *ROA* measures a company's return on assets. *CuRatio* is an estimate for a company's funding liquidity measured as its current ratio. *MBV* is a

company's market to book value, and *Lev* estimates a company's leverage ratio. *Liq* is a proxy for a firm's trading liquidity measured as the aggregated volume traded the previous year divided with the number of common shares outstanding at year-end. *Div* estimates the impact from a company's expected dividend, measured as a company's dividend paid, scaled by its average share price. *SDROA* aims to capture the variability of company earnings and is the standard deviation of the ROA. ϵ_{it} is the regression residual. If the ESG score coefficients are significantly different from zero, it indicates that ESG factor performance affects the firm market risk factor.

The next sections will specify each variable included in the regressions.

5.1.2 Specification of dependant variables

Total market risk was measured as the standard deviation of the daily stock returns the previous year following several previous studies, e.g. (Luo, Bhattacharya 2009), (Sassen, Hinze et al. 2016), (Bae, Chan et al. 2004), (Benlemlih, Girerd-Potin 2017).

Systematic risk was estimated with the CAPM model following the methodology in previous research, e.g. (Luo, Bhattacharya 2009), (Sassen, Hinze et al. 2016). Systematic risk is a company's sensitivity to overall market movements and should not change much over time (Sassen, Hinze et al. 2016). The systematic risk variable is β in the CAPM model below, and estimates were based on the previous five years' monthly excess return:

$$R_{it} = r_{rf} + \beta_i(r_m - r_f)_t + \epsilon_{it}$$

where $(r_m - r_f)$ represents the excess return of the market, r_{rf} the risk-free rate and R_{it} the company's monthly return. Separate linear models were run for each point in time (year) for the previous five years for each company, using monthly company return data, which generated a β per year and company. ϵ_{it} represents the regression residuals.

Most previous studies estimate the idiosyncratic risk variable with the Fama French three-factor model or Carhart four-factor model, e.g. (Luo, Bhattacharya 2009), (Sassen, Hinze et al. 2016), (Bae, Chan et al. 2004), (Benlemlih, Girerd-Potin 2017). Previous studies find improved quality of prediction with the Carhart four-factor model compared to the Fama French three-factor model, e.g. (Bello 2008). In this thesis, the Carhart four-factor model was estimated for the idiosyncratic risk variable as per Sassen et al.'s methodology. The following relationship was estimated:

$$R_{it} - R_{ft} = \alpha_i + \beta_{im}(r_m - r_f)_t + \beta_{is}SMB_t + \beta_{ih}HML_t + \beta_{iu}UMD_t + \epsilon_{it}$$

The model explains a company's excess return $(R_{it} - R_{ft})$ with its sensitivity to the overall market movement measured with the excess return of the market $(r_m - r_f)$ and three other market factors as well as a residual ϵ_{it}. SMB represents the difference in return between portfolios of small and big stocks, HML is the return difference between high and low book to market portfolios, and UMD is the difference in return between the previous day's high return portfolios minus low return portfolios.

The model was estimated for each company, and each year with daily company excess return data as well as daily market factor data. The idiosyncratic risk is the residuals of the models, measured as the standard deviation of the residuals during the previous year for each company.

5.1.3 CSR performance variables

The CSR pillar scores were obtained from ThomsonOne Refinitiv. The scores are data-driven and based on a company's relative performance to other companies (Refinitiv 2020). For environmental and social performance pillar scores, the company is ranked in comparison to other companies in its sector, whereas for governance, it is ranked relative to other companies in the same country (Refinitiv 2020). Each pillar score comes from the assessment of 10 category scores (Refinitiv 2020). Figure 3 below presents an overview of each of the pillar scores.

Figure 3. Overview of ESG pillar scores (Refinitiv 2020)

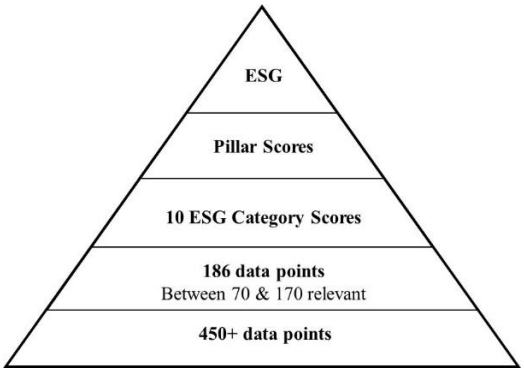
The environmental pillar score represents a company's impact on the surrounding natural environment (Refinitiv 2020). It can be related to land, air, and water in both eco-systems as well as on the non-living environment. It includes innovation in support of ecological development, the commitment a company shows to improving its environmental impact, as well as the actual impact such as emissions of waste, the effect on biodiversity, and resource use (for example, water usage and energy) (Refinitiv 2020).

The social score embodies a firm's impact on its workforce, employees, and overall community (Refinitiv 2020). It measures the amount of trust and loyalty the company receives from its surroundings. A company's diversity within its workforce, inclusion policy as well as working conditions, and the health and safety standards for its employees affect the score. The score also includes assessments of the company's human rights violations, data privacy, and product quality (Refinitiv 2020).

The governance score assesses whether the governance structure of a company is in the best interest of long-term shareholders (Refinitiv 2020). The score is affected by the company's CSR strategy, the diversity of its committees and management, and its shareholder rights. Effectiveness in board activities, balance in the board structure as well as compensation is considered (Refinitiv 2020).

Refinitiv has defined key principles of its methodology in assessing a company's score: the materiality of the factor evaluated based on the industry, the transparency and disclosure (if a company doesn't report material data points, it affects the score negatively), industry and country benchmarks and percentile scoring. The pillar scores are based on the category scores and express the performance as a percentage from 0-100% (Refinitiv 2020). Figure 4 presents an overview of Refinitiv's methodology.

Figure 4. Refinitiv ESG scoring methodology chart (Refinitiv 2020)



The combined ESG score was measured as an equally weighted average of the three pillar scores as per Sassen et al.'s methodology.

5.1.4 Specification of control variables

The control variables were selected as per the methodology of previous studies, e.g. (Sassen, Hinze et al. 2016), (Bouslah, Kryzanowski, et al. 2013), (Luo, Bhattacharya 2009), (Oikonomou, Brooks et al. 2012), (Benlemlih, Girerd-Potin 2017).

The measurement methodology of the variables follows Sassen et al.'s paper. Firm size was measured as the logarithm of the company's total assets in US dollars. Leverage was also included and measured as end-year long-term debt over total assets. Funding liquidity was measured with the current ratio, and trading liquidity was calculated as the aggregated volume traded over the previous year, divided with common shares outstanding at year-end. The profitability, as well as the earnings volatility, were incorporated as a variable with the company's ROA calculated as pretax income divided by the opening balance (the previous year's total assets) and a variable with the annual standard deviation of ROA over the last five years. The difference between growth and value firms was incorporated as the market to book ratio, measured as the market value of equity divided with the book value of equity. The dividend expectations were measured as the total dividends paid during the previous year, divided by the average share price the year before. Dividend payments were included with a time lag of one year since dividends are decided on before they are paid out.

5.2 Methodological considerations

5.2.1 Model assumptions

One of the features of the linear regression model is that the relationship between the dependant variable and independent variables is linear in approximation (Cook, Weisberg 1982). This approximation might be inappropriate if the risk correlates with ESG in a non-linear way. That would lead to insignificant results within the linear model. It could also mean that there would be other models with different results that could predict the relationship better (Cook, Weisberg 1982).

Secondly, the error terms should have a mean of zero, which is handled by including a constant in the regression model (Wooldridge 2010). The variables should be uncorrelated with the error terms, and the observations of the error terms should not correlate with each other (Jarque, Bera 1980). Most preferably, the residuals should be normally distributed (Jarque, Bera 1980). If the independent variables correlate with the error terms, it could lead to biased coefficient estimates since some of the variance that the error term explains is incorrectly attributed to the independent variable. The problem could be solved by adjustments of the model specification (Jarque, Bera 1980). Cross-sectional dependence occurs when the residuals correlate across entities and can lead to bias in test results (i.e., contemporaneous correlation) (Baltagi, Feng et al. 2012). If the error terms are not independent and follow a pattern over time, there is

autocorrelation (Bence 1995). Robustness adjusted standard errors can make results from models that suffer from autocorrelation interpretable (Sassen, Hinze et al. 2016).

Another necessary assumption that often time-series data violates is that the time series is stationary (Rappoport, Reichlin 1989). There is a weak form of stationary process when its mean and variance are constant over time, and the covariance between the two time periods depends only on the distance between the two periods and not on the actual time itself. A non-stationary time series also has different autocorrelation, variance, and mean over time (Rappoport, Reichlin 1989).

Another assumption behind the linear regression model is that there is homoscedasticity (Park 1966). That is, the error terms are the same across all values of the independent variables. The Breusch Pagan test examines heteroskedasticity, and it needs to be considered since the presence of heteroskedasticity leads to an untrustworthy interpretation of the results (Millo 2014). If there is heteroscedasticity, robust standard errors can adjust the results to make them interpretable (Millo 2014).

Also, the linear model assumes no perfect relationship between its independent variables, something defined as multicollinearity (Farrar, Glauber 1967). Multicollinear data makes it difficult to establish relationships between the independent and dependent variables and to specify the model (Curto, Pinto 2011). Even imperfectly correlated regressors can cause instability in the model (Curto, Pinto 2011). There are different methods to deal with multicollinearity, for instance, dropping variables causing multicollinearity or combining them, e.g., Ridge Regression (Chen 2012).

5.2.2 Selection and measurements of variables

The variable selection is based on Sassen et al.'s methodology. Several previous research models that estimate firm risk include the same variables, e.g. (Sassen, Hinze et al. 2016), (Bouslah, Kryzanowski, et al. 2013), (Luo, Bhattacharya 2009), (Oikonomou, Brooks et al. 2012), (Benlemlih, Girerd-Potin 2017). There might, however, be better model specifications, which would lead to a different outcome.

Besides, the variables for different factors are measured as per Sassen et al.'s methodology. Most previous studies have used similar measurement methods for systematic, idiosyncratic, and total firm market risk. The main differences are the number of market factors included in the models for idiosyncratic risk as well as the time periods estimated for the systematic risk

variable. The assumption of a five-year time period for the systematic risk estimation could possibly impact the systematic risk estimates and the outputs of the model.

The measurement methods for the control variables are mostly consistent with previous studies, e.g. (Sassen, Hinze et al. 2016), (Bouslah, Kryzanowski, et al. 2013), (Luo, Bhattacharya 2009), (Oikonomou, Brooks et al. 2012), (Benlemlih, Girerd-Potin 2017). One exception is the measure of company size; in this paper measured as the logarithm of total assets in US dollars. Some studies have included firm size as the market value of equity, e.g. (Benlemlih, Girerd-Potin 2017). There are arguments in favour of both methodologies. The market value of equity is based on expectations for the future and might, from that point of view, be a better predictor of the firm market risk (Benlemlih, Girerd-Potin 2017). At the same time, one of the arguments for lowered firm risk from size is the argument of survivorship bias since firms grow over time (Ben-Zion, Shalit 1975). From that perspective, total assets would be the better measure.

5.2.3 Other considerations

Overfitting of the model can appear if characteristics that are idiosyncratic to the sample results in misleading conclusions for the overall population (Babyak 2004). Such findings will thus be impossible to replicate as they are based on randomness in the sample. Predetermined models are more likely to produce replicable results and removing variables, refitting the model or, in other ways working with the model to achieve results increases the risk of overfitting (Babyak 2004).

Another issue with the linear regression model is how the regression is impacted by outliers (Cook, Weisberg 1982). If there are data points that not conform to the fitted line, this could lead to large parts of the data being ignored and that the results are determined based on only a few data points. There could be outliers impacting the results in this case.

There is also a risk of confounding from unknown factors that influence all or some of the regression variables (Greenland, Robins et al. 1999). This could be due to the exclusion of some variables or selecting the wrong variables for estimating the model. The model is, for example, not controlling for the different sectors the companies currently operate within. Industry could, for instance, impact my control variables such as ROA and leverage.

The next section presents an overview of the diagnostic tests performed, as well as the method applied to deal with the methodological considerations discussed.

5.3 Diagnostics and methodological adjustments

There may exist heterogeneity across companies and years since firm-specific, and time-specific characteristics could impact the financial variables as well as the ESG variables. Heterogeneity across firms makes each variable affected by individual firm-specific characteristics, which would bias estimates from a pooled OLS regressions (Baltagi, Feng et al. 2012). Initially, a Lagrange Multiplier test helped decide if a simple pooled OLS regression is appropriate through testing if variance across entities is zero (i.e., no difference across units and no panel effect).

Secondly, a fixed effect panel regression may be the most appropriate method since each firm should have individual characteristics that lead to unobserved effects correlated with the independent variables. Therefore, following previous research, e.g. (Sassen, Hinze et al. 2016), a Hausman test examined if there is a correlation between the error terms and the explanatory variables. If the firm unobserved fixed effects correlate with the explanatory variables, then a firm-fixed effect model is appropriate (Baltagi, Feng et al. 2012).

Besides, changing economic conditions over time should impact all variables. A dummy variable for years can estimate the trend and eliminate it through adding time fixed effects to the model (Sassen, Hinze et al. 2016). Adding year dummies to the original regression made it possible to examine if time fixed effects should be applied since it is possible to estimate if all the coefficients to the new variable equal zero. The following relationship estimates an additional standardised coefficient for the variable *Year* included in the regression:

$$TotRisk_{it} = \alpha_{it} + \beta_1 ESG_{it} + \beta_2 Size_{it} + \beta_3 ROA_{it} + \beta_4 CuRatio_{it} + \beta_5 MBV_{it} + \beta_6 Lev_{it} + \beta_7 Liq_{it} + \beta_8 Div_{it} + \beta_9 SDROA_{it} + \sum_{q=1}^{16} \beta_{10}\, Year_{qi} + \epsilon_{it}$$

where β_{10} represents all the year coefficients, and *Year* is a binary dummy variable. Rejecting the null hypothesis (i.e., all *Year* parameter estimates are significantly different from zero) would indicate that time fixed effects need to be applied. With a dummy variable added to the regression, heterogeneity across years would make the parameter estimates of the variable different from zero. Therefore a test with the null hypothesis that all coefficients equal zero was performed.

Afterward, the Breusch-Pagan test checked for heteroscedasticity (Millo 2014). Heteroscedasticity could be a problem in the estimated fixed effects models (i.e., the size of the

error term differs across values of the independent variable) (Sassen, Hinze et al. 2016). High ROA values, for example, might be more difficult to fit to the model compared to low values, whereas, for instance, ESG scores, might impact firm risk more consistently across all its observations. If there is heteroscedasticity, there should be robust standard errors to interpret the results correctly (Park 1966).

Time-dependence could also be important since the financial performance, as well as the ESG performance variable, might be correlated with the previous year's performance. The Breusch-Godfrey/Wooldridge test assesses if serial correlation is present (Wooldridge 2010). Robust Newey-West adjusted standard errors make results from models that suffer from both heteroskedasticity and autocorrelation interpretable (Hoechle 2007). Therefore the Wooldridge test for autocorrelation was performed to test if Newey-West robust standard errors should be applied.

Besides, cross-sectional dependence is a problem in macro panels with long time series and a small number of observations (Baltagi, Feng et al. 2012). The Pasaran CD test examines if there is cross-sectional dependence (Pesaran 2015). A Pasaran CD test was performed to check if the residuals correlate across entities. The null hypothesis in the Pasaran CD tests of independence is that residuals across entities are not correlated (Pesaran 2015).

Non-stationarity could be a problem if the variables' statistical properties change over time (Rappoport, Reichlin 1989). One example in this model would be if a company's ESG and firm risk grows simultaneously over time, one may estimate an incorrect relationship between the two variables. The residuals of the model were therefore tested for unit roots with a Pesaran and Shin test. The test is robust against cross-sectional dependence (Pesaran, Shin et al. 1996).

Finally, the model was tested for multicollinearity through a VIF test (VIF test checks for multicollinearity (Curto, Pinto 2011)) since the linear model assumes no perfect relationship between its independent variables (Farrar, Glauber 1967).

6. Data

6.1 Data sources and descriptive statistics

Company financials were obtained from Thomson Reuters' Datastream and Worldscope databases. The ESG pillar scores came from Refinitiv (former Thomson Reuter's financial and risk business). The market factors for the Carhart four-factor model, as well as the CAPM

model, were obtained from AQR's website. There was no data for the risk-free rates for the Nordic countries in the database, and the risk-free rate for Europe was therefore used as a proxy for the Nordic risk-free rate and came from Kenneth French's Fama French factor database.

All listed companies within the Nordic region (included in the OMX Stockholm All-Share Index, OMX Helsinki All-Share Index, OMX Copenhagen All-Share Index, and Oslo Stock Exchange All Share Index) were included as a starting point. If any of the data points during a particular year (financial or ESG pillar score) were missing, the company was excluded for that specific year. Among the 1,719 remaining observation, 68 were excluded since they were more than three standard deviations away from the mean to reduce the likelihood of impact from outliers.

In the end, there were 1,651 firm-year observations between 2004-2019 in an unbalanced panel dataset of firms in Denmark, Sweden, Norway, and Finland that consisted of both small, medium-sized, and large listed companies. The data set consists of 66 companies in 2004, and the number of firms increases to 225 companies in 2018, as more data becomes available over the years, and decreases to 23 companies in 2019[1].

Each variable is defined in Table 1 below, and Table 2 presents descriptive statistics. The first row reports descriptives for the ESG scores. These scores range from zero to one with higher scores indicating better performance. The mean is 0.58 for the combined ESG score and 0.64,0.61 and 0.49 for the environmental, social, and governance pillar scores, respectively. The scores for the sample are similar to the mean and median values of samples used in previous research, e.g., Sassen et al.'s European sample and Bouslah et al.'s US sample (Sassen, Hinze et al. 2016), (Bouslah, Kryzanowski et al. 2013). The mean and median systematic risk is slightly lower (systematic risk mean of 0.68) and very similar for the idiosyncratic risk measure (mean of 0.27) to statistics from samples at earlier research, e.g. (Sassen, Hinze et al. 2016), (Bouslah, Kryzanowski, et al. 2013). The total risk mean is 0.34 for the sample. The mean and medians are very similar for both ESG scores and risk measures.

The mean and median of the control variables are in line with the sample characteristics in previous studies, e.g. (Benlemlih, Girerd-Potin 2017), (Bouslah, Kryzanowski et al. 2013), (Sassen, Hinze et al. 2016). The mean (median) of the current ratio is 1.63 (1.37). The dividend mean is 0.03 (0.03), the leverage ratio is 0.17 (0.16), and the liquidity mean 0.95 (0.57), slightly

[1] The ESG score data for 2019 was not yet available for several of the companies when this thesis was conducted and the number of companies therefore significantly decreases in 2019 compared to the years before.

below the liquidity of European and American samples in previous research, e.g. (Benlemlih, Girerd-Potin 2017), (Bouslah, Kryzanowski et al. 2013), (Sassen, Hinze et al. 2016). It could mean that there is lower liquidity in the Nordic market. The market to book value variable mean is 3.17 (2.36) in the sample. The ROA has a variable mean of 0.09 (0.08) and the SDROA variable of 0.05 (0.03), which both are somewhat higher compared to previous studies with older samples from Europe and the US. The size variable mean is 15.17 (15.22) and is slightly below the size variable characteristics of samples in previous studies, e.g. (Sassen, Hinze et al. 2016). The Nordic market is smaller compared to the US or Europe, which may explain the lower liquidity, smaller companies, and higher ROA and SDROA in the sample.

Table 1. Variable description

Type of Variable	Name	Factor	Description
Independent	ESG	ESG Score	Measured as equally weighted ESG pillar scores
	EPillar	Environmental Score	Obtained from Refinitiv, measure of a firm's environmental impact expressed as a percentage (0-100%)
	SPillar	Social Score	Obtained from Refinitiv, measure of a firm's social impact expressed as a percentage (0-100%)
	GPillar	Governance Score	Obtained from Refinitiv, measure of a firm's governance impact expressed as a percentage (0-100%)
Dependent	TOTRisk	Total Risk	The standard deviation of daily stock returns over the previous year
	IR	Idiosyncratic Risk	The annualised standard deviation of the residuals in the Carhart four-factor model based on daily excess returns during the previous year
	Beta	Systematic Risk	Based on the coefficients in the CAPM, where each model was run over monthly excess returns for the previous five years
Control	CuRatio	Current Ratio	Current ratio obtained directly from Datastream defined as current total assets divided by current total liabilities
	DIV	Dividend	Dividends paid divided by average share price the previous year
	LEV	Leverage	Long term debt divided by total assets
	LIQ	Stock trading liquidity	Aggregated yearly volume traded during the previous year divided by common shares outstanding at year-end
	MTBV	Market to book value	Directly from Datastream defined as market value divided with book value of common equity
	ROA	Return on assets	Pretax income divided by the opening balance of total assets
	SDROA	SD of ROA	Standard deviation of ROA over the previous five years
	Size	Size	Natural logarithm of total assets in US dollar

Table 2. Descriptive statistics for the sample

Variable	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
ESG	0.11	0.48	0.59	0.58	0.70	0.92
EPillar	0.13	0.50	0.66	0.64	0.79	0.98
SPillar	0.07	0.47	0.63	0.61	0.77	0.99
GPillar	0.04	0.31	0.50	0.49	0.66	0.98
TOTRisk	0.12	0.25	0.30	0.34	0.39	0.92
IR	0.09	0.20	0.24	0.27	0.32	0.80
Beta	-0.63	0.43	0.67	0.68	0.90	1.78
CuRatio	0.18	1.09	1.37	1.63	1.86	19.64
DIV	0.00	0.01	0.03	0.03	0.04	0.09
LEV	0.00	0.08	0.16	0.17	0.25	0.67
LIQ	0.00	0.14	0.57	0.95	1.14	19.85
MTBV	0.16	1.45	2.36	3.17	3.81	26.24
ROA	-1.48	0.04	0.08	0.09	0.13	0.75
SDROA	0.00	0.02	0.03	0.05	0.06	0.67
Size	10.21	14.25	15.22	15.17	16.04	18.80
N 1651						

Note: Descriptive statistics of Nordic listed firms, including the countries Sweden, Denmark, Norway, and Finland, in the cleaned data set over the full period January 2004 - December 2019.

6.2 Limitations of data

Several limitations make it difficult to make inferences from the data since it would require the sample to be representative for all firms in the Nordics (i.e., randomly selected). The data selection process also has several limitations, as described below. Finally, the validity of the data is discussed.

All listed firms in the Nordics for a limited time period were included in the data, which creates implications for the population validity. Private firms are excluded and might have different risk characteristics compared to public firms. Besides, the selected time-period might not be representative of CSR performance and risk impact in the Nordics. The sample could be subject to survivorship bias; if companies who do not engage in CSR chose not to list, a sample only including listed firms would exclude low CSR performers. A small sample size due to limited data availability might result in a non-representative sample leading to biased outcomes and type II errors.

The data selection process can lead to a biased sample since larger companies might be more likely to be included in Refinitiv's database of ESG scores, and smaller companies might have

a different relationship between CSR performance and firm risk. Companies might also be more inclined to report ESG information if they are good performers or in industries that are more risk-sensitive to ESG performance.

Each year, the dataset has a different number of observations since an increasing number of firms have started to report ESG information over time. Unbalanced panel data is not a problem if observations are missing at random (Wooldridge 2010). In this case, there is an increasing number of firms with ESG scores over time. Better CSR performers and larger firms perhaps have scores for the earlier years to a greater extent, which may bias the results.

The Thomson Reuter databases are widely used in previous research (Sassen, Hinze et al. 2016). The historical financial data should be fairly represented as it is pulled from annual reports and other company filings. The ESG scores are, however, based on Refiniv's methodology and may not be representative of the company's ESG factor performance. Also, they might not be used among investors who may assess the performance within the ESG pillars dimensions differently.

Finally, since no data for the country risk-free rates were available, the European risk-free rate was used as a proxy for the Nordic risk-free rate when estimating the CAPM model and Carhart Four Factor model. The risk-free rate is most commonly measured as the government bond with the maturity of the time period examined (Pratt, Grabowski 2014). This approximation could impact the results since it would impact the dependant risk variables (i.e., idiosyncratic and systematic risk).

7. Results

This chapter presents the results from the regression model. The first section 7.1.1 test for heterogeneity of firms and years to establish the appropriate regression methodology. The following sections, 7.1.2-7.1.5 test for heteroscedasticity, autocorrelation, and stationarity, and multicollinearity. Section 7.2 presents the regression results, and finally, section 7.3 summaries the robustness checks.

7.1 Diagnostic tests

7.1.1 Heterogeneity across companies and years

Firstly, the Breusch-Pagan Lagrange multiplier test tested for variance across firms. The null hypothesis in the test is that the variance over firms is zero. If the null hypothesis fails to be rejected, it would mean no significant difference across firms and that a simple OLS regression should be applied. As shown in Table 3 below, a significant variance across firms could be confirmed with the Breusch-Pagan Lagrange test and needs to be adjusted for. Each of the three models has p-values <0.00, as presented in Table 3, column 3, which indicates that a panel regression model with fixed or random effects is appropriate. Previous research also find heterogeneity across firms in their samples, e.g. (Benlemlih, Girerd-Potin 2017), (Bouslah, Kryzanowski et al. 2013), (Sassen, Hinze et al. 2016).

Table 3. Breusch-Pagan Lagrange multiplier test statistics

dep. var.	chisq	p-value
TOTRisk	273	0.00
IR	585	0.00
Beta	955	0.00
(Pooled data)		

*Note: Three pooled regression models, including all variables, were estimated with total risk (TOTRisk), idiosyncratic risk (IR), and systematic risk (Beta) as dependent variables and including all control variables and the ESG variable for combined ESG performance. It is a chi-squared test, here rejected at *** p < 0.01.*

Secondly, a Hausmann test examined if a fixed or random effect panel regression model would be more suitable. The Hausmann statistic was significant at the 0.01 significance level for all three tests, as presented in Table 4, column 3, which implies that fixed effects for companies need to be applied in all regression models. The fixed-effects model is also in line with previous research that estimates the ESG firm risk relationship (e.g. (Benlemlih, Girerd-Potin 2017) (Bouslah, Kryzanowski et al. 2013) (Sassen, Hinze et al. 2016)).

Table 4. Hausmann test statistics

dep. var.	chisq	p-value
TOTRisk	46	0.00
IR	44	0.00
Beta	51	0.00
(Company fixed or random effect)		

*Note: First, three regression models with fixed effects, including all variables, were estimated with total risk (TOTRisk), idiosyncratic risk (IR), and systematic risk (Beta) as dependent variables and including all control variables and the ESG variable for combined ESG performance. Then three regression models with random effects including all variables were estimated with total risk (TOTRisk), idiosyncratic risk (IR), and systematic risk (Beta) as dependent variables and including all control variables and the ESG variable for combined ESG performance. The test includes both a random and a fixed-effects model for each dependent variable following the Wald criterion. It is a chi-squared test, here rejected at *** p < 0.01.*

Besides, changing economic conditions over time should impact all variables. There were significant effects for all models (Table 5) since the Pr(>Chisq)<0, as shown in column 3, which shows that there should be time fixed effects in the regression. Previous studies also apply time-fixed effects (e.g. (Benlemlih, Girerd-Potin 2017) (Bouslah, Kryzanowski et al. 2013) (Sassen, Hinze et al. 2016)).

Table 5. Year fixed effects: test statistics

dep. var.	chisq	Pr(>Chisq)
TOTRisk	1943	0.00
IR	890	0.00
Beta	64	0.00
(Company fixed effects)		

*Note: Three regression models, including all variables, were estimated with total risk (TOTRisk), idiosyncratic risk (IR), and systematic risk (Beta) as dependent variables, including all control variables and the ESG variable for combined ESG performance. It is a chi-squared test, here rejected at *** p < 0.01.*

7.1.2 Heteroscedasticity

The Breusch-Pagan test for homoskedasticity suggested that robust standard errors need to be applied to the coefficients since all models resulted in significant test statistics at the 0.01 significance level, as shown in Table 6, column 3 where all p-values<0. Benlemlih et al., among others, also find heteroscedasticity and apply robust standard errors (Sassen, Hinze et al. 2016), (Benlemlih, Girerd-Potin 2017), (Bouslah, Kryzanowski, et al. 2013).

Table 6. Breusch-Pagan test statistics

dep. var.	BP	p-value
TOTRisk	131	0.00
IR	159	0.00
Beta	205	0.00
(Company and yearly fixed effects)		

*Note: Three regression models, including all variables, were estimated with total risk (TOTRisk), idiosyncratic risk (IR), and systematic risk (Beta) as dependent variables, including all control variables and the ESG variable for combined ESG performance. For each model, the squared residuals are regressed on the independent variables as per the Breusch-Pagan test methodology. It is a chi-squared test, here rejected at *** p < 0.01.*

7.1.3 Autocorrelation and contemporaneous correlation

A Wooldridge test established serial correlation, and Table 7 shows the test statistics. There is serial correlation in all the models since the p-values are <0 for all three models (Table 7, column 3), and the error terms will thus be biased and robust Newey-West adjusted standard errors should be applied.

Table 7. Wooldridge test statistics for serial correlation

dep. var.	F	p-value
TOTRisk	78	0.00
IR	95	0.00
Beta	927	0.00

*Note: Three regression models, including all variables, were estimated with total risk (TOTRisk), idiosyncratic risk (IR), and systematic risk (Beta) as dependent variables, including all control variables and the ESG variable for combined ESG performance. Here rejected at *** p < 0.01*

Table 8 presents the results from the Pasaran CD test for contemporaneous correlation. The null hypothesis in the Pasaran CD tests of independence is that residuals across entities are not correlated. Cross-sectional dependence could be a problem in the total risk and systematic risk models but only at 0.1 significance level, and there was no cross-sectional dependence in the idiosyncratic risk model.

Table 8. Pasaran CD test statistics

dep. var.	Z	p-value
TOTRisk	-1.88	0.06
IR	-1.36	0.17
Beta	-2.22	0.03

*Note: Three regression models, including all variables, were estimated with total risk (TOTRisk), idiosyncratic risk (IR), and systematic risk (Beta) as dependent variables, including all control variables and the ESG variable for combined ESG performance. No cross-sectional dependence in total risk and idiosyncratic risk model, however, rejected for the systematic risk model at *** p < 0.01*

Several previous studies find autocorrelation and employ adjusted standard errors (clustered standard errors by firm), e.g. (Bouslah, Kryzanowski et al. 2013), (Sassen, Hinze et al. 2016)).

7.1.4 Stationarity

The residuals of the model were tested for unit roots with a Pesaran and Shin test. Table 9 presents the test statistics, and the hypothesis that the time series has a unit root is rejected at the 0.01 significance level, and non-stationarity should, therefore, not be a problem in the model. The p-values are all <0.01, as presented in Table 9, column 4. Other studies do not test for stationarity, e.g. (Benlemlih, Girerd-Potin 2017), (Bouslah, Kryzanowski, et al. 2013), (Sassen, Hinze et al. 2016).

Table 9. Pesaran and Shin (IPS) test for unit roots

	CIP test	Lag order	p-value
TotRisk	-1.728	2	<0.01
IR	-1.953	2	<0.01
Beta	-1.665	2	<0.01

*Note: Three regression models, including all variables, were estimated with total risk (TOTRisk), idiosyncratic risk (IR), and systematic risk (Beta) as dependent variables, including all control variables and the ESG variable for combined ESG performance. Pesaran and Shin (IPS) test for unit roots in panel models for the error terms, here rejected at *** $p < 0.01$*

7.1.5 Multicollinearity

Finally, the model was tested for multicollinearity through a VIF test. A VIF factor >10 suggests severe multicollinearity problems. The results from the VIF test are presented in Table 10. No VIF factors in any of the models were >2, which makes it reasonable to assume that multicollinearity should not impact the results. The largest VIF is for the Size variable of 1.6, as presented in column 3, Table 10. The results are in line with previous research, e.g., (Sassen, Hinze et al. 2016).

Table 10. VIF factors

dep. var.	ESG	Size	ROA	LEV	SDROA	LIQ	CuRatio	DIV	MTBV
TOTRisk	1.4	1.6	1.4	1.1	1.1	1.0	1.1	1.1	1.5
IR	1.4	1.6	1.4	1.1	1.1	1.0	1.1	1.1	1.5
Beta	1.4	1.6	1.4	1.1	1.1	1.0	1.1	1.1	1.5

Note: Three regression models, including all variables, were estimated with total risk (TOTRisk), idiosyncratic risk (IR), and systematic risk (Beta) as dependent variables, including all control variables and the ESG variable for combined ESG performance.

7.2 Regression outputs

The results from the three model specifications are presented in Table 11. Both company and time fixed effects were included for all models. Initially, the models were estimated with only control variables (column 2-4 in Table 11), and afterward, the ESG factor was added to the models (column 5-7 in Table 11).

Size has a significantly negative impact on total risk with a parameter estimate of -0.019 and idiosyncratic risk of -0.034 and no significant effect on systematic risk (Beta) with a standardised coefficient of -0.010 (column 3 Table 11). The results are expected based on previous research that finds lower firm risk from size (Ben-Zion, Shalit 1975). The idiosyncratic risk and total risk impact could be explained by theories suggesting that economies of scale,

diversification benefits, and survivorship of more successful firms over time reduces the idiosyncratic risk.

The standardized coefficient for ROA is negative for total risk (-0.204) and idiosyncratic risk (-0.214) at the 0.01 significance level as expected; however, it has an insignificant positive impact on systematic risk (standardized coefficient of 0.188). Strong returns may be an important protection from firm-specific shocks but may not provide any protection in market downturns.

Leverage and SDROA are insignificant for all models but with a positive impact as expected from previous research (Ben-Zion, Shalit 1975). The beta parameter estimate for leverage is 0.007, 0.016, and 0.010 for total risk, systematic risk, and idiosyncratic risk, respectively. The standardized coefficients for SDROA are 0.111, 0.408, and 0.057 for total risk, systematic risk, and idiosyncratic risk, respectively.

Trading liquidity has a significantly positive impact on all three risk measures at the 0.05 significance level with a total risk beta parameter estimate of 0.009, systematic risk of 0.023 and idiosyncratic risk of 0.005, which is in line with previous research and could indicate that there is either mispricing due to noise trading or less internal firm monitoring for liquid firms (Brogaard, Li et al. 2017).

Dividend has as expected a significantly negative impact at the 0.05 level for all risk measures, with the largest impact for systematic risk of -3.131. The total risk beta coefficient is -0.501, and the idiosyncratic risk coefficient is -0.501. The stronger impact on systematic risk is expected as dividends propose lower earnings volatility and higher protection of investor return in market downturns (Ben-Zion, Shalit 1975).

Both the parameter estimates for current ratio and market to book ratio are 0 and not significant for the total firm risk measure, however current ratio has a risk-reducing impact on idiosyncratic risk at 0.1 significance level with a coefficient of -0.003, and market to book value has a positive impact on systematic firm risk at 0.01 significance level with a coefficient of 0.017. The lower idiosyncratic risk from the current ratio can be explained by the lower volatility of return on liquid assets (Beaver, Kettler et al. 1970). Liquid assets can also be sold in times of a firm-specific shock, e.g. (Brogaard, Li et al. 2017). Market to book value was included to control for a firm's growth prospects. Firms with high market to book values are assumed to have higher growth prospects compared to firms with lower market to book values. The results were positive

for systematic risk, which suggests that high growth firms are more sensitive to market downturns.

In conclusion, all parameter estimates for the control variables are in line with expectations as per previous research, and most of them are significant. The model seems to incorporate a few of the factors impacting firm risk successfully.

The ESG factor was afterward added to all three models, as shown in columns 3-6 Table 11. The control parameter estimates are essentially the same with no change of significance level. The impact of ESG is not significant for any of the market risk measures. However, the coefficients of the independent variable ESG were all negative, with an average of -1.7% impact on total risk, an average of -12.8% impact on systematic risk, and an average of -3.4% on idiosyncratic risk.

There is no evidence in support of any of the hypotheses, and there is no solid proof that ESG performance has any overall impact on firm market risk factors for the period. The results are, however, indicative of a risk-reducing relationship but insignificant.

Table 11. Output for models with ESG combined score

	Total Risk		Beta		IR		Total Risk		Beta		IR	
ESG							-0.017		-0.128		-0.034	
							(0.029)		(0.160)		(0.025)	
Size	-0.019	**	-0.010		-0.034	***	-0.019	**	-0.005		-0.032	***
	(0.010)		(0.051)		(0.008)		(0.010)		(0.050)		(0.008)	
ROA	-0.204	***	0.188		-0.214	***	-0.202	***	0.199		-0.211	***
	(0.042)		(0.126)		(0.037)		(0.043)		(0.123)		(0.038)	
LEV	0.007		0.016		0.010		0.007		0.018		0.010	
	(0.042)		(0.184)		(0.041)		(0.042)		(0.184)		(0.040)	
SDROA	0.111		0.408		0.057		0.116		0.445		0.067	
	(0.144)		(0.623)		(0.117)		(0.142)		(0.611)		(0.115)	
LIQ	0.009	***	0.023	**	0.005	***	0.009	***	0.023	**	0.005	***
	(0.002)		(0.009)		(0.001)		(0.002)		(0.009)		(0.001)	
CuRatio	0.000		0.005		-0.003	*	0.000		0.005		-0.003	*
	(0.001)		(0.010)		(0.001)		(0.001)		(0.010)		(0.001)	
DIV	-0.501	**	-3.131	***	-0.520	***	-0.488	**	-3.032	***	-0.494	***
	(0.215)		(0.955)		(0.193)		(0.212)		(0.925)		(0.188)	
MTBV	0.000		0.017	***	-0.002		0.000		0.016	***	-0.002	
	(0.002)		(0.005)		(0.002)		(0.002)		(0.005)		(0.002)	
Observations	1651		1651		1651		1651		1651		1651	
adj. R^2	-0.082		-0.113		-0.019		-0.082		-0.112		-0.018	

*Note: Column 2-4 presents the coefficients for the three models (Total risk as dependent variable, systematic risk (Beta) as the dependent variable and idiosyncratic risk (IR) as dependent variable), including only control variables. Column 5-7 presents the coefficients for the model with the three models (Total risk as the dependent variable, systematic risk (Beta) as the dependent variable and idiosyncratic risk (IR) as dependent variable), including the ESG variable. Heteroscedasticity-robust Newey-West standard errors are in parentheses. All three models have fixed effects for both companies and years. * p < 0.10, ** p < 0.05, *** p < 0.01*

7.3 Robustness checks

A few robustness checks were performed to verify the results from the previous section. The most important concern is the definition of the independent variable, ESG performance, and whether an appropriate measure of sustainability performance is applied. The after-crisis time period was further examined as a second robustness check of the results.

7.3.1 Incorporating ESG dimensions

The relationship between a company's ESG performance and market risk factors can be impacted by how the scores are measured or if it is an appropriate measurement method. If the different dimensions of ESG impact firm risk differently, it might lead to unsatisfactory conclusions as one dimension's positive impact might offset another dimension's negative impact. Previous research has shown impact from different dimensions, and the results differ across the studies, e.g. (Sassen, Hinze et al. 2016), (El Ghoul, Guedhami et al. 2011), (Bouslah,

Kryzanowski, et al. 2013). Governance may, for example, have a negative impact on firm risk that may be offset by a positive impact of environmental performance.

Three additional relationships were estimated to more thoroughly examine how a company's sustainability performance impacts firm risk:

$$\begin{aligned} TotRisk_{it} = {} & \alpha_{it} + \beta_1 EPillar_{it} + \beta_2 SPillar_{it} + \beta_3 GPillar_{it} + \beta_4 Size_{it} + \beta_5 ROA_{it} \\ & + \beta_6 CuRatio_{it} + \beta_7 MBV_{it} + \beta_8 Lev_{it} + \beta_9 Liq_{it} + \beta_{10} Div_{it} \\ & + \beta_{11} SDROA_{it} + \epsilon_{it} \end{aligned}$$

$$\begin{aligned} Beta_{it} = {} & \alpha_{it} + \beta_1 EPillar_{it} + \beta_2 SPillar_{it} + \beta_3 GPillar_{it} + \beta_4 Size_{it} + \beta_5 ROA_{it} \\ & + \beta_6 CuRatio_{it} + \beta_7 MBV_{it} + \beta_8 Lev_{it} + \beta_9 Liq_{it} + \beta_{10} Div_{it} \\ & + \beta_{11} SDROA_{it} + \epsilon_{it} \end{aligned}$$

$$\begin{aligned} IR_{it} = {} & \alpha_{it} + \beta_1 EPillar_{it} + \beta_2 SPillar_{it} + \beta_3 GPillar_{it} + \beta_4 Size_{it} + \beta_5 ROA_{it} \\ & + \beta_6 CuRatio_{it} + \beta_7 MBV_{it} + \beta_8 Lev_{it} + \beta_9 Liq_{it} + \beta_{10} Div_{it} \\ & + \beta_{11} SDROA_{it} + \epsilon_{it} \end{aligned}$$

where β represents the associated coefficients. The combined ESG scores are in these regressions replaced with each component of ESG, the environmental pillar, social pillar, and governance pillar scores: *EPillar, SPillar,* and *GPillar*. The control and dependent variables are the same as in the first three regressions. If the pillar score coefficients are significantly different from zero, it indicates that a firm's performance within each of its ESG pillar dimensions affects the firm market risk factor.

The results presented in Table 12 are similar to previous findings, and the control variable estimates follow previous findings. The main exception is the standardised coefficients for the environmental pillar score, as they are positive.

There is a weak insignificant negative impact on total firm risk from the social pillar (-0.025) and governance pillar scores (-0.003) and a weak, insignificant positive impact from the environmental pillar score of 0.017 on total firm risk. The parameter estimates for the social pillar score in the systematic risk model is -0.117 and in the idiosyncratic risk model is -0.024. The governance pillar score parameter estimates are -0.109 and -0.012 for systematic and idiosyncratic risk, respectively. The environmental pillar score impacts systematic and idiosyncratic risk positively of 0.160 and 0.006, respectively. The coefficients are more negative (positive) for the model with systematic risk as the dependant variable. This may suggest that the pillar score, on average, has a large impact on the systematic risk variable. The

results from the robustness check do not provide enough evidence to confirm any of the hypotheses. They are, however, indicative of a negative impact from the social and government pillar scores and indicative of a positive impact from the environmental pillar score.

Table 12. Output from regression models with environmental, social and governance pillar scores

	Total Risk		**Beta**		**IR**	
EPillar	0.017		0.160		0.006	
	(0.022)		(0.136)		(0.016)	
SPillar	-0.025		-0.117		-0.024	
	(0.021)		(0.118)		(0.018)	
GPillar	-0.003		-0.109		-0.012	
	(0.014)		(0.076)		(0.014)	
Size	-0.019	*	-0.010		-0.032	***
	(0.010)		(0.049)		(0.008)	
ROA	-0.203	***	0.190		-0.211	***
	(0.043)		(0.123)		(0.038)	
LEV	0.006		0.020		0.010	
	(0.042)		(0.181)		(0.040)	
SDROA	0.116		0.420		0.067	
	(0.142)		(0.615)		(0.115)	
LIQ	0.008	***	0.021	**	0.005	**
	(0.002)		(0.010)		(0.002)	
CuRatio	0.000		0.007		-0.002	*
	(0.001)		(0.009)		(0.001)	
DIV	-0.487	**	-3.016	***	-0.493	**
	(0.212)		(0.917)		(0.188)	
MTBV	0.000		0.016	***	-0.002	
	(0.002)		(0.006)		(0.002)	
Year FE	YES		YES		YES	
Company FE	YES		YES		YES	
Observations	1651		1651		1651	
adj. R^2	-0.082		-0.107		-0.019	

*Note: Column 2 presents the coefficients for the model with the dependent variable for total risk. Column 3 presents the coefficients for the model with the dependent variable systematic risk (Beta). The third column presents the model with idiosyncratic risk as a dependent variable. Heteroscedasticity-robust Newey-West standard errors are in parentheses. All three models included fixed effects for both companies and years. * p < 0.10, ** p < 0.05, *** p < 0.01*

7.3.2 After-crisis period

Previous research has shown a different impact of CSR performance on firm risk during the financial crisis (Bouslah, Kryzanowski et al. 2018). Since the years of the financial crisis are included in the sample, it may limit the conclusions to be drawn from my results for other periods. The time period included in the regression was limited to 2010-2019 to see if there would be different results for the after-crisis period. This limits the number of observations but provides an additional robustness check.

The results from the regression for 2010-2019 are presented in Table 13. The parameter estimates for the control variables are similar to the measures for the 2004-2019 sample. For example, ROA is strongly negative, with significant estimates in the total risk model of -0.233 and idiosyncratic risk model of -0.220 at the 0.01 significance level. The main discrepancy between the control variable parameter estimates for the samples is the leverage coefficient for the systematic risk model. For 2010-2019 the leverage estimate is strongly negative of -0.447 at 0.01 significance level in the systematic risk model. The coefficient was insignificant and weakly positive for the full sample. The strongly negative coefficient contradicts previous research that finds higher risk from leverage. The finding instead suggests that the systematic risk is lower for firms with more leverage for the period. Another possibility could be that the systematic risk model poorly estimates the real relationship between the variables and systematic risk.

The coefficient of the independent variable ESG is -0.077 in the model with idiosyncratic risk as the dependent variable at the 0.05 significance level. The model that estimates total risk also has a significant negative ESG parameter estimate of -0.079, but at the 0.10 significance level. The standardised ESG coefficient for the model with Beta as the dependent variable was insignificant and positive of 0.139. The results support hypotheses 1 and 3 that a company's total firm market risk and idiosyncratic risk are impacted by corporate social performance.

Table 13. Output from regression models for 2010-2019 with ESG as independent variable

	Total Risk		Beta		IR	
ESG	-0.079	*	0.139		-0.077	**
	(0.041)		(0.150)		(0.033)	
Size	0.014		0.051		-0.001	
	(0.015)		(0.044)		(0.014)	
ROA	-0.233	***	0.177		-0.220	***
	(0.050)		(0.142)		(0.045)	
LEV	0.008		-0.447	***	0.016	
	(0.062)		(0.162)		(0.060)	
SDROA	0.102		1.032	*	0.036	
	(0.155)		(0.534)		(0.117)	
LIQ	0.007	*	0.009		0.003	
	(0.004)		(0.008)		(0.004)	
CuRatio	-0.001		0.019	**	-0.004	**
	(0.002)		(0.009)		(0.002)	
DIV	-0.113		-0.505		-0.239	
	(0.246)		(0.833)		(0.224)	
MTBV	-0.001		0.016	**	-0.003	*
	(0.002)		(0.007)		(0.002)	
Observations	1169		1169		1169	
adj. R^2	-0.162		-0.196		-0.133	

*Note: In column 2, the coefficients for the model with the dependent variable for total risk are presented. In column 3, the coefficients for the model with the dependent variable systematic risk (Beta) are presented. In the fourth column, the model with idiosyncratic risk as a dependent variable is presented. Heteroscedasticity-robust Newey-West standard errors are in parentheses. Fixed effects for both companies and years were included in all three models. * p < 0.10, ** p < 0.05, *** p < 0.01*

8. Discussion

8.1 Analysing the results

The first set of results presented in the previous section suggest an impact of ESG factors on firm risk during the period of 2004-2019. The parameter estimates for the ESG factors were negative, however, insignificant. Hypothesis 1, that corporate social performance impacts total firm market risk or for hypothesis 2, that corporate social performance impacts systematic risk or hypothesis 3, that corporate social performance impacts idiosyncratic risk, are thus not assuredly supported in the data. When limiting the time-period to data between 2010-2019, a negative impact from ESG performance was found for the total and idiosyncratic risk measures, at the 0.10 and 0.05 significance level, respectively. The overall inference from ESG performance is small in the studied setting.

One possibility is that ESG performance does not have an impact on firm market risk in the sample of data from 2004-2019. The negative coefficients for the ESG performance score could be by chance, and the firm market risk factors may thus not be impacted by ESG. Alternatively,

investors may not acknowledge or pay attention to the Refinitiv ESG performance scores, and it might thus not be incorporated in the market risk measure.

A second alternative is that there is an impact of CSR performance on firm market risk. The negative coefficient for ESG might not be by chance, and a negative relationship may thus be existing for all three market risk measures. This could, in that case, be due to the existence of moral capital in bad times as predicted by risk management theory. It could also be since the risk for stranded assets are lower. Stakeholder theory might also apply since a focus on stakeholders' implicit claims today might lower the risk of explicit claims in the future, which would lower the company risk. The increased transparency from CSR engagements could reduce agency costs and thus lead to better access to capital and lower risk. The model with systematic risk as dependant variable showed the most negative ESG coefficient. This could be by coincidence or indicate that the effects of CSR impacts systematic risk a lot. That would mean that a company that engages in CSR is less sensitive to market downturns. Such a finding would be in support of, for example, risk management theory since moral capital could make a firm less sensitive to market movements.

Another possibility is that there are issues with the model so that it fails to explain the CSR-firm risk relationship for the period correctly. ESG factors may be an inappropriate measurement method for corporate social performance. The scoring approach may be focused on the wrong factors or may weigh the factors improperly. In conclusion, the results are insignificant for the larger sample (2004-2019) but suggest a weak negative impact from ESG performance on total and idiosyncratic risk and a strong insignificant negative impact from ESG performance on systematic risk in the studied setting.

The results for the first sample was supported by the robustness check, which examined the separate pillar scores individually, since the independent pillar scores showed similar insignificant results. There is an insignificant negative impact from the social and governance pillar scores on all risk measures, and the environmental pillar score has an insignificant positive impact on all three market risk measures in the studied setting. Since the environmental pillar scores have positive coefficients, and the other pillar scores have negative coefficients, a combined ESG score may diffuse the results. Similar to previous findings, the systematic risk coefficient was the most negative (positive) for all three pillar scores. This could be by chance or could suggest that ESG greatly impacts systematic risk. A negative impact on firm risk from the governance pillar scores could indicate that better governance reduces agency costs. The social pillar score impact could be explained by the stakeholder theory and risk management

theory. Better performance might provide insurance-like protection in bad times, and theories about the risk of stranded assets might apply if the risk of losing customers due to unexpected future social pillar factors is reduced. If there is a positive impact from the environmental pillar score, it could be explained by managerial opportunism theory. Managers may overinvest in CSR in good times and benefit from the "warm glow" effect since they will be viewed as good global citizens. The interpretation of such a positive coefficient needs to be done cautiously since the pillar scores are measures of relative performance within each sector. In the study, the model is not controlling for sectors, and it could be that better environmental performance reduces firm risk but not relative to other players in its industry. Alternatively, environmental performance may only matter in some industries that are more sensitive to environmental performance, which is not controlled for, or it may be risky to be the environmental leader in a sector since it may require costs and investments in new, untested technology.

For the second robustness check, the time period was limited to the after-crisis period 2010-2019. The study of the more recent period provides support for hypotheses 1 and 3 since there is a significantly negative impact on idiosyncratic risk and total risk from ESG performance. The difference compared to including all years for the more extended period could either be explained by randomness in the samples or could indicate that the ESG performance relationship is different during more recent years. It could also be due to improved reporting and measurement of ESG over time or be due to changing investor preferences. The reduced idiosyncratic risk could be due to the avoidance of stranded assets and be explained by stakeholder theory. Better relationships with stakeholders today may reduce the likelihood of explicit claims in the future. There is no support for a relationship between ESG performance and systematic risk in the studied setting. The standardised ESG parameter was positive but insignificant for the systematic risk model, which makes it difficult to draw any conclusions. This could be by chance or indicate that systematic risk is higher among better ESG performers during the after-crisis period.

My findings are, for the most part, in line with previous research but somewhat less significant. Most previous studies find a significant risk-reducing relationships between aggregated ESG scores and total, systematic and idiosyncratic risk, e.g. (Orlitzky, Benjamin 2001), (Albuquerque, Koskinen et al. 2019), (Benlemlih, Jaballah et al. 2018), (Luo, Bhattacharya 2009), (Lee, Faff 2009). The results for the larger sample 2004-2019 are, therefore, in line with these studies as the results are indicative of risk-reducing effects on all three risk measures, however insignificant.

The results for the larger sample, 2004-2019, show a strong insignificant impact from ESG performance on systematic risk. Some previous research suggests a greater effect on the idiosyncratic risk measure compared to the systematic risk measure, e.g. (Sassen, Hinze et al. 2016). However, several previous studies demonstrate the impact on systematic risk, e.g. (Albuquerque, Koskinen et al. 2019), (Benlemlih, Jaballah et al. 2018). Therefore, the findings of a strong impact of ESG performance in the systematic risk measure model does not contradict previous research and may provide support for studies that find ESG to be a critical determinant of the systematic risk.

The first robustness check with the separate pillar scores finds an insignificant risk-reducing effect for the social and governance pillar scores and an insignificant risk increasing impact from the environmental pillar score for all three risk measures. Previous research on the different dimensions of ESG is limited and inconclusive. My results are in line with Bouslah et al. that find increased risk for environmental strengths for S&P500 firms and reduced firm risk from corporate governance and community strengths. On the other hand, Sassen et al.'s study finds no impact from the corporate governance pillar score and a risk reducing-impact on idiosyncratic risk only, for the social and environmental pillar scores. Several other studies find lower firm risk from corporate governance strengths, e.g. (Ferreira, Laux 2007), (Mathew, Ibrahim et al. 2018)), which is in line with my results.

The findings for the after-crisis period are significantly negative for the total and idiosyncratic risk, which follows most previous research that finds significant risk-reducing impact from ESG. The parameter ESG estimate for the systematic risk model is insignificant but strongly positive. Some studies find insignificant results from ESG strengths on systematic risk, e.g. (Oikonomou, Brooks et al. 2012). Most studies, however, find a significant risk-reducing relationship. The indication of higher systematic risk among better ESG performers during the after-crisis period is, therefore, not in line with most previous studies.

The discrepancy of the ESG performance – systematic risk correlation with previous research needs to be carefully understood. My insignificant finding could also mean that the positive coefficient is by chance or that the model poorly estimates the real relationship between the variables and systematic risk. The parameter estimate for the control variable leverage in the model also contradicts previous research. The leverage parameter estimate is significantly and strongly negative, and thus risk-reducing in the model. This may indicate that there is an issue with the model estimation and that the estimates for the systematic risk model are wrong.

The low adjusted R-squared in Table 11, Table 12, and Table 13 suggest that there is a large amount of unexplainable variation in the models. The market risk factors might be difficult to predict by nature. Alternatively, there could be a more appropriate model with different variables, or the model should be controlling for additional factors. Besides, the relationship examined might suffer from endogeneity since firms might experience higher CSR performance if they have a lower risk. The endogeneity was not examined in this paper but would need to be considered if a CSR performance firm risk relationship can be established.

There is limited inference from my results as with most of the previous research within this field. The method is sensitive to differences in ESG measures, the context of the study, the time period, as well as how representative the sample is for the general population. This was also confirmed by the discrepancies in results between the original time period and the robustness check for the later time period. As previously discussed, the sample is limited to only include listed Nordic firms, which poses several issues. Some ESG information is not mandatory to disclose in financial reports, and if only firms with high sustainability performance decide to disclose such information, the sample will only include good CSR performers. Larger firms tend to have measures of ESG performance in the database and are overrepresented in the sample. Private firms are excluded and might have different risk characteristics compared to public firms. There is also a risk of overfitting since random circumstances may be affecting the results from the sample, and the results might, therefore, be difficult to replicate.

8.2 Further implications

If there would be a risk-reducing relationship with any of the CSR dimensions, managers should consider CSR in their risk management strategies. It would, in that case, be beneficial to engage in activities that would reduce a company's impact on the surrounding natural environment, improve its relation to its workforce, employees, overall community as well as work with diversity, governance and CSR strategy. Besides, in that case, portfolio managers should consider CSR in their risk assessment. The findings of studies that examine the relationship between CSR performance and firm market risk are, therefore, of interest to both business managers and investors.

Previous research has proven the importance of differences between institutional environments and ESG measurement methods for the outcome of the study. Although the findings in this study were significant for the later period only, one cannot exclude the possibility that CSR performance impacts firm risk. The relationship between CSR performance and firm risk needs

to be examined in additional studies in the Nordic context. It is an important topic since such an impact would make a business case for CSR as well as has broader economic implications. Future research is therefore needed on the different dimensions of CSR as well as with varying measures of risk and ESG measure methodologies.

9. Conclusion

This paper examines whether corporate social responsibility impacts firm market risk. It fills an important research gap by investigating corporate social performance in a Nordic context and separately examines both total, systematic and idiosyncratic risk. The hypotheses were that ESG factor performance has an impact on total, systematic and idiosyncratic firm market risk. Three linear multivariate regression models with several control variables were estimated to study the CSR – firm risk relationship.

The relationship between ESG performance and firm risk is not confidently supported in the data for the full sample of firms in the period of 2004-2019 in the Nordics. There is yet, insignificant, weak risk-reducing effects of ESG performance with stronger effects for the systematic risk measure in the studied setting. These results could be coincidental, or a relationship between ESG performance, and firm risk might exist despite insignificant findings. When limiting the time-period to data between 2010-2019, a negative impact from ESG performance is found for the total and idiosyncratic risk measures, at the 0.10 and 0.05 significance level, respectively. It may be due to different characteristics of the ESG performance – firm market risk relationship, due to improved reporting and measurement of ESG or derive from random differences between the periods.

Further, the estimated results may have been affected by data limitations and methodological issues. The overall inference from ESG performance's impact on firm market risk is small in the studied setting. The results are in line with most previous research that finds a risk-reducing relationship for CSR performance and firm risk. Future research is needed to further examine the relationship between CSR and firm risk.

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