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The Reciprocal Relationship between Corporate Social Performance and Financial Risk

A quantitative study on publicly listed firms in the Nordics

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Abstract

The interest in corporate social performance (CSP) and socially responsible investing (SRI) has increased remarkably over the past years as a result of numerous global developments and heightened pressures from internal and external stakeholders. The mixed views and ambiguous empirical evidence on the implications that CSP has on corporations' financial risk has left corporate managers and investors with an unclear answer as to how much effort should be put into socially responsible activities. This paper purposefully attempts to fill this research gap by examining the relationship between CSP and financial risk for a sample of 150 publicly listed firms in the Nordics, excluding Iceland, between the years 2002 and 2017. We find it to be particularly interesting to investigate this region given the leading role that the Nordic countries play when it comes to sustainable investing. Environmental, social and governance (ESG) scores provided by Thomson Reuters ASSET4 database are used as proxies for CSP, whereas firm risk is measured by total, systematic and firm-specific risk.

By employing a panel autoregressive (VAR) model, we find a negative and bi-directional causality between aggregate ESG and total and specific risk. At a disaggregate level, we reveal that each ESG dimension also impacts total and specific risk negatively. The reciprocal effect of firm risk on CSP, in turn, depends on the ESG dimension in question: total and specific risk negatively affect environmental performance, positively and negatively impact social performance (alternatingly), and positively impact corporate governance. As for systematic risk, no significant interaction with the CSP measures is found.

Comprehensively, our findings provide evidence of an intricate relationship between CSP and firm risk and they support the idea that there is a business case for corporate social responsibility and performance in the Nordic market.

Keywords: Corporate Social Performance (CSP), Environmental, Social and Governance (ESG), Corporate financial risk, Nordic market.

Table of contents

Abbreviations

CAPM – Capital Asset Pricing Model

CSP – Corporate Social Performance

CSR – Corporate Social Responsibility

ESG – Environmental, Social and Governance

FE – Fixed Effect

KLD – Kinder, Lydenberg and Domini Index

LT – Long Term

LTM – Last Twelve Months

MLR – Multiple Linear Regression

MTB – Market-to-Book ratio

OVB – Omitted Variable Bias

RE – Random Effect

SRI – Socially Responsible Investing

VAR – Vector Autoregressive Model

1. Introduction

Corporate social performance (CSP) has grown to be a key priority for firms, stakeholders and investors. As defined by one of its proponents, CSP entails the extent to which a firm's policies and processes are motivated by actions of social responsibility and the degree to which a corporation's actions contribute towards the common good of society (Wood, 1991). The effectiveness of such pro-social actions can be assessed through the integration of environmental, social and governance (ESG) measures, which have proven to reach a growth rate of 123% for European investments between 2015 and 2017 (Eurosif, 2018). This confirms investors' growing commitment for incorporating ESG factors into their strategies. In financial markets the leading credit agencies Moody's, Fitch and S&P are all accounting for ESG factors in their credit analyses, as a way to comprehensively address risk factors affecting business risk, financial risk as well as management and governance (Standard & Poor's, 2018; Moody's, 2017; Fitch Ratings, 2019). The CFA Institute (2018) also reports that 65% of surveyed financial professionals ranked risk management as the primary reason for ESG integration in equity investments. Consequently, ESG has emerged as an important risk mitigating tool within financial markets.

While a large empirical focus has been set on the effect that CSP has on corporate financial performance, the literature on the association between CSP and corporate financial risk is, in relative terms, in its emerging stages. Still, research shows that businesses do not primarily get involved in CSP for the reason of financial performance and returns, but rather for the purpose of improving their risk management (CFA Institute, 2018). At an aggregated US, European and global level, existing studies find consistent results of a negative relationship between CSP and firm risk (e.g. Bouslah et al., 2013; Sassen et al., 2016; Chollet & Sandwidi, 2018). Still, there is much to explore about the relationship between CSP and firm risk, as the majority of previous studies do not capture the direction of causality between the two. Additionally, the results are ambiguous for different subsamples and subcategories of CSP and for different risk measures accounted for (Bouslah et al., 2013; Sassen et al., 2016). For instance, Bouslah et al. (2013) find both positive and negative relationships for distinct subsamples, suggesting that the aggregated findings for the CSP-risk interaction are not necessarily valid for subsamples at a disaggregate level.

In light of ESG engagement, the Nordic countries have been pioneers in introducing regulatory frameworks and standards designed to promote ESG efforts in financial management (Sandberg et al., 2009). Nordic firms have moreover, during the past decades, consistently been in the forefront when it comes to green investing and complying with socially responsible investing (SRI) behaviour (Climate Bond Initiative, 2018). In the Global Sustainable Competitiveness Index 2017, all Nordic countries excluding Iceland are covered in the top 5 list, with Sweden as the global leader (SolAbility, 2017). The Nordic countries are additionally ranked among the most highly performing global green bond issuers according to international indices for sustainable performance, including the Dow Jones Sustainability Index (Climate Bond Initiative, 2018). Swedish issuance of green bonds dominates in the region, representing 18% of the green bonds market in Europe in 2018, with its neighbouring Nordic countries following closely after (Climate Bonds Initiative, 2018). Despite the Nordics's leading position within SRI and ESG engagement, research done on the association between CSP and financial risk in this particular market is still, to the best of our knowledge, untapped.

We deem it of particular interest to investigate the relation between CSP and financial risk for the Nordic market. The purpose of this thesis is hence to empirically investigate the impact of CSP, in terms of aggregated ESG and the separate ESG dimensions, on corporate financial risk for Nordic listed firms. In light of this, our study attempts to elaborate on the following research questions:

1. *What relationship exists between Nordic firms' aggregated ESG performance and financial risk?*

2. *What relationship exists between Nordic firms' disaggregated environmental, social and governance performance and financial risk?*

With a panel of 150 Nordic listed firms between the years 2002-2017, we empirically explore the research questions by applying a panel fixed-effect approach, as the majority of prior studies do. Subsequently, we advance the research further by applying a panel vector autoregressive (VAR) model that captures the reciprocal interactions between financial risk and CSP. Such a method provides valuable insight as, to the best of our knowledge, it has thus far only been employed by three prior studies related to the CSP-risk link (Bouslah et al., 2013; Sassen et al., 2016; Chollet & Sandwidi, 2018). Notably, this study contributes to the existing research by examining the so-far untapped Nordic market, excluding Iceland, by valuably exploring the reciprocal interaction between CSP and financial risk, and by finding the sign of causality which captures the causal impact of CSP on firm risk and the corresponding impact of firm risk on CSP.

The subsequent sections of this study are structured as follows: *Chapter 2* initially sheds light on the relevant prior research performed on the association between corporate social performance and financial risk, followed by a description of how this study specifically contributes towards literature. *Chapter 3* elaborates on a number of relevant economic theories related to the CSP-risk link, which thereafter are used to define our research hypotheses. *Chapter 4* exposes the sources of data, alongside our dependent, independent and control variables that have been selected for the regression analysis. *Chapter 5* thereafter describes the chosen methodology used to answer our research question. *Chapter 6* elaborates on the results obtained and is followed by a further empirical and practical discussion of results and thesis limitations in *Chapter 7*. Finally, *Chapter 8* summarizes the study's findings, discusses the study's overall practical contributions, and concludes by highlighting plausible suggestions for future research.

2. Literature

This section initially presents an overview over related prior research performed on the relationship between corporate social performance and financial risk, followed by a description of how this study valuably contributes to literature.

2.1 Prior research

While the relationship between CSP and corporate financial performance proves to already be a well-researched topic (e.g. Waddock & Graves, 1997; Orlitzky et al., 2003; Margolis et al., 2009), literature conducted on the link between CSP and corporate financial risk still forms part of a comparatively less dominant theme in research. The following research articles are among the relatively few that exist on the CSP-risk link and, as will be shown, most of the existing studies are either restricted to small data samples or focus on aggregate CSP measures for firms in the European, U.S. or global market. While these studies' results at an aggregate level tend to come to the consensus that overall CSP has a risk-reducing effect for firms, the effect of CSP on corporate financial risk is less clear at a disaggregate level (Sassen et al., 2016).

An empirical study by Jo and Na (2012) examines the effect of CSP on total firm risk based on a data sample of 513 U.S. firms during the period from 1991 to 2010. The researchers contribute towards literature by focusing specifically on sinful industries, including for instance alcohol and tobacco, and they provide solid evidence of CSP engagement being significantly and negatively associated with total firm risk in controversial industries (Jo & Na, 2012). However, their research differs from this study in numerous ways. Firstly, their analysis is mostly limited to sinful industries. Secondly, in contrast to the VAR approach that this study employs, their OLS regressions with year-fixed effects and their simultaneous equations system adjusting for endogeneity problems, do not capture the reciprocal interaction between CSP and firm risk that this study attempts to do. Thirdly, Jo and Na (2012), similarly to most other studies, focus on the relationship between CSP and corporate financial risk for U.S. firms, whereas our research evaluates the seemingly untapped Nordic market. Lastly, while Jo and Na (2012) only look at total firm risk, this study assesses the link between CSP and all three risk types, namely firm-specific, systematic and total risk.

Bouslah et al. (2013) similarly evaluates the effect of CSP on firm risk, but do so by looking at both firm-specific risk and total risk, while using a panel dataset for a sample of 3100 U.S.

firms during the period from 1991 to 2007. The researchers, similarly to this study, take on a panel VAR approach which captures the reciprocal interaction between firm risk and CSP. They further look at the impact of each individual dimension of CSP separately and find that, when looking at the whole sample of firms, only two of their dimensions of CSP (i.e. Employee Relations and Human Rights) are significantly and negatively related to both firm-specific and total risk. Instead, when dividing the original sample of firms into subsamples, they find both negative and positive relationships with firm-specific and total risk, and argue that the varying results depend on the nature of the business and the specific dimension within CSP that is taken into account (Bouslah et al., 2013; Oikonomou et al., 2012; Harjoto & Jo, 2015). Accordingly, as the study by Bouslah et al. (2013) itself suggests, aggregate results are not necessarily indicative of specific subcategories or sub-regions, and can therefore not be directly applied to the Nordic market that our study examines.

The study on the relationship between CSP and financial risk by Harjoto and Jo (2015) is based on a sample of 2034 U.S. firms between the years 1993 and 2009. At an aggregate level, the researchers confirm that greater CSP engagement reduces financial risk, measured by firm-specific risk. In line with this result, they find a negative association between CSP and firm-specific risk when looking at the legal aspect independently (Harjoto & Jo, 2015), whereas they show that normative corporate social responsibility (CSR) increases financial risk. Harjoto and Jo (2015) further apply an IV estimation approach, which, in contrast to this study, does not account for the reciprocal relationship in which firm risk and CSP impact each other. In accordance with most prior research, Harjoto and Jo's (2015) study also focuses on the American market, while this thesis differently investigates the Nordic market.

Sassen et al. (2016) initially employs a panel fixed effect model on a large European dataset with 921 firms between 2002 and 2014 to address the impact of corporate social performance on systematic, firm-specific and total risk. Their findings suggest that higher CSP, measured through ESG ratings, lowers all three types of risk (Sassen et al., 2016). When subsequently looking at the social dimension of ESG, they find that social performance has a significant risk-reducing effect on all three risk measures, whereas environmental performance only affects total and systematic risk of firms in environmentally sensitive industries (Sassen et al., 2016). As for corporate governance they find no significant effect on any firm risk measure. Sassen et al. (2016) additionally employs a panel VAR model through which they find a bidirectional relationship between corporate governance and all risk measures, whereas they provide evidence of a unidirectional correlation between the disaggregate environmental and social pillars and all three corporate financial risk measures. While the study by Sassen et al. (2016) makes use of the panel VAR model, similarly to this study, it is based on a European dataset, meaning that the results are valid at a collective European level but not necessarily for specific European countries nor for the Nordics.

Among the more recent empirical studies analysing the relationship between firms' CSP and their financial risk, is the one by Chollet and Sandwidi (2018) based on 3,787 firms worldwide between 2003 and 2012. Similarly to our study, it makes use of the panel VAR model that enables the researchers to study the direction of causality between CSP and risk (Chollet & Sandwidi, 2018). The researchers find a virtuous circle between CSP and risk, suggesting that good CSP reduces financial risk, and thereafter reinforces the firms' commitment to good environmental and governance practices (Chollet & Sandwidi, 2018). While the results from Chollet and Sandwidi (2018) are highly interesting, their sample is different from our thesis sample with regards to one key characteristic. This study aims to find the relationship between ESG and financial risk in Nordic countries, while the research by Chollet and Sandwidi (2018) examines the relationship at an aggregate global level. As previous research suggests that the relationship between CSP and firm risk varies on a disaggregate level (e.g. Bouslah et al., 2013), the results are not necessarily applicable to a Nordic sample.

Reported in *Table 1* below, is a summary of the previous research performed on the relationship between CSP and financial risk.

Table 1: Previous empirical research on the link between CSP and financial risk

Authors	Sample Market	Number of Firms	Time Period	Aggregate CSP Measure	Measure of Financial Risk	Findings: Relationship between CSP and financial risk
Jo and Na (2012)	US	513	1991 - 2010	MSCI ESG (formely KLD)	Total risk	Negative at aggregate level
Bouslah, Kryzanowski and M'Zali (2013)	US	3100	1991 - 2007	KLD	Firm-specific and total risk	Negative at aggregate level; positive and negative causality for different subsamples
Harjoto and Jo (2015)	US	2034	1993 - 2009	KLD	Firm-specific risk	Negative at aggregate level
Sassen, Hinze and Hardeck (2016)	Europe	921	2002 - 2014	ASSET4	Systematic, firm-specific and total risk	Negative at aggregate level
Chollet and Sandwidi (2018)	World	3787	2003 - 2012	ASSET4	Systematic, firm-specific and total risk	Negative at aggregate level
This study	Nordics (excluding Iceland)	150	2002 - 2017	ASSET4	Systematic, firm-specific and total risk	

Summarizing, there is an overlapping consensus of literature results indicating a negative association between CSP and corporate financial risk when accounting for aggregate ESG scores. However, an aggregate CSP measure can hide underlying effects and relationships. In fact, at a disaggregate level, existing research shows consistent evidence of a heterogeneous impact of CSP on corporate financial risk. These differing findings largely depend on the chosen data samples, as well as the CSP and risk measures employed by the researchers.

2.2 This study's contribution to literature

This study contributes towards literature related to the CSP-risk link in three main ways. Firstly, this thesis takes on a different perspective on assessing the association between CSP and corporate financial risk by exclusively attributing the empirical research to the so-far untapped Nordic market. Previous research has for the most part either assessed the U.S. market or looked at the relation between CSP and financial risk at a global level (Oikonomou et al., 2012; Jo & Na, 2012; Bouslah et al., 2013; Chollet & Sandwidi, 2018). The study by Sassen et al. (2016) is the one that is closest to this study in terms of market sample as it focuses on the European market. However, an aggregate analysis on European firms cannot directly predetermine the relationship between CSP and financial risk for Nordic corporations. There are several reasons for why this argument holds. For instance, research proves that cultural differences play a major role in decision making, and even more so when it comes to ethical decision-making (Rawwas, 2005). Such cultural aspects can further influence the way in which investors react to news, and a stock's volatility and financial risk is determined accordingly. Moreover, prior research suggests that differing political climates, regulatory frameworks and labour market institutions influence the importance of CSP across countries (Chollet & Sandwidi, 2018). In addition to the above, the Nordic region currently lies in the forefront of green investing globally, with solutions that are looked up to and assessed in terms of applicability to international markets (Climate Bond Initiative, 2018). As such, the interest and importance of CSP can be expected to be relatively higher in the Nordics compared to other European countries. This indicates that the CSP-risk relationship found in prior research on a European level is not necessarily applicable to the Nordic region.

Secondly, from a methodological point of view, this study valuably contributes to literature by accounting for the panel vector autoregressive model which not only sheds light on how CSP affects financial risk, but also on how financial risk affects CSP in return. Apart from the research conducted by Chollet and Sandwidi (2018), Bouslah et al. (2013) and Sassen et al. (2016), our study is among the few that are able to capture this reciprocal effect between financial risk and CSP, whereas other prior research relies on standard lagged OLS or panel regressions and hence miss out on the interaction in which the variables affect each other (e.g. Oikonomou, et al., 2012; Harjoto & Jo, 2015). Accordingly, through this study, we can identify the interaction between CSP and financial risk by providing evidence of the reciprocal causality between the financial risk measures and the CSP dimensions.

Lastly, we advance the study conducted by Chollet and Sandwidi (2018), Bouslah et al. (2013) and Sassen et al. (2016), by exploring the sign (negative or positive) of the causality between CSP and corporate financial risk, as opposed to most existing empirical research. As such, we are able to empirically show whether past low risk tends to permit a firm to increase its CSP engagement, and whether high financial risk could encourage firms to invest more in CSP.

3. Hypotheses

The legitimacy and value in firms' concern for social responsibility has been a long-standing debate and views have been mixed with regards to the implications that such efforts have on corporations' financial risk and performance. While early viewpoints advocate that firms incur costs when engaging in socially responsible activities, which in return puts them at an economic disadvantage relative to less responsible firms (Friedman, 1970), more recent literature argues against this assertion. Barney (1991) and Porter and Kramer (2006), for instance, claim that firms' engagement in CSP can contribute towards enhanced valuation, returns, reputation and brand image, as well as reduced financial risk. As such, the following section will discuss a number of relevant economic theories that will help to shed light on the link between financial risk and CSP. These theories will thereafter be used to define our research hypotheses.

3.1 Economic theories

As defined by Freeman and Phillips (2002), the ***stakeholder theory*** stipulates that a firm's success is reliant on the strength of the relationship between corporate management and the firm's stakeholder groups, including customers, employees, suppliers, investors and regulators. This entails both aligning interests and maintaining support from all key groups involved in the business, while simultaneously maximizing shareholder value over time (Freeman & Phillips, 2002).

In line with the stakeholder theory, it is possible to argue for a negative association between CSP and corporate financial risk. One can claim that with greater concern for CSP, corporations have a higher chance at preventing any lawsuits and legal proceedings, which in return strengthens their relationship with the government and the financial community (McGuire et al., 1988). Further, disclosure of CSP activities contributes towards reducing information asymmetries and instead increases transparency and mutual trust between the firm and external investors who experience lower perceived risk (Chang et al., 2014). As consumers tend to have a preference towards being associated with socially responsible firms, corporate social performance can generate a positive correlation for customers on corporate brand and reputation (Hur et al., 2013). Additionally, CSP might increase firm attractiveness in the eyes of potential employees as well as help maintain employee retention rates high (Turban & Greening, 1997). Altogether, the above findings are indications of a risk-reducing effect from

CSP, as CSP contributes towards aligning investment decisions with stakeholder needs and priorities, thereby lowering corporate financial risk and stock volatility in the capital market.

Another relevant theory when discussing the link between CSP and financial risk is the ***risk management theory*** stipulating that, in the event of a crisis, a firm will experience an "insurance-like" protection by having engaged in CSP activities (Godfrey, 2005). This is because positive moral capital alleviates any negative stakeholder assessments and related sanctions in the occurrence of a bad act (Godfrey, 2005). CSP provides a reservoir of positive attributions to a firm that stakeholders tend to hold on to even during crisis periods (Godfrey, 2005). With stakeholders reacting less sensitively to negative news, trust will be enhanced, firm reputation will be preserved and loyalty to the company will be stronger. With both a stimulated company image and reduced chances of sanctions by stakeholders, a firm's future cash flows will be substantially less volatile, which in return conserves the company's economic value and reduces its financial risk (Sharfman & Fernando, 2008). In fact, as empirically demonstrated by Godfrey (2009), the loss of shareholder wealth in the occurrence of a negative event is lower for firms with CSP engagement compared to those without.

In addition to indicating a negative relationship between CSP and financial risk, the ***slack resource theory*** assists in providing evidence of a cyclical pattern between the two variables. Due to higher past firm performance and engagement in CSP, firms are more likely to have more established social policies and actions set in place, which thereby lowers corporate financial risk and increases the firm's resource availability (Chollet & Sandwidi, 2018). The theory successively indicates that with relatively greater slack resources, the expected firm volatility is reduced even further and companies will be more willing to take on future costs related to CSP as well as they will be in a more favourable state to further invest in corporate social performance in the future (Ullmann, 1985). This pattern then repeats itself, indicating a reciprocal causality between CSP and financial risk.

The ***agency theory*** is another theory that can assist in explaining the relationship between firm risk and CSP, with a particular focus on the governance dimension. The theory stipulates that there is an often-found misalignment of interest between the "principal" (shareholders) who delegates authority to the "agent" (manager), who in turn actually completes the work (Jensen & Meckling, 1976; Ross, 1973). The distribution of risk is not necessarily always aligned, as the manager is utilizing the resources of the shareholders. While the shareholders will always bear the ultimate risk of their investment, regardless of the risk level of the firm, the managers do not incur any or only a low risk in this aspect as the financial loss will be a burden for shareholders. Managers, on the contrary, suffer from the personal risk of getting fired in the case of high firm risk, as the expectations on management performance is significantly higher (Ross, 1973). As such, the risk exposure of the shareholders and managers will be aligned in high risk firms, while low risk firms will suffer from a misalignment of risk exposure between the managers and the shareholders. Managing such a conflict of interest is a question of setting in place well-functioning governance mechanisms and incentives (Shleifer & Vishny, 1997). This implies that, while the agency theory may not give a clear indication of the relationship between risk and CSP on an aggregate level, it is possible to expect the firm risk to have a positive impact specifically on the governance dimension of CSP.

3.2 Hypotheses formulation

On the basis of the economic theories and prior research discussed, we have constructed the research hypotheses which will guide the analysis of our results. Independently from the sign of causality (positive or negative), prior research conducted on the CSP-risk relationship, as well as relevant economic theories, give indication of the existence of a link between CSP and corporate financial risk (e.g. Jo & Na, 2012; Oikonomou, et al., 2012; Bouslah et al., 2013; Chang et al., 2014; Sassen et al., 2016).

When looking at the sign of causality, both the stakeholder theory and the risk management theory, along with results from previous research, support the affirmation that there is a negative correlation between firms' ESG scores and their financial risk. The stakeholder theory stipulates that the higher the firm's engagement in CSP, the lower its financial risk (Freeman & Phillips, 2002; McGuire et al., 1988). Similarly, the risk management theory confirms that CSP activities alleviate negative reactions by stakeholders in the event of a crisis, which in return increases loyalty to the company and reduces long-term financial risk (Godfrey, 2005). In line with these theories, researchers have empirically shown that firm's good ESG performance strengthens firm reputation (Fombrun et al., 2000), reduces perceived risk by investors and lowers the chances of civil proceedings and law suits, all of which contributes to a reduced financial risk (Jo & Na, 2012; Chang et al., 2014; Sassen et al., 2016). Accordingly, as there seems to be an overarching number of research articles and theories from CSP literature that predominantly indicate a negative rather than positive relationship between financial risk and CSP (e.g. Chollet & Sandwidi, 2018; Harjoto & Jo, 2015), we postulate our first hypothesis as follows:

***Hypothesis 1**: Aggregate ESG performance has a negative effect on firms' financial risk.*

While most research indicates that CSP efforts lower the level of firm risk, we claim it to be equally relevant to explore whether lower financial risk in return also impacts the level of CSP that a firm subsequently engages in. In accordance with the slack resource theory, corporate social activities reduce financial risk through strengthened management conduct, leading to managers having a higher incentive to improve CSP efforts in the future. Highly performing firms can rely on their financial stability to make long-term investments without worrying about their short-term performance, which includes CSP-related investments (Chollet & Sandwidi, 2018). As such, it is possible to expect a cyclical interaction between ESG, as a measure of CSP, and financial risk, thereby leading to a "virtuous circle" in which both ESG and financial risk codetermine each other (Orlitzky & Benjamin, 2001). This leads to our second hypothesis:

***Hypothesis 2**: As aggregate ESG performance impacts financial risk, and this impact on risk affects firm engagement in ESG, there is a reciprocal relationship between ESG and financial risk.*

As outlined by Scholtens (2008), looking at ESG scores at an aggregate level may lead to a negligence of underlying effects and relationships between CSP and firm risk. This being said, prior research has not yet formed a consensus of results indicating the direction of causality that each of the three ESG dimensions have on the three measures of financial risk. For instance, Sassen et al. (2016) find a significantly negative effect of social performance on all three risk measures, a significantly negative impact between all risk measures and environmental performance, but only for firms in environmentally sensitive industries, and no significant results for governance performance. Contrarily, Collet and Sandwidi (2018) show that the separate environmental, social and governance scores significantly and negatively affect all three measures of risk. Correspondingly, this explains the generic articulation of our third hypothesis:

***Hypothesis 3**: Disaggregate environmental, social and governance performances each separately affect firms' systematic, firm-specific and total risk.*

4. Data

The following section outlines the chosen data sample for this study. The sample characteristics will be discussed, alongside a depiction of the risk measures as dependent variables, the ESG measures as independent variables and our chosen control variables and their predicted impact on firm risk.

4.1 Data collection

The data used in this study is collected from Thomson Reuters Datastream, Nasdaq and Oslo Børs. Thomson Reuters Datastream collects and offers both financial and non-financial data that fulfils the need for a reliable and sufficient dataset to study ESG and financial risk. The benchmark index data is collected from Nasdaq and Oslo Børs, both of which are also considered reliable sources. Firm-specific data is collected from Thomson Reuters Datastream because the ASSET4 database, which provides the ESG ratings, is owned by Thomson Reuters. We use ASSET4 as it is among the most widely used rating databases in Europe, providing the best historical coverage of European companies compared to other ESG rating providers (Sassen et al., 2016). Apart from a couple of studies that also make use of Thomson Reuters ASSET4 (Sassen et al., 2016; Chollet & Sandwidi, 2018), other prior research on the CSP-risk link has alternatively made use of surveys from company officials, the Fortune's Most Admired Companies (MAC) ratings, as well as distinct CSP measures provided by the KLD rating agency and Bloomberg Sustainability (Oikonomou et al., 2012; Jo & Na, 2012; Bouslah et al., 2013; Harjoto & Jo, 2015). Compared to these, ASSET4 covers publicly traded companies at a global scale and offers objective and relevant ESG data on listed firms within a broad range of industries, which allows for thorough socially responsible investment analysis (Thomson Reuters, 2018).

The sample of Nordic firms included in the study is based on the availability of ESG ratings in the ASSET4 database. Nordic listed corporations include corporations that are listed on a public stock exchange in either Sweden, Norway, Denmark or Finland. Due to limited data for companies listed on a stock exchange in Iceland, these firms are excluded although Iceland is a part of the Nordic region. This paper will therefore here on after refer to Nordic corporations as those listed on a stock exchange in Sweden, Norway, Denmark or Finland. ASSET4 has published ESG ratings for 150 Nordic listed corporations in total during the period between 2002 and 2017 (*Appendix 1*). Since ASSET4 selects the firms receiving an ESG rating, the selection is not random. As a result, the population that our thesis examines is defined as ASSET4 ESG-rated firms listed on a stock exchange in the Nordics. The subsequent implication is that our results are externally valid for the population of ASSET4 ESG-rated firms in the Nordics, and not necessarily for Nordic listed firms in general. Further, only publicly listed corporations are included in the study since share prices are needed in order to calculate firm risk measures.

The study covers the period between 2002 and 2017 since ASSET4 provides time series of ESG ratings tracing back to 2002 and ratings for 2018 had not yet been published as of January 2019 when data was collected (Thomson Reuters, 2018). The number of rated firms increases with time, with initially 63 firms in 2002 and 137 firms in 2017. All 150 publicly listed firms are included in the sample, in order to utilize all the available data. As a result, the data is unbalanced and some firms included do not have observations for the complete time period. These observations that have not been reported for a certain time period are automatically dropped in Stata if, for example, stock price is available but not the ESG score. Further, it is important to mention that, while the validation system for data quality is consistently improved upon, Thomson Reuters' methods for assessing the ESG ratings have, to the best of our knowledge, not changed substantially during the sample period (i.e. Thomson Reuters, 2010-2018).

All data is collected in the respective currencies (SEK, NOK, EUR and DK). This is because potential foreign exchange rate differences should not be reflected in the returns for each firm. Still, when controlling for firm size, we need the data in the same currency. Hence, we collect foreign exchange rates from SEK, DK and NOK to EUR for all respective dates. The FX rates are only used to calculate the market capitalization and total assets in the same currency (EUR).

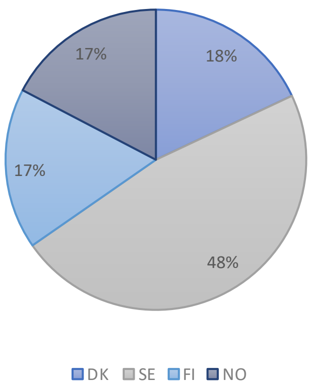
The data is further collected on a monthly basis since we want to utilize some variation in share prices, but at the same time avoid potential noise that may arise when using daily or weekly data. The dataset consists of 20,961 monthly observations, including data for both share return and ESG in the same period. The ESG ratings are also collected on a monthly basis although ESG scores for the average firm are most commonly updated once per year, following companies' own ESG disclosure publications (Thomson Reuters, 2018). For our data sample, the ESG ratings, on average, changed 0.98 times per year, suggesting that the rating in some cases is not changed (i.e. kept at the same level) at the annual assessment. The ratings are further updated and published at different times during the year depending on firms' reporting dates.

In some cases, the ratings are updated more frequently if, for example, there is a meaningful change in the firms' reporting or corporate structure (Thomson Reuters, 2018). These updates are also captured in the monthly observations, and ratings hence reflect the time when the market receives the ESG rating information. For the panel VAR regressions, annual observations are used to capture the impact of annual lags. We do, however, perform a robustness check that controls for any differences in the results if monthly data had been used in the panel VAR regressions instead.

4.2 Sample description

The final sample consist of 48% Swedish stocks and 17%-18% Norwegian, Finnish and Danish stocks, respectively (Figure 1). The distribution is based on how ASSET4 has decided to rate firms in each country, and largely corresponds to the size of the stock exchanges in each country.

Figure 1: Distribution of countries in sample



While almost half of the sample represents only ¼ of the countries included in the study, the industry distribution is more widespread. The most common industry included is Industrial Machinery, which represents 7.3% of the total sample (Table *2*). The second most common industry sectors include banks, building materials & fixtures and real estate holding & development, each constituting 5.3% of the total sample (Table *2*). The distribution of industries is considered relatively wide and sufficient to represent the market. A complete list of firm industries is further presented in *Appendix 1*.

Table 2: Distribution of largest industries in sample

Industry group	Number of firms	% of total
Industrial Machinery	11	7.3%
Banks	8	5.3%
Building Mat. & Fix.	8	5.3%
Real Estate Hold, Dev	8	5.3%
Oil Equip. & Services	7	4.7%
Marine Transportation	5	3.3%
Medical Equipment	5	3.3%
Specialty Finance	5	3.3%

Note: further industries represent less than 3% of the total sample.

As presented in Table *3* below, large capitalization firms represent a majority of firms included in the sample. Around 1/3 of the sample is characterized by Swedish large cap firms, and thereafter Finnish and Danish large cap firms each represent 15% of the total sample. While large cap firms equate to 75% of the sample, 19% of the firms are mid cap size and the remaining 6% of the sample firms are small cap size. The market capitalization determines the classification and the classification is based on the market cap in January 2019. Large cap represents a market capitalization above 1 billion EUR, while a market capitalization between 150 million EUR and 1 billion EUR is considered as mid cap. A market capitalization below 150 million EUR is considered to be small cap in Table *3*. The sample coverage does not reflect the average business size in the Nordics and the results of the study only directly apply to the population of the sample.

Table 3: Distribution of market capitalization classifications in sample

Country		No. Firms	% in country	% of total
Sweden				
	Large Cap	52	73%	35%
	Mid Cap	15	21%	10%
	Small Cap	4	6%	3%
Finland				
	Large Cap	23	88%	15%
	Mid Cap	3	12%	2%
	Small Cap	0	0%	0%
Norway				
	Large Cap	16	62%	11%
	Mid Cap	7	27%	5%
	Small Cap	3	12%	2%
Denmark				
	Large Cap	22	81%	15%
	Mid Cap	3	11%	2%
	Small Cap	2	7%	1%

4.3 Benchmark indexes and risk-free rates

In order to enable calculations of various risk measures, benchmark index data is needed. Separate indexes are used based on which country the stock is listed in. Stock indexes for each country are selected based on characteristic similarities with the sample. For each country, large cap firms represent a majority of the sample (Table *3*).

For Swedish stocks, OMX Stockholm 30 (OMXS30) is used as the benchmark index, consisting of the 30 most traded stocks on the Stockholm Stock Exchange. Only 32% of the Swedish firms included in the sample are as of January 2019 included in the OMXS30 index, which can be explained by the relatively large number of Swedish firms rated by ASSET4. Still, as illustrated in Table *3*, 73% of the Swedish stocks are large cap size and OMXS30 is additionally the most recognized index in Swedish stock exchanges.

For Danish stocks, OMX Copenhagen 20 (OMXC20) is used as the benchmark index, consisting of the 20 most traded stocks on Nasdaq Copenhagen. Among the Danish firms in the sample, 67% are included in the OMXC20 index as of January 2019. While 81% of the Danish stocks in our sample are included in OMX Copenhagen 25 (OMXC25) index, data is limited as the index was created in 2016. Hence, we use OMXC20 and consider the index to be a sufficiently representative benchmark for the Danish stocks in our sample.

For Finnish stocks, we use OMX Helsinki 25 (OMXH25) as the benchmark index. OMXH25 encompasses the 25 most actively traded stocks on the Helsinki Stock Exchange. Among the Finnish stocks in our sample, 81% are included in OMXH25 as of January 2019. As a result, we consider the OMXH25 index to be a suitable benchmark for the Finnish stocks in our sample.

For the Norwegian stocks in our sample, we use the Oslo Børs index (OBX), consisting of the 25 most liquid firms on the Oslo Stock Exchange. In total, 58% of the Norwegian stocks in the sample are included in the OBX index as of January 2019. We consider this to be sufficiently representative of our sample.

To calculate risk measures, risk-free interest rates are furthermore required. As we use different benchmark indexes for each country, we also make use of country-specific risk-free rates, in order to be consistent. For each country, monthly 10-year government bond rates are used as our risk-free interest rates.

4.4 Variables

4.4.1 Corporate financial risk

Risk is a critical determinant of shareholder wealth and may be defined as the likelihood of an unexpected unfortunate outcome of an occurrence (Bodie et al., 2014). As these outcomes can either be negative or positive, risk can be classified as having both an upside and downside. On the one side, risk may be associated with the occurrence of a negative event, in which case it contributes towards destroying firm value. On the other side, it may be associated with the potential of realizing unexpected gains, in which case it has a positive connotation. Regardless of the type of risk, however, it is still embedded in the idea of hindering a firm from performing sure financial planning since future cash flows may fluctuate depending on the occurrence of any unexpected event (Sharpe, 1964). In this paper, we are concerned about risk in terms of corporate financial risk, which relates to the volatility of the price of a stock compared to its expected value (Berk & DeMarzo, 2017).

Previous research examining the relationship between CSP and financial risk makes use of varying risk measures. The research by Jo and Na (2012), for instance, solely looks at firm risk in terms of total risk. Bouslah et al. (2013) apply also firm-specific risk in addition to total risk, whereas Sassen et al. (2016) and Chollet and Sandwidi (2018) employ all three risk measures, namely firm-specific, systematic and total risk. One may argue that traditional portfolio theories indicate that firm-specific risk should not be compensated for as it can be eliminated through diversification in well-constructed portfolios. However, more recent theoretical models have relaxed this assertion by proving that financial markets also price firm-specific risk and by arguing that investors, in general, do not obtain well-diversified portfolios in practice (Goyal & Santa-Clara, 2003). In light of this, and for comparability with previous and potential future literature on this study's topic, we deem it relevant to explore all three risk measures.

Systematic risk, also known as market risk, can be defined as "fluctuations of a stock's return that are due to market-wide news" (Berk & DeMarzo, 2017, p.370). As implied in its definition, systematic risk cannot be eliminated through diversification strategies and hence deserves to be rewarded (Sharpe, 1964; Mossin, 1966; Lintner, 1975). Such risk co-varies with any fluctuations in macroeconomic factors, including interest rate risk, currency risk, policy changes, inflation and business cycles (Murphy, 2012). For the purpose of comparability with prior research (Oikonomou et al., 2012; Sassen et al., 2016; Chollet & Sandwidi, 2018), systematic risk will be measured through the beta of the Capital Asset Pricing Model (CAPM), which depicts the relative volatility of a stock compared to the market's volatility (Bodie et al., 2014). More specifically, we estimate the firms' market risk by using the out of sample CAPM beta associated with the corresponding benchmark portfolio as a first measure of firm risk (Chollet & Sandwidi, 2018). This is among the most commonly used metrics for measuring systematic risk within the research field and it is against this background that we employ this method. The CAPM beta for the last twelve months (LTM) is estimated by running CAPM regressions with excess firm return as an outcome variable and the corresponding market premium as the explanatory variable. The coefficient for the market premium $(r_{mt} - r_{ft})$ is the CAPM beta $BETA_{it}$.

$$r_{it} = \alpha + BETA_{it}(r_{mt} - r_{ft}) + e_{it}$$

Firm-specific risk is "inherent in the firm's operations and its management, independently of market influence" (Chollet & Sandwidi, 2018, p.5). Such risk hence captures risk related to a stock return's fluctuations resulting from firm-specific news, implying that it can be eliminated through diversification since it is unrelated across stocks (Berk & DeMarzo, 2017). Some researchers advocate that the firm-specific risk is irrelevant for investors because it can be mitigated by portfolio diversification (Sharpe, 1964). We will, however, follow other previous studies that incorporate the firm-specific risk in addition to other risk measures and use the firm-specific risk as our second measure of financial risk (e.g., Chollet & Sandwidi, 2018; Oikonomou et al., 2012). The firm-specific risk is estimated by taking the annualized standard deviation of the LTM CAPM residuals e_{it}, as suggested by Chollet and Sandwidi (2018).

$$SPECIFIC\ RISK_{it} = \sigma(e_{it}) \times \sqrt{12}$$

The ***total risk*** consists of both systematic risk and firm-specific risk and reflects a firm's stock volatility (Berk & DeMarzo, 2017). We measure the total risk ($VOLATILITY_{it}$) of the investment in firm *i* by annualizing the standard deviation of the LTM monthly returns (Chollet & Sandwidi, 2018; Harjoto & Jo, 2015; John et al., 2008).

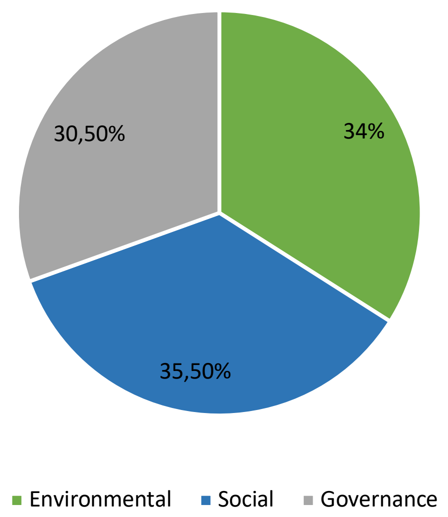
$$VOLATILITY_{it} = \sigma_{it} \times \sqrt{12}$$

The volatility is commonly used as a measure of total risk, which in finance and accounting literature usually represents the firm risk (Ross et al., 2011). The total risk is used as our main measure of firm risk since not only systematic risk, but also the firm-specific risk affects stock return (e.g., Shleifer & Vishny, 1997; Duan et al., 2010).

4.4.2 Environmental, social, governance scores

As commonly done in research on the association between CSP and financial risk, we measure CSP of firms in our sample through ***ESG-scores*** (e.g. Jo and Na, 2012; Sassen et al., 2016; Chollet & Sandwidi, 2018) provided by Thomson Reuters ASSET4 database. The ESG score is based on firm-level environmental, social and governance scores with a combined weight of 100% (Thomson Reuters, 2018). As illustrated in Figure 2, the weights are relatively similar between the three categories. Still, the greatest weight is placed on the social dimension and the second highest weight is given to the environmental dimension (Figure 2).

Figure 2: ESG category weights



ESG ratings play a significant role in all firms' decision-making processes and they shed light on corporations' overall operational choices, risk levels and management quality (Galbeath, 2013). ESG scores provided by ASSET4 are widely used in financial markets due to their availability in Thomson Reuters (Chollet & Sandwidi, 2018) and the ranking scale stretches from 0 to 100, where 0 implies no contribution towards environmental, social and governmental concerns, and 100 implies full support. In line with, for example, Sassen et al. (2016) and Chollet and Sandwidi (2018), we consider the ESG scores from ASSET4 to be good proxies for CSP for this study and, in accordance with the same studies, we expect aggregate ESG performance to have a risk reducing effect for our sample of firms in the Nordics. An overview over specific ESG measures that firms can undertake is provided in Table 4 below.

Table 4: The three pillars of ESG (Thomson Reuters, 2019)

Environmental	**Social**	**Governance**
Resource reduction	Employment quality	Board structure
Emission reduction	Health and safety	Compensation policy
Product innovation	Training and development	Board functions
	Diversity	Shareholders rights
	Human rights	Vision and strategy
	Community	
	Product responsibility	

The ***environmental (ENV) dimension*** of ESG has increased in importance in recent years due to the growing concern for climate change, resource scarcity, and our overall carbon footprint which has resulted in stiffer regulation and taxation policies (PwC, 2019). The ENV pillar is a measure of firms' impact on the global environmental footprint, in the form of carbon, waste, plastics and water usage (Thomson Reuters, 2019). As outlined in Table 4, the ENV score captures firms' effectiveness in reducing the emissions of the above mentioned resources, and encompasses the measures taken to support more sustainable and innovative product offerings (Thomson Reuters, 2019). Nowadays, firms are faced with the challenge of adapting their operations and ways of doing business in such a way to accommodate for the changing environment in which cleaner, smarter and more sustainable products and services are demanded (World Economic Forum, 2018). Companies that are able to anticipate these environmental changes and proactively manage to develop new technologies accordingly, will be better positioned for maintaining a lower risk profile relative to competitors (CFA Institute, 2015). While prior research has not reached a consensus as to its effect on firm risk, it can be expected that the ENV pillar will have a negative impact on firm risk, especially considering the growing concern for, amongst others, climate change and the growing environmental footprint in recent years.

Social concerns play a key role in determining how corporations manage their stakeholder relationships. The ***social (SOC) dimension*** encompasses everything from employment quality, customer satisfaction, labour conditions, and diversity to community relations and human rights (Thomson Reuters, 2019). According to research, firms subject to negative news with regards to their safety and health records, for instance, face substantial reputational damages which in return negatively affect the corporation's profitability (CFA Institute, 2008). On the contrary, news praising a firm's social practices can notably enhance a corporation's brand image (Thomson Reuters, 2019). In line with the above and the research performed by Sassen et al. (2016), we expect that the SOC pillar will have a risk-reducing effect for the firms in our sample.

The ***corporate governance (GOV) dimension*** measures a company's processes designed to assist agents to adopt a long-term orientation and to take actions that satisfy the interests of shareholders. Such governance processes control for, for instance, board structure, compensation policies and firm vision and strategy (Thomson Reuters, 2019) by establishing well-functioning incentives, regulations, and through improved monitoring and transparency (Berk & DeMarzo, 2017). Well-governed firms are perceived as being less risky in the eyes of socially responsible investors who, in turn, will exert lower rates of return, leading to higher firm value (Bauer et al., 2004). Further, with good corporate governance mechanisms in place, firms are more likely to have more efficient operations, which in return results in higher expected cash flow streams in the future (Jensen & Meckling, 1976). Further, as governance mechanisms help to align the interest of all shareholders and to reduce any conflicts of interest between shareholders and managers, we expect that corporate governance will have a negative impact on firm risk.

4.5 Control variables

Firm-specific control variables are included in the regressions to capture characteristics that change over time for firms and might affect the firm risk. In line with previous studies that examine CSP and firm risk, we include firm size, firm growth, debt ratio and market-to-book ratio as control variables (e.g. Jo & Na, 2012; Sassen et al., 2016; Chollet & Sandwidi, 2018).

Firm size is measured as the natural logarithm of total assets (Table 5). Including firm size as a control variable accounts for effects of firm size on firm risk. The firm size effect has been examined for many years, and Banz (1981) suggests that small cap firms generate greater returns on average compared to large cap or mid cap. Banz (1981) further argues that the excess return from small stocks is due to an additional risk factor of small firms. While more recent studies suggest that the size effect on risk has decreased, we still expect the coefficient of firm size to be slightly negative (Chaibi et al., 2015).

Firm growth captures the effect of the growth rate on firm risk, and is measured as the percentage growth in total assets compared to the previous year (i.e. annual growth rate). We calculate the growth in total assets based on total assets in the respective currencies, since we do not want exchange rates to affect the growth rate. We control for the growth since this can have an impact on the firm risk. In line with previous research, we expect the firm growth to have a positive impact on firm risk (Bowman, 1979).

The ***debt ratio*** captures the effect of the firm's capital structure on firm risk, and is estimated by the book value of debt as a percentage of common equity and book value of debt (Table 5). Since the debt ratio could have an effect on the financial risk, we include debt ratio as a control variable in the regressions. Modigliani and Miller (1958) are well known for their contribution within the topic and propose that the firm risk increases with financial leverage. Leverage is commonly used as a control variable in regressions that evaluate firm risk (e.g. Jo & Na, 2012; Sassen et al., 2016; Chollet & Sandwidi, 2018). We use the variable of leverage from Thomson Reuters Datastream as Chollet and Sandwidi (2018) do, but construct the debt to asset ratio rather than debt to equity. Since there is a consensus in previous research indicating a positive relationship between firm risk and debt ratio, we expect the coefficient to be positive.

The ***market-to-book ratio (MTB)*** represents the ratio between the market value of common equity and book value of common equity (Table *5*). The market-to-book ratio captures the effect of growth and value companies on firm risk (Sassen et al., 2016). Companies that trade on a low MTB ratio are generally interpreted as value stocks that trade cheaply in the market compared to their book value. Fama and French (2018) propose that value companies with low MTB ratios in general generate abnormal returns due to additional risk. Since research suggests that the MTB ratio has an impact on firm risk, we include the MTB ratio as a control variable (e.g. Jo & Na, 2012; Sassen et al., 2016; Chollet & Sandwidi, 2018). In line with Fama and French (2018), we expect the coefficient of the MTB variable to be negative.

In contrast to previous research, we do not include industry and country control variables as we include firm fixed effect which already controls for these characteristics (e.g. Jo & Na, 2012; Sassen et al., 2016; Chollet & Sandwidi, 2018). All variables used in our regressions are explained and presented in Table *5*.

Table 5: Variable description

Abbreviation	Variable	Description
Dependent variables		
VOLATILITY	Total risk	LTM annualized standard deviation of stock return
LN_VOL	Ln(Total risk)	Natural log of LTM annualized standard deviation of stock return
BETA	Systematic risk	LTM CAPM beta
LN_BETA	Ln(Systematic risk)	Natural log of LTM CAPM beta
SPECIFIC_RISK	Specific risk	LTM annualized standard deviation of CAPM residuals
LN_SPECIFIC_RISK	Ln(Specific risk)	Natural log of LTM annualized standard deviation of CAPM residuals
Independent variables		
ESG	ESG score	Environmental Social Governance score provided by ASSET4
ENV	Environmental score	Environmental pillar score provided by ASSET4
SOC	Social score	Social pillar score provided by ASSET4
GOV	Governance score	Governance pillar score provided by ASSET4
Control variables		
debt_ratio	Debt ratio	Book value of debt as % of common equity and book value of debt
ln_total_assets	Firm size	Natural logarithm of total assets (sum of total current assets, long term receivables, investment in unconsolidated subsidiaries, net property plant and equipment, other investments and other assets)
growth_TA	Firm growth	Growth in total assets over the past previous 12 months
MTB	Market-to-Book ratio	Market value of common equity over book value of common equity
year	Year for observation	Dummy variable for the observations year
firm_id	Firm identification	Dummy variable for each firm

4.6 Excluded outliers

The regressions will exclude some outliers for the market-to-book ratio variable. In the 1st percentile market-to-book ratios range between -93.87 and 0.18. The negative market-to-book ratios stem from negative book values of equity which is relatively uncommon. Only 224 observations have MTB ratios below 0. In the 99th percentile MTB ratios range between 19.05 and 235.57. As these outliers affect our regression model and coefficients, we have decided to exclude them. We set the restriction so that the regression includes observations only for MTB ratios between 0 and 20, approximately representing the 1st and 99th percentile. As 98% of our observations are within this range, we consider this to more accurately represent the relationship between MTB and volatility. When we check the density of the other variables included in the regression model, there are no further issues with outliers.

4.7 Descriptive statistics

In *Table 6*, some descriptive statistics of the data is presented. The ESG scores in the full sample range between a minimum of 10.84 and a maximum of 90.74, with a mean of 56.35 (*Table 6*). The range can be considered wide with respect to the potential minimum of 0 and the potential maximum of 100. The mean environmental score is 66.76 with a minimum of 8.42 and maximum of 97.38 (*Table 6*). Similarly, the mean social score is 63.89 with a minimum and maximum of 4.08 and 99.13, respectively (*Table 6*). The lowest mean among the ESG dimensions is the one for the governance rating, with a mean of 50.47 and values ranging between 1.83 and 96.64 in the sample (*Table 6*).

Looking at the market capitalization, the lowest market cap during the full time period is 1.7 million EUR for Fastighets Balder in 2001 (*Table 6*). The largest market capitalization during the entire time period is for Nokia in year 2000 with a value of 295 billion EUR (*Table 6*). The medium firm size during the whole period is 5.2 billion EUR, implying that our average observation is equivalent to a large cap firm (over 1 billion EUR in market cap).

The sample mean debt ratio of 0.38 indicates that the mean observation has a capital structure composed of 38% total debt compared to 62% common equity (*Table 6*). The minimum debt ratio is 0 and the maximum debt ratio is 1.57, where all observations above 100% debt indicate a negative book value of common equity. The same applies for any observation with a negative market-to-book ratio, which can be explained by the negative book values of common equity (*Table 6*).

The average LTM beta is 0.95, suggesting that when the market goes up by 1 percentage point the average stock goes up by 0.95 percentage points (*Table 6*). Looking at the long-term (LT) beta from the last 24 months, the mean of 0.96 is close but slightly higher (*Table 6*). The LTM beta has a minimum of -7.57, suggesting that for each percentage point increase in the benchmark index that year, the stock went down almost 8 percentage points (*Table 6*). The maximum LTM beta is 10.10, suggesting that for each percentage point that the market went up by in the respective year, the stock went up by 10 percentage points (*Table 6*).

The volatility measure and specific risk measure are intuitively more challenging to interpret. The mean LTM volatility suggests that the annualized standard deviation of monthly stock returns is 0.31. The LTM mean of specific risk suggests that the annualized standard deviation of the CAPM monthly residuals is 0.27. Long-term volatility and specific risk based on the last

24 months are also calculated as a robustness control. They are relatively similar, but have slightly higher minimum values and slightly lower maximum values, in other words closer to the mean.

Table 6: Descriptive statistics

	mean	sd	min	max
Ln Volatility	-1.31	0.47	-2.70	0.73
Volatility	0.31	0.18	0.07	2.08
Volatility (LT)	0.32	0.17	0.09	1.71
Ln Beta	-0.20	0.84	-8.03	2.31
Beta	0.95	0.80	-7.57	10.10
Beta (LT)	0.96	0.59	-5.20	6.16
Ln Specific risk	-1.45	0.48	-3.04	0.73
Specific risk	0.27	0.17	0.05	2.07
Specific risk (LT)	0.28	0.16	0.08	1.70
ESG	56.35	15.07	10.84	90.74
ENV	66.76	29.37	8.42	97.38
SOC	63.89	28.67	4.08	99.13
GOV	50.47	24.87	1.83	96.64
Debt ratio	0.38	0.25	0.00	1.57
Ln Debt ratio	-1.21	0.98	-8.52	0.45
Ln Total assets	14.69	1.97	5.95	22.58
Growth Total assets	0.21	7.18	-1.00	1064.31
MTB	3.03	7.82	-93.78	235.57
MTB^2	70.31	1,169.99	0.00	55,493.23
Market Capitalization (€M)	5,206.79	10,943.62	1.70	294,901.10
year	2,008.88	5.46	1,999.00	2,018.00
N	34,050			

5. Methodology

The following section elaborates on the chosen empirical methodology of this study. The regression models are presented with reference to the various tests that must be performed for specifying the correct functional form.

5.1 Panel data methodology

A panel data consists of continual observations over time for the same units. In our case, the units are 150 public firms listed on a Swedish, Norwegian, Finnish or Danish stock exchange. Panel data allows us to control for unobserved characteristics that are constant over time for the individual firm (Wooldridge, 2016). There are three main methods that are commonly used for panel data sets, namely; pooled ordinary least squares (OLS), fixed effect (FE) estimation, and random effect (RE) estimation (Wooldridge, 2016). We have performed various tests for the multiple linear regression (MLR) assumptions, and conclude that a pooled OLS is not preferred over FE or RE as some of the assumptions required to perform a pooled OLS are violated. One potential concerning violation is the assumption of a zero conditional mean. The main concern is that some omitted variables are correlated with the explanatory variables, making the regression results biased. Since we suspect that some omitted variables may be correlated with explanatory variables, we do not consider a pooled OLS, and perform a Hausman test to determine if a FE or RE model is preferred. In addition, we apply a panel vector autoregressive methodology to deal with potential issues of endogeneity.

We use the Hausman test to determine if FE or RE should be used, where the idea is that RE should be used unless the test rejects the null hypothesis (Wooldridge, 2016). The main difference between the FE and RE model, is that FE allows for a correlation between the fixed unobserved effect a_i and the explanatory variables (Wooldridge, 2016). The Hausman test examines if there is a correlation between the unobserved effect and any explanatory variable, by considering if there is a systematic difference in coefficients between a RE and FE model (Wooldridge, 2016). As illustrated in Table 7, we can see that the test rejects the null hypothesis of no systematic difference in the regression coefficients. The results hold for all three measures of firm risk as the dependent variable, suggesting that a fixed effect model should be used in our regressions. The results also confirm our concern for the zero conditional mean assumption, as the test suggests that the unobserved effect seems to be correlated with the explanatory variables. We can hence conclude that FE is preferred over RE, regardless of the firm risk measure.

Table 7: Hausman test

Dependent variable	Chi2	Prob>Chi2
Ln Volatility	74.55	0.0000
Ln Beta	45.81	0.0000
Ln Specific risk	91.02	0.0000

Note: table presents results for all risk measures as dependent variable

In order to perform the inference for the FE estimations, we rely on homoscedasticity and the residuals being serially uncorrelated across time. As such, we will use the clustering approach to obtain fully robust standard errors and test statistics. By using clustered standard errors through the *vce (cluster firm_id)* command in Stata, we correct for any potential issues with autocorrelation and heteroskedasticity in our regression model.

5.2 Functional form and regression model specification

In order to determine the functional form of our regression model, we use the RESET test for nested models and thereafter the Davidson-MacKinnon test for non-nested models. Initially, we use the natural logarithm of financial risk measures as the dependent variable, as this is suggested by the outcomes of the RESET test. Moreover, the RESET test indicates that MTB should also be included in a squared form. We additionally test the functional form specification through the Davidson-MacKinnon test, in order to determine which functional form the variables should have.

Table 8: Davidson-MacKinnon test

Test	F	Prob>F
(1) Log-level	5.07	0.0243
(2) Log-log	357.90	0.0000
(3) Log-level/log	1.63	0.2017

From the first test presented in Table 8, we can conclude that a log-level regression model is rejected at the 5% significance level. In this model specification, all explanatory variables are in level form. When we test the second model from Table 8 in log-log form, we can also reject this regression model at the 1% significance level, indicating that not all explanatory variables should be in a log form.

When we finally test to include some explanatory variables in log and others in level form, we end up with the following models (with the functional forms of model 3 in Table 8) where we cannot reject that the regression model's functional form is misspecified:

$$LN(VOL)_{it} = \beta_0 + \beta_1 ESG_{it} + \beta_2 \text{LN(TA)}_{it} + \beta_3 \text{growth}TA_{it} + \beta_4 \text{LN } (debt\_ratio)_{it} + \beta_5 MTB_{it} + \beta_6 {MTB^2}_{it} + \sum_{t=1}^{n} \partial_t \, year_t + \varepsilon_{it}$$

$$LN(BETA)_{it} = \beta_0 + \beta_1 ESG_{it} + \beta_2 \text{LN(TA)}_{it} + \beta_3 \text{growth}TA_{it} + \beta_4 \text{LN } (debt\_ratio)_{it} + \beta_5 MTB_{it} + \beta_6 {MTB^2}_{it} + \sum_{t=1}^{n} \partial_t \, year_t + \varepsilon_{it}$$

$$LN(SPECIFIC\ RISK)_{it} = \beta_0 + \beta_1 ESG_{it} + \beta_2 \text{LN(TA)}_{it} + \beta_3 \text{growth}TA_{it} + \beta_4 \text{LN } (debt\_ratio)_{it} + \beta_5 MTB_{it} + \beta_6 {MTB^2}_{it} + \sum_{t=1}^{n} \partial_t \, year_t + \varepsilon_{it}$$

As we conclude that this regression model is not misspecified, we use this functional form as the basis of our regression model in the study, both for the fixed effect regressions and the panel VAR regressions. The outcome variables of the fixed effect regression models are the total risk measured by $LN(VOL)_{it}$ the systematic risk measured by $LN(BETA)_{it}$ and the idiosyncratic risk defined as $LN(SPECIFIC\ RISK)_{it}$, which measures the natural log of the standard deviation of CAPM residuals. The regressions will hence be estimated separately for each risk variable as the outcome variable.

The explanatory variable of interest is the ESG_{it} score for firm *i* in time period *t*. In addition, we will also estimate the regression using the ESG-dimensions as the main explanatory variable, namely ENV_{it}, SOC_{it} and GOV_{it}. The coefficient for the CSP variable will indicate whether there is a significant relationship between the CSP measure and firm risk, or not. Moreover, we include some control variables that vary across firms over time. The control variable LN(TA)_{it} measures the firm size by taking the natural logarithm of total assets in EUR.

The growthTA_{it} variable measures the firm growth by taking the LTM growth in total assets. The control variable LN $(debt\_ratio)_{it}$ measures the natural log of total debt as a percentage of common equity and total debt, and the market-to-book ratio MTB_{it} measures the relationship between the market value and book value of common equity. A squared market-to-book ratio is also included to ensure accurate model specification.

We will also, in line with previous researchers assessing CSP and firm risk, include year fixed effect $\sum_{t=1}^{n} \partial_t \, year_t$ in the regression model (e.g. Jo & Na, 2012; Sassen et al., 2016; Chollet & Sandwidi, 2018). Year fixed effect will control for differences in firm risk that can be explained by the year. The risk of all firms in the sample may for example be affected by the state of the economy and potential financial crises that may increase stock volatility.

As we employ a fixed effect methodology, the unobserved fixed effect a_i is eliminated. All variables are time-demeaned through the fixed effect (within) transformation (Wooldridge, 2016). Since time invariant characteristics of each firm are controlled for with firm fixed effects, any feature that varies between firms but not over time is already controlled for. As a result, there is no need to include controls for industry or country since these do not vary for firms over time. The time-demeaned regression models for the fixed effect regressions are presented below. As previously mentioned, these regressions will be estimated for the aggregate ESG score, as well as for the separate ESG dimensions.

$$LN(\ddot{VOL})_{it} = \alpha_{it} + \delta_1 \ddot{ESG}_{it} + \delta_2 LN(\ddot{TA})_{it} + \delta_3 \ddot{growthTA}_{it} + \delta_4 LN(\ddot{debt\_ratio})_{it} + \delta_5 \ddot{MTB}_{it} + \delta_6 \ddot{MTB}_{it}^2 + \sum_{t=1}^{n} \partial_t \ddot{year}_t + u_{it}$$

$$LN(\ddot{BETA})_{it} = \alpha_{it} + \delta_1 \ddot{ESG}_{it} + \delta_2 LN(\ddot{TA})_{it} + \delta_3 \ddot{growthTA}_{it} + \delta_4 LN(\ddot{debt\_ratio})_{it} + \delta_5 \ddot{MTB}_{it} + \delta_6 \ddot{MTB}_{it}^2 + \sum_{t=1}^{n} \partial_t \ddot{year}_t + u_{it}$$

$$LN(\ddot{SPECIFIC\ RISK})_{it} = \alpha_{it} + \delta_1 \ddot{ESG}_{it} + \delta_2 LN(\ddot{TA})_{it} + \delta_3 \ddot{growthTA}_{it} + \delta_4 LN(\ddot{debt\_ratio})_{it} + \delta_5 \ddot{MTB}_{it} + \delta_6 \ddot{MTB}_{it}^2 + \sum_{t=1}^{n} \partial_t \ddot{year}_t + u_{it}$$

5.3 Panel vector autoregressive model selection and specification

To further our research methodology and extend the existing literature, we apply a panel VAR model, which enables us to examine the reciprocal interaction between firm risk and CSP. The panel VAR approach additionally deals with potential simultaneity problems as well as reverse causality that might be an issue in the FE methodology.

A correlation between the error term and an explanatory variable results in endogeneity, which can lead to biased estimates since it violates the exogeneity assumption. One potential cause of endogeneity is omitted variables that are correlated with explanatory variables included in the regression (Wooldridge, 2016). When we apply a fixed effect approach which controls for characteristics of firms that are constant over time and include multiple time-variant control variables, we assume that omitted variables should not be an issue in our FE regressions. Other potential causes of endogeneity are, however, simultaneity or reverse causality. While we aim to study the impact of CSP on firm risk, it is also likely that a correlation originates from firm risk that influence CSP. To deal with potential simultaneity and reversed causality issues, we apply the Granger causality test based on a panel vector autoregressive model. All variables in a VAR model are treated as endogenous and interdependent, and each variable has an equation explained by its own lagged values and other lagged model variables to explain its development (Canova & Ciccarelli, 2013).

The panel VAR model, compared to fixed effect models, offers a rich structure that is able to capture additional characteristics of the data (Chollet & Sandwidi, 2018). By using forward mean differencing transformation in the panel VAR approach, the mean of all future observations is subtracted and the firm fixed effects are eliminated (Abrigo & Love, 2015). Since past observations are not used in the transformation, they remain valid instruments that allow for the use of lagged dependent variables as instruments (Abrigo & Love, 2015).

Sassen et al. (2016) as well as Chollet and Sandwidi (2018) use a second-order panel VAR model, which is also suggested by Wooldridge (2010). We do, however, choose the optimal lag order based on Hansen's (1982) J statistic and the MBIC, MAIC and MQIC metrics, which is suggested by Abrigo and Love (2015). The Stata command *pvarsoc* is used to generate the various measures used in the model selection. Based on minimizing the J statistic and the smallest MBIC, MAIC and MQIC metrics discussed by Abrigo and Love (2015), we end up with a third-order panel VAR model using the first five lags as instruments. We define the simultaneous panel VAR model equations as follows:

$$Risk_{i,t} = \alpha_0 + \alpha_1 Risk_{i,t-1} + \alpha_2 Risk_{i,t-2} + \alpha_3 Risk_{i,t-3} + \alpha_4 ESG_{i,t-1} + \alpha_5 ESG_{i,t-2} + \alpha_6 ESG_{i,t-3} + \partial_7 x_{i,t-1} + \partial_8 x_{i,t-2} + \partial_9 x_{i,t-3} + \cdots + u_{it}$$

$$ESG_{i,t} = \partial_0 + \partial_1 ESG_{i,t-1} + \partial_2 ESG_{i,t-2} + \partial_3 ESG_{i,t-3} + \partial_4 Risk_{i,t-1} + \partial_5 Risk_{i,t-2} + \partial_6 Risk_{i,t-3} + \partial_7 x_{i,t-1} + \partial_8 x_{i,t-2} + \partial_9 x_{i,t-3} + \cdots + u_{it}$$

where $Risk_{i,t}$ ($LN(VOL)_{it}$, $LN(BETA)_{it}$, and $LN(SPECIFIC\ RISK)_{it}$,) and $ESG_{i,t}$ (ESG_{it}, ENV_{it}, SOC_{it} and GOV_{it}) represent the endogenous variables. $Risk_{i,t-1}$, $Risk_{i,t-2}$ and $Risk_{i,t-3}$ represent firm risk in the years t-1 (lag 1), t-2 (lag 2) and t-3 (lag 3). Further, $ESG_{i,t-1}$, $ESG_{i,t-2}$ and $ESG_{i,t-3}$ represent the ESG performance in the years t-1 (lag 1), t-2 (lag 2) and t-3 (lag 3). To correct for potential issues with autocorrelation and heteroskedasticity, we cluster the standard errors through the *vce (cluster firm_id)* command in Stata.

In line with Sassen et al. (2016) and Chollet and Sandwidi (2018), we apply a multivariate panel VAR that also includes time-varying control variables x_{it} in the panel VAR regressions. Accordingly, the simultaneous panel VAR model equations specified above also include the same control variables as in the fixed effect regressions, x_{it}, which represent all control variables used, including their values in the years t-1, t-2 and t-3.

5.4 Granger causality test

Since the panel VAR regressions generate a large number of coefficients, the coefficients are generally difficult to interpret (Chollet & Sandwidi, 2018). Therefore, the Granger causality test is performed on each separate regression to test if CSP Granger-causes firm risk and if firm risk Granger-causes CSP. Formally speaking, we say that an x variable "Granger-causes" variable y if variable y can be better predicted using historical data of both x and y than it can be estimated using past values of y only (Granger, 1969). Specifically, we conclude that ESG Granger-causes firm risk if the ESG coefficients α_4, α_5 and α_6 differ significantly from zero in the risk equation. We further infer that firm risk Granger-causes ESG if the risk coefficients ∂_4, ∂_5 and ∂_6 differ significantly from zero in the ESG equation. The outcomes of the test can suggest three possible scenarios: a unidirectional, bi-directional or neutral relationship. When the direction of causality is determined by the Granger causality test, the sign of the causality is assessed. To examine the sign, we consider the signs of the statistically significant VAR regression coefficients.

5.5 Unbalanced Panel

Performing a fixed effect or panel VAR estimation on an unbalanced panel is not much more challenging than on a balanced panel (Wooldridge, 2016). The within transformation in the FE approach is applied to the available time periods, which is adjusted by Stata (Wooldridge, 2010). The more challenging part is to determine why the panel is unbalanced (Wooldridge, 2016). Problems arise from unbalanced panels if some observations for a firm are missing for certain time periods and if they are correlated with the idiosyncratic error term u_{it}. This can be a serious problem with unbalanced panel data, since a potential sample selection problem could result in biased estimators (Wooldridge, 2016). Still, the benefit of using a fixed effect approach or panel VAR approach, compared to pooled OLS or RE, is that FE and panel VAR allow attrition (firms leaving the sample) to be correlated with the unobserved individual fixed effect a_i. The potential issue arises only when the attrition is correlated with the idiosyncratic error term u_{it} that varies over time (Wooldridge, 2016). This means that if some firms are more likely to go out of business in the initial sampling, for example due to being in a specific industry, it is captured by the unobserved fixed effect and the attrition does not cause a problem.

6. Results & Analysis

This chapter of the thesis presents and interprets our empirical results of the correlation between firm risk and CSP. The results are shown and discussed for both the fixed effect and panel VAR models, and various robustness checks are performed for both aggregate and disaggregate ESG dimensions.

6.1 Fixed effect regressions - aggregate ESG

6.1.1 Total risk

The regression results with total risk as dependent variable are presented in Table 9. The firm fixed effect regression specification for this section (column 3 Table 9) is presented below:

$$LN(VOL)_{it} = \beta_0 + \beta_1 ESG_{it} + \beta_2 \text{LN(TA)}_{it} + \beta_3 \text{growth}TA_{it} + \beta_4 \text{LN}\ (debt\_ratio)_{it} + \beta_5 MTB_{it} + \beta_6 MTB^2{}_{it} + \sum_{t=1}^{n} \partial_t\, year_t + \varepsilon_{it}$$

Column 1 in Table 9 illustrates the regression outcomes from a firm fixed effect regression without any control variables, nor year fixed effects. In this case we have a statistically significant ESG coefficient of -0.0031, suggesting that volatility decreases 0.31 percentage points as ESG increases by 1 score (e.g. from 52 to 53). In the second column of Table 9, we also add several time-varying control variables to the regression (firm growth, firm size, MTB, MTB squared and debt ratio) and the ESG coefficient is no longer statistically significant. This relationship is confirmed in column 3 when we also include year fixed effects in the regression equation (Table 9). Consequently, we can conclude that the fixed effect estimation suggests that there is no impact of ESG rating on total risk, when controlling for firm FE, year FE and time-varying control variables. This implies a concern for omitted variable bias (OVB) in the first column, because the ESG coefficient becomes insignificant when adding time-varying controls and year fixed effect. An insignificant impact of ESG on total risk is not in line with our expectations, as we anticipated a negative correlation.

Looking at the R-squared, adding a year FE in column 3 seems to increase the explanatory power of the regression model (Table 9). We can also see that the size of the control coefficients is smaller, suggesting that the coefficients, when excluding year FE, might be over-estimated.

Additionally, in column 3, the firm growth variable becomes significant. The signs of the control coefficients follow our expectations, with firm size (ln total assets) having a negative impact on total risk, while firm growth (growth in total assets) and debt ratio have, as we expected, a positive impact on total risk. Further, the expectation is that market-to-book ratio should negatively impact total risk. However, the relationship we find, presented in column 3, follows what is commonly known in econometrics as a u-shape. This occurs when the regression model captures the increasing effect of *x* on *y*, owing to the regression model's logarithmic dependent variable and its independent variable that is negative in simple form, while positive when squared (Woodridge, 2016). This means that when the MTB ratio is low, the impact on total risk is negative, but for high MTB ratios, the impact on firm risk is positive (Table 9). The reason for this is that the coefficient for MTB is negative, but the coefficient for MTB squared is positive (Table 9).

Table 9: FE regression results – aggregate ESG and total risk

VARIABLES	(1) Ln Volatility	(2) Ln Volatility	(3) Ln Volatility
ESG	-0.00310**	0.000925	0.00123
	(0.00148)	(0.00139)	(0.00131)
Growth TA		0.00556	0.0609**
		(0.0360)	(0.0305)
Ln Total assets		-0.201***	-0.148***
		(0.0367)	(0.0446)
MTB		-0.182***	-0.113***
		(0.0175)	(0.0172)
MTB^2		0.00976***	0.00660***
		(0.00117)	(0.00103)
Ln Debt ratio		0.0256	0.00132
		(0.0197)	(0.0164)
Constant	-1.159***	2.080***	1.426**
	(0.0839)	(0.543)	(0.716)
Observations	19,919	19,613	19,613
R-squared	0.005	0.130	0.363
Number of firms	148	146	146
Year FE	No	No	Yes
Firm FE	Yes	Yes	Yes
Controls	No	Yes	Yes

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

6.1.2 Systematic risk

In Table *10*, the regression outcomes are presented where systematic risk is the outcome variable. The firm fixed effect regression specification for this section (column 3 Table *10*) is illustrated below:

$$LN(BETA)_{it} = \beta_0 + \beta_1 ESG_{it} + \beta_2 \text{LN(TA)}_{it} + \beta_3 \text{growth}TA_{it} + \beta_4 \text{LN } (debt\_ratio)_{it}$$
$$+ \beta_5 MTB_{it} + \beta_6 MTB^2{}_{it} + \sum_{t=1}^{n} \partial_t \, year_t + \varepsilon_{it}$$

We can see that the ESG coefficients are insignificant in all columns, giving a consistent indication of ESG not having a significant impact on systematic risk (Table *10*). This result is not in line with our expectations, as we had anticipated a negative relationship.

The R-squared of the regressions are very low, suggesting that our regression model is not particularly good at predicting systematic risk regardless of the regression specification (Table *10*). The u-shaped impact of MTB on systematic risk is consistent with the results we found for total risk in Table 9. The coefficients for firm growth, firm size and debt ratio are not statistically significant, suggesting that these control variables do not affect the systematic risk of firms in our sample. The firm size coefficient was, however, statistically significant when excluding year FE, but since the variable is no longer significant when including year FE we consider the coefficient in column 2 as biased (Table *10*).

Table 10: FE regression results – aggregate ESG and systematic risk

VARIABLES	(1) Ln Beta	(2) Ln Beta	(3) Ln Beta
ESG	0.000990	-0.000671	-0.000759
	(0.00216)	(0.00222)	(0.00237)
Growth TA		0.0652	0.0662
		(0.0439)	(0.0486)
Ln Total assets		0.104**	0.0713
		(0.0501)	(0.0625)
MTB		-0.0818***	-0.0821***
		(0.0246)	(0.0280)
MTB^2		0.00575***	0.00582***
		(0.00153)	(0.00164)
Ln Debt ratio		-0.0297	-0.0404
		(0.0312)	(0.0310)
Constant	-0.199	-1.587**	-0.649
	(0.123)	(0.751)	(0.992)
Observations	18,660	18,395	18,395
R-squared	0.000	0.010	0.022
Number of firms	148	146	146
Firm FE	Yes	Yes	Yes
Year FE	No	No	Yes
Controls	No	Yes	Yes

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

6.1.3 Specific risk

In Table 11, the regression results are presented with specific risk as the outcome variable. The corresponding firm fixed effect regression specification (column 3 Table 11) is presented below:

$$LN(SPECIFIC\ RISK)_{it} = \beta_0 + \beta_1 ESG_{it} + \beta_2 \text{LN(TA)}_{it} + \beta_3 \text{growth}TA_{it} + \beta_4 \text{LN}\ (debt\_ratio)_{it} + \beta_5 MTB_{it} + \beta_6 MTB^2{}_{it} + \sum_{t=1}^{n} \partial_t\, year_t + \varepsilon_{it}$$

In this case, we can see that the ESG coefficient is statistically significant on at least the 10% significance level for all regression model specifications (Table 11). When the ESG score goes up by one point, the specific risk increases by 0.208 percentage points, conditional on time-varying controls as well as firm- and year fixed effect (Table 11). The coefficient is relatively similar compared to when excluding year FE, but is slightly lower in column 3, suggesting an overestimated coefficient in column 2 when omitting year FE (Table 11).

The R-squared increases significantly when adding year FE in column 3, indicating that including year dummies improves the predictive power of our regression model (Table 11). All time-varying control variables in column 3 are statistically significant on at least a 10% significance level. Firm size has a negative coefficient and firm growth has a positive coefficient, both of which are in line with our expectations. The market-to-book ratio coefficients are consistent with previous results in Table 9 and Table 10, showing a u-shaped impact on specific risk. The debt ratio has a positive coefficient, which is consistent with both our expectations and previous regression specification results (Table 11).

Table 11: FE regression results – aggregate ESG and specific risk

VARIABLES	(1) Ln Specific risk	(2) Ln Specific risk	(3) Ln Specific risk
ESG	-0.00242*	0.00254**	0.00208*
	(0.00136)	(0.00117)	(0.00115)
Growth TA		-0.000459	0.0562*
		(0.0364)	(0.0310)
Ln Total assets		-0.251***	-0.226***
		(0.0335)	(0.0400)
MTB		-0.171***	-0.117***
		(0.0177)	(0.0193)
MTB^2		0.00849***	0.00588***
		(0.00130)	(0.00120)
Ln Debt ratio		0.0436***	0.0266*
		(0.0162)	(0.0153)
Constant	-1.364***	2.587***	2.482***
	(0.0775)	(0.502)	(0.611)
Observations	19,814	19,516	19,516
R-squared	0.003	0.154	0.309
Number of firms	148	146	146
Firm FE	Yes	Yes	Yes
Year FE	No	No	Yes
Controls	No	Yes	Yes

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

6.1.4 Robustness

To check for robustness of our results and their robustness across risk definitions, we use various measures of firm risk calculated in different ways to see if the results hold. Chollet and Sandwidi (2018) use long-period beta as an alternative measure of systematic firm risk, by taking the beta and volatility of the last five years return. We re-estimate our regressions based on the last 24 months' data, as opposed to the last 12 months used in our initial regressions, since taking the last five years' data reduces the number of observations accounted for significantly. The results for aggregate ESG using fixed effect are robust for alternative measures of firm risk, where the last 24 months of observations are used. The ESG coefficients are still insignificant when using the long-period total risk and systematic risk as the dependent variable (*Appendix 2*).

With an increased interest for socially responsible investments, it is further realistic to imagine that the impact of ESG may change over time (Global Sustainable Investment Alliance, 2018). To make sure that the results hold across varying time periods, we run the regressions for limited time periods, in line with the study by Chollet and Sandwidi (2018). The first sub-period is 2002-2007, and represents the time period before the financial crisis of 2008. The second sub-period represents the period during and after the financial crisis and is limited to the years 2008-2017. When controlling for both firm and year FE, the ESG coefficient is insignificant for both the total, first and second time period for total risk and systematic risk (*Appendix 3*). When looking at specific risk, the ESG coefficient is insignificant for the first and second time period, but significant at a 10% significance level for the total time period (*Appendix 3*).

Since the emphasis investors place on CSP may vary across countries, we re-estimate all regressions based on country specific subsamples. As opposed to numerous previous studies, we consider the relationship between CSP and firm risk on a country level. As we expect that there may be differences between the relationships within a European sample, we may also suspect that a collective result for the whole of the Nordics might not apply for all separate Nordic countries. Previous studies (e.g. Chollet & Sandwidi, 2018) suggest that the importance of CSP varies across countries due to differences in political climate, regulatory frameworks and labour market institutions. Hence, we estimated the regressions for four sub-samples based on each country in our sample: Sweden, Norway, Finland and Denmark. The ESG coefficient, when having total risk as the outcome variable, is insignificant for the total sample, as well as for Swedish, Finnish and Danish stocks separately, but significant at a 10% significance level for Norwegian stocks (*Appendix 4*). For the Norwegian sample, an increase in ESG score by one point results in a 0.626 percentage point increase in total risk (*Appendix 4*). We can, however, conclude that for Nordic stocks in general, the impact of ESG on total risk is insignificant. The systematic risk results are robust across all countries, where the ESG coefficient is insignificant for all subsamples (*Appendix 5*). For specific risk as the dependent variable, ESG coefficients are no longer significant for Sweden, Finland and Denmark (*Appendix 6*). The ESG coefficient for specific risk as the outcome variable, which is significant at a 10% level for the whole sample, is also significant for the Norwegian subsample at a 10% significance level (*Appendix 6*). We can regardless conclude that the impact of ESG on specific risk only appears to be significant for Norwegian stocks and not for the other countries in our sample.

In Table 12, the outcomes of the robustness checks are presented. For total risk and systematic risk, we find a robust insignificant impact of ESG on risk, suggesting that our initial conclusion holds. The robustness checks hence support that there is no impact of ESG on total and systematic risk, when controlling for firm and year fixed effects as well as the commonly used time-varying control variables. For specific risk, on the contrary, the significant results we initially found do not seem to hold in our robustness checks, suggesting that we cannot trust that there is a significant impact of ESG on specific risk. We will hence conclude that we find no significant impact of ESG on any financial risk measure for Nordic firms, when applying a firm fixed effect approach.

Table 12: Summary of robustness checks

	Total risk	Systematic risk	Specific risk
Long-term risk	Results robust	Results robust	Results changed
Varying time periods	Results robust	Results robust	Results changed
Across countries	Results robust	Results robust	Results changed

6.2 Fixed effect regressions – disaggregate ESG

With robust results suggesting that the aggregated ESG score does not impact financial risk, we continue to look at the disaggregated ESG pillars; environmental score, social score and governance score. Accordingly, Chollet and Sandwidi (2018) suggest that it is difficult to demonstrate a significant interaction between ESG and firm risk at an aggregate level, as the different ESG dimensions impact risk in varying ways.

6.2.1 Total risk

In Table 13, the regression results are presented for the three pillar scores' impact on total risk. The firm fixed effect regression specification for this section is presented below, with one single CSP measure as the main explanatory variable included in each column (aggregate ESG in column 1, EVN in column 2, SOC in column 3 and GOV in column 4). The regression model specification below illustrates the regression model in column 1:

$$LN(VOL)_{it} = \beta_0 + \beta_1 ESG_{it} + \beta_2 \text{LN(TA)}_{it} + \beta_3 \text{growth}TA_{it} + \beta_4 \text{LN } (debt\_ratio)_{it} + \beta_5 MTB_{it} + \beta_6 MTB^2{}_{it} + \sum_{t=1}^{n} \partial_t \, year_t + \varepsilon_{it}$$

The regressions indicate that when controlling for firm and year FE as well as time varying controls, there is no significant impact on total risk for either the environmental score, social score or the governance score (Table 13).

Table 13: FE regression results – disaggregate ESG and total risk

VARIABLES	(1) Ln Volatility	(2) Ln Volatility	(3) Ln Volatility	(4) Ln Volatility
ESG	0.00116 (0.00129)			
ENV		8.36e-05 (0.000821)		
SOC			8.87e-05 (0.000730)	
GOV				0.000846 (0.000749)
Observations	19,626	19,677	19,677	19,665
R-squared	0.362	0.362	0.362	0.363
Number of firms	146	146	146	146
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

6.2.2 Systematic risk

In Table 14, we illustrate the regression outcomes for the three pillars' impact on systematic risk. The firm fixed effect regression specification for this section is presented below, with one single CSP measure as the main explanatory variable included in each column:

$$LN(BETA)_{it} = \beta_0 + \beta_1 ESG_{it} + \beta_2 \text{LN(TA)}_{it} + \beta_3 \text{growth}TA_{it} + \beta_4 \text{LN } (debt\_ratio)_{it} + \beta_5 MTB_{it} + \beta_6 MTB^2{}_{it} + \sum_{t=1}^{n} \partial_t \, year_t + \varepsilon_{it}$$

Similarly to the previous results, we find no significant impact on systematic risk of any ESG dimension when controlling for firm FE, year FE and time-varying controls (Table 14).

Table 14: FE regression results – disaggregate ESG and systematic risk

VARIABLES	(1) Ln Beta	(2) Ln Beta	(3) Ln Beta	(4) Ln Beta
ESG	-0.000867			
	(0.00234)			
ENV		-0.00147		
		(0.00130)		
SOC			-0.000261	
			(0.00125)	
GOV				3.48e-05
				(0.00137)
Observations	18,404	18,453	18,453	18,441
R-squared	0.022	0.022	0.021	0.021
Number of firms	146	146	146	146
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

6.2.3 Specific risk

The corresponding regression outcomes, but with specific risk as the outcome variable, are presented in Table 15. The firm fixed effect regression specification for each single CSP measure as the main explanatory variable is defined as follows:

$$LN(SPECIFIC\ RISK)_{it} = \beta_0 + \beta_1 ESG_{it} + \beta_2 \text{LN(TA)}_{it} + \beta_3 \text{growth}TA_{it} + \beta_4 \text{LN}\ (debt\_ratio)_{it} + \beta_5 MTB_{it} + \beta_6 MTB^2{}_{it} + \sum_{t=1}^{n} \partial_t\, year_t + \varepsilon_{it}$$

The results are consistent with previous findings, namely that there is no statistically significant impact of either environmental, social or governance score on specific risk, controlling for firm FE, year FE and time-varying control variables.

Table 15: FE regression results – disaggregate ESG and specific risk

VARIABLES	(1) Ln Specific risk	(2) Ln Specific risk	(3) Ln Specific risk	(4) Ln Specific risk
ESG	0.00200*			
	(0.00114)			
ENV		0.000643		
		(0.000786)		
SOC			0.000125	
			(0.000622)	
GOV				0.000607
				(0.000733)
Observations	19,530	19,581	19,581	19,569
R-squared	0.309	0.308	0.307	0.308
Number of firms	146	146	146	146
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

6.2.4 Robustness

The regression results when using ENV, SOC and GOV as main explanatory variables are robust for long-term measures of total risk, systematic risk and specific risk (*Appendix 7*). The insignificant impact of the environmental score ENV on all risk measures is robust for various time periods, including for the sub-period (1) year 2002-2007 and (2) year 2008-2017 (*Appendix 8*). The impacts of SOC and GOV, respectively, on all risk measures are also robust and insignificant across various time periods (*Appendix 8*).

The impact of the environmental pillar score on total risk and systematic risk is further insignificant and robust for Sweden and Denmark as subsamples, while the impact is negative at a 5-10% significance level in Finland and positive at a 1-10% significance level in Norway (*Appendix 9* and *Appendix 10*). The impact of ENV on specific risk is robust and insignificant in the whole sample as well as in Sweden, Denmark and Finland, but positive and significant at a 1% significance level in Norway as a subsample (*Appendix 11*). The impacts of the social pillar score and the governance pillar score on total, systematic and specific risk are insignificant and robust across all countries in the Nordics (*Appendix 9*, *Appendix 10* and *Appendix 11*).

In light of the above, we can hence conclude that with a firm and year fixed effect model, we find robust results suggesting that the ESG dimensions separately have no statistically significant impact on firm risk. The only exception where the results are not completely robust is for the environmental score that has (1) a negative effect on total and systematic risk in Finland, and (2) a positive effect on all risk measures in Norway. However, regardless of potential significant results on subsamples, we find robust insignificant results on a Nordic level between the ESG dimensions and firm risk.

We further test the fixed effect regressions robustness when using annual observations as opposed to monthly observations. All results are robust, where all correlations between CSP measures and risk measures are insignificant, besides the correlation between ESG and specific risk which was also significant for the monthly data. Hence, we can conclude that the results of the fixed effect estimations do not change if using annual observations.

6.3 Panel VAR regressions

In line with previous studies (e.g. Sassen et al., 2016; Chollet & Sandwidi, 2018), we extend the research further by applying a multivariate panel VAR approach. As discussed in the methodology chapter, we use a third-order VAR model with 5 lags of endogenous variables with clustered standard errors. As Sassen et al. (2016) and Chollet and Sandwidi (2018) does, we use annual observations in the panel VAR regressions. This is because ESG, ENV, SOC and GOV are updated on an annual basis by ASSET4, and monthly lags do not entail enough variation. The panel VAR regressions are multivariate since we include the same control variable as in the FE regressions (firm growth, firm size, MTB, squared MTB and debt ratio). As the ESG dimensions may have different impacts on firm risk, we apply the panel VAR approach on each separate pillar score in addition to the aggregate ESG score.

6.3.1 ESG score

We start by looking at the Granger causality test to determine if there is a causal relationship between aggregate ESG and firm risk. The results of the Granger causality test, presented in Table 16, suggest that ESG does Granger-cause total risk and specific risk at a 5% significance level. The causality test further rejects the null hypotheses stating that total risk and specific risk does not Granger-cause ESG, suggesting that there is a circular relationship in which ESG and the risk measures affect each other separately (Table 16). Hence, the direction of causality goes both ways when considering total risk and specific risk. For systematic risk, the test cannot reject the null hypotheses, suggesting that ESG does not impact systematic risk and systematic risk does not impact ESG (Table 16). The result contradicts the results found in the fixed effect regressions, where no significant correlation between ESG and firm risk was found.

Table 16: Granger causality test for aggregate ESG

Null hypothesis	Chi2	Prob>Chi2
ESG does not Granger-cause Ln Volatility	9.747	0.021
Ln Volatility does not Granger-cause ESG	48.496	0.000
ESG does not Granger-cause Ln Beta	0.922	0.820
Ln Beta does not Granger-cause ESG	3.353	0.340
ESG does not Granger-cause Ln Specific risk	7.882	0.049
Ln Specific risk does not Granger-cause ESG	19.745	0.000

The multivariate panel VAR results are presented in Table 17, and are based on a regression specification matrix in which firm risk is explained by lagged values of risk, aggregate ESG score and lagged control variables $x_{i,t-n}$. The regressions in Table 17 account for all three firm risk measures as the outcome variable (total, systematic and specific risk) in column 1, 3 and 5 respectively, as illustrated by the following regression specification:

$$Risk_{i,t} = \alpha_0 + \alpha_1 Risk_{i,t-1} + \alpha_2 Risk_{i,t-2} + \alpha_3 Risk_{i,t-3} + \alpha_4 ESG_{i,t-1} + \alpha_5 ESG_{i,t-2} + \alpha_6 ESG_{i,t-3} + \partial_7 x_{i,t-1} + \partial_8 x_{i,t-2} + \partial_9 x_{i,t-3} + \cdots + u_{it}$$

The corresponding impact of firm risk on ESG is presented in column 2, 4 and 6 and is based on the regression specification below:

$$ESG_{i,t} = \partial_0 + \partial_1 ESG_{i,t-1} + \partial_2 ESG_{i,t-2} + \partial_3 ESG_{i,t-3} + \partial_4 Risk_{i,t-1} + \partial_5 Risk_{i,t-2} + \partial_6 Risk_{i,t-3} + \partial_7 x_{i,t-1} + \partial_8 x_{i,t-2} + \partial_9 x_{i,t-3} + \cdots + u_{it}$$

The impact of ESG on total risk is interpreted as negative in column 1, since the only significant lagged ESG coefficient is negative (Table 17). The corresponding impact of total risk on ESG is also interpreted as negative based on significant lags (Table 17). The causal impact of ESG on specific risk is negative, since the significant lagged ESG coefficient in column 5 has a negative sign (Table 17). The equivalent impact of specific risk on ESG is also negative as illustrated in column 6 (Table 17). Consequently, these results suggest that an increasing ESG score lead to a decrease in total risk and systematic risk, which in turn increases the ESG score further.

Table 17: Panel VAR regression results for aggregate ESG

VARIABLES	(1) Ln VOL	(2) ESG	(3) Ln BETA	(4) ESG	(5) Ln SR	(6) ESG
L1. Ln VOL	0.485***	-0.350				
	(0.0491)	(0.839)				
L2. Ln VOL	-0.0782*	-4.672***				
	(0.0460)	(0.686)				
L3. Ln VOL	0.186***	0.497				
	(0.0444)	(0.649)				
L1. ESG	-0.0122***	0.660***	0.00299	0.753***	-0.0113**	0.718***
	(0.00401)	(0.0533)	(0.0109)	(0.0823)	(0.00461)	(0.0522)
L2. ESG	0.000837	0.0641*	2.17e-05	0.111**	-0.00255	0.0723**
	(0.00326)	(0.0385)	(0.00773)	(0.0478)	(0.00312)	(0.0345)
L3. ESG	-0.000505	-0.161***	-0.00444	-0.0925**	-0.000154	-0.116***
	(0.00225)	(0.0253)	(0.00580)	(0.0365)	(0.00246)	(0.0252)
L1. Ln BETA			0.140**	-0.912*		
			(0.0606)	(0.506)		
L2. Ln BETA			0.0165	-0.335		
			(0.0627)	(0.526)		
L3. Ln BETA			-0.0412	-0.444		
			(0.0541)	(0.466)		
L1. Ln SR					0.0954	-3.406***
					(0.0647)	(0.913)
L2. Ln SR					0.0437	-1.302**
					(0.0493)	(0.661)
L3. Ln SR					0.0429	-0.768
					(0.0467)	(0.653)
Observations	878	878	633	633	878	878

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

6.3.2 Environmental score

The Granger causality test for the causal relationship between environmental score and firm risk is presented in Table 18. The test suggests that ENV Granger-causes total risk and specific risk at a 1% and 5% significance level, respectively (Table 18). The test further suggests that the total risk and specific risk Granger-cause ENV at a 1% significance level (Table 18), similarly to the relationship found between risk and ESG in Table 16. These results are not in line with the results of the fixed effect regressions (Table 13), where we found no significant correlation between ENV and total risk when controlling for firm FE, year FE and time-varying controls. We can further not reject the null hypothesis of a causation between ENV and systematic risk, suggesting that there is no causal relationship between the two variables.

Table 18: Granger causality test for environmental score

Null hypothesis	Chi2	Prob>Chi2
ENV does not Granger-cause Ln Volatility	12.099	0.007
Ln Volatility does not Granger-cause ENV	33.885	0.000
ENV does not Granger-cause Ln Beta	0.988	0.804
Ln Beta does not Granger-cause ENV	2.380	0.497
ENV does not Granger-cause Ln Specific risk	10.036	0.018
Ln Specific risk does not Granger-cause ENV	12.114	0.007

The regressions in Table 19 account for total, systematic and specific risk as the outcome variable and are based on the succeeding regression specification:

$$Risk_{i,t} = \alpha_0 + \alpha_1 Risk_{i,t-1} + \alpha_2 Risk_{i,t-2} + \alpha_3 Risk_{i,t-3} + \alpha_4 ENV_{i,t-1} + \alpha_5 ENV_{i,t-2} + \alpha_6 ENV_{i,t-3} + \partial_7 x_{i,t-1} + \partial_8 x_{i,t-2} + \partial_9 x_{i,t-3} + \cdots + u_{it}$$

The regression specification below illustrates the corresponding impact of firm risk on the environmental score:

$$ENV_{i,t} = \partial_0 + \partial_1 ENV_{i,t-1} + \partial_2 ENV_{i,t-2} + \partial_3 ENV_{i,t-3} + \partial_4 Risk_{i,t-1} + \partial_5 Risk_{i,t-2} + \partial_6 Risk_{i,t-3} + \partial_7 x_{i,t-1} + \partial_8 x_{i,t-2} + \partial_9 x_{i,t-3} + \cdots + u_{it}$$

According to the significant lagged ENV coefficients in Table 19, the impact of ENV on total risk (column 1) and specific risk (column 5) is negative. The corresponding impact of total risk (column 2) and specific risk (column 6) on ENV is also negative (Table 19). The results imply a circular relationship, where an increase in ENV leads to a decrease in total- and specific risk, which in turn leads to an additional increase in environmental performance. This relationship is consistent with the circular relationship found for total- and specific risk and aggregate ESG performance (Table 16).

Table 19: Panel VAR regression results for environmental score

VARIABLES	(1) Ln VOL	(2) ENV	(3) Ln BETA	(4) ENV	(5) Ln SR	(6) ENV
L1. Ln VOL	0.486***	-0.748				
	(0.0577)	(1.844)				
L2. Ln VOL	-0.0733	-7.249***				
	(0.0548)	(1.351)				
L3. Ln VOL	0.225***	1.539				
	(0.0444)	(1.369)				
L1. ENV	-0.0108***	0.519***	-0.00517	0.801***	-0.00921***	0.652***
	(0.00336)	(0.0943)	(0.00704)	(0.0914)	(0.00335)	(0.0713)
L2. ENV	-0.000647	0.166***	0.000917	0.140**	-0.00214	0.165***
	(0.00193)	(0.0584)	(0.00402)	(0.0593)	(0.00172)	(0.0509)
L3. ENV	-0.000843	-0.203***	-0.00294	-0.0169	0.000336	-0.0703
	(0.00178)	(0.0563)	(0.00318)	(0.0641)	(0.00202)	(0.0499)
L1. Ln BETA			0.196***	0.511		
			(0.0593)	(0.644)		
L2. Ln BETA			0.0496	-0.203		
			(0.0532)	(0.546)		
L3. Ln BETA			-0.0704	0.575		
			(0.0525)	(0.561)		
L1. Ln SR					0.127	-4.728***
					(0.0787)	(1.827)
L2. Ln SR					-0.0209	-2.420**
					(0.0485)	(1.080)
L3. Ln SR					0.0255	-1.669
					(0.0453)	(1.095)
Observations	883	883	638	638	883	883

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

6.3.3 Social score

The Granger causality test that determines if there is a causal relationship between SOC and firm risk is presented in Table 20. For the social dimension, we find that SOC Granger-causes firm risk for all risk measures (total, systematic and specific) on at least a 5% significance level (Table 20). Similarly, total risk and specific risk Granger-cause SOC at a 1% significance level, and systematic risk Granger-causes SOC at a 10% significance level (Table 20). These results are consistent with previous findings with the panel VAR model for total risk and specific risk. The social dimension is however the first ESG pillar that so far has a significant correlation with systematic risk. These results, using a multivariate panel VAR approach, are similarly not consistent with the findings from the fixed effect regression outcomes of a non-significant correlation between SOC and firm risk presented in Table 13, Table 14 and Table 15.

Table 20: Granger causality test for social score

Null hypothesis	Chi2	Prob>Chi2
SOC does not Granger-cause Ln Volatility	12.685	0.005
Ln Volatility does not Granger-cause SOC	67.888	0.000
SOC does not Granger-cause Ln Beta	8.223	0.042
Ln Beta does not Granger-cause SOC	7.652	0.054
SOC does not Granger-cause Ln Specific risk	15.778	0.001
Ln Specific risk does not Granger-cause SOC	68.884	0.000

In Table 21, the regression results are presented for the multivariate panel VAR approach considering the social dimension. The regressions account for total, systematic and specific risk as the outcome variable and are based on the following regression specification:

$$Risk_{i,t} = \alpha_0 + \alpha_1 Risk_{i,t-1} + \alpha_2 Risk_{i,t-2} + \alpha_3 Risk_{i,t-3} + \alpha_4 SOC_{i,t-1} + \alpha_5 SOC_{i,t-2} + \alpha_6 SOC_{i,t-3} + \partial_7 x_{i,t-1} + \partial_8 x_{i,t-2} + \partial_9 x_{i,t-3} + \cdots + u_{it}$$

The corresponding impact of firm risk on the social dimension is based on the following regression specification:

$$SOC_{i,t} = \partial_0 + \partial_1 SOC_{i,t-1} + \partial_2 SOC_{i,t-2} + \partial_3 SOC_{i,t-3} + \partial_4 Risk_{i,t-1} + \partial_5 Risk_{i,t-2} + \partial_6 Risk_{i,t-3} + \partial_7 x_{i,t-1} + \partial_8 x_{i,t-2} + \partial_9 x_{i,t-3} + \cdots + u_{it}$$

We can conclude from the significant lagged SOC coefficients that the impact of SOC on total risk (column 1) and specific risk (column 5) is negative, while the impact of SOC on systematic risk (column 3) is positive (Table 21). The impact of total risk on SOC is further negative in the short run from the second-year lag, but positive in the longer run from the third-year lag (Table 21). Systematic risk only has positive coefficients looking at the impact on SOC, while we should keep in mind that the Granger-causation only was significant at a 10% level (Table 20). Specific risk has, similarly to total risk, a negative impact on SOC in the short-run but could have a positive impact in the longer run if considering the second-year lag (10% significance level) as statistically significant (Table 21). The negative impact of SOC on total risk and specific risk is consistent with previous panel VAR results, while the alternating impact of total and specific risk on SOC is inconsistent with previous findings for ESG and ENV (Table 17 and Table 19). The relationship between SOC and systematic risk is further the first ESG pillar for which we find a significant correlation between CSP and systematic risk.

Table 21: Panel VAR regression results for social score

VARIABLES	(1) Ln VOL	(2) SOC	(3) Ln BETA	(4) SOC	(5) Ln SR	(6) SOC
L1. Ln VOL	0.443***	-1.398				
	(0.0589)	(1.779)				
L2. Ln VOL	-0.148**	-10.79***				
	(0.0597)	(1.503)				
L3. Ln VOL	0.300***	3.654***				
	(0.0597)	(1.179)				
L1. SOC	-0.0100***	0.532***	-0.0109	0.794***	-0.00943***	0.600***
	(0.00341)	(0.0733)	(0.00881)	(0.113)	(0.00265)	(0.0794)
L2. SOC	0.000420	0.0639	0.0102**	0.102	-0.000305	0.0954*
	(0.00177)	(0.0537)	(0.00520)	(0.0756)	(0.00166)	(0.0517)
L3. SOC	0.000401	-0.0229	0.000349	0.0187	0.000468	-0.0226
	(0.00161)	(0.0383)	(0.00343)	(0.0415)	(0.00147)	(0.0352)
L1. Ln BETA			0.199**	-0.504		
			(0.0825)	(1.132)		
L2. Ln BETA			0.0798	0.841		
			(0.0725)	(0.945)		
L3. Ln BETA			-0.0238	1.571*		
			(0.0611)	(0.882)		
L1. Ln SR					0.148**	-14.41***
					(0.0680)	(2.026)
L2. Ln SR					-0.00286	2.567*
					(0.0485)	(1.505)
L3. Ln SR					0.166***	-0.0549
					(0.0560)	(1.446)
Observations	883	883	638	638	883	883

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

6.3.4 Governance score

In Table 22, the test results of causality are presented for the governance score using the Granger causality test. The causality test suggests that, based on a 10% significance level (but almost significant at 5% level), GOV Granger-causes specific risk (Table 22). We can however not conclude a significant impact of GOV on total risk or systematic risk (Table 22). Still, total risk and specific risk do Granger-cause GOV at a 1% significance level, suggesting that there is a causal relationship, but that it is the risk that influences GOV and not the other way around (Table 22). We can, similarly to previous results for ESG and ENV, conclude that we have no evidence of a causation between systematic risk and GOV (Table 22). The results of the multivariate panel VAR approach are inconsistent with the fixed effect regression outcomes of a non-significant correlation between firm risk and GOV (Table 13, Table 14 and Table 15).

Table 22: Granger causality test for governance score

Null hypothesis	Chi2	Prob>Chi2
GOV does not Granger-cause Ln Volatility	1.848	0.605
Ln Volatility does not Granger-cause GOV	52.453	0.000
GOV does not Granger-cause Ln Beta	3.693	0.297
Ln Beta does not Granger-cause GOV	1.737	0.629
GOV does not Granger-cause Ln Specific risk	7.745	0.052
Ln Specific risk does not Granger-cause GOV	52.914	0.000

The regression results for the governance score using a multivariate panel VAR model are presented in Table 23. The regressions for total, systematic and specific risk as the outcome variable are based on the following regression specification:

$$Risk_{i,t} = \alpha_0 + \alpha_1 Risk_{i,t-1} + \alpha_2 Risk_{i,t-2} + \alpha_3 Risk_{i,t-3} + \alpha_4 GOV_{i,t-1} + \alpha_5 GOV_{i,t-2} + \alpha_6 GOV_{i,t-3} + \partial_7 x_{i,t-1} + \partial_8 x_{i,t-2} + \partial_9 x_{i,t-3} + \cdots + u_{it}$$

The impact of firm risk on the governance dimension is illustrated by the succeeding regression specification:

$$GOV_{i,t} = \partial_0 + \partial_1 GOV_{i,t-1} + \partial_2 GOV_{i,t-2} + \partial_3 GOV_{i,t-3} + \partial_4 Risk_{i,t-1} + \partial_5 Risk_{i,t-2} + \partial_6 Risk_{i,t-3} + \partial_7 x_{i,t-1} + \partial_8 x_{i,t-2} + \partial_9 x_{i,t-3} + \cdots + u_{it}$$

Based on significant lagged risk coefficients, we can confirm a positive impact of both total risk (column 2) and specific risk (column 6) on GOV (Table 23). The impact of GOV on specific risk (column 5) is further negative, consistent with previous results for the impact of CSP on firm risk (Table 23). The correlation between GOV and specific risk does consequently move in the opposite directions, where an increase in GOV results in reduced specific risk, which in turn decreases the GOV score (Table 23).

Table 23: VAR regression results for governance score

VARIABLES	(1) Ln VOL	(2) GOV	(3) Ln BETA	(4) GOV	(5) Ln SR	(6) GOV
L1. Ln VOL	0.489***	6.548***				
	(0.0656)	(1.258)				
L2. Ln VOL	-0.0326	5.841***				
	(0.0449)	(1.173)				
L3. Ln VOL	0.187***	-0.398				
	(0.0505)	(1.258)				
L1. GOV	-0.00411	0.482***	0.00574	0.595***	-0.00775**	0.568***
	(0.00350)	(0.0606)	(0.00591)	(0.0649)	(0.00319)	(0.0738)
L2. GOV	-0.00153	0.169***	0.000683	0.154***	-0.00242*	0.161***
	(0.00167)	(0.0346)	(0.00246)	(0.0393)	(0.00145)	(0.0368)
L3. GOV	0.000245	-0.0909**	-0.00313	-0.123***	-0.00151	-0.0677*
	(0.00125)	(0.0367)	(0.00244)	(0.0390)	(0.00112)	(0.0373)
L1. Ln BETA			0.198***	1.068		
			(0.0491)	(0.924)		
L2. Ln BETA			0.0528	0.236		
			(0.0581)	(0.945)		
L3. Ln BETA			-0.0694	0.0491		
			(0.0570)	(0.815)		
L1. Ln SR					0.0304	8.447***
					(0.0686)	(1.328)
L2. Ln SR					0.0187	3.601***
					(0.0515)	(1.275)
L3. Ln SR					0.00783	0.581
					(0.0528)	(1.203)
Observations	882	882	637	637	882	882

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

6.3.5 Robustness for panel VAR results

For the panel VAR regressions, we use annual observations in line with previous research (i.e. Sassen et al., 2016; Chollet & Sandwidi, 2018). In this regard, we perform an additional robustness control in which we use monthly data for the panel VAR regressions. The reason for this is that we estimate the fixed effect regressions with monthly data, and want to rule out the possibility that the form of data has an impact on our results. The results using monthly observations are to a large extent insignificant (*Appendix 12*). We interpret this simply as a lack of variation in the three monthly lags included, and not as a lack of robustness in our annual VAR results. The results from the panel VAR regressions are further relatively robust when considering long-period measures of firm risk (24 last months) and the overall conclusions remain (*Appendix 12*). Our results are also very robust for the second time period, while the first time period shows overall insignificant results (*Appendix 13*). Interestingly, the only significant ESG dimension in the first time period is the social score that illustrates a negative impact on total and specific risk, suggesting that the importance of CSP has evolved in later years (*Appendix 13*). Overall, we can confirm that the results seem to have a time effect, where the effect is only more significant in later years (*Appendix 13*).

While the results vary to some extent across countries, the general conclusion of a negative and bi-directional relationship between CSP and firm risk remains (*Appendix 14*). The results are however lacking in significance, where Finland, Norway and Denmark (the smallest subsamples) show insignificant correlations between CSP measures and firm risk in general (*Appendix 14*). We interpret this as a lack of variation due to small sample sizes, since the results are significant for the Swedish subsample which is larger.

As a final robustness check, we estimated the regressions again with the sample restricted to firms that were included in the sample from the beginning of the analysed period, in 2002. This robustness check is suggested by Sassen et al. (2016), as there are large differences in the sample size and the selection of firms in the sample is determined by ASSET4. While 150 firms in total are included in the analysis, only 63 firms were included in the initial sample in 2002. The firm coverage increases substantially in the ASSET4 database over time, and should not be a factor that impacts the regression results. The results are both significant and robust when we restrict the sample to the 63 initial sample firms (*Appendix 13*). Hence, the continuous selection of firms into ASSET4 does not impact the results of our analysis. Accordingly, we conclude that the results we find are robust to various robustness checks and our overarching conclusions remain.

(1) Aggregate ESG negatively impacts total and specific risk

The negative impact of the aggregate ESG score on total and specific risk is highly robust. The first panel VAR regression result is robust in the following robustness checks: (1) when using long-period total risk as an alternative risk measure, (2) for the second time period subsample between the years 2008-2017, (3) for the restricted subsample including only the 63 initial sample firms, (4) for the Swedish subsample, and lastly (5) for the Norwegian subsample (*Appendix 12*, *Appendix 13* and *Appendix 14*). The negative and significant impact of ESG on specific risk is robust for (1) the second time period subsample, (2) the restricted subsample for the initial 63 firms, and lastly (3) the Swedish subsample (*Appendix 13* and *Appendix 14*). The result is not robust when using monthly observations, which we interpret as a lack of variation and impact of monthly lags (*Appendix 12*). Further, the result is not robust for the first time period between the years 2002-2007, suggesting that the effect of ESG on firm risk has evolved over time as the effects are only significant in later years (*Appendix 13*).

(2) ENV, SOC and GOV negatively impact total and specific risk

The results of a negative impact of the ESG dimensions on total/specific risk are considered as satisfactorily robust and hence reliable. The impact of ENV on total/specific risk is robust when (1) using monthly observations, (2) for the second time period subsample, and (3) for the restricted subsample including the initial sample of firms (*Appendix 12* and *Appendix 13*). The impact of SOC is robust for (1) the first time period, (2) the second time period, (3) the initial sample firms and (4) the Danish subsample (*Appendix 13* and *Appendix 14*). The impact of GOV is robust for (1) the second time period, and (3) for the initial sample (*Appendix 13*). Interestingly, we do find a negative impact of GOV on total risk when using (1) long-term risk measures, and (2) for the initial sample (*Appendix 12* and *Appendix 13*). Therefore, the negative impact of GOV on specific risk seems to apply for total risk as well. Since specific risk is a determinant of total risk and GOV appears to have a negative impact on both specific/total risk depending on the risk measure, we will treat this as an indication of a negative and significant impact of GOV on total risk as well. Our conclusion is therefore that all ESG dimensions have a significantly negative impact on both specific and total risk.

(3) Total and specific risk negatively impact ESG and ENV

A negative and bidirectional relationship is found between total/specific risk and the CSP measures ESG and ENV, where total/specific risk negatively impact ESG and ENV. The negative impact of total risk on ESG and ENV is robust (1) when using long-period volatility, and (2) for the second time period, while the impact has alternating signs for the initial sample (Appendix *12* and Appendix *13*). The negative impact of specific risk on ESG and ENV is robust (1) for the second time period, and (2) for the initial sample, while the impact has alternating signs when using long-period specific risk (Appendix *12* and Appendix *13*). In addition, the impact of total/specific risk on ENV is robust for the Swedish subsample (Appendix 14), while the impact of specific risk on ESG shows a significant positive coefficient for the Norwegian subsample (Appendix 14). Although one coefficient has the opposite sign for the Norwegian subsample, the result is satisfactory robust on a Nordic level and our conclusion of a negative impact of total/specific risk on ESG and ENV remains.

(4) Total and specific risk impact SOC with alternating signs of lags

Following the established negative impact of SOC on total/specific risk, our results suggests a bidirectional relationship in which SOC in return impacts total/specific risk negatively in the short-term (1-2 years) but positively in the longer term (2-3 years). The alternating impact of total risk on SOC is robust for (1) the initial sample, and (2) the Danish sample (Appendix *13* and *Appendix 14*). The corresponding impact of systematic risk is robust for long-period risk measures (*Appendix 12*). However, the impact of specific risk is significant and negative for the initial sample (Appendix *13*). In addition, the impact of total and specific risk is negative and significant for the second time period (*Appendix 12*). These results support the negative short-term effect, while there are no indications of a significant positive effect in the longer term, at least not for the three lagged years included. While the result holds for a limited number of robustness checks, all significant results reveal the same relationship. Thus, we will consider the alternating impact of total/specific risk on SOC as robust.

(5) Total and specific risk positively impact GOV

A bidirectional relationship between total/specific risk and GOV is additionally found. While total/specific risk have a negative impact on GOV, in turn, the GOV dimension has an offsetting positive impact on total/specific risk. This counteracting positive impact is robust for both total and specific risk for (1) the second time period, (2) the initial sample, and (3) the Swedish subsample (*Appendix 13* and *Appendix 14*). The positive impact of specific risk on GOV is additionally robust when using monthly observations (*Appendix 12*). However, when using long-term risk measures, the impact has alternating signs, suggesting that the impact differs in the short- and long-run (*Appendix 12*). However, as all significant robustness checks support a positive impact, we consider the result to be robust and reliable.

(6) Systematic risk positively impacts SOC, with a corresponding positive impact of systematic risk on SOC

The final result suggests that SOC has a significant and positive impact on systematic risk, and that systematic risk has a positive and significant impact on SOC. This result is, however, not reliable as it does not hold in any robustness checks performed. Instead, the impact of SOC on systematic risk is significant and negative for (1) the initial sample, and (2) when using long-period beta as risk measure (*Appendix 12* and *Appendix 13*). The impact of systematic risk on SOC is, similarly, significant only when using long-period beta as a risk measure, where the sign is negative rather than positive (*Appendix 12*). As the robustness checks either suggest a neutral relationship (insignificant) or a completely opposite relationship, we cannot consider this result as reliable. We will hence not consider this result in the following sections, as there is no evidence that it holds.

6.4 Summary of results

The results from our fixed effect regressions suggest that there is no significant correlation between any firm risk measure and ESG, ENV, SOC or GOV. While we do find a significant impact of ESG on specific risk, the result is only significant at a 10% significance level and is far from robust, implying that the result is not reliable. As such, the FE model suggests that there is no causal impact of CSP on firm risk.

The results from using a multivariate panel VAR approach on annual observations are summarized in Table 24 and Table 25. The results suggest a clear negative impact on specific risk from both aggregate ESG and the three separate ESG dimensions (Table 24). Similarly, the impact on total risk is also negative for both ESG and the three ESG dimensions (Table 24). We interpret the impact of GOV on total risk as significant and negative, as this is suggested by our robustness controls. We find no significant impact on systematic risk of any CSP measure, similarly for SOC that initially indicated a significant impact which was not robust in any robustness controls (Table 24).

Table 24: Summary results – impact of CSP on firm risk

	Total risk	Systematic risk	Specific risk
ESG	Significant (-)	Not significant	Significant (-)
ENV	Significant (-)	Not significant	Significant (-)
SOC	Significant (-)	Not robust	Significant (-)
GOV	Significant (-) [a)]	Not significant	Significant (-) [b)]

[a)] Insignificant in initial regressions, but robustness checks suggest a significant (-) impact
[b)] Significant at a 10% significance level

The panel VAR outcomes suggest that total risk and specific risk Granger-cause ESG and ENV with a negative significant impact, whereas the impact on GOV is consistently significant and positive (Table 25). The impact of total risk and specific risk on SOC is negative in the short run and positive in the long-run, with alternating signs of the lagged coefficients (Table 25). Systematic risk does not significantly impact any CSP measure, as the initial positive impact on SOC was not robust (Table 25).

Table 25: Summary results – impact of firm risk on CSP

	ESG	ENV	SOC	GOV
Total risk	Significant (-)	Significant (-)	Significant (±)	Significant (+)
Systematic risk	Not significant	Not significant	Not robust	Not significant
Specific risk	Significant (-)	Significant (-)	Significant (±)	Significant (+)

* Significant at a 10% significance level

7. Further discussion

To elaborate further on our analysis of results, this section will discuss our results in light of the thesis' research questions, hypotheses, applicable economic theories and prior research. The research questions posed in this study were:

(1) What relationship exists between Nordic firms' aggregated ESG performance and financial risk?

(2) What relationship exists between Nordic firms' disaggregated environmental, social and governance performance and financial risk?

The limitations to our study will thereafter be discussed.

7.1 Fixed effect regression results

The results from our fixed effect estimations indicate an insignificant correlation between CSP and firm risk. While we did find a positive impact of ESG on specific risk at a 10% significance level, the result was not robust in any of the robustness checks and we do therefore not consider the result as reliable. While both approaches control for firm fixed effect and the same control variables, the insignificant results obtained with the FE approach are in contrast to the significant and robust results found from using a panel VAR regression approach.

The main difference between VAR and FE is that the panel VAR approach predicts the impact between the variables based on lagged values from previous years. The varying results, depending on a VAR approach as opposed to a FE approach, hence suggest that the impact of CSP on firm risk is not simultaneously determined in the same time period. The more advanced features of the panel VAR approach, that capture the interaction between variables over time, are hence more reliable. However, we cannot conclude that the variables have an immediate impact on each other. Rather, we interpret our results as a strong indication of a lagged impact of CSP on firm risk, and vice versa.

7.2 Panel VAR regression results

7.2.1 Aggregate ESG negatively impacts total and specific risk

At an aggregate level, when testing for the effect of CSP, measured by ESG scores, on firm risk, we find that firms' aggregate ESG scores have a significant and negative impact on both specific risk and total risk. This result is in line with our first hypothesis stating that aggregate ESG performance has a risk-reducing effect for firms.

The negative relationship between CSP and corporate financial risk that we have empirically obtained, adds to the consensus of results from other research, when looking at the aggregate ESG level. Jo and Na (2012) find a risk reducing effect for CSP engagement by firms in controversial industries, and Sassen et al. (2016), Chang et al. (2014) and Chollet and Sandwidi (2018) all present evidence of CSR activities being negatively associated with both total risk and specific risk for samples of firms in the U.S., Europe and the global market. Our regression results hence show that also Nordic firms with higher corporate social performance will experience lower financial risk. In accordance with the stakeholder theory, these results are reasonable to conclude upon. Higher CSP engagement reduces the chances of potential lawsuits, it enhances transparent communication between managers and external investors, as well as it increases perceived firm value and attractiveness in the eyes of both employees and consumers (McGuire et al., 1988). As such, socially responsible firms are able to mitigate both total and specific risk by accounting for ESG and all stakeholders' interests. Similarly, in line with the risk management theory, greater concern for CSP facilitates higher stakeholder loyalty to the company even during periods of financial downturns. As these loyal stakeholders will have a lower incentive to sensitively react to negative news, the respective firm will experience lower volatility and financial risk (Godfrey, 2005).

Contrarily to specific risk and total risk, when looking at the association between CSP and systematic risk, we find that aggregate ESG does not significantly affect systematic risk. A reason for this may be that most occurrences in the market place that influence a certain firm's engagement in CSP do not similarly affect the resulting firms in the market, indicating a minimal impact of CSP on a firm's systematic risk (Cornell & Shapiro, 1987). Accordingly, our first hypothesis, arguing for a negative relationship between aggregate ESG and firm risk, is supported when it comes to total and firm-specific risk, but not for systematic risk.

7.2.2 ENV, SOC, and GOV negatively impact total and specific risk

For a more thorough comprehension of what drives the negative correlation between CSP and corporate financial risk, we regressed the three ESG pillars disjointedly against the three measures of risk. Performing such regressions reiterates prior research stating that, while aggregate results may indicate a negative relationship between CSP and firm risk, each of the three ESG dimensions may interact distinctly with a firm's level of risk (Scholtens, 2008). According to our third hypothesis' prediction, the disaggregate ESG dimensions respectively affect all three measures of firm risk. Keeping this in mind, we find that the separate ESG pillars have a significant and negative effect on total and specific risk, with the exception of the GOV score which in our panel VAR regressions does not significantly impact total risk. However, from our panel VAR robustness controls, the negative and significant impact of GOV on specific risk seems to apply for total risk as well.

Intuitively, it makes sense that firms with higher environmental, social and governance efforts face lower total and firm-specific risk in the future. To begin with, higher environmental performance puts firms in a better position to foresee environmental upheavals while reducing the probability of negative impacts on cash flows from environmental crises (Bouslah et al., 2013). Thereafter, greater social performance diminishes firm risk owing to its strong link to the firm's external relations and social reputation, both of which are clearly visible to the public. Lastly, a good governance performance may reduce firm risk as strong governance mechanisms help to reduce conflicts of interest between owners and managers through effective incentives, regulations, improved monitoring and transparency (Berk & DeMarzo, 2017). As such, our result is in line with the stakeholder theory and supports our third hypothesis.

Our results echo the findings in the research performed by Chollet and Sandwidi (2018) in terms of the disaggregate ENV, SOC and GOV pillars, where all impacts are found to be negative on firm risk. Further, the research conducted by Sassen et al. (2016) shows a significantly negative effect of social and environmental performance on firm-specific/total risk, whereas it finds no significant results for governance scores and firm risk. This is to a large extent in line with our results, except we do find a significant impact of GOV on specific risk, and our robustness checks give indication of GOV having a negative impact on total risk as well.

7.2.3 Total and specific risk negatively impact ESG and ENV

From the panel VAR regressions, we additionally find a bidirectional relationship between risk and ESG at an aggregate level. This indicates that while ESG impacts specific and total risk, in return both specific and total risk impact aggregate ESG. In light of this, our result conforms to the second hypothesis postulating that ESG reduces firm risk and this reduction stimulates firms to engage further in CSP. Our results hence imply that there is a reciprocal correlation between CSP and financial risk, and support the existence of a "virtuous cycle" between aggregate ESG and financial risk for firms in the Nordic region. This result converges with the findings by Chollet and Sandwidi (2018) and can be backed up by arguing in line with the slack resource theory which supports the idea that CSP and financial risk codetermine each other (Orlitzky & Benjamin, 2001). The negative bidirectional relationship further makes sense from an intuitive perspective. Engaging in ESG activities reduces the firm risk as expected, in line with the stakeholder theory. Firms with low financial risk can then make more long-term investments, as for instance in ESG activities, since there is a low concern for short-term survival.

On a disaggregate level, we also find a negative impact of total/specific risk on ENV. This implies that low financial risk increases firm engagement in environmental performance. Intuitively, as environmental commitments often require long-term investments (e.g. emission reduction and waste disposal), low risk can be a facilitating factor that enables firms to fund these investments (Chollet & Sandwidi, 2018).

7.2.4 Total and specific risk impact SOC with alternating signs of lags

Our third compelling finding extracted from the panel VAR model shows that both specific and total risk significantly affect the disaggregate SOC pillar with shifting signs (positive and negative) of lags. More specifically, we find that the impact of specific and total risk on SOC is negative in the short-run (lag from year t-1 and t-2), whereas it is positive in the long-run (lag from year t-2 and t-3). Such a result provides valuable practical insight for corporate managers. This is because, firstly, we provide empirical evidence indicating that bearing low risk can significantly facilitate an increased social engagement by firms in the short-run. Secondly, in the long-run, bearing low risk does not incentivise the firm to engage in SOC. Equivalently, our results show that high financial risk incites firms to invest more in socially responsible activities in the long-run.

The conclusion that can be drawn from such a result is that there is in fact a reciprocal causality between SOC performance and total/ specific risk for Nordic firms. This is line with the slack resources theory which reinforces the idea of a "virtuous circle" between CSP and financial risk, as well as it supports our second hypothesis. Relevant to note is also the fact that this study is among the very few that can empirically prove the existence of the reciprocal relationship, alongside the research by Chollet and Sandwidi (2018). The authors argue that the alternating coefficient signs can be explained by firms' strategic changes in CSP engagement (Chollet & Sandwidi, 2018).

7.2.5 Total and specific risk positively impact GOV

Lastly, based on the panel VAR regressions, we find that previous high total and specific risk have a positive impact on GOV in subsequent years. The interesting finding provides an important insight for investors, as it suggests that high financial risk puts additional pressure on good governance practices. Our results indicate a bidirectional relationship between GOV and total/specific risk, in which good governance stimulates lower financial risk. Lower financial risk, in return, has a negative impact on GOV, suggesting a counteracting relationship between risk and governance. This offsetting impact of total/specific risk on GOV is in contrast to the results obtained by Chollet and Sandwidi (2018) which shows a negative impact of risk on GOV. The two-step effect, in which past high risk gives firms an incentive to increase ESG engagement, does hence not seem to apply for the governance dimension in our Nordic sample.

As this result holds for nearly all robustness checks, we conclude that the impact of risk on GOV is different for a Nordic sample, compared to a negative effect for a global sample found by Chollet and Sandwidi (2018). Still, there is a lack of previous studies investigating the reciprocal relationship between financial risk and ESG dimensions and this result is hence only directly comparable with the studies by Chollet and Sandwidi (2018), Sassen et al. (2016) and Bouslah et al (2013). However, Berk and DeMarzo (2017) argue that there is a strong cultural aspect of governance, which supports the idea that the impact of risk on governance actually may differ in a Nordic context compared to the global relationship.

The relationship found is, to a large extent, in line with the agency theory. The risk of financial losses is always in the hands of owners, independently of the level of firm risk. Managers, on the contrary, do not bear this risk since the ultimate risk of financial losses is suffered by the owners themselves. Managers do, however, bear the risk of getting fired/replaced, which is a risk that is increasing with the firm risk since the expectations on management is growing. Consequently, both shareholders and managers suffer from high risk when firm risk is high, while mainly shareholders suffer from higher risk when the firm risk is low. The conflict of interest arising from an uneven risk distribution when firm risk is low supports the idea that a low risk firm may have poor governance. However, when the firm risk is high, the stakes are high for both owners and managers, considering that the threat of getting replaced/fired as a manger increases. As this threat of getting replaced is increasing with firm risk, the conflict of interest between owners and managers diminishes as the firm risk rises. Consequently, taking on high risk has a positive impact on governance quality in the Nordics.

7.3 Research limitations

When analysing this paper's findings, one must be aware of certain limitations that the study may be subject to. The first limiting factor regards the external validity of our research. As our data is retrieved from Thomson Reuters'ASSET4 database, the number of Nordic firms included in the study is restricted by the availability of ESG scores reported in the database. As such, our sample is confined to 150 firms for the time period 2002 – 2017. Considering that the firms are not incorporated into ASSET4 randomly, the sample is not representative of the entire population of publicly listed firms in the Nordics. Instead, as other prior studies do, we consider our population as ASSET4 ESG-rated firms, which implies that our findings cannot necessarily be generalized to the entire population of Nordic publicly listed firms. Also, it is valid to note that the population constraint, and the subsequent external validity implication, is one that is also persistent throughout all previous research performed on the CSP-risk relation (e.g. Bouslah et al., 2013; Sassen et al., 2016; Chollet & Sandwidi, 2018).

A second limitation of this study relates to the ways in which financial risk is being measured. The study employs a firm's financial risk (total, systematic and specific) for the last 12 months return as an original measure of firm risk, correspondingly to previous research (Sassen et al., 2016; Chollet & Sandwidi, 2018). As a robustness control, we employ long-period financial risk measures based on the last 24 months return. However, we could have applied further measures of firm risk. For example, we could have measured firm risk based on the latest five years return, as done by Chollet and Sandwidi (2018), especially considering that a firm's systematic risk is mainly subject to slow changes over time. Alternatively, we could have applied a Fama-French approach when calculating specific and systematic risk as a robustness control, in addition to the applied CAPM approach in this study (Fama & French, 2004). Still, our study performs strongly by accounting for all three measures of risk (total, systematic and specific risk), as opposed to some prior research that makes use of only one or a combination of two risk measures (e.g. Jo & Na, 2012; Harjoto & Jo, 2015).

A final limiting factor to this study lies in our reliance on the ESG data that ASSET4 offers as a measurement of firms' CSP levels. We do not perform any comparative analyses or controls for other rating agencies, such as KLD, which could have been done as a way to control for the quality of the ESG data used. Nonetheless, our reliance on the data reported can be rationalized by considering that Thomson Reuters Datastream has been widely used by practitioners for investment purposes as well as by academics in previous studies related to CSP and risk (Eccles et al, 2015; Sassen et al., 2016; Chollet & Sandwidi, 2018). Additionally, it is also relevant to note that the collected data is verified through a process in which it is standardized and compared against historical data (Thomson Reuters, 2019).

8. Conclusion

The following section completes our paper with an overview over the main findings and conclusions, followed by a reflection upon the study’s practical implications. Conclusively, we shed light on potential advancements for future research.

8.1 Conclusion

The purpose of this study is to investigate the relationship between corporate social performance and corporate financial risk in the Nordics. A sample of 150 publicly listed Nordic firms are retrieved from the ASSET4 database and used over the time period between 2002 and 2017. Our particular interest and focus on the Nordic region stem from numerous publications suggesting that Norway, Sweden, Denmark and Finland are current leaders in integrating socially responsible efforts into business and investment strategies (e.g. Climate Bond Initiative, 2018; SolAbility, 2017).

In light of the main research questions at hand, our primary panel VAR regression results show there to be a negative and bidirectional interaction between aggregated ESG and total and specific risk. We can therefore intuitively conclude that engaging in CSP activities reduces total/specific risk and, in return, Nordic firms with low risk will be strongly stimulated to invest more in CSP. In line with this aggregate result, we also find that each of the three disaggregate ESG pillars impact total and specific risk negatively. However, we see that the reciprocal effects of risk on the separate ESG pillars, in turn, vary depending on which ESG dimension is accounted for. Firstly, total/specific risk negatively affect environmental performance. Secondly, total/specific risk alternate between a positive and negative impact on social performance, and thirdly, corporate governance is impacted by total/specific risk in a positive way. Overall, our findings reveal a rather complex interaction between corporate financial risk and the disaggregated CSP measures. Moreover, the highly significant results for the Nordic sample are insightfully comparable to the aggregate negative interaction found between CSP and firm risk in studies with larger samples, including the U.S., global and European markets.

8.2 Practical implications

The aforementioned results of this study provide new and compelling implications for corporate managers and investors alike. Firstly, from a management perspective, the negative impact found of ESG on total/specific risk implies that investments in ESG activities can be used as a risk management tool. As our results indicate that ESG performance is effective in alleviating firm risk, our findings suggest that CSP is a risk factor that needs to be taken into account and can provide corporate benefits if successfully integrated in business decisions. Even with high corporate financial risk, corporate managers can scale up their CSP investments without having to expect higher future risk exposure or without running into financial repercussions in the long-run (Orlizky & Benjamin, 2001).

Secondly, from an investment perspective, the result indicating a negative bidirectional causality between CSP and firm risk is particularly compelling for socially responsible investors who strive to manage their risk exposure. This is because our results suggest that by tilting one's investments towards socially responsible corporations, investors in the Nordics will be able to mitigate their long-term risk as the relationship found between CSP and risk is circular. Investors who want to manage the risk-level of their portfolio can observe and use a firm's corporate social performance as an indicator of future financial risk when taking investment decisions.

Lastly, this study aids investors in the Nordics to make better-informed investment decisions as we interestingly find a positive impact of total/specific risk on governance, suggesting that the level of risk impacts the quality of governance in the Nordics. This has implications for the board of directors in the Nordics as it suggests that additional incentives for management to run the firm efficiently may be needed if the firm risk is low. Running a high-risk firm requires good management performance with a threat of being replaced otherwise, while managers for a low-risk firm face a lower threat of being fired/replaced. This result is especially interesting, as the positive impact of firm risk on governance in the Nordics does not seem to apply on a global sample (Chollet & Sandwidi, 2018). Paying particular attention to this finding will therefore be a crucial part of risk management for investors in the Nordics, as the relationship in the Nordics seems to deviate from previous research on a world-wide sample.

8.3 Suggestions for future research

Building on this study's findings, subsequent research could interestingly explore further the underlying rationale behind the shifting sings (alternatingly positive and negative) of coefficients that we observed when regressing total and specific risk against the social dimension of CSP. While one explanation for such a result could be firms' changes in CSP engagement strategies, it could be fruitful to study this area more thoroughly in order to gain a more comprehensive understanding of the presumably non-linear interaction between corporate financial risk and social performance. Coupled with investigating the non-linearity between CSP and firm risk that was observed in this study, it could also be useful to look into the issue of under- or overinvestment in CSP efforts and its implication on the CSP-risk link. Such an advancement would interestingly show whether the obtained results in this study hold for all levels of CSP, or whether the interaction between CSP and the financial risk measures varies in importance at high versus low CSP levels.

Moreover, and as previously discussed, this study relies on the ESG data provided by Thomson Reuters ASSET4 database. While Thomson Reuters is a widely used and trustworthy rating agency, its provided ESG scores may differ relatively to other rating agencies due to distinct ways of integrating sustainability principles and criteria into the respective assessment models for corporate performance. In this regard, it could be valuable to challenge the robustness of this study's results by performing comparative analyses or controls for the ESG scores offered by other well-known rating agencies, such as KLD or Bloomberg Sustainability.

As a last extension to this study, researchers could consider exploring the relation between CSP and financial risk in alternative markets to the Nordics. In previous literature, a large emphasis has been set on either the U.S. or the European market as a whole. As such, it could be particularly fruitful to expand research to other contexts, as for instance to emerging markets. The Nordic market examined in this study is known for its leading performance when it comes to socially responsible investing, so a study exploring a region in which SRI is still in its early stages and not as widespread as it is in the Nordics could be an insightful complementing research to ours. As our findings revealed differing results even at a country-level, it could also be of interest to explore the relation between CSP and firm risk for individual countries.

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Appendix

Appendix 1: List of sample firms

Firm name	Firm ID	Country	Industry
A P MOLLER MAERSK B	1	DK	Marine Transportation
BANG AND OLUFSEN	2	DK	Consumer Electronics
CARLSBERG B	3	DK	Brewers
CHRISTIAN HANSEN HOLDING	4	DK	Biotechnology
COLOPLAST B	5	DK	Medical Supplies
DANSKE BANK	6	DK	Banks
DMPKBT.NORDEN	7	DK	Marine Transportation
DSV 'B'	8	DK	Trucking
FLSMIDTH AND CO.	9	DK	Building Mat.& Fix.
GENMAB	10	DK	Biotechnology
GN STORE NORD	11	DK	Medical Equipment
H LUNDBECK	12	DK	Pharmaceuticals
ISS	13	DK	Business Support Svs.
JYSKE BANK	14	DK	Banks
NKT	15	DK	Electrical Equipment
NOVO NORDISK 'B'	16	DK	Pharmaceuticals
NOVOZYMES B	17	DK	Biotechnology
ORSTED	18	DK	Multiutilities
PANDORA	19	DK	Clothing & Accessory
ROCKWOOL INTERNATIONAL B	20	DK	Building Mat.& Fix.
SANTA FE GROUP	21	DK	Business Support Svs.
SIMCORP	22	DK	Software
SYDBANK	23	DK	Banks
TOPDANMARK	24	DK	Prop. & Casualty Ins.
TRYG	25	DK	Full Line Insurance
VESTAS WINDSYSTEMS	26	DK	Renewable Energy Eq.
WILLIAM DEMANT HOLDING	27	DK	Medical Equipment
ALFA LAVAL	28	SE	Industrial Machinery
ASSA ABLOY B	29	SE	Building Mat.& Fix.
ATLAS COPCO A	30	SE	Industrial Machinery
AXFOOD	31	SE	Food Retail,Wholesale
BEIJER REF B	32	SE	Industrial Machinery
BERGMAN & BEVING	33	SE	Divers. Industrials
BILLERUDKORSNAS	34	SE	Paper
BOLIDEN	35	SE	General Mining
CASTELLUM	36	SE	Real Estate Hold, Dev
CLAS OHLSON B	37	SE	Home Improvement Ret.
CTT SYSTEMS	38	SE	Aerospace

DUSTIN GROUP	39	SE	Specialty Retailers
ELECTROLUX B	40	SE	Dur. Household Prod.
ELEKTA B	41	SE	Medical Equipment
ENIRO	42	SE	Publishing
ERICSSON B	43	SE	Telecom. Equipment
FABEGE	44	SE	Real Estate Hold, Dev
FASTIGHETS BALDER B	45	SE	Real Estate Hold, Dev
FINGERPRINT CARDS B	46	SE	Electronic Equipment
GETINGE B	47	SE	Medical Equipment
GUNNEBO	48	SE	Electronic Equipment
HENNES & MAURITZ B	49	SE	Apparel Retailers
HEXAGON B	50	SE	Software
HEXPOL B	51	SE	Specialty Chemicals
HOLMEN B	52	SE	Paper
HOVDING SVERIGE	53	SE	Recreational Products
HUFVUDSTADEN A	54	SE	Real Estate Hold, Dev
HUSQVARNA B	55	SE	Dur. Household Prod.
ICA GRUPPEN	56	SE	Food Retail,Wholesale
INDUSTRIVARDEN A	57	SE	Specialty Finance
INTRUM	58	SE	Specialty Finance
INVESTOR B	59	SE	Specialty Finance
JM	60	SE	Real Estate Hold, Dev
KINDRED GROUP SDR	61	SE	Gambling
KINNEVIK B	62	SE	Specialty Finance
KUNGSLEDEN	63	SE	Real Estate Hold, Dev
LINDAB INTERNATIONAL	64	SE	Building Mat.& Fix.
LOOMIS B	65	SE	Business Support Svs.
LUNDBERGFORETAGEN B	66	SE	Real Estate Hold, Dev
LUNDIN PETROLEUM	67	SE	Exploration & Prod.
MEKONOMEN	68	SE	Auto Parts
MODERN TIMES GROUP MTG B	69	SE	Broadcast & Entertain
NCC B	70	SE	Heavy Construction
NEDERMAN HOLDING	71	SE	Building Mat.& Fix.
NIBE INDUSTRIER B	72	SE	Building Mat.& Fix.
NOBIA	73	SE	Furnishings
NOBINA	74	SE	Transport Services
NOLATO B	75	SE	Divers. Industrials
ORIFLAME HOLDING	76	SE	Personal Products
RATOS B	77	SE	Specialty Finance
SAAB B	78	SE	Aerospace
SANDVIK	79	SE	Industrial Machinery
SAS	80	SE	Airlines
SECTRA B	81	SE	Medical Equipment

SECURITAS B	82	SE	Business Support Svs.
SKANDINAVISKA ENSKILDA BANKEN A	83	SE	Banks
SKANSKA B	84	SE	Heavy Construction
SKF B	85	SE	Industrial Machinery
SSAB A	86	SE	Iron & Steel
SVEDBERGS I DALSTORP B	87	SE	Building Mat.& Fix.
SVENSKA CELLULOSA AKTIEBOLAGET SCA B	88	SE	Forestry
SVENSKA HANDELSBANKEN A	89	SE	Banks
SWEDBANK A	90	SE	Banks
SWEDISH MATCH	91	SE	Tobacco
SWEDISH ORPHAN BIOVITRUM	92	SE	Pharmaceuticals
TELE2 B	93	SE	Mobile Telecom.
TELIA COMPANY	94	SE	Mobile Telecom.
TRELLEBORG B	95	SE	Industrial Machinery
VBG GROUP B	96	SE	Auto Parts
VOLVO B	97	SE	Comm. Vehicles,Trucks
WIHLBORGS FASTIGHETER	98	SE	Real Estate Hold, Dev
AMER SPORTS	99	FI	Recreational Products
CARGOTEC 'B'	100	FI	Comm. Vehicles,Trucks
ELISA	101	FI	Fixed Line Telecom.
FORTUM	102	FI	Con. Electricity
HUHTAMAKI	103	FI	Containers & Package
KEMIRA	104	FI	Specialty Chemicals
KESKO B	105	FI	Food Retail,Wholesale
KONE 'B'	106	FI	Industrial Machinery
KONECRANES	107	FI	Comm. Vehicles,Trucks
METSO	108	FI	Industrial Machinery
NESTE	109	FI	Integrated Oil & Gas
NOKIA	110	FI	Telecom. Equipment
NOKIAN RENKAAT	111	FI	Tires
NORDEA BANK	112	FI	Banks
ORIOLA CORPORATION B	113	FI	Medical Supplies
ORION B	114	FI	Pharmaceuticals
OUTOKUMPU 'A'	115	FI	Iron & Steel
OUTOTEC	116	FI	Industrial Machinery
SAMPO 'A'	117	FI	Prop. & Casualty Ins.
SANOMA	118	FI	Publishing
STORA ENSO R	119	FI	Paper
TIETO OYJ	120	FI	Computer Services
UPM-KYMMENE	121	FI	Paper
UPONOR	122	FI	Building Mat.& Fix.
WARTSILA	123	FI	Industrial Machinery

YIT	124	FI	Heavy Construction
AKASTOR	125	NO	Oil Equip. & Services
AKER BP	126	NO	Exploration & Prod.
DNB	127	NO	Banks
DNO	128	NO	Exploration & Prod.
EQUINOR	129	NO	Integrated Oil & Gas
FRONTLINE	130	NO	Marine Transportation
GJENSIDIGE FORSIKRING	131	NO	Full Line Insurance
GOLAR LNG (NAS)	132	NO	Oil Equip. & Services
INFRONT	133	NO	Software
MARINE HARVEST	134	NO	Farm Fish Plantation
NORSK HYDRO	135	NO	Aluminum
ORKLA	136	NO	Food Products
PETROLEUM GEO SERVICES	137	NO	Oil Equip. & Services
PROSAFE	138	NO	Oil Equip. & Services
REC SILICON	139	NO	Specialty Chemicals
SCHIBSTED A	140	NO	Publishing
SEADRILL	141	NO	Oil Equip. & Services
STOLT-NIELSEN	142	NO	Marine Transportation
STOREBRAND	143	NO	Full Line Insurance
SUBSEA	144	NO	Oil Equip. & Services
TEAM TANKERS INTL.	145	NO	Marine Transportation
TELENOR	146	NO	Mobile Telecom.
TGS-NOPEC GEOPHS.	147	NO	Oil Equip. & Services
TOMRA SYSTEMS	148	NO	Industrial Machinery
VEIDEKKE	149	NO	Heavy Construction
YARA INTERNATIONAL	150	NO	Specialty Chemicals

Appendix 2: Robustness FE estimations - aggregate ESG (long-term risk measures)

VARIABLES	(1) Ln Volatility	(2) Ln Volatility	(3) Ln LT Volatility	(4) Ln LT Volatility	(5) Ln Beta	(6) Ln Beta	(7) Ln LT Beta	(8) Ln LT Beta	(9) Ln Specific risk	(10) Ln Specific risk	(11) Ln LT Specific risk	(12) Ln LT Specific risk
ESG	0.000925	0.00123	0.000985	0.000333	-0.000671	-0.000759	-0.00145	-0.000818	0.00254**	0.00208*	0.00210*	0.00115
	(0.00139)	(0.00131)	(0.00138)	(0.00135)	(0.00222)	(0.00237)	(0.00237)	(0.00245)	(0.00117)	(0.00115)	(0.00116)	(0.00119)
Growth TA	0.00556	0.0609**	-0.0162	0.0303	0.0652	0.0662	-0.0319	-0.0349	-0.000459	0.0562*	-0.000500	0.0443
	(0.0360)	(0.0305)	(0.0342)	(0.0331)	(0.0439)	(0.0486)	(0.0393)	(0.0426)	(0.0364)	(0.0310)	(0.0314)	(0.0311)
Ln Total assets	-0.201***	-0.148***	-0.219***	-0.160***	0.104**	0.0713	0.105*	0.0925	-0.251***	-0.226***	-0.276***	-0.236***
	(0.0367)	(0.0446)	(0.0385)	(0.0472)	(0.0501)	(0.0625)	(0.0604)	(0.0685)	(0.0335)	(0.0400)	(0.0346)	(0.0421)
MTB	-0.182***	-0.113***	-0.161***	-0.0918***	-0.0818***	-0.0821***	-0.0979***	-0.0949***	-0.171***	-0.117***	-0.147***	-0.0928***
	(0.0175)	(0.0172)	(0.0180)	(0.0189)	(0.0246)	(0.0280)	(0.0262)	(0.0303)	(0.0177)	(0.0193)	(0.0174)	(0.0197)
MTB^2	0.00976***	0.00660***	0.00820***	0.00522***	0.00575***	0.00582***	0.00736***	0.00739***	0.00849***	0.00588***	0.00665***	0.00427***
	(0.00117)	(0.00103)	(0.00110)	(0.00104)	(0.00153)	(0.00164)	(0.00149)	(0.00168)	(0.00130)	(0.00120)	(0.00118)	(0.00117)
Ln Debt ratio	0.0256	0.00132	0.00810	-0.00776	-0.0297	-0.0404	-0.0236	-0.0341	0.0436***	0.0266*	0.0217	0.0101
	(0.0197)	(0.0164)	(0.0194)	(0.0168)	(0.0312)	(0.0310)	(0.0301)	(0.0298)	(0.0162)	(0.0153)	(0.0169)	(0.0161)
Constant	2.080***	1.426**	2.379***	1.577**	-1.587**	-0.649	-1.521	-1.532	2.587***	2.482***	3.004***	2.500***
	(0.543)	(0.716)	(0.575)	(0.708)	(0.751)	(0.992)	(0.929)	(1.061)	(0.502)	(0.611)	(0.521)	(0.638)
Observations	19,613	19,613	19,354	19,354	18,395	18,395	18,782	18,782	19,516	19,516	19,103	19,103
R-squared	0.130	0.363	0.150	0.402	0.010	0.022	0.019	0.039	0.154	0.309	0.184	0.359
Number of firms	146	146	145	145	146	146	145	145	146	146	145	145
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix 3: Robustness FE estimations - aggregate ESG (time periods)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
VARIABLES	Ln Volatility	Ln Volatility	Ln Volatility	Ln Beta	Ln Beta	Ln Beta	Ln Specific risk	Ln Specific risk	Ln Specific risk
ESG	0.00123	0.000521	0.000582	-0.000759	-0.00116	-0.000833	0.00208*	0.00145	0.000599
	(0.00131)	(0.00161)	(0.00176)	(0.00237)	(0.00329)	(0.00344)	(0.00115)	(0.00150)	(0.00169)
Growth TA	0.0609**	0.0204	0.0567	0.0662	0.0495	0.0564	0.0562*	0.0158	0.0391
	(0.0305)	(0.0385)	(0.0347)	(0.0486)	(0.0661)	(0.0566)	(0.0310)	(0.0399)	(0.0380)
Ln Total assets	-0.148***	0.0439	-0.153***	0.0713	0.166	0.0904	-0.226***	-0.0106	-0.215***
	(0.0446)	(0.0982)	(0.0425)	(0.0625)	(0.156)	(0.0749)	(0.0400)	(0.0879)	(0.0463)
MTB	-0.113***	-0.0204	-0.131***	-0.0821***	0.0198	-0.105***	-0.117***	-0.0358	-0.135***
	(0.0172)	(0.0278)	(0.0208)	(0.0280)	(0.0446)	(0.0319)	(0.0193)	(0.0319)	(0.0256)
MTB^2	0.00660***	0.00263	0.00753***	0.00582***	0.00171	0.00734***	0.00588***	0.00327	0.00641***
	(0.00103)	(0.00221)	(0.00118)	(0.00164)	(0.00237)	(0.00214)	(0.00120)	(0.00263)	(0.00143)
Ln Debt ratio	0.00132	-0.0109	-0.000519	-0.0404	-0.0388	-0.0722**	0.0266*	0.00525	0.0291*
	(0.0164)	(0.0332)	(0.0160)	(0.0310)	(0.0685)	(0.0357)	(0.0153)	(0.0375)	(0.0162)
Constant	1.426**	-1.748	1.399**	-0.649	-2.848	-1.367	2.482***	-1.093	2.174***
	(0.716)	(1.468)	(0.636)	(0.992)	(2.351)	(1.156)	(0.611)	(1.303)	(0.684)
Observations	19,613	5,683	13,906	18,395	5,301	13,082	19,516	5,587	13,906
R-squared	0.363	0.292	0.422	0.022	0.022	0.022	0.309	0.277	0.335
Number of firms	146	103	146	146	103	146	146	103	146
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
First period	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No
Second period	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes
Controls									

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The first time period is defined as years between 2002-2007, and the second time period is defined as years between 2008-2017

Appendix 4: Robustness FE estimations - aggregate ESG (total risk across countries)

VARIABLES	(1) Ln Volatility	(2) Ln Volatility	(3) Ln Volatility	(4) Ln Volatility	(5) Ln Volatility
ESG	0.00123	0.000142	0.000601	-0.000913	0.00626*
	(0.00131)	(0.00179)	(0.00294)	(0.00229)	(0.00364)
Observations	19,613	8,252	3,837	4,186	3,338
R-squared	0.363	0.408	0.426	0.367	0.373
Number of firms	146	69	27	26	24
Firm FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes
SE	Yes	Yes	No	No	No
DK	Yes	No	Yes	No	No
FI	Yes	No	No	Yes	No
NO	Yes	No	No	No	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix 5: Robustness FE estimations - aggregate ESG (systematic risk across countries)

VARIABLES	(1) Ln Beta	(2) Ln Beta	(3) Ln Beta	(4) Ln Beta	(5) Ln Beta
ESG	-0.000759	7.90e-05	-0.00879	-0.000824	0.00619
	(0.00237)	(0.00297)	(0.00778)	(0.00451)	(0.00437)
Observations	18,395	7,781	3,535	3,937	3,142
R-squared	0.022	0.050	0.070	0.036	0.055
Number of firms	146	69	27	26	24
Firm FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes
SE	Yes	Yes	No	No	No
DK	Yes	No	Yes	No	No
FI	Yes	No	No	Yes	No
NO	Yes	No	No	No	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix 6: Robustness FE estimations - aggregate ESG (specific risk across countries)

VARIABLES	(1) Ln Specific risk	(2) Ln Specific risk	(3) Ln Specific risk	(4) Ln Specific risk	(5) Ln Specific risk
ESG	0.00208*	-0.000291	0.00281	0.00163	0.00731*
	(0.00115)	(0.00163)	(0.00167)	(0.00272)	(0.00356)
Observations	19,516	8,252	3,837	4,090	3,337
R-squared	0.309	0.373	0.409	0.295	0.292
Number of firms	146	69	27	26	24
Firm FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
SE	Yes	Yes	No	No	No
DK	Yes	No	Yes	No	No
FI	Yes	No	No	Yes	No
NO	Yes	No	No	No	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix 7: Robustness FE estimations – ESG dimensions (long-period risk measures)

VARIABLES	(1) Ln LT Volatility	(2) Ln LT Beta	(3) Ln LT Specific risk
ENV	-0.000648	-0.00131	7.45e-05
	(0.000828)	(0.00137)	(0.000813)
SOC	-0.000309	-0.000252	-0.000311
	(0.000771)	(0.00137)	(0.000652)
GOV	0.000790	0.000401	0.000475
	(0.000778)	(0.00140)	(0.000766)
Number of firms	145	145	145
Firm FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Controls	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note: The table presents regressions for each CSP dimension in separate regressions

Appendix 8: Robustness FE estimations across time period

VARIABLES	(1) Ln Volatility	(2) Ln Volatility	(3) Ln Beta	(4) Ln Beta	(5) Ln Specific risk	(6) Ln Specific risk
ENV	-0.000243	0.00101	-0.00191	-0.00102	0.000548	0.000913
	(0.000980)	(0.00102)	(0.00167)	(0.00188)	(0.000978)	(0.00110)
SOC	-0.000559	-0.000257	- 0.000617	-0.00226	-0.000406	-0.000275
	(0.000855)	(0.000982)	(0.00152)	(0.00201)	(0.000765)	(0.000874)
GOV	-0.000867	0.00111	-0.00137	0.000686	-0.000239	0.000613
	(0.000846)	(0.000905)	(0.00159)	(0.00173)	(0.000954)	(0.000948)
Observations	5,707	13,958	5,323	13,129	5,611	13,958
R-squared	0.292	0.421	0.024	0.022	0.276	0.335
Number of firms	103	146	103	146	103	146
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
First period	Yes	No	Yes	No	Yes	No
Second period	No	Yes	No	Yes	No	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note 1: The first time period is defined as years between 2002-2007, and the second time period is defined as years between 2008-2017
Note 2: The table presents regressions for each CSP dimension in separate regressions

Appendix 9: Robustness FE estimations (total risk) across countries

VARIABLES	(1) Ln Volatility	(2) Ln Volatility	(3) Ln Volatility	(4) Ln Volatility
ENV	-0.00161	0.00112	-0.00286*	0.00528***
	(0.00113)	(0.00176)	(0.00160)	(0.00179)
SOC	-0.000252	-0.00134	0.000621	0.000842
	(0.00114)	(0.00139)	(0.00173)	(0.00208)
GOV	-0.000136	0.00174	-0.000313	0.000323
	(0.00125)	(0.00138)	(0.00169)	(0.00181)
Number of firms	69	27	26	24
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
SE	Yes	No	No	No
DK	No	Yes	No	No
FI	No	No	Yes	No
NO	No	No	No	Yes
Controls	Yes	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note: The table presents regressions for each CSP dimension in separate regressions

Appendix 10: Robustness FE estimations (systematic risk) across countries

VARIABLES	(1) Ln Beta	(2) Ln Beta	(3) Ln Beta	(4) Ln Beta
ENV	-0.00185	-3.46e-05	-0.00592**	0.00391*
	(0.00177)	(0.00423)	(0.00266)	(0.00204)
SOC	0.00128	-0.00303	7.75e-05	-5.14e-05
	(0.00177)	(0.00356)	(0.00294)	(0.00200)
GOV	-0.000369	0.00210	-0.000829	0.00449
	(0.00224)	(0.00359)	(0.00134)	(0.00262)
Number of firms	69	27	26	24
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
SE	Yes	No	No	No
DK	No	Yes	No	No
FI	No	No	Yes	No
NO	No	No	No	Yes
Controls	Yes	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note: The table presents regressions for each CSP dimension in separate regressions

Appendix 11: Robustness FE estimations (specific risk) across countries

VARIABLES	(1) Ln Specific risk	(2) Ln Specific risk	(3) Ln Specific risk	(4) Ln Specific risk
ENV	-0.00138	0.00113	-0.000786	0.00641***
	(0.00119)	(0.00137)	(0.00147)	(0.00204)
SOC	-0.000528	-0.00125	0.00144	0.00105
	(0.000943)	(0.000778)	(0.00158)	(0.00215)
GOV	2.81e-05	0.00175	-0.000423	-0.00133
	(0.00106)	(0.00114)	(0.00178)	(0.00207)
Number of firms	69	27	26	24
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
SE	Yes	No	No	No
DK	No	Yes	No	No
FI	No	No	Yes	No
NO	No	No	No	Yes
Controls	Yes	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note: The table presents regressions for each CSP dimension in separate regressions

Appendix 12: Robustness panel VAR estimations – annual data, monthly data and long-term risk measures

	Annual data			**Monthly data**			**Long-term risk-measures**		
Null hypothesis	Chi2	Prob>Chi2	Coeff. Sign	Chi2	Prob>Chi2	Coeff. Sign	Chi2	Prob>Chi2	Coeff. Sign
ESG does not Granger-cause Ln Volatility	9,747	0,021	negative	1,686	0,640		6,640	0,084	negative
Ln Volatility does not Granger-cause ESG	48,496	0,000	negative	2,078	0,556		22,411	0,000	negative
ESG does not Granger-cause Ln Beta	0,922	0,820		0,909	0,823		10,289	0,016	negative
Ln Beta does not Granger-cause ESG	3,353	0,340		11,936	0,008	negative	30,831	0,000	negative
ESG does not Granger-cause Ln Specific risk	7,882	0,049	negative	1,342	0,719		1,606	0,658	
Ln Specific risk does not Granger-cause ESG	19,745	0,000	negative	1,926	0,588		18,103	0,000	both
ENV does not Granger-cause Ln Volatility	12,099	0,007	negative	10,349	0,016	negative	2,899	0,407	
Ln Volatility does not Granger-cause ENV	33,885	0,000	negative	4,408	0,221		12,658	0,005	negative
ENV does not Granger-cause Ln Beta	0,988	0,804		0,281	0,964		28,337	0,000	negative
Ln Beta does not Granger-cause ENV	2,380	0,497		10,811	0,013	negative	22,786	0,000	both
ENV does not Granger-cause Ln Specific risk	10,036	0,018	negative	9,958	0,019	negative	1,185	0,757	
Ln Specific risk does not Granger-cause ENV	12,114	0,007	negative	3,772	0,287		7,890	0,048	both
SOC does not Granger-cause Ln Volatility	12,685	0,005	negative	4,291	0,232		3,047	0,384	
Ln Volatility does not Granger-cause SOC	67,888	0,000	both	2,596	0,458		25,663	0,000	negative
SOC does not Granger-cause Ln Beta	8,223	0,042	positive	3,179	0,365		21,946	0,000	negative
Ln Beta does not Granger-cause SOC	7,652	0,054	positive	5,486	0,140		27,045	0,000	negative
SOC does not Granger-cause Ln Specific risk	15,778	0,001	negative	6,032	0,110		1,354	0,716	
Ln Specific risk does not Granger-cause SOC	68,884	0,000	both	2,075	0,557		38,825	0,000	both
GOV does not Granger-cause Ln Volatility	1,848	0,605		1,693	0,638		8,945	0,030	negative
Ln Volatility does not Granger-cause GOV	52,453	0,000	positive	4,991	0,172		67,387	0,000	both
GOV does not Granger-cause Ln Beta	3,693	0,297		4,124	0,248		1,750	0,626	
Ln Beta does not Granger-cause GOV	1,737	0,629		1,137	0,768		3,624	0,305	
GOV does not Granger-cause Ln Specific risk	7,745	0,052	negative	1,272	0,736		1,865	0,601	
Ln Specific risk does not Granger-cause GOV	52,914	0,000	positive	9,167	0,027	positive	34,707	0,000	both

Appendix 13: Robustness panel VAR estimations – time periods and initial sample

	First time period			Second time period			Initial sample		
Null hypothesis	Chi2	Prob>Chi2	Coeff. Sign	Chi2	Prob>Chi2	Coeff. Sign	Chi2	Prob>Chi2	Coeff. Sign
ESG does not Granger-cause Ln Volatility	0,033	0,848		9,359	0,025	negative	21,516	0,000	negative
Ln Volatility does not Granger-cause ESG	0,008	0,996		56,526	0,000	negative	37,753	0,000	both
ESG does not Granger-cause Ln Beta	0,405	0,300		2,130	0,546		5,784	0,123	
Ln Beta does not Granger-cause ESG	0,669	0,716		4,670	0,198		1,251	0,741	
ESG does not Granger-cause Ln Specific risk	0,868	0,648		9,764	0,021	negative	11,724	0,008	negative
Ln Specific risk does not Granger-cause ESG	1,603	0,449		38,796	0,000	negative	16,679	0,001	negative
ENV does not Granger-cause Ln Volatility	1,149	0,563		22,889	0,000	negative	14,312	0,003	negative
Ln Volatility does not Granger-cause ENV	2,268	0,322		39,024	0,000	negative	44,397	0,000	both
ENV does not Granger-cause Ln Beta	2,295	0,317		1,412	0,703		16,441	0,001	negative
Ln Beta does not Granger-cause ENV	10,952	0,004	both	5,806	0,121		2,301	0,512	
ENV does not Granger-cause Ln Specific risk	1,304	0,521		20,096	0,000	negative	11,016	0,012	negative
Ln Specific risk does not Granger-cause ENV	3,543	0,17		16,183	0,001	negative	19,417	0	negative
SOC does not Granger-cause Ln Volatility	4,644	0,098	negative	13,783	0,003	negative	20,778	0	negative
Ln Volatility does not Granger-cause SOC	0,021	0,990		58,124	0,000	negative	89,712	0,000	both
SOC does not Granger-cause Ln Beta	2,300	0,317		5,665	0,129		9,589	0,022	negative
Ln Beta does not Granger-cause SOC	0,254	0,881		5,079	0,166		3,185	0,364	
SOC does not Granger-cause Ln Specific risk	5,265	0,072	negative	32,296	0,000	negative	13,155	0,004	negative
Ln Specific risk does not Granger-cause SOC	1,842	0,398		46,203	0,000	negative	73,793	0,000	negative
GOV does not Granger-cause Ln Volatility	0,608	0,738		2,257	0,521		7,886	0,048	negative
Ln Volatility does not Granger-cause GOV	0,583	0,747		35,250	0,000	positive	65,706	0,000	positive
GOV does not Granger-cause Ln Beta	1,842	0,398		10,491	0,015	positive	4,893	0,180	
Ln Beta does not Granger-cause GOV	2,464	0,292		2,671	0,445		10,730	0,013	positive
GOV does not Granger-cause Ln Specific risk	0,168	0,919		7,649	0,054	negative	9,380	0,025	negative
Ln Specific risk does not Granger-cause GOV	0,386	0,824		52,272	0,000	positive	39,839	0,000	positive

Appendix 14: Robustness panel VAR estimations across countries

Countries	Sweden			Norway			Finland			Denmark		
Null hypothesis	Chi2	Prob> Chi2	Coeff. Sign	Chi2	Prob> Chi2	Coeff. Sign	Chi2	Prob> Chi2	Coeff. Sign	Chi2	Prob> Chi2	Coeff. Sign
ESG does not Granger-cause Ln Volatility	6,704	0,082	negative	6,192	0,045	negative	0,475	0,788		0,167	0,920	
Ln Volatility does not Granger-cause ESG	0,667	0,881		3,516	0,172		0,106	0,949		0,048	0,977	
ESG does not Granger-cause Ln Beta	1,668	0,644		6,209	0,045	negative	1,810	0,178		1,895	0,388	
Ln Beta does not Granger-cause ESG	4,990	0,173		3,657	0,161		0,428	0,513		7,174	0,028	both
ESG does not Granger-cause Ln Specific risk	9,732	0,021	negative	2,632	0,268		0,664	0,717		0,115	0,944	
Ln Specific risk does not Granger-cause ESG	2,073	0,557		8,068	0,018	positive	0,249	0,883		0,031	0,985	
ENV does not Granger-cause Ln Volatility	2,938	0,401		0,645	0,725		0,056	0,973		0,650	0,723	
Ln Volatility does not Granger-cause ENV	12,235	0,007	negative	0,150	0,928		0,115	0,944		4,132	0,127	
ENV does not Granger-cause Ln Beta	0,900	0,825		0,212	0,899		6,243	0,044	negative	0,437	0,804	
Ln Beta does not Granger-cause ENV	1,326	0,723		4,578	0,101		2,185	0,335		0,695	0,707	
ENV does not Granger-cause Ln Specific risk	1,658	0,646		0,497	0,780		1,601	0,449		1,468	0,480	
Ln Specific risk does not Granger-cause ENV	11,245	0,010	negative	0,181	0,913		1,831	0,400		0,915	0,633	
SOC does not Granger-cause Ln Volatility	10,873	0,012	positive	2,838	0,242		1,362	0,506		5,811	0,055	negative
Ln Volatility does not Granger-cause SOC	1,992	0,574		2,645	0,266		1,226	0,542		4,912	0,086	both
SOC does not Granger-cause Ln Beta	12,106	0,007	positive	0,391	0,823		2,537	0,281		1,770	0,413	
Ln Beta does not Granger-cause SOC	3,714	0,294		0,535	0,765		0,069	0,966		0,741	0,690	
SOC does not Granger-cause Ln Specific risk	7,826	0,050	both	0,618	0,734		0,383	0,826		3,061	0,216	
Ln Specific risk does not Granger-cause SOC	4,957	0,175		0,999	0,607		1,078	0,583		2,104	0,349	
GOV does not Granger-cause Ln Volatility	0,869	0,833		2,000	0,368		1,461	0,482		0,060	0,907	
Ln Volatility does not Granger-cause GOV	32,122	0,000	positive	0,465	0,793		2,964	0,227		1,910	0,167	
GOV does not Granger-cause Ln Beta	14,572	0,002	positive	2,034	0,362		1,091	0,580		0,290	0,865	
Ln Beta does not Granger-cause GOV	8,778	0,032	negative	0,348	0,840		0,031	0,985		5,537	0,063	positive
GOV does not Granger-cause Ln Specific risk	2,611	0,456		2,760	0,252		5,180	0,075	both	1,129	0,569	
Ln Specific risk does not Granger-cause GOV	35,119	0,000	positive	0,188	0,910		2,628	0,269		1,045	0,593	