Risk and Return on ESG Rated Companies

An Empirical Study on ESG for Listed Companies in the Nordic Countries

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Abstract

This thesis investigates risk and return on ESG - environment, social and governance - rated public companies in the Nordic countries over the period 2018 - 2022. We further divide our sample into two sub-periods, in an attempt to capture the effect of market uncertainties.

Our findings suggest that companies with high ESG scores exhibit a lower total and systematic risk than poorly rated ESG firms. We find that all ESG stock yields significantly higher abnormal returns than the market. We further construct a high rated and a poorly rated ESG portfolio for our sample period and apply a long-short investment strategy. We find negative and unsignificant alphas. The Sharpe and Treynor ratio show a shift in risk-adjusted returns during the COVID-19 period, where the highly rated ESG portfolio exhibits higher risk-adjusted returns than the low rated ESG portfolio.

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1.0 Introduction

In this thesis, we study the risk and return on ESG rated public companies in the Nordic countries over the period 2018 - 2022, in order to answer the following research question.

How do risk and return differ in companies with high- and low ESG ratings in the Nordic countries? How are risk and return affected in times of high market uncertainty?

ESG (Environment, Social and Governance) is used to measure an investment or an asset's sustainability. It captures how well a business scores on environmental, social and governance factors. It has become an important concept for investors and businesses, in 2022 33% of public listed companies in Norway, Sweden, Denmark, and Finland have an ESG rating from Refinitiv Eikon. Amel-Zadeh and Serafeim (2018) state that 82.1% of professional investors use ESG information in an investment decision.

We contribute to the literature by investigating risk and return for publicly listed ESG rated companies in the Nordic countries, in the time period 2018-2022. We further contribute by dividing our sample into sub-samples, in order to capture the effects of the COVID-19 pandemic, and the war in Ukraine has on Nordic companies with ESG ratings. We are currently in a period of high market uncertainty, and we want to investigate if the result from previous literature holds for the Nordic countries today, during these market conditions.
There are, to our knowledge, limited studies regarding ESG and performance in the Nordic countries, that capture the implications of the pandemic.

Kempf and Osthoff (2007), Statman and Glushkov (2009) and Díaz et al. (2021), show that stocks with high ESG rating have the potential to earn higher abnormal returns than poorly rated ESG stocks. Kumar et al. (2016) shows that ESG stocks exhibit lower risk and higher returns than comparable stocks, for most industries. Oppositely, Dunn et al. (2018) show that companies with high ESG rating have a lower risk, but also lower return, than low rated ESG stocks. Sassen et al. (2016) and Chollet and Sandwidi (2018) show that an increase in ESG factors can lead to a decrease in financial risk.

To answer the research question, we construct four portfolios based on ESG ratings, focusing particularly on the top and bottom quantiles. To analyze the risk, we have calculated the systematic- and total risk and Sharpe- and Treynor ratio. Our results show that portfolios with high ESG score exhibit a lower risk than portfolios with low ESG score in times of market uncertainty.

In order to analyze risk-adjusted return, we will first analyze the factor-adjusted returns and then compare our risk-adjusted measures. To analyze abnormal returns, we run a return regression using Fama-French 3-factor, Carhart 4-factor, and Fama-French 5-factor models. Our analysis shows that our low rated ESG portfolios obtain a slightly higher abnormal return than our high rated ESG portfolio, however the differences are not statistically significant. We further analyze risk-adjusted return by looking at Sharpe ratio and Treynor ratio, where we find that the highly rated ESG portfolio exhibits higher risk-adjusted returns than the low rated ESG portfolio, measured by Sharpe and Treynor ratio.

2.0 Literature and Hypothesis Development

The purpose of this chapter is to provide an overview of the existing literature in the academic field and develop a hypothesis.

2.1 A Brief Introduction to Sustainable Investing

Investing sustainably has in recent years become more important to investors. If we look back to the 1970's, Friedmans shareholder theory shareholder theory had a stronger footing than it does today. The Shareholder theory states that a firm should always maximize shareholder's profit, and further that the shareholders are the only ones to whom the company is responsible (Friedman, 1970). Friedman further acknowledges that individuals have social responsibilities, however he states corporations fulfill their responsibilities to their shareholders, by maximizing shareholder value.
In recent years, the shareholder theory has received critique on its views that the only responsibility of corporations is to maximize profit. It has been argued that corporations have a corporate social responsibility (CSR) that goes beyond profit maximization. Schaefer (2007); Orlitzky et al. (2003); Russo and Fouts (1997) found that a firm's financial performance is positively impacted by social and environmental performance.

We can see that there has been a large shift from 1970 to today. In 2000 FN introduced the Millennium Development Goals that had a purpose of ensuring sustainable development, equality and fighting global poverty. In 2015 the millennium development goals were succeeded by FNs Sustainable Development Goals, whose purpose is an extension of the millennium development goals (FN, 2023). This has been a factor for promoting the importance of social responsibility, sustainability, and human rights, among countries, companies, and investors.

The principle of sustainable investing is often referred to as "Socially Responsible Investment" (SRI) or "Environmental Social Governance" (ESG) in research and finance. The ESG term was first used in a report that was published by the United Nations Global Compact in 2004 and has since gained momentum among investors (The Global Compact, 2004). The similarities with the different approaches are that they want to do well while doing good, and it reflects that investors want to receive both financial and social returns (Starks et al., 2019).

The SRI approach entails omitting or pursuing specific investments based on their ethical considerations. This can mean using a negative screening approach, excluding sin companies such as alcohol, weapons, and gambling. It can also mean using a positive screening approach to include only do-good companies (Starks et al., 2019).
ESG - Environmental, Social, and Governance- is used to construct sustainability to investment strategy, and the three factors are used to measure the firm's performance in the three categories. The ESG factors are used as a way to measure non-financial factors regarding a firm's ability to operate sustainably and responsibly. This concerns the environment such as resource usage and pollution. Social relations, entailing how the company manages relations with employees, suppliers, community, and customers. Governance, concerning leadership, audits, shareholder rights, and CSR strategy. ESG can also be used as a financial risk assessment, where a good ESG rating might indicate more stable returns in the long run (Starks et al., 2019; PWC, 2023).

2.2 ESG and firm performance – Empirical Evidence

ESG has become an important term for investors and companies. Despite being a relatively new term, there has been much research about the topic in previous years, where a lot of the research looks at the relationship between ESG, performance, and risk.

2.2.1 Risk

It is widely accepted in the literature that risk and return are closely related with one another, and that higher risk yields higher returns. Sassen et al. (2016) and Chollet and Sandwidi (2018) show that an increase in ESG factors can lead to a decrease in financial risk. Chollet and Sandwidi (2018) further find that CSR integration in investments and decision making can lead to long-term risk mitigation and performance advantages. This indicates that a portfolio consisting of highly rated ESG stocks has the potential to perform better, with a lower level of risk, than a portfolio consisting of poorly rated ESG stocks, or conventional stocks.

Dunn et al. (2018) investigate if stocks with better ESG-exposure have lower risks. According to Dunn et al. (2018) stock-specific volatility is higher for the worst-rated ESG stocks, than for the best-rated ESG stocks, by up to 15%. They find that the worst rated ESG stocks have a higher beta than the best rated ESG stocks, at 3%. They further find that stocks with the worst ESG-exposure tend to earn higher returns, which is in line with Chollet and Sandwidi (2018) findings that high ESG can lead to performance advantages.

Kumar et al. (2016) finds that ESG companies show lower volatility than conventional stocks in the same industry. In contrast to the traditional theory that higher risk yields higher return, they find that ESG companies, which exhibit lower volatility, have the potential to achieve higher equity returns in 8 of 12 industries. They find that the ESG stocks had lower volatility in all 12 industries studied, on average 26% lower. Despite the lower volatility, the ESG investments can achieve a higher equity return. This relationship between ESG exposure and total risk is consistent with Sassen et al. (2016) and Chollet and Sandwidi (2018). Sassen et al. (2016) also assumed the systematic risk, measured in beta, to be more affected by industry-specific characteristics.

2.2.2 Return

Researchers have in the past couple of years tried to explain the uncertain, but timely positive link between ESG and performance. Friede et al. (2015) look at 2200 previous academic studies and find approximately 90% of the studies show a non-negative relationship between ESG and corporate financial performance. In addition, they found that the majority of studies found a positive correlation between ESG and corporate financial performance.

A commonly used method for evaluating return performance, is implementing a trading strategy consisting of buying stocks with a high sustainability rating and selling stocks with a low sustainability rating – a long-short strategy – in order to look at the differences of the investments.

Kempf and Osthoff (2007) analyze the market from 1992-2004, using the Carhart four factor model for a long-short portfolio strategy, consisting of buying stocks with a high SRI rating and selling stocks with a low SRI rating. They find that investors can achieve higher abnormal returns by investing in socially responsible stocks, by up to 8.7% per year. They further split the time period into two sub-periods to capture the effects of market uncertainties in the periods, however, find no significant differences here because of a small sample size. Statman and

Glushkov (2009) analyze stocks with socially responsible ratings in the period of 1992-2007. Using a long-short portfolio strategy and find that investing in socially responsible stocks gives investors an advantage compared to conventional investors. They further find that excluding stocks associated with alcohol, gambling, and weapons – traditional sin stocks – puts the investors at a disadvantage compared to conventional investors.

Borges et al. (2013) look at the period 1992-2009 and find that ESG was positively related with statistically significantly higher abnormal returns in the 1992-2004 window but find no such correlation for the rest of the sample period. They argue that this is because of mispricing and market underreactions, and further state that as attention to ESG increases, mispricing and market underreactions related to sustainable investing are evened out. This is contrary to Kempf and Osthoff (2007) and Statman and Glushkov (2009).
Hartzmark and Sussman (2019) find that investors value sustainability and steer their money away from low-ESG investments, toward high-ESG investments. However, they further find no evidence that high-ESG portfolios outperform low-ESG portfolios.

2.2.3 Risk-Adjusted Return

Risk-adjusted return considers the relationship between risk and return, which is about lower risk for a portfolio or investment, for the same or higher returns (Kumar et al., 2016). According to Elton et al. (1996), the alpha from the factor models can be used as a measure of risk-adjusted returns. These models adjust for the risk explained by the factors included in the respective models. Other common measures for comparing risk-adjusted returns are the Sharpe- and Treynor ratio. Kumar et al. (2016) and Díaz et al. (2021) are some of the authors that analyze the risk-adjusted return related to ESG investing. Díaz et al. (2021) found a negative Sharpe ratio in top-rated and bottom-rated ESG portfolios, as well as the S&P 500 index, during the initial COVID-19 period. Despite being negative, the portfolio with the highest ESG score had the best Sharpe ratio. In addition, the portfolio with the lowest ESG score had a more negative Sharpe ratio than the S&P 500 index. Kumar et al. (2016), who look at ESG stocks and comparable stocks, found a greater Sharpe- and Treynor ratio for ESG stocks than comparable stocks, in nine of twelve industries. This means that if investors had invested in ESG stocks, they would have been able to earn a higher average return for the same amount of risk as comparable stocks. Both research from Kumar et al. (2016) and Díaz et al. (2021) suggest that investing in ESG can yield higher risk-adjusted returns, than conventional or poorly rated ESG stocks.

2.3 Sustainable investment for investors

2.3.1 The Investor Perspective

Research often looks at ESG effects on risk and return from an investors point of view. Amel-Zadeh and Serafeim (2018) research how and why investors use reported ESG information. They found that 82.1% of professional investors use ESG information in an investment decision. 63.1% do it in order to achieve higher return on their investment, whereas only 32.6% report having ethical motives for investing in ESG. This implies that there can exist financial motives for engaging in an ESG based investment strategy.

Several authors (Kempf and Osthoff, 2007; Statman and Glushkov, 2009; Kumar et al., 2016) find that investors can achieve higher abnormal return by investing in stocks and funds that have strong sustainability characteristics. Contrary to this, Hartzmark and Sussman (2019) find no evidence that highly rated ESG portfolios outperform poorly rated ESG portfolios, even though they find investors clearly value sustainability.

This raises a discussion about whether or not making sustainable investment does yield higher returns than investing in stocks with lower sustainability ratings.

Amit and Wernerfelt (1990) are among those who suggest that firm-specific risk can, from an investor's point of view, be eliminated through diversification. It is therefore more relevant for investors to focus on market risk, as it is always present (Amit and Wernerfelt, 1990; Bodie et al., 2021).

2.3.2 Market Uncertainties

The past few years have been affected by market uncertainties connected to COVID-19 and the war in Ukraine. Market uncertainty is periods where it's difficult for an investor to consider a market because of high volatility (Chang and Choi, 2017). Díaz et al. (2021) have a sample period from January – April 2020, in an attempt to analyze the effects of COVID-19. They find that stocks with a high ESG score have lower losses and slightly higher standard deviation than stocks with low ESG score, in the period Jan-Apr 2020. In addition, the portfolio consisting of a high ESG score had a better Sharpe ratio than the low ESG portfolio, indicating that highly rated ESG stocks show better risk-adjusted returns than poorly rated ESG stocks. Their findings show that firms with a high ESG score outperform the S&P 500 index, and that firms with low ESG score underperform the S&P 500 index. Companies with stronger ESG characteristics tend to be more resilient during the volatile market conditions of COVID-19. Díaz et al. (2021) further looks at industry returns, for portfolios with high and low ESG ratings. Their findings suggest that the impact of ESG ratings vary across industries. They further find that, compared with pre COVID-19 findings, such impacts reverse directions during COVID-19.

Broadstock et al. (2021) analyzed ESG performance during times of the financial crisis and presented evidence from the COVID-19 pandemic. They look at period 3. February.020 - 30. March 2020, and compared to the same period one year prior, in 2019. They found that companies with ESG performance generally have a lower risk during a financial crisis and are positively associated with higher short-term cumulative returns during the COVID-19 crisis. They further found evidence that suggests firms with high ESG exposure are more resilient during a financial crisis, indicating to investors that ESG performance can be seen as a sign of stability, future stock performance, and risk mitigation. They find that the highly rated ESG stocks experienced less trading activity than low-rated ESG stocks, indicating that investors of ESG stocks or portfolios might be considered more patient and less likely to sell out, leading to lower losses in times of market uncertainty.

There is also a limited amount of research about risk and return for ESG rated companies in the Nordic countries. We wish to further investigate the relationship between ESG, risk, and returns. We want to contribute to the literature by researching how Nordic companies with different ESG scores perform in regard to risk and return.

We can see from the literature that there are conflicting results about whether ESG leads to higher performance, and for what level of risk exposure. Most of the existing literature focuses on older time periods and does not cover the most recent years. Díaz et al. (2021) and Broadstock et al. (2021) research the COVID-19 period, but only the initial months of COVID-19. This does not capture the before- and aftereffects of COVID-19 and the war in Ukraine.

2.4 Hypotheses and Contribution

Based on the literature review, we will contribute to the literature by investigating further the relationship between ESG, risk, and risk-adjusted returns among publicly listed companies in the Nordic countries.

Research from Dunn et al. (2018) shows that stocks with low ESG ratings have a higher risk and beta, and Kumar et al. (2016) shows that firms with ESG scores are less volatile than comparable stocks. We want to investigate if this is true for the listed companies in the Nordic countries. We expect, based on the literature, that stocks with high ESG scores exhibit a lower level of risk in periods of uncertainty (Díaz et al., 2021; Broadstock et al., 2021). Considering this, we create the following hypothesis:

H1: Stocks with a higher ESG score exhibit lower risk, than those with lower ESG score

It is our belief that companies with a low ESG rating are more exposed to risks in the market. Risk and return are closely related terms, particularly from an investor's point of view. Based on this we want to investigate whether a portfolio consisting of highly rated ESG stocks has a higher risk-adjusted return, in periods with market uncertainties.
We expect that stocks with high ESG scores exhibit a higher risk-adjusted return. This is based on Kumar et al. (2016) that analyzes the risk-adjusted return for ESG stock vs comparison group. Díaz et al. (2021) also found that companies with high ESG score have a higher risk-adjusted returns than the index and companies with low ESG score. In addition, Kempf and Osthoff (2007) and Statman and Glushkov (2009) found that stocks that are socially responsible can achieve a higher abnormal return. Based on this we want to answer the following hypothesis:

H2: The risk-adjusted return is higher for stocks with high ESG score, than those with low ESG score

3.0 Data and Methodology

3.1 Data

In this section we will describe our data collection process and include descriptive statistics of our final sample. We will further comment on the limitations of our data set.

3.1.1 Sample

We have used the Refinitiv Eikon Database to collect data on Nordic listed companies with ESG ratings. The ESG rating is issued by Refinitiv on a yearly basis.
There is a limited amount of research regarding ESG, risk and performance in the Nordic countries, and none that focuses on the last five-year period. We are therefore choosing to focus on the Nordic countries. Iceland has been excluded due to the low number of listed companies on the Iceland stock exchange. This leaves us with the four countries of Norway, Sweden, Denmark, and Finland.

In order to obtain a representative data sample, we started with all publicly listed firms in Norway, Sweden, Denmark, and Finland. We further filtered for companies that had ESG ratings available in the Refinitiv database. Companies obtaining ESG ratings is a phenomenon that only in recent years has gained popularity, and far from all listed companies have ESG scores available. Collecting historical data for only companies that have continuous ESG ratings available for the entire five-year sample period, leaves us with a very small sample. We have therefore set the minimum criteria that a company must have at least three ESG rating data points, in the last five years. It was not a requirement for the ESG data to be continuous, but once a company has obtained a score, they tend to have an ESG score every year thereafter. The data in our sample therefore all have an ESG rating for a minimum of the past three years, and some for up to the last five years. This gives us a sample of 331 listed companies. We included active listed companies from the Nordic countries. Companies that have gone bankrupt in the sample period are not excluded but because of our three-year continuous ESG rating criteria, the companies that go bankrupt do not fulfil these criteria. This could lead to survivorship bias; this will be explained in the weakness of the dataset.

We collect monthly data on returns, market capitalization and beta of individual companies. We follow Dunn et al. (2018) and Díaz et al. (2021) that look at high and low ESG ratings. We sort the companies into four categories, A, B, C, and D, based on their ratings. Group A and D are the top and bottom quantiles. Since the ESG ratings are issued per year, the companies included in each group vary from year to year based on the ESG rating.
With the intention of researching the market irregularities of the COVID-19 period, we use historical data for the past five years (2018-2022). We also include the first two months of 2023, due to data availability. Since the ESG ratings for 2023 are not yet published, we extend the 2022 ESG rating for these two months.

We follow Kempf and Osthoff (2007) and split the sample into two sub-periods. One before COVID-19, the other after. We do this in an attempt to capture how portfolios consisting of different ESG ratings hold up in a crisis and react to irregularities in the market.
Our sample is split into two sub-periods, which we will refer to as Before: 01.2018- 02.2020 and After: 03.2020-02.2023. The period after COVID-19 consists of 10 more months than before period before COVID-19. The after-period captures a period characterized by high market uncertainties. The coronavirus was identified in January 2020 and lockdowns in Norway, Denmark and Finland happened between 11-16 march. Sweden avoided the lockdown. This is the justification for our split, and dividing the sample the way we have.

3.1.2 Definition of ESG

Eikon is one of the largest operations in the world that collects ESG content. In figure 1 we can see by which factors the three pillars are individually measured by in total 10 categories, that build up the ESG factors (Refinitiv, 2022).

Figure 1.

ESG Pillars

Environmental	Social	Governance
Resource use	Product responsibility	Management
Emissions	Human rights	Shareholders
Innovation	Community	CSR Strategy
	Workforce	

Grading system

The ESG scores are graded into category A-D. The ESG rating from Refinitiv is between 0 and 1, zero being worst and 1 being best. Refinitiv calculates the score based on the measurements in figure 1 above. We have further used Refinitiv's grading system in order to create different quantiles based on ESG score. A score between 0 – 0.25 is placed in quantile D, 0.25 - 0.50 in quantile C, 0.50 - 0.75 in quantile B, and a score between 0.75 - 1 is placed in quantile A (Eikon, 2021). Refinitiv`s description and score range of the different ESG grades can be found in appendix A.

3.1.3 Sample Descriptives

In table 1 we have presented descriptives of ESG, country and industry from our sample.

Table 1.

ESG scores and three pillars across four countries

The table below shows descriptive of ESG and Country from our sample. The descriptives of ESG show the mean, standard deviation, lowest and highest observation from our sample. Country show overall listed public companies and how many that are in our sample.

	Obs.	Mean	Std. dev	Min	Max
ESG	1 395	53.6	19.9	1.4	93.2
Social	1 395	57.2	22.2	0.6	95.7
Governance	1 395	53.2	22.8	1.2	96.8
Environment	1 395	48.0	26.7	0	98.2

Country	**Denmark**	**Finland**	**Norway**	**Sweden**
Listed companies	170	185	367	1037
From our sample	48	42	67	174
Percent in our sample	28%	23%	18%	17%

In table 1 the ESG descriptives from our sample are listed. The table also shows how the Mean is different in Social, Governance and Environment. Social has the highest Mean and Environment the lowest.

Table 1 further shows the number of listed companies per country, and the number of companies per country included in the sample. It further shows the percentage of listed companies per country, that have been included (28% of Danish listed companies, 23% of Finnish listed companies, 18% of Norwegian listed companies, and 17% of Swedish listed companies).

Figure 2.

Industry descriptive from our sample

This figure shows how our dataset is distributed in different industries in each group. The list of industries can be seen in table 2.

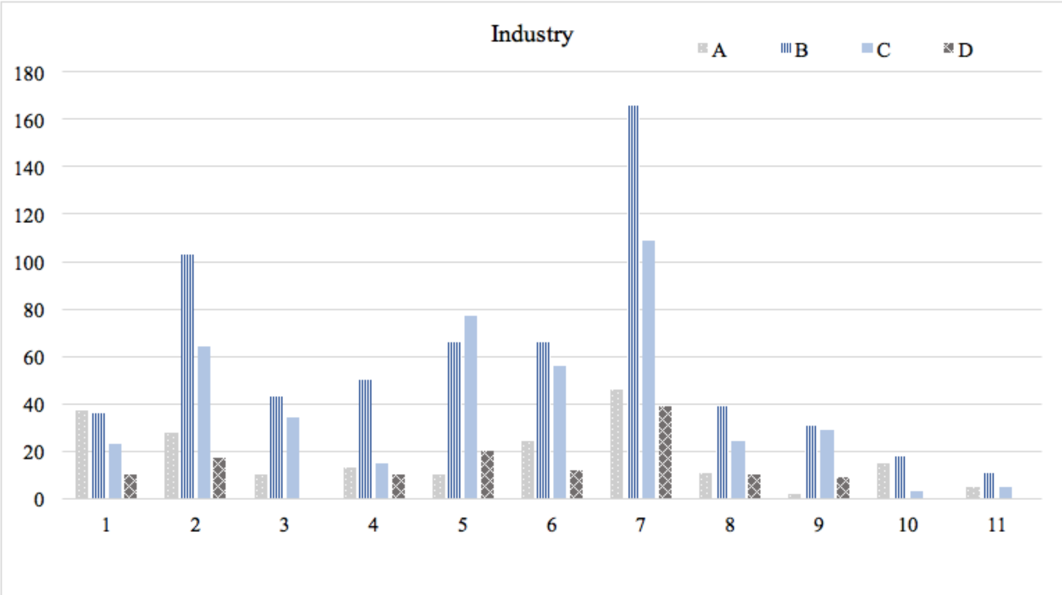


Table 2

Industry overview

The table below shows which numbers are connected to which industries.

Number	Industry
1	Basic materials
2	Consumer discretionary
3	Consumer staples
4	Energy
5	Financials
6	Health care
7	Industrials
8	Real estate
9	Technology
10	Telecommunications
11	Utilities

In figure 2 we have organized our sample into different industries, following Díaz et al. (2021) and Kumar et al. (2016). Table 2 presents an overview of which numbers the industries are in. We can see from the table that the highest number of companies are in the industries sector.

3.1.4 Limitations of the Data Set

Like previously mentioned, ESG is a recent phenomenon. Collecting historical data from Refinitiv Eikon has therefore been challenging, since not many companies have many years of available ESG data. This leaves with a sample on the smaller size.

We have divided the data into two sub-periods, in order to look at the effects of COVID-19. The two periods do not have the same number of months. The post- COVID-19 period has 10 more months than the pre-COVID-19 period. There are also less observations in 2018 and 2019. These small sub-samples might lead to unsignificant results because of the small size.

Looking at only a five-year period, leaves us with monthly return data for 61 months. This is a short sample period, especially when we divide the data into pre- and post-sub periods. This might lead to non-significant results in the regressions.

Our criteria to only include companies that have at least three years of compounded ESG score could lead to survivorship bias. Firms that have gone bankrupt or been affected by mergers and acquisitions are automatically excluded from our sample, due to the data criteria. Our sample might therefore be affected by survivorship bias. Survivorship bias is where funds that survive in the data set are the better funds and, the funds that are performing poorly are omitted due to bankruptcy or merging (Stock and Watson, 2020). This leads to the possibility that our sample might overstate performance. Survivorship bias could be controlled by not excluding firms subject to bankruptcy or mergers.

In our thesis we are using Refinitiv as a provider for data and ESG ratings. Berg et al. (2022) and Huber et al. (2017) shows that there can be a significant variation in ESG ratings, depending on the provider.

3.2 Methodology

We will present descriptive analysis and risk measures to answer hypothesis one. In the second part we will first analyze the factor-adjusted return and then present measures of risk-adjusted return and long-short portfolio to answer hypothesis two.

3.2.1. Descriptive Analysis

In this section we will analyze descriptive analysis using panel data, where we have N different entities and T different time periods (Stock and Watson, 2020).
Where N= 4 groups of ESG score and T= 62 months (over the period 01.2018- 02.2023). We will first show the equal weighted summary statistics for the total period, and then divide the time period to before and after COVID-19.

Risk can be divided into systematic, firm-specific, and total risk. (Sassen et al., 2016; Chollet and Sandwidi, 2018; Dunn et al., 2018).

Total risk can be captured by a firm's overall volatility (Dunn et al., 2018; Sassen et al., 2016). We have, in line with other studies, analyzed a firm's volatility (Chollet and Sandwidi, 2018; Sassen et al., 2016; Broadstock et al., 2021; Díaz et al., 2021) by calculating the annualized standard deviation.
Systematic risk is in line with Sassen et al. (2016) and Dunn et al. (2018) calculated by using the CAPM beta of each company. Beta is a measure for systematic risk and tells us how the stock moves relative to the market. A beta equal to one tells us that the stock is moving the same as the market. We have collected the beta from Refinitiv Eikon and used this to calculate the average beta in each of our groups.
It is known that firm-specific risk can, for investors, be eliminated by diversification. This is mentioned by e.g., Amit and Wernerfelt (1990) and Bodie et al. (2021). We are therefore focusing on market risk, or systematic risk as it is also called.

We found monthly and weekly return, beta and market capitalization from Eikon Refinity. We then analyzed the volatility from the return. The market capitalization, referred to as the MCAP, of each firm is collected in the Euro currency. This makes it possible to compare the market capitalization in the different countries without changing the currency.

3.2.2 Risk Measures

In 1964 Sharpe introduced a measure of performance of mutual funds, termed the reward-to-variability ratio, now more commonly termed the Sharpe Ratio. The Sharpe ratio is a measure of risk and risk-adjusted return, based on excess return of the portfolio and standard deviation, a measure of reward per unit risk (Berk & DeMarzo, 2020). It is a popular measure for comparing risk and risk-adjusted returns, and a higher Sharpe ratio indicates better efficiency for the investment (Kumar et al., 2016). In line with Kumar et al. (2016) and Díaz et al. (2021), we will analyze the Sharpe ratio as a measure of risk and risk-adjusted return.

$$Sharpe\ ratio = \frac{(R_p - R_f)}{\sigma_p}$$

Equation 1

The Treynor ratio is another measure of risk and risk-adjusted returns, that compares the return of a stock with the beta (Kumar et al., 2016). This is an alternative to the Sharpe ratio that compares the return of a stock with the standard deviation. Since the Treynor ratio divides excess return by the beta, it is therefore dependent on systematic risk, whereas the Sharpe is more dependent on the total risk.

$$Treynor\ ratio = \frac{(R_p - R_f)}{\beta_p}$$

Equation 2

3.2.3 Factor-adjusted returns

We are here going to look at the Fama-French 3-factor, Carhart 4-factor, and Fama-French 5-factor return regressions. We will look at the regressions for the four quantiles individually, before following a long-short investment strategy, with a long position in quantile A, and a short position in quantile D. We do this in order to capture the differences between the top and bottom quantiles of ESG scores.

Capital Asset Pricing Model

The Fama-French and Carhart factors are collected from the Kenneth R. French data library. We use the factor variables calculated for European markets. At the time of data collection, the Fama-French factors were available to January 2023.

The factor models are developed to explain variations in portfolio returns, by including factors that explain excess returns. They are an extension of the Capital Asset Pricing Model (CAPM), introduced by Sharpe (1964) and Lintner (1965) which was made to explain portfolio return but includes only the market factor as a risk factor. The CAPM is given by:

$$R_{it} = R_{ft} + \beta_i(R_{mt} - R_{ft})$$

Equation 3

Fama—French Three-Factor Model

The three-factor model is designed to capture the relationship between return and size and the relationship between return and price ratios (Fama & French, 1993). The asset pricing model expands on the CAPM model by adding price and value risk. SMB is the difference in returns of a diversified portfolio of small stocks minus a diversified portfolio of large stocks. HML is the difference in returns of a diversified portfolio of high M/B stocks and a diversified portfolio of low M/B stocks.

$$R_{it} - R_{ft} = \alpha_{it} + \beta_1 MktRF_t + \beta_2 SMB_t + \beta_3 HML_t + e_{it}$$

Equation 4

α_{it} is the abnormal return of the portfolio.
R_{it} is the return of portfolio i at time t.
R_{ft} is the risk-free rate f at time t.
$MktRF_t$ is the market risk premium
SMB_t is the size factor at time t

HML_t is the value factor at time t

The Fama-French factors are constructed using the 6 value-weight portfolios formed on size and book-to-market (French, 2023). SMB is the average return of three small portfolios minus the average return of three large portfolios. HML is the average return on two value portfolios minus the return of two growth portfolios. R_m-R_f is the excess return of the market.
The Fama French factors and the momentum factor are developed for several markets. In our analysis we are using the European factors, as they most resemble the Northern European market.
The beta coefficients on the right side of equation 4, 5, and 6, measure the sensitivity to the factors in the model, for the portfolios. β_1, the coefficient for market index excess return, is the estimate of an investment or portfolios market risk. β_2, the coefficient for SMB, and β_3, the coefficient for HML, are estimates for betas against these two factors.

Carhart Four-Factor Model

Carhart (1997) expands the Fama-French 3-factor model by adding an additional momentum factor, that captures Jagadeesh and Titman's (1993) one year momentum anomaly.
The momentum factor simulates a portfolio that buys the previous year's winning stocks and sells the previous year's losing stocks (Carhart 1997). A positive factor loading on the WML factor means that the investment is responding with winning stocks.

$$R_{it} - R_{ft} = \alpha_{it} + \beta_1 MktRF_t + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 WML_t + e_{it}$$

Equation 5

WML_t is the momentum factor at time t
The other factors are the same as explained under Equation 4.

Fama—French Five-Factor Model

In the five-factor model Fama and French add factors of profitability and investment into the model. The profitability factor RMW, robust minus weak, is the difference between the returns

in diversified portfolios with robust and weak profitability. This accounts for the portfolio's exposure to differences in profitability.
The investment factor CMA, conservative minus aggressive, is the difference between returns in diversified portfolios of stocks of low and high investment firms. (Fama & French, 2015)
If the five factors capture all variations in expected return, then the intercept alpha will be zero.

$$R_{it} - R_{ft} = \alpha_{it} + \beta_1 MktRF_t + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 RMW_t + \beta_5 CMA_t + e_{it}$$

Equation 6

RMW_t is the profitability factor at time t. Robust minus weak.
CMA_t is the investment factor at time t. Conservative minus aggressive.
The other factors are the same as explained under Equation 4.

Long-short portfolio

The long-short is a trading strategy that goes long in a high rated portfolio, and short in a low rated portfolio. The dependent variable is the value weighted return for the long-short portfolio. The portfolio has a long position in the top quantile A, and a short position in the bottom quantile D. This strategy will be used to analyze the differences between the high and low rated portfolios, quantile A and D.

3.2.4 Risk-Adjusted Return

To answer Hypothesis 2, that risk-adjusted return is higher for stocks with high ESG score than those with low ESG score, we will present measures of risk-adjusted return. According to Elton et al. (1996), the alpha from the factor models can be used as a measure of risk-adjusted returns. These models adjust for the risk explained by the factors included in the respective models. Other common measures for comparing risk-adjusted returns are the Sharpe- and Treynor ratio, which were presented above in section 3.2.2.

3.3 Sample Descriptives

Table 3 shows sample descriptives of our sample to present an overview of our data.

Table 3.

Descriptive regression

The table below shows the descriptive analysis from regression in Excel, before and after COVID-19. The sample is split into Before COVID-19: 01.2018- 02.202 and after COVID-19: 03.2020-02.2023. For each group the table below shows the mean, median, largest, and smallest observations of the annual volatility, monthly return, beta, and MCAP- market capitalization. The market capitalization is shown as number in millions.

	Mean		Median		Largest		Smallest	
	Before	**After**	**Before**	**After**	**Before**	**After**	**Before**	**After**
				Volatility				
A	21.2%	36.3%	20.3%	33.4%	62.5%	217.8%	0.2%	0.1%
B	25.7%	35.0 %	24%	32%	130%	263 %	0.0%	0.4%
C	27.6%	36.3%	25%	30.3%	210%	281.3%	0.0%	1.5%
D	27.1%	51.7%	23%	44.8%	85%	416.5%	0.0%	0.12%
				Return				
A	0.6%	1.0%	0.6%	1.0%	40.5%	49.4%	-30.2%	- 41.4%
B	0.4%	1.4%	0.5%	1.1%	60.8%	183 %.	-53.7%	-98.5%
C	0.3%	2.3%	0.6%	1.6%	94.2%	237%	-65.5%	-90.8%
D	0.4%	2.5%	0.9%	1.2%	34.7%	244%.	-59%	-77,5%
				Beta				
A	1.07	1.06	1.09	1.08	2.37	2.37	0.01	0.22
B	1.00	1.22	0.93	1.15	3.93	4.65	0.05	0.03
C	0.88	1.06	0.85	1.03	2.78	4.11	1.08	1.59
D	0.98	1.21	0.93	1.15	2.66	3.19	0.12	0.19
				MCAP				
A	16 197	15 158	9 309	7 714	132498	305 143	413	284
B	6 370	6 024	3 151	2 031	260 254	268 545	14	7.4
C	4 209	4 124	962	735	251 477	417 770	1.9	0.2
D	5 296	1 072	598	202	151 253	25 685	0.07	0.06

*MCAP- Numbers in millions.

Table 3 shows how the volatility changes from before and after COVID-19 in all the groups. The change is especially large in group D, where we can see that the mean increases a lot. We can also see a large increase in the largest observation in group D.

In addition, table 3 also shows that the largest monthly return in group D is much higher after COVID-19. We can see an increase from 34.7% to 244% before and after. The shift in group A is not as high before and after, 40.5% to 49.4%.

Beta in group A before and after COVID-19 is pretty similar. The average beta in group D is below the market beta before COVID-19 and shifts to 1.21 after. We can also see that there is a bigger difference in the largest in group D, where the largest beta is 2.66 before and 3.19 after. The largest beta in group A is the same before and after COVID-19.

Market capitalization shows that group A has a much higher average than group D. In addition, group D decreases the market capitalization by over 80% after COVID-19. The decrease in group A is much smaller.

4.0 Results and Discussion

In this section, we will present the results from our analysis.
We will first present a descriptive analysis where we analyze patterns and developments regarding risk. We will analyze the Sharpe- and Treynor ratio, before moving on to factor adjusted returns. Finally, we will present an overview and discussion of our risk and risk-adjusted return measures.

4.1 Descriptive Analysis

We start off by conducting an initial analysis where we compare statistics for each of our four quantiles A, B, C and D. In Table 4 we present the equal weighted volatility, return, beta, and market capitalization, before and after COVID-19. In addition, we will show how the monthly average volatility, return and beta moves over time. This is inspired by Dunn et al. (2018). We will also present descriptive analysis of industry in the different groups to analyze if some industries are more volatile than others. This is inspired by Díaz et al. (2016) and Kumar et al. (2016).

Table 4.
Descriptive analysis across different ranking

The table below shows the average volatility, beta, return, and market capitalization (number in million) in each group. First is the average Total descriptive from period 01.2018-02.2023. The sample is split into Before COVID-19: 01.2018- 02.202 and after COVID-19: 03.2020-02.2023.

	Annual Volatility	Monthly Beta	Monthly Return	Annual Return	Monthly MCAP
			Total		
A	30.8%	1,06	0.9%	10.8%	15 904 M
B	40.1%	1,15	1.1%	13.0%	6 144 M
C	47.1%	1,00	1.6%	19.3%	4 183 M
D	56.6%	1,15	1.9%	23.1%	2 261 M
			Before COVID-19		
A	25.0%	1.07	0.6%	6.9%	16 197 M
B	28.7%	1.00	0.4%	5.3%	6 370 M
C	32.4%	0.89	0.3%	3.3%	4 290 M
D	31.7%	0.98	0.4%	5.1%	5 296 M
			After COVID-19		
A	326%	1.06	1.0%	12.5%	15 776 M
B	42.7%	1.22	1.4%	16.5%	6 044 M
C	50.1%	1.06	2.3%	27.1%	4 124 M
D	60.7%	1.20	2.5%	30.1%	1 073 M

*MCAP- number in million

Table 4 shows that for the total period, the volatility, beta, and return is highest in group D. The table also shows that the market capitalization is on average much higher in group A, than any of the other groups.

The descriptive analysis for our sample shows a higher volatility for the low-ESG quantile. The volatility for group A increases from 25% volatility before COVID-19 to 32.6% after COVID-19, a difference of 7.6%. Group D has on average 31.7% annual volatility before and 60.7% after, an increase of 29%. This indicates that group D has had a more extreme reaction to the volatile market conditions between March 2020 and today.

The return in group A changes from 6.9% before COVID-19, to 12.5% after COVID-19. Group D has a more dramatic increase in average return, from 5.5% to 30.1%.

Table 4 shows that before COVID-19, group A had a higher beta than group D. After COVID-19 the beta for A has in practice remained more or less the same, only an increase on 0.01. The beta for D has increased noticeably, with an increase of 0.22. The higher beta for portfolio D indicates that portfolio D is more exposed to market risk.

In group A, market capitalization has remained more or less stable before and after COVID-19, dropping only from 16 197 million to 15 776 million. In group D, market capitalization drops by 80% after COVID-19, from 5 296 million to 1 073 million. This indicated that the value of portfolio D has decreased drastically post- COVID-19. This could mean investors in portfolio D are selling their shares. According to Broadstock et al. (2021) stocks with high ESG rate have investors that are more resilient and avoid selling their shares during COVID-19 Market capitalization will be considered in the value weighted Fama & French regression.

Our results are consistent with Dunn et al. (2018), which found that stocks with low ESG exposures have higher stock specific and total volatility. They also found that the worst quantile has a higher beta (of 3%), as well as higher returns than the best quantile.
This is consistent with our results of the total time period from January 2018 - February 2023.

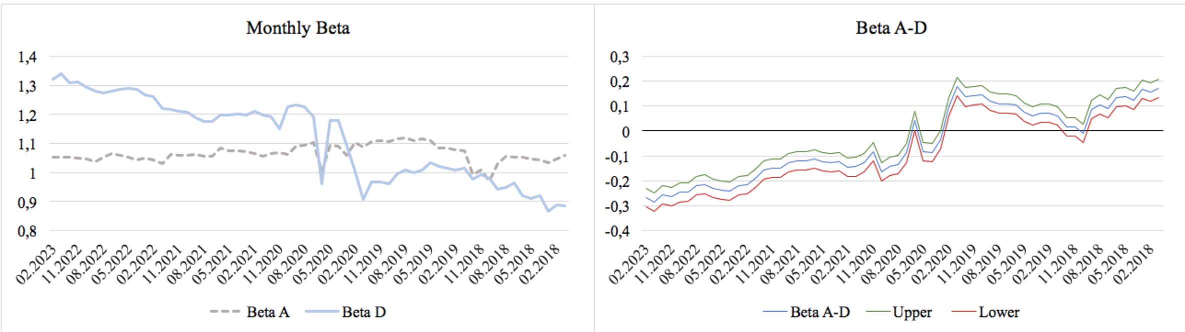
Our results so far give an indication that hypothesis 1, that companies with high ESG scores exhibit a lower risk, is correct. Since our thesis focuses on times of market uncertainties, the figure below visualizes the development of the risk and return for our sample.

Figure 3.
Risk measure of quantile A and D over time

The figure below shows on the left side how the monthly volatility (a) and beta (b) in group A and D moves over our sample period. The right side shows the difference between A and D and the upper and lower 95% confidence level. This will help us to see if there is some period that is significantly different. The upper and lower confidence level will show the interval where 95% in which all sample will result (Mindrila & Balentyne, 2013).

a)

b)



We have visualized how the average monthly volatility and beta moves over time. We do this in order to visualize and better understand the fluctuations in the market. This is also inspired by the article from Dunn et al. (2018).

Figure 3 a) shows on the left side how the average monthly volatility in group A and D moves over time. The volatility in our data period has a large increase in the last months of 2018, the beginning of 2020, and the beginning of 2022. The results are as expected because of periods with high market uncertainty. There was a drop in the stock market in October 2018, lockdown because of COVID-19 happened in March 2020, and Russia's invasion of Ukraine happened February 2022.

Our results in figure 3 b) show that beta in group A is more stable and constant with the market than group D. Before March 2020 we can see that portfolio D on average had a lower beta than portfolio A. The average beta of portfolio D increases post- COVID-19 and is now significantly higher than before. It remains at a higher level for the remainder of the sample period.

The right side of figure 3 a) and b) shows the difference of volatility and beta between A and D, the upper and lower bar. This will help us to see if there is some period that is significantly difference between portfolio A and D. The period above zero will tell us that A has a higher volatility and beta. The period below zero will tell us that D has a higher volatility and beta. When the bars cross zero, this will tell us that this is not significant.

From figure 3 a) on the right side, we can see that the volatility in most of the cases is below zero, indicating that group D has higher volatility. There are some periods in the beginning of 2018 and in 2019 where the confidence level is between the zero line. This means that the results are not significant and are difficult to interpret. In June to August 2018 the volatility was higher in group A.

In figure 3 b) on the right side, we can see that the difference in beta has shifted in the beginning of 2020. From 2018 to 2020 the beta is in most cases above zero, indicating that the beta is significantly higher in group A. There are some unsignificant period in the end of 2018 and middle of 2020 where the confidence level is between zero. We can see a shift in the beginning of 2020 where the beta becomes higher in group D.

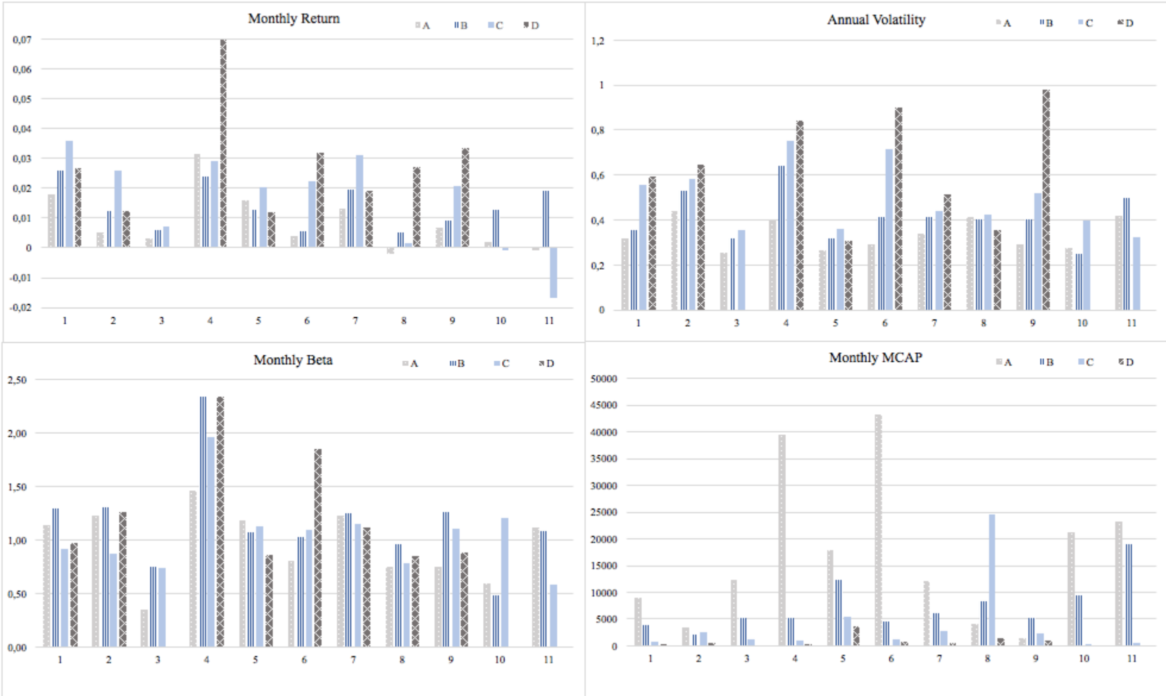
Our results so far are consistent with the results from Dunn et al. (2018) and give support to our hypothesis, that stocks with high ESG scores exhibit a lower risk than stocks with low ESG score.

In line with Kumar et al. (2016) and Díaz et al. (2021), we will also present an overview of the different industries in the sample, in order to research if industries are affected differently by risk. Please note that since our sample is rather small, the number of companies in each industry may be small, and perhaps not representative of the Nordic market. From figure 2 above, we can see the distribution of companies in each industry and group.

Figure 4.

Total summary statistics across different industries and ranking

Below we can see the average return, volatility, beta, and market capitalization for the total sample period, 01.2018-02.2023, in each industry and each group. The sectors that are in the different numbers are described in table 2.



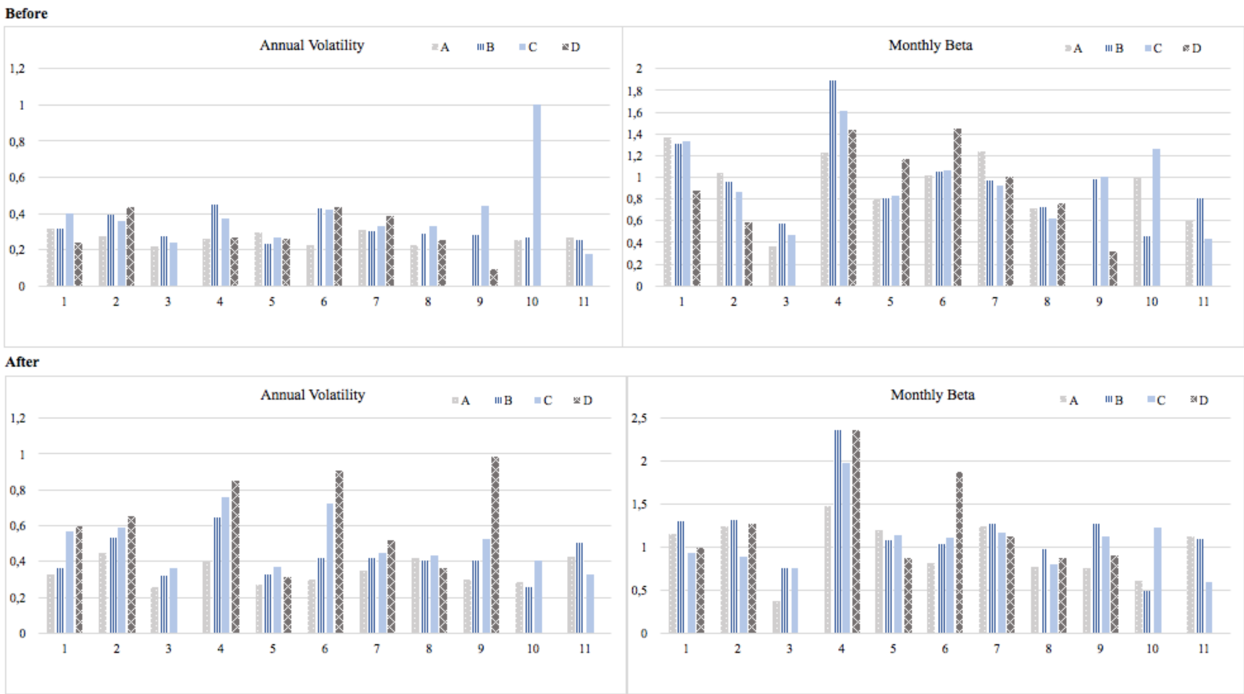
The results in figure 4 confirmed results from Kumar et al. (2016) and Díaz et al. (2021) that return, and volatility is varying in the different industries. From the table above we can see that the beta is fairly constant in the groups in each industry, this in line with the assumption from Sassen et al. (2016). Figure 4 shows that the return in group D is especially high in the Energy sector. We can also see that the volatility in most industries is higher in group D. There are three industries that do not have companies with the lowest ESG score. Group D has the highest volatility in the Energy, Health Care and Technology sector.

Figure 4 indicates that industries are affected differently in times of market uncertainties. Some industries are more vulnerable than others. We have therefore also calculated the risk measures, volatility, and beta before and after COVID-19. Graphs on the industry return and market capitalization before and after COVID-19 are in appendix B.

Figure 5.

Before and after COVID-19 summary descriptives across different industries and ranking

Figure 5 shows the average annual volatility and the average monthly return for each group before (01.2018-02.2020) and after (03.2020-02.2023) COVID-19. The sectors that are in the different numbers are described in table 2.



From figure 5 we can see that the volatility in group D increases a lot after COVID-19, especially in Energy, Health Care and Technology. Kumar et al. (2016) also found energy and technology to have the highest volatility in ESG companies, in addition to Food & Beverage. Unlike our analysis they compared a reference group and found the reference group to have a higher volatility in each industry.

Figure 5 shows that the volatility in group A is more stable in each industry and is not as affected by market uncertainties as group D. The figure shows that the monthly beta increase after COVID-19. We can see that the increase in beta is more affected by the industry than the groups. The energy and Health Care sector has the highest increase in group D.

Our results so far give support to hypothesis 1, that stocks with high ESG scores exhibit a lower level of risk. However, we can see indications that the beta might be affected by industry characteristics. This is also in line with results from Kumar et al. (2016), Díaz et al. (2021) and Sassen et al. (2016).

Our results so far can only give an indication of the patterns in our data sample. To compare the risk in the groups, we have calculated the Sharpe and Treynor ratio.

4.2 Risk Measures of ESG Stocks

Table 5.

Sharpe and Treynor

Table 5 presents the Sharpe- and Treynor ratio of all the quantiles, A, B, C and D. We can see the total ratios (01.2018-01.2023), in addition to before (01.2018-02.2020) and after (03.2020-02.2023) COVID-19.

	Sharpe				Treynor			
	A	B	C	D	A	B	C	D
Total	0.332	0.229	0.334	0.266	0.013	0.011	0.022	0.016
Before	0.202	0.231	0.247	0.255	0.006	0.009	0.019	0.016
After	0.411	0.236	0.323	0.273	0.018	0.012	0.024	0.017

We can see from the Sharpe and Treynor ratio for the total sample period, that quantile C is the best option. This contradicts our hypothesis that stocks with high ESG score exhibit a lower risk. We would expect that group A had the highest Sharpe and ratio, followed by B and C and group D the lowest, in descending order. We cannot see such a pattern here.

However, we can see a positive shift in both Sharpe- and Treyor ratio in our two sub-periods, before and after COVID-19. This indicates the risk-adjusted performance of all our four groups becomes better in the after covid period, compared to before. Group A has a particularly high increase in Sharpe ratio, indicating that they react well to the risks experienced during the COVID-19 period.

The Treynor ratio shows positive changes comparing the before and after sub-periods, however the development in Treynor ratio is much lower than for Sharpe ratio. According to Sassen et al. (2016) beta is more affected by industry-specific risk. Our results indicate the same, that the total risk is more affected within the different quantiles. Kumar et al. (2016) found that in most of the industries stocks with ESG score had a better Sharpe- and Treynor ratio than the comparable stocks. Díaz et al. (2021) analyzed the Sharpe ratio in times of COVID-19 and found that the top-rated portfolios had the best Sharpe ratio. This is in line with our finding that quantile A exhibits a better shape ratio than quantile D between March 2020 and January 2023.

Our results so far show support to our hypothesis 1, that stocks with high ESG score exhibit lower risk than low rated ESG stocks. We do not find the clear pattern of risk between our four quantiles that we were expecting. However, we do see indication that quantile D exhibits higher total and systematic risk than quantile A, during our sample period, particularly after covid.

To answer hypothesis 2, that stocks with high ESG score exhibit higher risk-adjusted returns than stocks with low ESG score, we have first analyzed the return using Fama-French and Carhart regression, to look at the abnormal returns. We will further connect it to the Sharpe and Treynor ratio.

4.3 Factor-Adjusted Returns of ESG Portfolios

In this section we look at the return regression from Fama-French 3-factor model, Carhart 4-factor model, and Fama-French 5-factor models. We will implement a long-short portfolio strategy in order to comment on the differences between the best rated and worst rated ESG portfolios. We continue to divide our sample into two sub-periods, in an attempt to capture how our sample reacted to the COVID-19 pandemic.

We have constructed both equal weighted and value weighted portfolios for each of the four quantiles. Below we show the value weighted Fama-French 3-factor, Carhart 4-factor, and Fama-French 5-factor regression for our sample period, 2018 – 2022. The equal weighted Fama-French and Carhart regressions can be found in the appendix F-H. In the appendix, we also show Fama-French 3-factor, Carhart 4-factor, and Fama-French 5-factor return regression for our two sub-periods, before (Jan 2018 – Feb 2020) and after (Mar 2020 – Jan 2023) COVID-19, for both value weighted and equal weighted portfolios. This can be seen in appendix C-E, and F-H.

Table 6.

Fama-French-Carhart Regression

The table reports the results obtained from a time series return regression of a value-weighted portfolio consisting of ESG-stocks in all four quantiles (A, B, C, and D), using the Fama-French 3-Factor, Carhart 4-Factor, and Fama-French 5-factor model. Standard error is shown in the parentheses. ***, **, and * indicate 1%, 5%, and 10% significance. The standard error is shown in parenthesis.

	Dependent variable: Value weighted Portfolio Return											
	3 Factor				4 Factor				5 Factor			
	A	B	C	D	A	B	C	D	A	B	C	D
α	0.011***	0.009***	0.018***	0.015***	0.011***	0.009***	0.017***	0.016***	0.009***	0.006	0.013***	0.012**
	(0.003)	(0.003)	(0.005)	(0.006)	(0.003)	(0.003)	(0.005)	(0.006)	(0.003)	(0.003)	(0.004)	(0.006)
Mkt-RF	0.611***	0.798***	0.934***	0.864***	0.587**	0.793***	0.991***	0.792***	0.563***	0.717***	0.779***	0.766***
	(0.058)	(0.064)	(0.087)	(0.357)	(0.072)	(0.079)	(0.106)	(0.135)	(0.063)	(0.070)	(0.092)	(0.125)
SMB	-0.016	0.326	0.344	0.616	0.007	0.345	0.289	0.686	0.027	0.273	-0.004	0.476
	(0.189)	(0.209)	(0.281)	(0.616)	(0.007)	(0.215)	(0.288)	(0.365)	(0.197)	(0.218)	(0.287)	(0.392)
HML	-0.205*	-0.335***	-0.574***	-0.442***	-0.236**	-0.339***	-0.500***	-0.536***	0.137	0.186	0.309	0.155
	(0.086)	(0.095)	(0.128)	(0.163)	(0.102)	(0.113)	(0.151)	(0.192)	(0.199)	(0.220)	(0.290)	(0.395)
WML					-0.066	-0.054	0.158	-0.201				
					(0.114)	(0.127)	(0.169)	(0.215)				
RMW									0.905**	0.092***	0.553	0.743
									(0.304)	(0.336)	(0.443)	(0.604)
CMA									0.023	-0.379	-1.540***	-0.710
									(0.342)	(0.378)	(0.498)	(0.679)
Obs.	61	61	61	61	61	61	61	61	61	61	61	61

The main variable of interest in our analysis is the alpha. The alpha shows us the abnormal returns, controlled for the variables included in the respective 3-factor, 4-factor, and 5-factor models. Table 6 show that the alphas for all quantiles of the 3-, 4-, and 5-factor models are statistically significant at the 1% level, with the exception of quantile D in the five-factor model which is significant at a 5% level, and quantile B in the five-factor model which is not significant.

The alpha for all four quantiles is positive for the 3-, 4-, and 5-factor models. This implies an excess return for all portfolios, relative to market returns, controlled for the factors in the 3-, 4-, and 5-factor models. This indicates that investing in stocks that have an ESG rating will yield abnormal returns, no matter the ESG-rating. This is in line with our expectations, that investing in ESG and caring about sustainability is associated with higher returns than the overall market.

The market risk-free rate coefficient estimates the market risk, or systematic risk, that the individual portfolio or investments are exposed to. All portfolios show positive and significant coefficients for the 3-, 4-, and 5-factor models.

SMB coefficients have no significant results. However, a negative coefficient means that the portfolio is not responding to the return of small capitalization firms, and a positive coefficient means it does respond to the return of small capitalization firms.
Our 3- and 4-factor model shows negative HML coefficient for all portfolios, indicating a low book-to-market ratio. All variables are statistically significant at either 1%, 5%, or 10%. A, B and D have a negative WML, indicating that the portfolios are not responding to the winning stocks. However, none of the results are statistically significant.
Portfolio A and B have a significant and positive coefficient of RMW, this means that they are responding with robust investments.
The last coefficient CMA has a positive result in portfolio A and negative in B, C and D. This indicates that portfolio A responds more to return of conservative investments and the others do not. However only portfolio C is statistically significant.

In order to answer our hypothesis and investigate if higher ESG rating is associated with higher risk-adjusted return than low ESG ratings, we will look at the difference in the top and bottom quantiles. We implemented a long-short investment strategy, in line with Kempf and Osthoff (2007), Statman and Glushkov (2009) and Díaz et al. (2021). We long the high rated ESG portfolio (A) and short the low rated ESG portfolio (D). The purpose of this is to look at the differences between investing in highly rated ESG stocks and poorly rated ESG stocks.

Table 7.

Long-Short Portfolio

The table presents the results from the Fama-French 3-factor, Carhart 4-factor, and Fama-French 5-factor models, using a long-short strategy. The portfolio has a long position in the top quantile, portfolio A, and a short position in the bottom quantile, portfolio D. The long-short is a trading strategy that goes long in a high rated portfolio, and short in a low rated portfolio. The dependent variable is the value weighted return and the equal weighted return for the long-short portfolio, in the period 2018-2022. ***, **, and * indicate significance at the 1%, 5%, and 10% level.

	Dependent variable: Portfolio Return					
	3 Factor		4 Factor		5 Factor	
	VW	EW	VW	EW	VW	EW
a	-0.005	-0.005	-0.006	-0.004	-0.004	-0.008*
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Mkt-RF	-0.255***	-0.287***	-0.207*	-0.336***	-0.207*	-0.362***
	(0.099)	(0.088)	(0.122)	(0.108)	(0.114)	(0.098)
SMB	-0.614*	-0.436	-0.661**	-0.389	-0.433	-0.434
	(0.321)	(0.285)	(0.330)	(0.292)	(0.357)	(0.306)
HML	0.239	0.184	0.302**	0.120	-0.003	0,694**
	(0.146)	(0.130)	(0.173)	(0.154)	(0.360)	(0.308)
WML			0.134	-0.136		
			(0.195)	(0.173)		
RMW					0.180	1.108**
					(0.550)	(0.471)
CMA					0.780	-0.184
					(0.619)	(0.529)
Obs.	61	61	61	61	61	61

Table 7 shows the difference in abnormal returns for the portfolio consisting of highly rated ESG stocks, minus the portfolio consisting of poorly rated ESG stocks. Only the alpha for the equal weighted five-factor model is significant at the 10% level. All other alphas are non-significant.

The alphas for the 3-factor, 4-factor, and the value weighted 5-factor model are similar at between negative 0.004 and negative 0.006. This indicates that for these models, portfolio D has between 0.4% - 0.6% higher abnormal return than portfolio A, for the period 2018-2022. However, we do not find a statistically significant difference from zero for any of these values. The 5-factor equal weighed alpha is slightly lower at -0.008. This indicates that portfolio D has a 0.8% higher abnormal return than portfolio A. This is the only intercept that shows statistical significance, at a 10%-level. From this we can see that portfolio D has a slightly higher abnormal return than portfolio A, for the period 2018-2022.

This contradicts our hypothesis that highly rated ESG stocks exhibit higher risk-adjusted return, measured by abnormal returns. This is also contradicting Kempf and Osthoff (2007) and Statman and Glushkov (2009) who find high ESG exposure to yield higher abnormal returns.

The market risk free rate is negative and significant for all factor models. This indicates that our low rated portfolio has a higher beta than our high rated portfolio. The significant difference implies there is a connection between systematic risk ESG rating.
For the SMB coefficient have negative values for all models, however only the value weighted 3- and 4-factor models are significant at a 10% and 5% level. These negative values mean that portfolio D responds better to firms with small market capitalization than portfolio A. This is expected due to our previous descriptive summary, that shows portfolio A has a larger average market capitalization than portfolio D.
The coefficient of HML is significant and positive at 4 factor value weighed and 5 factor equal weighted, this indicates that A has a higher book-to-market ratio than D.
The last significant coefficient is the 5-factor equal weighted RMW. The coefficient is positive, indicating that portfolio A consists of companies that make more robust investments than portfolio D.

We further take inspiration from Kempf and Osthoff (2007) and divide our sample into two sub periods of pre- and post-COVID-19, In an attempt to capture the market uncertainties connected to the period. We have therefore divided the long-short portfolio into two sub periods, January 2018 – February 2020, and March 2020 – January 2023, termed before COVID-19 and after COVID-19

Table 8.

Long-Short Portfolio with sub-periods

The table presents the results from the Fama-French 3-factor, Carhart 4-factor, and Fama-French 5-factor models, using a long-short strategy. The portfolio has a long position in the top quantile A, and a short position in the bottom quantile D. The dependent variable is the value weighted (VW) return and the equal weighted (EW) return for the long-short portfolio. The regressions are run for the period before the COVID-19 pandemic (January 2018 - February 2020), and the period after (March 2020 - January 2023). ***, **, and * indicate significance at the 1%, 5%, and 10% level.

Dependent value: Portfolio Return												
	3 Factor				4 Factor				5 Factor			
	VW		EW		VW		EW		VW		EW	
A-D	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After
a	-0.011	-0.001	-0.008	-0.004	-0.016*	0.001	-0.007	-0.003	-0.007	-0.002	-0.006	-0.009
	(0.010)	(0.006)	(0.008)	(0.006)	(0.009)	(0.007)	(0.008)	(0.007)	(0.010)	(0.007)	(0.008)	(0.009)
Mkt-RF	-0.268	-0.225**	-0.254	-0.302***	-0.098	-0.315**	-0.265	-0.388**	-0.241	-0.218	-0.313*	-0.431***
	(0.219)	(0.109)	(0.175)	(0.110)	(0.211)	(0.146)	(0.191)	(0.148)	(0.225)	(0.137)	(0.178)	(0.130)
SMB	-0.121	-0.857**	-0.513	-0.409	-0.421	-0.762**	-0.494	-0.318	0.083	-0.768*	-0.249	-0.523
	(0.729)	(0.355)	(0.584)	(0.357)	(0.675)	(0.370)	(0.609)	(0.373)	(0.769)	(0.400)	(0.609)	(0.378)
HML	0.007	0.244*	0.041	0.197	0.228	0.143	0.026	0.100	-0.969	0.278	0.148	0.914**
	(0.537)	(0.143)	(0.430)	(0.144)	(0.497)	(0.181)	(0.448)	(0.182)	(0.887)	(0.413)	(0.703)	(0.391)
WML					0.821**	-0.208	-0.053	-0.201				
					(0.348)	(0.227)	(0.313)	(0.229)				
RMW									-0.431	0.423	1.472	1.090*
									(1.241)	(0.608)	(0.983)	(0.575)
CMA									1.913	0.298	1.165	-0.656
									(1.563)	(0.692)	(1.237)	(0.655)
Obs.	26	35	26	35	26	35	26	35	26	35	26	35

As we can see from table 8, the intercepts for both the value weighted and equal weighted 3-, 4-, and 5-factor models are negative or close to zero. Only the value weighted four factor alphas for the sub-period before COVID-19 is significant, at a 10% level.

Based on the previous table (7) it is not unexpected that we have negative alphas, indicating the low rated ESG portfolio has a higher abnormal return than the high rated ESG portfolio, for both sub-periods. We can however see a pattern differentiating the two periods.

The after-period (March 2020 – January 2023) exhibits alphas closer to zero than the before period (January 2018 – February 2020). This indicates that even though portfolio D outperforms portfolio A in both sub periods, the difference between abnormal return is lower in the after period, March 2020 – January 2023 (except for the equal valued 5-fctor model). The differences are, however, not statistically significant. This might be due to our small sample size for the two sub-periods.

Kempf and Osthoff (2007) find no notable differences between the two periods in their study (1992-1997 and 1998-2004), and they further find no significant alphas using this approach, which they explain is most likely due to their small sample size.

4.4 Risk-Adjusted Return

The risk-adjusted returns measure the return of an investment, relative to the amount of risk exposure. If several investments have the same return in a given period, the one with the lowest risk will have a better risk-adjusted return.

We will first look at the risk-adjusted returns for the top and bottom quantile portfolios before and after COVID-19, in addition we will look at the difference and development of the portfolio A and D. Then we will analyze the risk-adjusted returns for the long-short portfolio, and further look the two sub periods.

Table 9.

Risk-adjusted Return

The table shows the Sharpe ratio, Beta, Treynor ratio, and Alphas from value weighted The Fama-French 3-factor model, Carhart 4-factor model, and Fama-French 5-factor model. We have again split the portfolios into two sub-periods, before COVID-19 (January 2018 - February 2020) and after COVID-19 (March 2020 - January 2023). The table also shows the difference in portfolios A and D, before and after COVID-19. ***, **, and * indicate 1%, 5%, and 10% significance for the alphas from the factor models.

	Before COVID-19			After COVID-19		
	A	D	Difference	A	D	Difference
Sharpe	0.202	0.255	-0.053	0.411	0.273	0.138
Beta	1.073	0.977	0.096	1.059	1.210	-0.151
Treynor	0.006	0.016	-0.010	0.018	0.017	0.001
Alpha 3-factor	0.006	0.015	-0.009	0.014**	0.015*	-0.001
Alpha 4-factor	0.006	0.021**	-0.015	0.015**	0.014*	0.001
Alpha 5-factor	0.006	0.011	-0.005	0.011**	0.012	-0.001

In the period before COVID-19, portfolio A has a lower Sharpe ratio than portfolio D indicating higher-risk adjusted returns for portfolio D. This shifts directions during COVID-19, as portfolio A experiences a doubling of the Sharpe ratio. This means that after COVID-19 portfolio A achieves a higher return per unit of risk. This is consistent with Díaz et al (2021), who find that during COVID-19, a top ESG portfolio has a better Sharpe ratio than a bottom ESG portfolio.

Our results show that the total beta is higher in group D. Both portfolio A and D have a higher beta than 1.0. Before COVID-19 group D had a lower beta than group A. The beta for portfolio D increases steadily in the five-year period, as we can also see by figure 3 b), from 0.977 before COVID-19, to 1.210 after COVID-19. Group A has a more constant beta that develops closer to the market.

In the period before COVID-19 portfolio D had a higher Treynor ratio than portfolio A, by 0.01. This difference is evened out during COVID-19, the difference becoming only 0.001 in favor of portfolio A. This means that after COVID-19 portfolio A and D has rather similar risk-adjusted returns, measured by market risk. Sassen et al. (2016) assumed that the market risk, measured in beta, is more affected by industry specific characteristics. We also found in figure 5 that the beta is more consistent within the groups in each industry.

Since the alphas show risk-adjusted returns controlled for the factors included in the models, an alpha above zero implies abnormal returns over market returns. All alphas for the sub-periods are positive, indicating positive abnormal returns over market returns. The 4-factor alpha shows significant values before and after covid, and we can determine a higher abnormal return for portfolio D before covid, than after, relative to the market. The other alphas do not show significance before and after covid, and we cannot determine a pattern in development for our two periods, that is statistically significant from zero. This is not surprising considering our small sample size and time period.

So far, our results from the Sharpe and Treynor ratio supports hypothesis 2, that risk-adjusted return is higher for stocks with high ESG score than those with low ESG score, during times of market uncertainties, measured in COVID-19. We get conflicting results from the factor-regression in table 7 and 8, where alphas indicate that group D has a higher abnormal return than group A. However, the results are not statistically significant. To test our second hypothesis further we have calculated the risk-adjusted measurements for the long-short portfolio.

Table 10.

Risk-adjusted Return - Long-Short Portfolio

This table shows the Sharpe ratio, beta, Treynor ratio, and the alphas from the Fama-French 3-factor, Carhart 4-factor, and Fama-French 5-factor models, calculated from the long-short portfolio. The measurements are shown for the total portfolio and divided into the two sub-periods of before and after COVID-19. ***, **, and * indicate 1%, 5%, and 10% significance for Fama-French-Carhart model alphas.

	Before	After	Total
Sharpe	-0.223	-0.059	-0.129
Beta	-3.69	-0.22	-1.70
Treynor	0.003	0.012	0.003
Alpha 3-factor	-0.011	-0.001	-0.005
Alpha 4-factor	-0.016*	0.001	-0.006
Alpha 5-factor	-0.007	-0.002	-0.004

We have calculated the Sharpe ratio, beta, Treynor ratio, as well as the three- four- and five-factor alphas for the long-short portfolio. We do this in order to look at the difference between the top and bottom rated portfolios and see if a long-short portfolio strategy is more profitable. From table 10 we can see that the long-short portfolio has a negative Sharpe ratio and beta. The negative Sharpe ratio indicates that a long-short portfolio strategy is not profitable. It is not unexpected that we get a negative Sharpe ratio, because the excess return of our long-short portfolio is negative. The beta is calculated for the long-short portfolio, using the CAPM equation, equation number 3, described in the methodology. The negative beta indicated that the long-short portfolio returns are negatively correlated with the market.

The Treynor ratio is also lower in this portfolio than portfolio A and D. The result from table 7 and 8 (that show the long-short portfolio strategy for the 3-,4- and 5-factor models) yield negative alphas, suggesting that portfolio D has higher abnormal returns than portfolio A. Even though most of those variables show no statistical significance, they show an indication that portfolio D yields higher abnormal returns than portfolio A, and that a long-short investment strategy is not profitable.

The negative Sharpe ratio indicates that the long-short investment strategy is in our case not profitable. Our negative alphas indicate that portfolio D has higher abnormal returns than portfolio A, also indicating that the long-short portfolio is not profitable. Our factor alphas are, however, not statistically significant.

We achieve conflicting results in our analysis. Our factor for the long-short portfolio yields negative and unsignificant alphas. The Sharpe ratio indicates higher risk-adjusted returns for portfolio A, particularly in the after COVID-19 sub-period. The Treynor ratio shows very little difference for the portfolios, but in total portfolio D has a 0.003 higher Treynor ratio.

There can be various reasons for these conflicting results. The factor models are highly dependent on the factors included in the models to explain abnormal returns, whilst Sharpe ratio and Treynor ratio is dependent on the volatility and systematic risk of the individual portfolio/investment. Our sample is also on the small side, and this combined with the high volatility of the period, can lead to non-significant results.

5.0 Conclusion

In this thesis we have investigated the risk and return of ESG rated companies in the Nordic countries, in order to investigate how risk and return differ in companies with high- and low ESG ratings in this area. We investigate how these portfolios hold up during a period of high market uncertainty due to the pandemic.

We contribute to the literature by investigating risk and return for publicly listed ESG rated companies in the Nordic countries, in the time period 2018-2022. We further contribute by dividing our sample into sub-samples, in order to capture the effects of the COVID-19 pandemic, and the war in Ukraine has on Nordic companies with ESG ratings. There are, to our knowledge, limited studies regarding ESG and performance in the Nordic countries, that capture the implications of the pandemic.

We found in our descriptive analysis that group D show an indication of higher total and systematic risk than group A. We further see that group D reacts more violently to the COVID-19 pandemic, becoming more volatile, whilst portfolio A remains more stable in terms of total and systematic risk. Our results from the Sharpe and Treynor ratios support our hypothesis 1, that stocks with high ESG score exhibit lower risk than low rated ESG stocks, during times of uncertainties. However, when analyzing the risk using Sharpe and Treynor ratio we did not get the pattern we expected, that entailed risk steadily decreasing with higher ESG score.

When testing the 3-, 4-, and 5- factor models, we find that all portfolios yield significant and positive abnormal returns, higher than the market. Our long-short portfolio yields negative and unsignificant alphas, indicating that our results are not statistically significant from zero. The long-short investment strategy does thus not give support to our hypothesis 2, that highly rated ESG stocks exhibit higher risk-adjusted returns than low rated ESG stocks.
In addition to calculating factor-adjusted return, we calculate the Sharpe ratio and Treynor ratios as measures of risk-adjusted returns. We find that portfolio D reports a very stable Sharpe and Treynor ratio, for both sub-periods of our sample. Portfolio A has a lower Sharpe and Treynor ratio than portfolio D before covid, however experiences a shift and has a higher Sharpe and Treynor ratio than portfolio D after covid. Portfolio A has a higher Sharpe ratio for the total sample period.

We further calculated the risk-adjusted return for the long-short portfolio and found that this investment strategy was not profitable. Where both portfolio A and D had a higher Sharpe- and Treynor ratio than the long-short portfolio.

5.1 Policy Implications and Further Research

We need to discuss the policy implications for our findings.
Investing in green stocks and funds has become important to investors. We see from our results that stocks that have an ESG rating, no matter if it is low or high, show significant positive abnormal returns, compared to the market. This is valuable information for investors who want to achieve a high return on investment, whilst investing in the Nordic market. This is further important for managers, since investors want to do well and do good in their investment decisions, by making sustainable investments.

Further research could expand the analysis by looking at a larger data sample, including other countries or regions, to see if the results are consistent with those of other areas. In addition, analyze and compare other periods of market uncertainty and financial crisis to further investigate the patterns, and additional tests could be done in order to further investigate the relationship between ESG and risk. Another addition to the research could be to look into investors' motivation for investing in ESG stocks.

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Appendix

Appendix A

ESG Grading System from Refinitiv Eikon (Eikon, 2021).

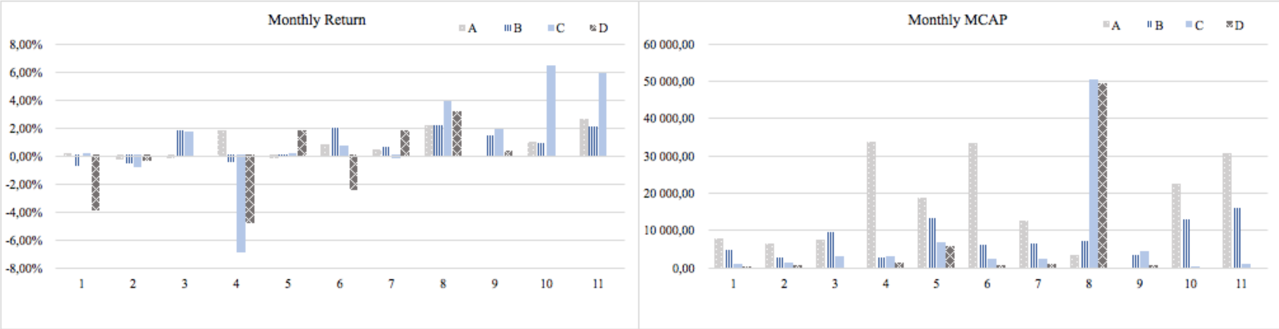
Score range	**Grade**	**Description**
0.0 – 0.25	D	*”Indicates poor relative ESG performance and insufficient degree of transparency in reporting material ESG data publicly”*
0.25 - 0.5	C	“*Indicates satisfactory relative ESG performance and moderate degree of transparency in reporting material ESG data publicly”*
0.5 - 0.75	B	*“Indicates good relative ESG performance and above average degree of transparency in reporting material ESG data publicly”*
0.75 - 1.0	A	*“Indicates excellent relative ESG performance and high degree of transparency in reporting material ESG data publicly”*

Appendix B

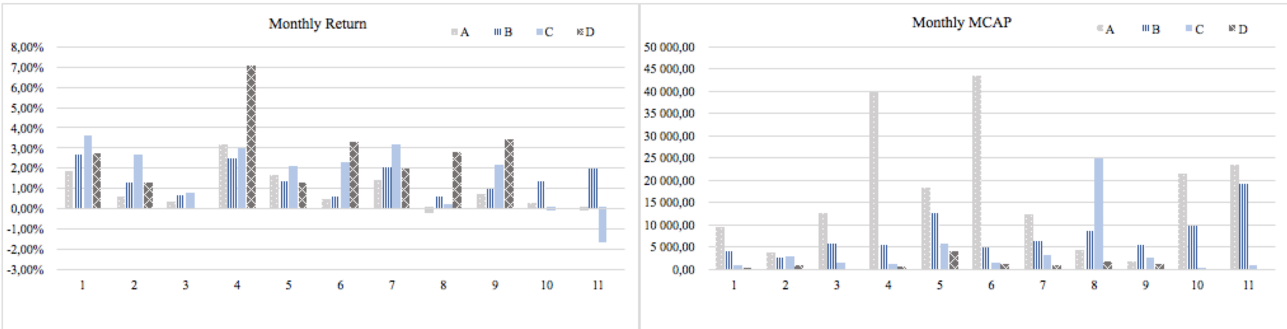
Before and after COVID-19 summary statistics in different industries and ranking

The table below shows the average monthly Return and Market capitalization in each industry for each group before and after COVID-19.

Before



After



Fama-French-Carhart regressions Value Weighted

Below we can see the value weighted Fama-French-Carhart regressions, in appendix C-E.

Appendix C

Value weighted 3-factor model before and after COVID-19.

Dependent variable: VW portfolio return								
	A		B		C		D	
3-factor	Before	After	Before	After	Before	After	Before	After
Alfa	0,006	0,014***	0,007*	0,009	0,016**	0,019**	0,015	0,015*
	(0,005)	(0,004)	(0,004)	(0,005)	(0,005)	(0,007)	(0,010)	(0,007)
Mkt-RF	0,667***	0,576***	0,798***	0,781***	0,756***	0,983***	0,935***	0,798***
	(0,100)	(0,077)	(0,090)	(0,092)	(0,115)	(0,125)	(0,230)	(0,129)
SMB	-0,252	0,071	-0,076	0,459	0,050	0,356	-0,122	0,948**
	(0,334)	(0,249)	(0,299)	(0,299)	(0,385)	(0,406)	(0,769)	(0,418)
HML	-0,415	-0,191	-0,519**	-0,313**	-0,490*	-0,601***	-0,422	-0,433**
	(0,246)	(0,100)	(0,220)	(0,121)	(0,283)	(0,164)	(0,565)	(0,169)
Obs	26	35	26	35	26	35	26	35

Appendix D

Value weighted 4-factor model before and after COVID-19.

Dependent variable: VW portfolio return								
	A		B		C		D	
4 Factor	Before	After	Before	After	Before	After	Before	After
Alfa	0,006 (0,005)	0,015*** (0,005)	0,009** (0,004)	0,008 (0,006)	0,015** (0,005)	0,017** (0,008)	0,021** (0,009)	0,014* (0,008)
Mkt-RF	0,642*** (0,108)	0,547*** (0,104)	0,752*** (0,093)	0,798*** (0,126)	0,784*** (0,124)	1,082*** (0,168)	0,740*** (0,217)	0,857*** (0,174)
SMB	-0,208 (0,345)	0,102 (0,263)	0,005 (0,297)	0,441 (0,317)	-0,000 (0,397)	0,252 (0,425)	0,221 (0,694)	0,886* (0,440)
HML	-0,448* (0,254)	-0,223* (0,128)	-0,580** (0,219)	-0,293* (0,155)	-0,453 (0,292)	-0,490** (0,261)	-0,676 (0,511)	-0,367* (0,215)
WML	-0,121 (0,177)	-0,067 (0,161)	-0,225 (0,153)	0,041 (0,195)	0,138 (0,204)	0,230 (0,261)	-0,943** (0,357)	0,138 (0,270)
Obs	26	35	26	35	26	35	26	35

Appendix E

Value weighted 5-factor model before and after COVID-19.

Dependent variable: VW portfolio return								
	A		B		C		D	
5 Factor	Before	After	Before	After	Before	After	Before	After
Alfa	0,006 (0,005)	0,011** (0,004)	0,006 (0,004)	0,004 (0,005)	0,017*** (0,005)	0,010 (0,006)	0,011 (0,011)	0,012 (0,008)
Mkt-RF	0,641*** (0,105)	0,509*** (0,088)	0,812*** (0,093)	0,661*** (0,100)	0,789*** (0,119)	0,689*** (0,128)	0,883*** (0,243)	0,721*** (0,161)
SMB	-0,184 (0,359)	0,083 (0,257)	-0,206 (0,318)	0,420 (0,293)	0,041 (0,406)	-0,124 (0,372)	-0,261 (0,800)	0,867* (0,469)

HML	-0,222	0,245	-0,346	0,416	-0,959*	0,829**	0,749	-0,017
	(0,415)	(0,266)	(0,367)	(0,302)	(0,469)	(0,385)	(0,924)	(0,485)
RMW	0,626	0,978**	-0,388	1,407***	-0,735	1,184**	1,046	0,574
	(0,580)	(0,391)	(0,514)	(0,445)	(0,656)	(0,556)	(1,293)	(0,713)
CMA	0,144	-0,117	-0,788	-0,400	0,410	-2,188***	-1,787	-0,433
	(0,731)	(0,445)	(0,647)	(0,507)	(0,826)	(0,645)	(1,627)	(0,812)
Obs	26	35	26	35	26	35	26	35

<u>Equal Weighted</u>

Below we can see the equal weighted Fama-French-Carhart regressions, in appendix F-H.

Appendix F

Equal Weighted 3-factor model total, before and after covid.

Equal Weighted 3-Factor model Total

Dependent variable: EW portfolio return				
3 Factor Total	A	B	C	D
Alfa	0,006*	0,006*	0,008**	0,012**
	(0,003)	(0,003)	(0,004)	(0,005)
Mkt-RF	0,804***	0,943***	0,864***	1,089***
	(0,065)	(0,066)	(0,069)	(0,097)
SMB	0,320	0,796***	0,384***	0,775**
	(0,189)	(0,210)	(0,225)	(0,315)
HML	-0,088	-0,156	-0,190*	-0,269*
	(0,086)	(0,096)	(0,102)	(0,143)
Obs.	61	61	61	61

Equal Weighted 3-Factor model before and after COVID-19

	Dependent variable: EW portfolio return							
	A		B		C		D	
3-factor	Before	After	Before	After	Before	After	Before	After
Alfa	0,004	0,006	0,003	0,006	-0,002	0,013**	0,010	0,010
	(0,006)	(0,005)	(0,004)	(0,005)	(0,005)	(0,005)	(0,008)	(0,007)
Mkt-RF	0,745***	0,890***	0,950***	0,919***	0,777***	0,854***	0,999***	1,108***
	(0,124)	(0,082)	(0,098)	(0,089)	(0,112)	(0,089)	(0,177)	(0,127)
SMB	-0,115	0,423	0,261	0,959***	0,181	1,059***	0,407	0,852**
	(0,414)	(0,267)	(0,326)	(0,290)	(0,374)	(0,290)	(0,589)	(0,411)
HML	-0,331	-0,065	-0,536**	-0,114	-0,383	-0,196*	-0,372	-0,261
	(0,305)	(0,108)	(0,240)	(0,117)	(0,275)	(0,117)	(0,443)	(0,166)
Obs	26	35	26	35	26	35	26	35

Appendix G

Equal Weighted 4-factor model total, before and after COVID-19.

Equal Weighted 4-Factor model Total

	Dependent variable: EW portfolio return			
4 Factor Total	A	B	C	D
Alfa	0,008**	0,007*	0,009**	0,011***
	(0,003)	(0,003)	(0,004)	(0,005)
Mkt-RF	0,739***	0,910***	0,819***	1,073***
	(0,079)	(0,080)	(0,085)	(0,119)
SMB	0,383*	0,828***	0,927***	0,790**
	(0,215)	(0,216)	(0,230)	(0,324)
HML	-0,172	-0,198*	-0,248**	-0,290*
	(0,113)	(0,113)	(0,121)	(0,170)
WML	-0,181	-0,090	-0,123	-0,045
	(0,127)	(0,127)	(0,136)	(0,191)
Obs.	61	61	61	61

Equal Weighted 4-Factor model before and after COVID-19.

Dependent variable: EW portfolio return								
	A		B		C		D	
4 Factor	Before	After	Before	After	Before	After	Before	After
Alfa	0,007	0,006	0,004	0,006	0,000	0,013**	0,012	0,008
	(0,005)	(0,005)	(0,004)	(0,005)	(0,005)	(0,005)	(0,008)	(0,008)
Mkt-RF	0,662***	0,790***	0,901***	0,918***	0,710***	0,846***	0,927***	1,173***
	(0,124)	(0,112)	(0,101)	(0,121)	(0,114)	(0,121)	(0,187)	(0,171)
SMB	0,030	0,443	0,348	0,960***	0,300	1,068***	0,533	0,783*
	(0,397)	(0,282)	(0,324)	(0,307)	(0,365)	(0,307)	(0,596)	(0,433)
HML	-0,439	-0,086	-0,600**	-0,116	-0,471*	-0,205	-0,465	-0,187
	(0,292)	(0,138)	(0,238)	(0,150)	(0,292)	(0,150)	(0,439)	(0,211)
WML	-0,400*	-0,044	-0,238	-0,002	-0,326*	-0,019	-0,347	0,152
	(0,204)	(0,173)	(0,167)	(0,189)	(0,188)	(0,188)	(0,307)	(0,266)
Obs	26	35	26	35	26	35	26	35

Appendix H

Equal Weighted 5-factor model total, before and after COVID-19.

Equal Weighted 5-Factor model Total

Dependent variable: EW portfolio return				
5 Factor Total	A	B	C	D
Alfa	0,004	0,003	0,005	0,010*
	(0,003)	(0,003)	(0,004)	(0,005)
Mkt-RF	0,719***	0,846***	0,782***	1,077***
	(0,071)	(0,069)	(0,078)	(0,113)
SMB	0,249	0,702***	0,742***	0,699**
	(0,222)	(0,216)	(0,243)	(0,353)
HML	0,456**	0,456**	0,290	-0,223
	(0,224)	(0,218)	(0,245)	(0,356)
RMW	0,895***	0,954***	0,482	0,196
	(0,342)	(0,333)	(0,374)	(0,543)
CMA	-0,450	-0,557	-0,674	-0,281
	(0,384)	(0,374)	(0,421)	(0,611)
Obs.	61	61	61	61

Equal Weighted 5-Factor model before and after COVID-19.

	Dependent variable: EW portfolio return							
	A		B		C		D	
5 Factor	Before	After	Before	After	Before	After	Before	After
Alfa	0,004	0,002	0,002	0,001	-0,002	0,009*	0,008	0,011
	(0,006)	(0,005)	(0,005)	(0,005)	(0,005)	(0,005)	(0,009)	(0,008)
Mkt-RF	0,696***	0,705***	0,939***	0,779***	0,790***	0,730***	1,009***	1,130***
	(0,125)	(0,096)	(0,103)	(0,097)	(0,120)	(0,105)	(0,187)	(0,161)
SMB	-0,005	0,328	0,213	0,846***	0,148	0,891***	0,250	0,867*
	(0,428)	(0,280)	(0,353)	(0,284)	(0,411)	(0,307)	(0,641)	(0,468)
HML	0,070	0,510*	-0,237	0,678**	-0,478	0,438	-0,074	-0,388
	(0,495)	(0,289)	(0,407)	(0,293)	(0,475)	(0,317)	(0,740)	(0,484)
RMW	1,144	0,858**	0,203	1,257***	-0,306	0,700	-0,338	-0,214
	(0,629)	(0,425)	(0,596)	(0,432)	(0,665)	(0,467)	(1,035)	(0,712)
CMA	0,145	-0,539	-0,517	-0,679	-0,068	-0,814	-1,037	0,098
	(0,871)	(0,484)	(0,717)	(0,491)	(0,837)	(0,513)	(1,304)	(0,811)
Obs	26	35	26	35	26	35	26	35