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How much do you need to care about ESG investing in the Nordics?

An empirical study of the relationship between ESG and portfolio performance in the Nordic stock market.

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Abstract

This research delves into the nuanced relationship between Environmental, Social, and Governance (ESG) considerations and portfolio performance in the Nordic stock market. Employing the mean-variance method, this study analyzes in-sample (2013-2017) and out-of-sample (2018-2023) periods, comparing high and low-rated E-, S-, G-, and ESG portfolios against the Nordic index OMX40. Findings suggest a neutral or slightly negative relationship between ESG and financial performance. Low E-stocks show higher risk-adjusted returns and low G-stocks exhibit superior returns. The research underscores the significance of considering regional-, sectorial and company size biases and the limitations of ESG ratings, providing valuable insights for stakeholders in sustainable finance.

Keywords: ESG investing, mean-variance optimization, ESG portfolio comparison.

Table of content

1. Introduction

In recent years, the integration of Environmental, Social, and Governance (ESG) criteria into investment decision-making has gained significant traction, especially in the Nordics, which is a region known for its commitment to progressive ESG standards. As of the end of 2022, the global sustainable assets under management reached $30.3 trillion, constituting 24.4% of the total global assets under management, which amounted to $124.5 trillion, as reported by the Global Sustainable Investment Alliance (2023). PwC's projections (2022) indicate a sustained trend going forward, foreseeing a compound annual growth rate of 12.9% from 2021 to 2026.

One main driver of ESG investing growth is UN Agenda 2030, a sustainability agreement to combat climate change, social injustice and provide a foundation for a globally sustainable future (UN, n.d.). This has increased public scrutiny which has further pushed investors to redirect investments into sustainable companies, often measured with ESG. Additionally, regulatory initiatives such as The Green Deal Industrial Plan in the EU and Inflation Reduction Act in the USA have had an impact on ESG growth due to their large investments into sustainable company projects.

The rationale for incorporating ESG factors into investment strategies extends beyond mere ethical considerations; it may also affect risk resilience and ultimately risk-adjusted returns in a fast-evolving global market. In this context, this research paper seeks to examine the relationship between ESG considerations and portfolio performance in the Nordic stock market. The Nordic region, comprising Denmark, Finland, Iceland, Norway, and Sweden, has been at the forefront of this transition, demonstrating a commitment to sustainability and corporate responsibility.

Since the majority of sustainability reporting is performed on a voluntary basis, there is yet to form a consensus on how to report, interpret or value ESG factors. This leads to a fragmented view on the true effect of ESG investing. Therefore, the aim is to help set a consensus for the Nordic market on the relationship between ESG and portfolio performance to identify if ESG investing is an optimal strategy, as well as potential strengths and weaknesses. This leads to answering the following question:

1. “What is the relationship between ESG and portfolio performance in the Nordics?”

To find the answer this thesis will apply the mean-variance method to optimize an in-sample period in 2013-2017 and compare to an out-of-sample period in 2018-2023. High rated E-, S-, G- and ESG portfolios consisting of the 25% highest scores are compared against the 25% lowest rated E-, S-, G- and ESG portfolios and the Nordic index OMX40, consisting of the 40 largest companies in the Nordic markets. This assessment aims to discern whether companies with higher ESG ratings demonstrate superior financial performance and evaluate the portfolios' relative strengths and weaknesses.

The analysis yields several key findings. Firstly, the overall relationship between ESG and financial performance in the Nordics appears neutral or slightly negative, with high ESG portfolios not consistently outperforming low ESG portfolios. Secondly, the increasing preference for high E- and G-rated stocks indicates a demand surge from ESG motivated investors, reducing demand for low E- and G-rated stocks. Consequently, stocks with low E-ratings demonstrate outperforming risk-adjusted returns, and stocks with low G-ratings exhibit superior returns. Thirdly, ESG investing introduces regional, sector, and market capitalization biases, impacting risk exposure. High ESG portfolios display a more diverse regional and sector mix but tend to include larger companies to a higher degree. Lastly, ESG ratings may not be optimal as a proxy for ESG value due to sector inclusions of controversial industries in high ESG companies. This aligns with previous research, suggesting the need for clearer criteria in sustainable practices, providing an opportunity for lawmakers to establish transparent guidelines.

This research holds paramount significance for investors, financial analysts, and policymakers operating in the Nordic region and beyond. By unraveling the intricate relationship between ESG factors and portfolio performance, the findings of this study can inform investment strategies, contribute to the development of sustainable finance practices, and foster a deeper understanding of the relationship between corporate responsibility and financial success.

Subsequent sections first delve into the theory of how ESG can add value and be used as an investment method, followed by the basics of the ESG efficient frontier and the hypothesis in Section 2. Thereafter, previous empirical research findings are explored in Section 3. In Section 4, methodology and data are described and discussed. In section 5 results and discussions regarding these are formulated and lastly a conclusion summarizes key results and their implications in Section 6.

2. Theory

This section dives into the question if ESG is value-adding and if ESG investing as an investment strategy is beneficial from a theoretical perspective. It also explores an ESG extended capital asset price model and forms the hypothesis for ESG investing in the Nordic region.

2.1 Relationship between financial performance and ESG

William F. Sharpe introduced in 1966 the Sharpe ratio, as a measurement of fund performance. It takes the expected returns minus the risk-free rate, divided by the standard deviation. This creates a ratio of returns and risk where a higher Sharpe ratio represents a higher return per risk factor, thus indicating a more efficient portfolio. It is the relative increase between volatility and return that is significant, which origins from the assumption that investors would prefer less volatility. It is widely used as a measurement of risk adjusted returns, not only for funds but for different types of securities including stock portfolios.

ESG measures non-financial factors that can inform and thereby influence investors' investment choices. In modern portfolio theory, first introduced by Harry Markowitz in 1952, two of the assumptions of the model are that the investor is rational and maximizes their utility by maximizing risk adjusted returns. Thus, the question is whether a rational investor should care about ESG or not. Here theorists vary.

Potential benefits of ESG on financial performance for a firm are lower cost of capital, decreased reputational and litigation risk, improved efficiency and improved capital inflow. MSCI (2020) concludes that high ESG lowers the cost of capital, both through a lowered cost of equity and a lowered cost of debt. This affects credit ratings and thereby increases profit margins for the firm. Chasiotis et al. (2020) point out a financial risk related to the reputational risk with ESG. They argue that possible litigation risk and reputational risk affects firm valuation. Swarnalatha and Prasanna (2013) document increased productivity resulting in increased profitability for firms with high employee satisfaction, indicating a more effective use of human capital. EY Parthenon (2022) attests that capital inflow to sustainable funds is almost in line with inflow to traditional funds due to the rapid growth of ESG investing. In the first half of 2022 ESG funds had inflows of USD

120bn versus traditional investing of USD 139bn. Consequently, firms can lose capital inflow due to investors' ESG standards. Fonseca (2020) confirms this standpoint and explains that enhanced transparency decreases information asymmetry and therefore investor risks.

There are researchers claiming potential negative effects of increasing ESG ratings, such as the cost of sustainability reporting and possible a competitive disadvantage by disclosing sensitive data to competitors lowering valuation and/or financial performance. Rubin and Barnea (2006) suggest conflicting interest between executives and shareholders can lead to overinvesting, in especially social and governance improvements where the costs outnumber the gains.

ESG investing comes in many forms and a viewpoint on the optimal ESG investing theory differs. According to Eccles and Serafeim (2013), ESG investing's value-adding capabilities are illustrated with the Performance Frontier. The Performance Frontier describes the relationship between financial performance and ESG through the key factor innovation. Firms with high innovation exhibit improved financial performance when increasing ESG value and the opposite relationship is demonstrated when innovation is low. For a firm to be successful in ESG efforts it boils down to identifying industry specific key areas of improvement, quantifying them with financial performance indicators, focusing on innovation and communicating this clearly to shareholders. If a company is exhibiting these qualities, an ESG investment strategy could be wise.

Edsmans (2023) challenges this view by considering ESG as an intangible asset, pointing out ESG ratings are subjective due to the difficult nature of valuing intangible assets. He further explains that all investors should care about ESG, however, it should only be part of the investment decision instead of an investment strategy.

2.2 The ESG Efficient frontier

Pedersen et al. (2021) propose a solution of an ESG efficient frontier, extending the capital asset pricing model (CAPM) with an ESG component. Here are three different investors identified: Type-U (ESG-unaware), Type-A (ESG-aware) and Type-M (ESG-motivated). Type-U are indifferent to ESG Score and have a standard mean-variance maximization as a solution to their utility maximizing problem. Type-A takes ESG into their investor decision due to the belief that since others care about ESG it will therefore affect future return and risk. The solution to their utility maximization problem is a standard mean-variance optimization where they extend their view on expected return and variance by taking ESG-factors into account when computing them.

Type-M has not only a preference for low risk and high returns but also prefers a high ESG-score. Their utility maximization solution boils down to maximizing the Sharpe ratio for a given level of ESG.

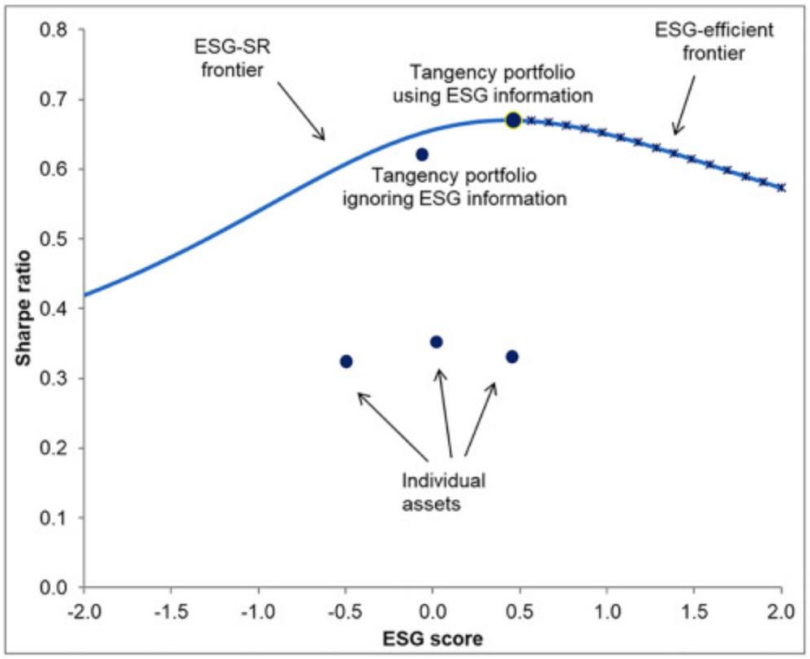

Figure 1: The ESG-SR frontier (Pedersen et al, 2021, p. 574).

Pedersen et al. (2021) further illustrate that for Type-M investors an ESG-SR efficient frontier can be identified, resembling the standard mean-variance efficient frontier. In Figure 1 the ESG-SR frontier is displayed, showing a concave line with a maximum Sharpe ratio portfolio at the maximum point has a certain ESG-score. To increase the ESG-score of the portfolio any point on the ESG efficient frontier can be chosen, resulting in a slightly lowered Sharpe ratio.

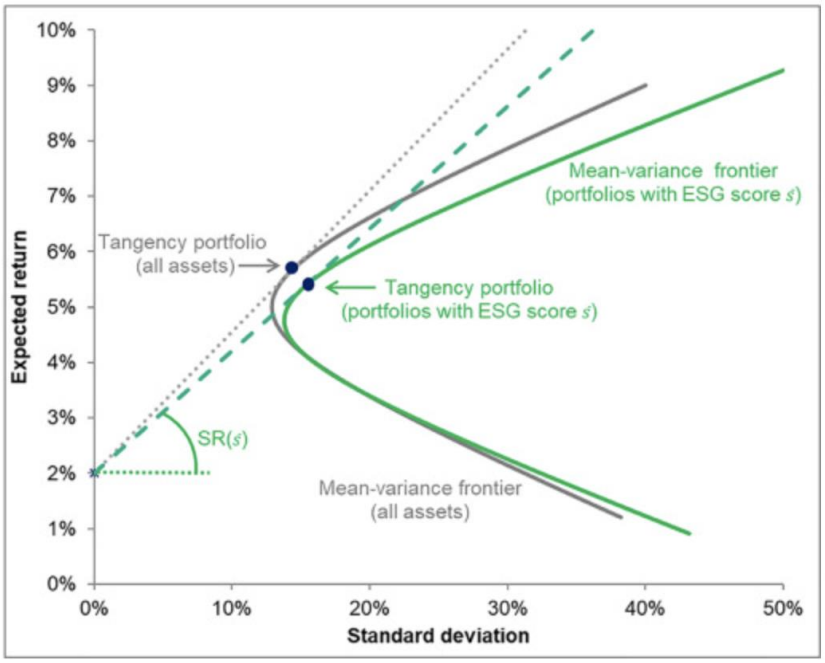

Figure 2: Mean-variance frontier for all assets and ESG-SR (Pedersen et al, 2021, p. 574).

In Figure 2 both the standard mean-variance model frontier and the ESG-SR frontier are illustrated, depicting the differences in achievable returns in relation to standard deviation. The maximum achievable Sharpe ratio is lower for ESG-SR frontier due to the ESG restriction, this creates a subset of the investment universe leading to less diversification benefits.

Pedersen et al. (2021) continue to explain the fluctuating results in earlier empirical work on the relationship between ESG and portfolio performance and demonstrate that the markets distribution of respective investor type will affect the outcome. If the market consists of mainly Type-U investors, then high ESG companies will outperform the market due to these companies' future risk and return being undervalued since these types of investors pay no attention to ESG. If the market is generally comprised of Type-A investors, then ESG will not be a predictor of future value but instead will have a neutral relationship. If the market is dominated by Type-M investors, then high ESG companies will exhibit lower returns than the market since investors are willing to reduce returns to obtain a higher ESG-rated portfolio.

If all investors are present in the market, then three things are possible. A high ESG company can exhibit a higher, equal or lower expected return. The demand for high ESG companies derives from type-M investors and consequently increases the price of the securities with increasing demand. With a higher presence of Type-M, high ESG companies may yield lower expected

returns since the investors are willing to sacrifice some returns for the ESG utility. Companies with lower ESG scores will be excluded or downweighed by Type-M investors and exhibit lower prices with a higher cost of capital. If the market has many Type-U investors then higher ESG companies yield a higher expected return since they do not value ESG-factors into firm fundamental value, hence leaving the companies undervalued.

Pederson et al. (2019) continues to explain the effect of an increasing number of Type-M over time or with a higher preference of ESG over time at Type-M investors. This would result in higher prices for high ESG stocks. During a transition period, expectations play a key role. If an increase of Type-M is expected then expected returns are unaffected, however, if this is unexpected then high ESG stocks would yield a return boost during the repricing period.

According to Global Risk Profile´s (GRP, 2021) ranking of 178 countries, the Nordic countries Finland, Sweden, Iceland and Norway are the top 4 ESG ranked countries with the lowest ESG risk scores. Denmark is not far behind on top 10. This indicates a pronounced inclination that Nordic investors prioritize ESG higher than other regions. This raises the question of how the relationship between financial performance and ESG is in the Nordics. If the relationship is positive, negative or neutral will provide insight into what type of investors preferences are present in the market to establish if ESG investing is financially rational.

3. Previous research

This section explores previous empirical research on the relationship between ESG and portfolio performance. First the relationship between ESG and returns is investigated, thereafter the relationship between ESG and risk is explored and lastly a dive into possible biases identified in earlier research.

3.1 Empirical research on relationship between ESG and returns

There have been several previous empirical studies on the relationship between ESG and optimal portfolio selection. Earlier empirical studies show a fragmented view on ESG effect on portfolio performance. More recent empirical work has a more defined consensus on the relationship between ESG and portfolio performance. A comprehensive study by Friede et al. (2015), reviewed over 2 000 empirical studies on the relationship of ESG and portfolio performance and concludes that 90% of the studies established a non-negative relationship with 48.2% of the studies found a positive relationship. Thus, indicating a strong empirical support for a positive or neutral

relationship alluding that high ESG portfolios can possibly achieve excess returns. Alessandrini and Jondeau (2020a) and Lindsey et al. (2023) empirically showed the possibility of comprising a portfolio with high ESG without sacrificing any return, possibly slightly improving risk adjusted returns.

Consequently, the consensus is that it is possible to invest in higher ESG companies without sacrificing returns, but a positive effect is unsure. Friede et al. (2015) point out that research papers focused on the relationship between companies and ESG tend to show a higher degree of correlation than the relationship of ESG portfolios and that might be a reason for finding neutral relationships.

Studies on the ESG portfolio performance yield varying results in different regions. Friede et al. (2015) and Cesarone et al. (2022) highlight studies performed on US market more frequently show a positive relationship compared to Europe markets, who instead often finds a neutral relationship. In the Nordic area this seems to follow this conclusion even though the results are more fragmented. Hoepner and Schopohl (2018) showed with their study on the public funds in Norway (GPFG) and in Sweden (AP-funds) that the pensions funds sectorial and/or ethical exclusion did not affect return compared to benchmark index. This indicates that negative screening of Nordic companies does not seem to either harm or improve financial performance.

Pesheva and Lueg (2020) investigated how sustainability reporting on Nordic market affected total shareholder returns and demonstrated a positive correlation with Bloomberg ESG data, with governance having the highest correlation of the three pillars. Furthermore, they discovered a non-linear relationship where a maximum can be reached, after that point the total return will instead decrease.

Aurvoll Langeland and Ugland (2019) explored the performance effect of ESG investing in the Nordic market and instead discovered a negative correlation between ESG score and return on asset. They suggest that Nordic companies are sustainable in a higher degree which makes the marginal improvement of continuing to higher ESG ratings smaller. They continue explaining if a company already obtain an optimal level of ESG, then deviating from that will ultimately result in profit loss. Further, they concluded that the G and E pillar were statistically significant, and the social pillar had no significant effect.

A variety of different methods are used to investigate the relationship between ESG and portfolio performance. The methods vary from simpler models such as negative or positive screening, statistical regression models and variations of mean-variance optimization model to factor models and alpha- or beta methods in combination with restrictions.

The benefit of a more complicated model with more restrictions is that the result is likely more precise than a simpler model, both because of the refinement by additional restrictions and more realistic assumptions. However, a weakness is that portfolio optimization requires large quantities of data as well as software for handling large matrix calculations. This results in a lengthy and complicated optimization process. A simpler model will be less data intensive and therefore easier to implement. The cost will instead be the limitations of the model and therefore the assumptions that can be derived. Since there is no consensus on the best model to apply for ESG portfolio analysis and different models are able to yield similar results, this thesis will implement a mean-variance optimization method on presorted data because of the model simplicity. It will extend a simple positive screening to resemble integrated ESG investing, without becoming overly complicated to implement in practice.

In lack of global consistent ESG grading system, a wide spread of measurement used to approximate ESG value. In my review of literature, I identified data from mainly Thomson Reuters Eikon, MSCI, Bloomberg, S&P and Refinitiv. When screening for the Nordic market I identified that Bloomberg covers 43,7% of the Nordic market compared to 32,6%, 17,4% and 6,7% for S&P, Sustainalytics and MSCI, respectively. Therefore, Bloomberg ESG data will be used as proxy for ESG value in this thesis.

The most recent period studied for the Nordic area is until 2020. Here lies a possibility to a newer time period to identify the current relationship by investigating in sample 2013-2017 and out of sample 2018-2023.

3.2 Empirical research on relationship between risk and ESG

Studies looking closer on the relationship of risk and ESG portfolios mainly agree that ESG portfolio exhibits lower risk than traditional investing. Horn (2023) attest that a higher ESG-rating significantly lowers idiosyncratic risk. Additionally, he revealed that low ESG-rating companies exhibit lower idiosyncratic risk than unrated companies yet are still higher than a high ESG-rated company. Chen et al. (2022) found, when examining the Chinese stock market, evidence that both

operational- and market risk were decreased by ESG factors. Further they identify a more noticeable effect with higher ESG ratings.

ESG investing does not only lead to a decrease in risk, but it can also potentially create other areas of portfolio risk. Enlarged regional bias has been observed previously by several researchers when optimizing a portfolios ESG score. Alessandrini and Jondeau (2020b) identified in their global studies a regional bias, predominantly by high ESG portfolios overweighted by American and European companies. The Nordic countries are in close geographical proximity to each other, likely indicating regional bias as a minor risk factor.

Further, Alessandrini and Jondeau (2020b) also identify a sectorial bias in ESG portfolios, in a higher degree excluding high polluting and ethically controversial industries. This might lead to higher risk exposure for an ESG portfolio.

Drempetic et al. (2019) points out that ESG data show a market size bias, leading to only larger companies receiving ESG ratings. He further questions the validity of ESG ratings as a proxy for ESG value. Dobrick et al. (2023) further corroborate this view by finding a market size bias in Refinitiv ESG data.

4. Methodology and data

This section outlines the data collection process, initial sorting, descriptive statistics of the data and subsequent calculations. It provides a chronological walkthrough of the mean-variance optimization, emphasizing key interpretations derived from the analysis. The section concludes with a brief discussion of method limitations, enhancing transparency regarding potential constraints.

4.1 Data Collection and pre-sorting

The first step was to identify all listed companies in the Nordic market through Investing.com (n.d.) stock-screener tool. Thereafter all historical data were collected from Bloomberg, including monthly end-of-day stock prices, market capitalization, sector, subsector and ESG scores. Bloomberg assesses companies based on environmental, social, and governance criteria with their own system on a scale from 0-10 whereas 10 represents the best ESG-score. Individual scores for respective E-, S- and G pillars were also collected. Data was extracted through the Bloomberg Excel-add in via the historical formula function as well as the current function.

The investment universe includes 1521 listed companies whereas for 31st of December 2017, 175 of these have a Bloomberg ESG-, E-, S- and G-rating. To achieve fairly distributed portfolios, I filtered out all companies that did not have available stock prices from 2013 which made the final number of assets 149. Countries included are Sweden, Norway, Finland, Denmark and Iceland. The analysis covered a specified time period, from 1st January 2013 to 4th December 2023, to capture a meaningful representation of current market conditions and trends. This means that stock prices at the last stock day in December of 2012 were collected to be able to calculate the first return for January 2013. These time periods are divided into two sub-periods with an in-sample period ranging from 2013-2017 and an out-of-sample period 2018-2023. Comparing an in-sample and out-of-sample period is essential when testing if ESG factors can be used to predict financial performance.

To identify all ESG portfolios a positive screening was performed on a predetermined threshold of the 25% companies with highest ESG, E, S, and G ratings, respectively. The threshold of 25% was chosen with respect to leaving an adequate sample size to comprise the portfolios as well as still being able to compare low rated companies against high rated. This corresponds to a respective score equal to or higher than 4, 4, 3.25 and 6.45. A negative screening for the 25% lowest ESG-, E-, S-, and G rated portfolios was then constructed, resulting in the respective scores being equal to or lower than 2.2, 0.5, 1.3 and 4.87. This corresponds to a possible number of 37-38 assets for each high or low rated portfolio and 149 assets for a portfolio consisting of all ESG rated assets. Notably, the data was thoroughly screened for missing values due to reasons such as company name or ticker changes, incorrect data and similar instances. These were thereafter corrected to improve portfolio results reliability.

4.1.1 Descriptive statistics on data

Table 1: Descriptive statistics on the full screened dataset of 149 assets.

Descriptive statistics on monthly basis			
Time period	**2013-2023**	**2013-2017**	**2018-2023**
Average return	0,99%	1,27%	0,76%
Median return	0,71%	0,92%	0,50%
Standard deviation	11,73%	8,87%	13,68%
Descriptive statistics on yearly basis			
Time period	**2013-2023**	**2013-2017**	**2018-2023**
Average return	12,59%	16,29%	9,54%
Median return	8,84%	11,68%	6,14%
Standard deviation	40,62%	30,71%	47,39%

In Table 1 the average return, median return and standard deviation are visible for the whole period as well as both the subperiods. It is evident that the in-sample period 2013-2017 outperform the out-of-sample period 2018-2023 with both higher returns and lower volatility. In all periods the return is on average positive, showing a time trend with increasing stock prices.

Table 2: Descriptive data on E-, S-, G-, and ESG respectively for 2018 and 2023.

2018	**Min**	**Max**	**Median**	**Mean**	**Std**
ESG Score	0,75	6,38	3,16	3,17	1,19
E Score	0	9,18	2,29	2,47	2,10
S Score	0,22	6,92	2,00	2,44	1,45
G Score	2,60	7,62	5,36	5,53	1,04
2023	**Min**	**Max**	**Median**	**Mean**	**Std**
ESG Score	1,64	7,62	4,23	4,26	1,20
E Score	0	8,37	4,41	4,12	2,09
S Score	0,22	8,02	2,99	3,34	1,74
G Score	2,84	8,14	6,05	5,97	1,09

Table 2 provides descriptive data for the E-, S-, G-, and ESG scores, revealing key insights. In 2018, the minimum score for ESG, E, and S scores is 0 or close to 0, indicating the presence of substantially low-rated companies in the dataset. Conversely, the G score for the same year shows a minimum rating of 2.60, suggesting that most of the sample already exhibits relatively better governance practices. Average scores for ESG, E, and S fall within the lower scoring range,

signaling that many companies had limited ESG practices in 2018. In contrast, the average G score exceeds 5, indicating a focus on good governance practices among the majority of companies in 2018.

Table 2 showcases an average improvement of all scores from 2018 to 2023. Notably, E Scores have witnessed the most substantial growth, escalating from an average score of 2.47 in 2018 to 4.12 in 2023. The highest rating has increased across all ESG scores. While some companies have not shown improvement in their E or S scores since 2018, it is noteworthy that the lowest scoring company on ESG and G scores has demonstrated an increase since 2018. This overall trend indicates a positive trajectory toward higher ESG ratings over the specified time period.

Table 3: Correlation matrix for E-, S-, G- and ESG ratings.

Correlation matrix				
	ESG	**E**	**S**	**G**
ESG	1	0,75	0,70	0,47
E	0,75	1	0,19	0,27
S	0,70	0,19	1	0,24
G	0,47	0,27	0,24	1

Table 3 depicts the correlation matrix for E-, S-, G-, and ESG ratings. Notably, ESG exhibits a high correlation with both E and S Scores, registering 0.75 and 0.70, respectively. This suggests that portfolios optimized for ESG will likely feature higher E and S scores. In contrast, the remaining scores display lower correlations, indicating that some companies may prioritize specific pillars over others. Importantly, all correlations are positive, signifying that changes in one pillar are likely to positively influence others. Improvements in one ESG aspect contribute to overall positive movement across the ESG spectrum.

4.1.2 Calculations on data

Before beginning the mean-variance optimization method, I need to compute monthly returns and the monthly risk-free rate. To get returns from the stock prices, the monthly percentage was identified through Equation 1 below.

$$r_t = \frac{P_t - P_{t-1}}{P_{t-1}} \quad (1)$$

Where r_t represent the monthly return for time t, P_t adhere to closing stock price for end of month at time t and P_{t-1} signifies the closing stock pris for end of previous month from time t.

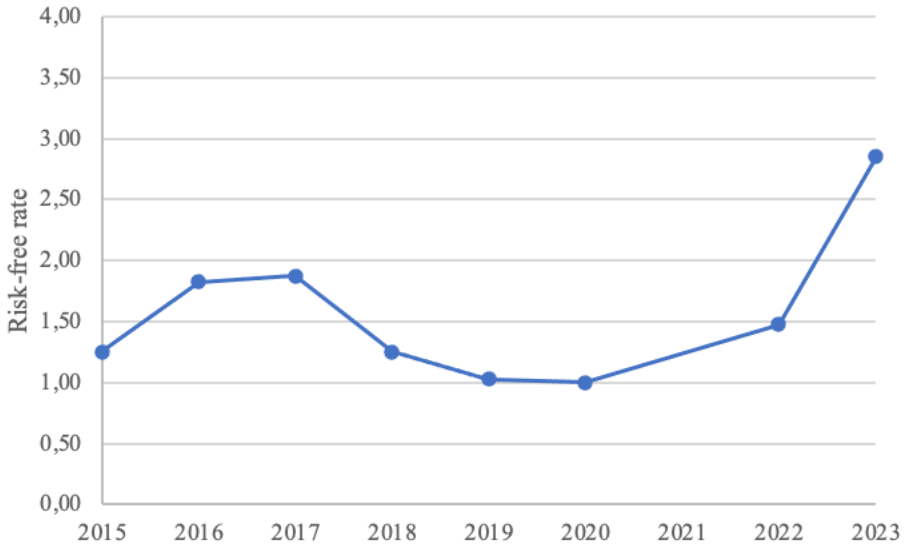

Figure 3: Yearly average risk-free rate in the Nordics between 2015-2023.

The risk-free rate was set to be constant during the whole period and chosen from data from Statista (2023a-d) were derived by taking the average of the averaged risk-free rate during the years 2015-2023 for Norway, Sweden, Finland and Denmark. This calculation yielded a yearly risk-free rate of 1.57%, corresponding to a monthly risk-free rate of 0.13%. During this period, the risk-free rate has remained relatively stable between 1-2% as seen in Figure 3 and only increased in the two recent years, which is captured by the data included.

4.2 Mean-Variance Optimization

The mean-variance optimization will be performed in identical manner on all portfolios consecutively on their respective filtered out data set. Only long portfolios are constructed by imposing a no-short sale constraint. To perform the optimization expected return, variance and covariance of the respective data sets is required, which is estimated using historical data from the in-sample period. Thereafter I will maximize the Sharpe-ratio, representing the risk-adjusted performance of the portfolio. This leads to different weight distributions of the assets for respective data set, resulting in 9 portfolios will hereafter be referred to as ’ESG all’, ‘ESG high’, ‘E high’, ‘S high’, ‘G high’. ‘ESG low’, ‘E low’, ‘S low’ and ‘G low’.

To calculate the expected return the arithmetic mean is applied for all monthly data through the Excel formula “Average”, which is based on Equation 2.

$$E(r) = \frac{\sum_{i=1}^{n} r_i}{n} \quad (2)$$

Where $E(r)$ represent the expected return, r_i denotes the return of asset i and n indicates the total number of assets i.

The variance of the individual assets is used to help identify the standard deviation of each asset, which is the risk measurement. To calculate the variance of each asset the sample variance formula is applied and thereafter adjusted to receive the standard variation through Equation 3.

$$Std = \sqrt{\frac{\sum_{i=1}^{n}(r_t - \overline{r})^2}{n-1}} \quad (3)$$

Where Std denotes the standard deviation of the monthly returns, $\overline{r}$ adhere to the average monthly change and n indicates the total number of months.

To utilize the benefit of diversification to minimize the variance in the respective portfolios the covariance of each individual assets with each other is required. Covariance between each pair of stocks is determined by employing Equation 4.

$$Cov(r_{i,t}, r_{j,t}) = \frac{\sum (r_{i,t} - \overline{r_i})(r_{j,t} - \overline{r_j})}{n-1} \quad (4)$$

where $r_{i,t}$ and $r_{j,t}$ represent the returns of two stocks for time t, $\overline{r_i}$ and $\overline{r_j}$ denotes their respective means, and n equals the number of observations.

With many assets matrix calculations are needed to be able to optimize the portfolios. The covariance matrix is constructed by organizing the computed covariances into a matrix format. This matrix captures the relationships and dependencies between each pair of stocks. The diagonal consists of the asset's individual variance and remaining number are the respective covariances. This creates a symmetric square matrix of m x m, where m represents the total number of assets in the data set.

All portfolios are comprised of multiple assets which together provide a portfolio expected return and a portfolio standard deviation. The expected return for the portfolio is identified by multiplying the respective assets included in the portfolios with their weight of the whole portfolio, as seen in Equation 5.

$$E(r_p) = \sum_{i=1}^{n} w_i r_i \tag{5}$$

Where $E(r_p)$ represent the portfolios expected return, w_i denotes the weight for asset i and r_i adhere to the return of the asset i.

The portfolio variance is identified with matrix multiplication of where the respective asset weights of the portfolio and the covariance matrix as illustrated in Equation 6. In Excel this calculation is made through the MMULT-function. The standard deviation is thereafter found by simply taking the square root of the portfolio variance.

$$\sigma_p^2 = [w_1, w_2, w_3 \ \dots w_n] * \begin{bmatrix} Cov_{1,1} & Cov_{1,2} & Cov_{1,3} & \dots & Cov_{1,n} \\ Cov_{2,1} & Cov_{2,2} & Cov_{2,3} & \dots & Cov_{2,n} \\ Cov_{3,1} & Cov_{3,2} & Cov_{3,3} & \dots & Cov_{3,n} \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ Cov_{n,1} & Cov_{n,2} & Cov_{n,3} & \cdots & Cov_{n,n} \end{bmatrix} * \begin{bmatrix} w_1 \\ w_2 \\ w_3 \\ \vdots \\ w_n \end{bmatrix} \tag{6}$$

Where the first multiplier denotes the transposed column weight vector, the second multiplier represent the covariance matrix and the third multiplier represent the weight column vector.

With Excel Solver-tool, it is now possible to optimize respective portfolios through the Sharpe ratio, as defined in Equation 7. The Solver-tool tries possible solutions to the maximizing problem by adjusting the holding weights on each asset until the Sharpe ratio reaches a maximum. The mean-variance optimization problem is formulated as followed:

$$\max \quad Sharpe = \frac{E(r_p) - r_f}{\sigma_p} \tag{7}$$

$$\text{s.t.} \quad w_i \geq 0$$

$$\sum_{i=1}^{n} w_i = 1$$

Where r_f represents the risk-free rate, σ_p represents the portfolios standard deviation and w_i denotes the weight of asset i.

Performance evaluation is determined based on various metrics, including annualized returns, standard deviation, and the Sharpe ratio. Additionally, a sector, size and regional analysis will be performed to assess these risk factor effects.

There are three main possible outcomes from the thesis: a negative, positive or neutral relationship between ESG factors and financial performance on the Nordic market. To assess this the

benchmark OMX40 Nordic is used to represent what an investor could have achieved using a passive investment method instead of an active one. OMX40 Nordic was chosen as benchmark due to the liquidity of containing stocks, the sector mix and Nordic mix. By comparing the portfolios against each other and the benchmark it is possible to identify which portfolio performed better, worse or in line with the benchmark.

4.3 Limitations of chosen method and data

Researchers are divided with the usage of mean-variance optimization. Michaud (1989) critiques the mean-variance strategy by stating that for the optimization to work correctly it requires information that cannot be properly estimated, resulting in a simple equal distribution investment strategy outperforming the mean-variance optimized one out-of-sample.

Bielstein and Hanauer (2018) agree with the mean-variance poor out-of-sample results and suggest optimizing on forward-looking data instead, applying analysts' predictions on future stock value. Due to information limitations for the Nordic market where not all companies have analyst coverage, this is hard to implement and therefore was not an option for this thesis.

Allen et al. (2019) challenges this view and instead found that mean-variance can outperform other strategies out-of-sample due to the forecasting ability of individuals and further supports that 60 monthly observations are enough to compute an accurate covariance matrix.

Independent of viewpoint, there are several limitations of the method and data that should be considered. A possible limitation of the Excel-solver tool is that it is trying possible solution until it finds a maximum point, however, it is possible that this is a local maximum point and not the global maximum point. This might result in overlooking more optimized portfolios.

Another limitation is that the model does not take into consideration the transaction costs, resulting in possibly impacting the practical feasibility of implementing the suggested portfolios.

Additionally, there is always a possibility of measurement errors in the data collected from Bloomberg. For instance, by measuring returns from stock prices the possible dividend payout is not directly included, which may not represent the true return of each stock. It is also possible that Bloomberg's ESG ratings may not accurately reflect true ESG value. The lack of full transparency in Bloomberg's calculation methodology raises concerns about the subjectivity of their ESG ratings, potentially compromising their objectivity. This may undermine the reliability of

Bloomberg's ESG scores as a proxy for genuine ESG value. Another factor may be the lack of public information required to create a fair ESG rating since sustainability reporting for most of the companies is not required or standardized.

All these limitations with the method and data lead to the interpretations of the result being approximated and ideal for big picture interpretations rather than preciseness.

5. Results & Discussion

The result will be presented in separate sections, starting with the financial performance of the portfolios, followed by descriptive analysis in first asset allocation, followed by size and geographical allocation and lastly sector allocation for the respective portfolios.

5.1 Financial and ESG performance

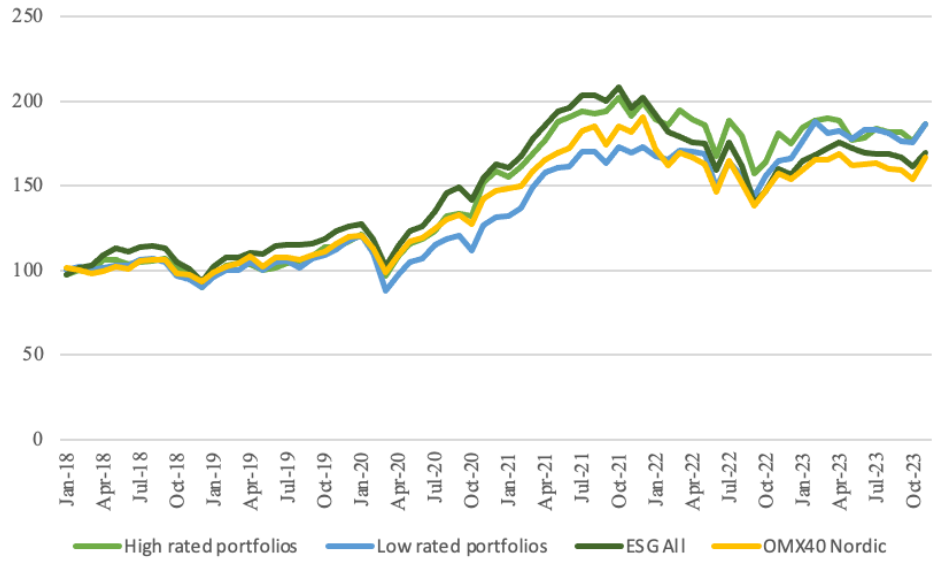

Figure 4: The portfolio value for high rated-, low rated-, 'ESG All' and benchmark OMX40 Nordic between 2018-2023, normalized to 100 in January 2018.

Figure 4 illustrates the normalized values for the high ESG rated portfolios, low ESG rated portfolios and the 'ESG All' portfolio alongside the OMX40 Nordic market index over the specified time frame. Until January 2022, 'ESG All' appears to exhibit superior performance compared to other portfolios and the market index, closely trailed by high ESG-rated portfolios. However, by November 2023, both high-rated and low-rated portfolios align closely, indicating no apparent distinction between companies with varying ESG ratings. Overall, all portfolios broadly mirror the

movements of the market index, with respective portfolios showing values at or slightly above the market index towards the end of the period.

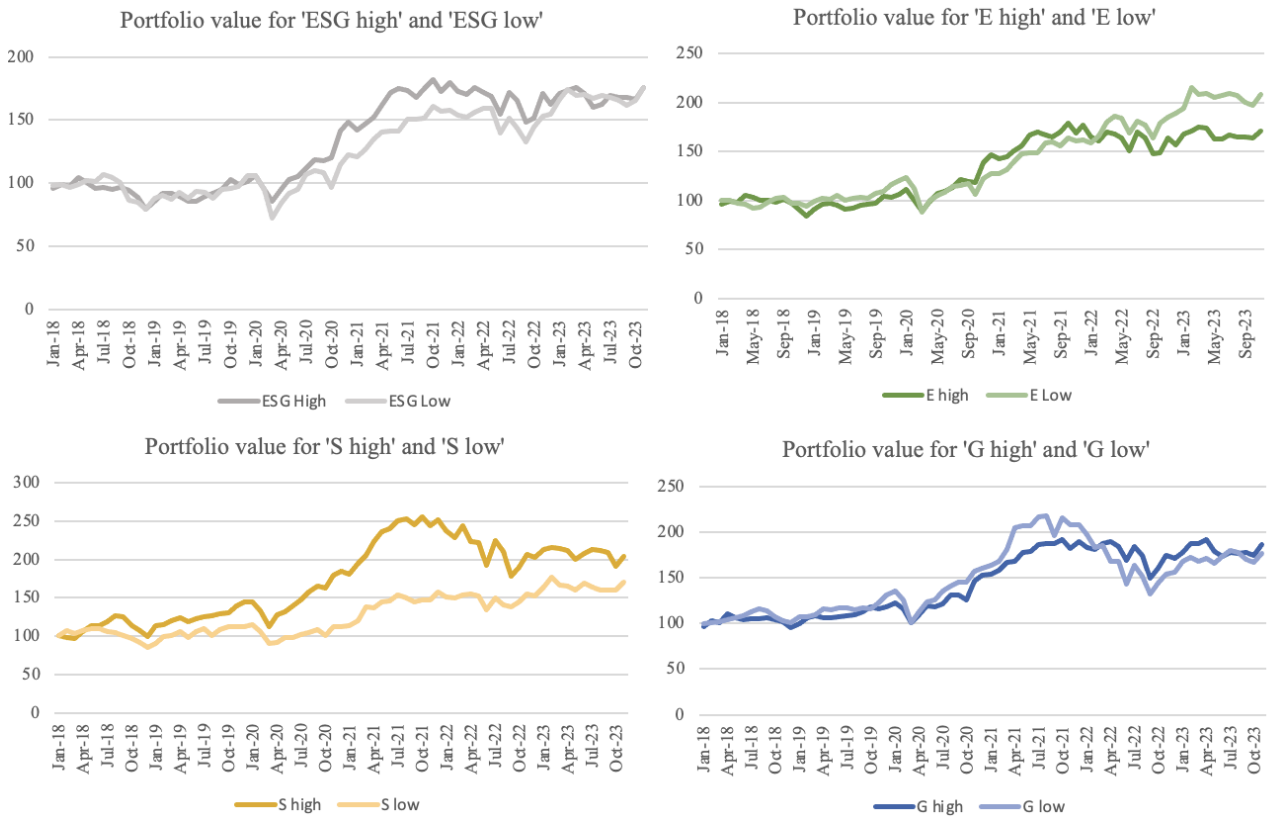

Figure 5: Four subgraphs illustrating portfolio value for respective ESG pillar between 2018-2023, normalized to 100 in January 2018.

Figure 5 depicts four subgraphs, each showcasing both high and low-rated portfolios for E, S, G, and ESG pillars. In the case of ESG portfolios, both 'ESG high' and 'ESG low' closely track each other, except during the pandemic years when 'ESG high' slightly outperforms 'ESG low'. This observation might suggest that high ESG portfolios demonstrate lower volatility during crises, although further detailed analysis would be needed to make a conclusive assessment. ‘E high’ and ‘E low’ closely track each other until January 2022, where the ‘E low’ portfolio outperforms ‘E high’. Portfolio ‘S high’ consistently exhibits a superior performance compared to ‘S low’ during the entire period. This indicates that it might exist a positive relationship between higher rated social portfolios and portfolio performance. 'G high' and 'G low' predominantly mirror each other throughout the given time frame. Nevertheless, 'G low' demonstrates higher volatility compared to 'G high,' resulting in periods of superior value and others of diminished value when contrasted.

Table 4: Annual financial and ESG performance of all portfolios in sample 2013-2017 and out of sample 2018-2023.

In sample 2013-2017							
Portfolio	**Expected Return**	**Standard Deviation**	**Sharpe Ratio**	**ESG Score**	**E Score**	**S Score**	**G Score**
ESG all	31,3%	10,8%	2,90	3,33	2,70	2,40	5,89
ESG high	27,3%	10,8%	2,53	4,70	4,71	3,60	6,41
ESG low	32,7%	11,3%	2,90	1,90	0,37	1,43	5,41
E high	28,1%	10,7%	2,63	4,45	4,78	3,13	6,13
E low	31,5%	11,6%	2,71	1,86	0,10	1,55	5,36
S high	30,1%	10,6%	2,84	4,18	3,41	4,15	5,59
S low	75,2%	13,4%	5,63	2,82	3,05	0,84	5,30
G high	27,8%	9,9%	2,80	3,81	3,19	2,57	6,86
G low	31,9%	12,4%	2,57	2,37	1,34	1,97	4,44
Out-of-sample 2018-2023							
Portfolio	**Actual return *(CAGR)***	**Standard Deviation**	**Sharpe Ratio**	**ESG Score**	**E Score**	**S Score**	**G Score**
OMX40 Nordic Index	10,8%	17,6%	0,61	4,55	4,81	3,30	6,15
ESG all	8,3%	18,1%	0,46	4,47	4,74	2,91	6,42
ESG high	7,9%	19,5%	0,41	5,56	6,21	4,12	6,77
ESG low	10,5%	23,2%	0,45	3,41	3,47	1,95	5,67
E high	8,4%	18,8%	0,45	5,30	6,18	3,77	6,41
E low	14,2%	19,2%	0,74	3,02	2,80	1,80	5,87
S high	12,2%	22,1%	0,55	4,90	4,73	3,98	6,44
S low	9,7%	19,1%	0,51	3,59	4,71	1,28	5,18
G high	10,1%	17,5%	0,58	4,91	5,03	3,50	7,04
G low	12,0%	21,1%	0,57	3,24	2,83	1,82	5,05

Table 4 above displays key financial and ESG performance for all portfolio optimized in sample and held out of sample. Evidently, all optimized portfolios perform poorer 2018-2023 than in the sample period 2013-2017 as expected. In the in-sample period all portfolios exhibit excellent returns, ranging from 27,3%-75,2% yearly compared to the long-time Nordic market average of 10,10% (Curvo, n.d.). Standard deviation on all portfolios is low. Notably, high rated ESG portfolios appear to exhibit slightly less standard deviation compared to their low ESG rated opposite, indicating high ESG decreases risk. This is in line with previous research findings by Horn (2023). This results in high Sharpe-ratios, indicating excellent risk-adjusted returns. The

highest Sharpe-ratio portfolio is ‘S low’, followed by ‘ESG all’ and ‘ESG low’. This indicates again that higher ESG portfolios do not seem to outperform low ESG portfolios in this period, instead low rated ESG portfolios seem to perform better than high ones. Thus, implying a neutral or negative relationship.

In the out-of-sample period 2018-2023 the portfolio performances change. Notably, all portfolios display Sharpe-ratios that are substantially inferior to the in-sample period. To assess the portfolio's true performance the OMX40 Nordic has been included as a benchmark for the overall Nordic market performance. Three portfolios performed better than the market when reviewing return performance, namely ‘E low, ‘S high’ and ‘G low’. Due to including both high rated and low rated ESG portfolios, the conclusion is higher ESG does still not seem to enhance portfolio performance. Arguably, since the majority of the portfolios are low ESG portfolios one could argue that the relationship between high ESG and financial performance can be negative. This would be in line with a substantial presence of individuals Type-M investors according to Pedersen et al. (2021), confirming Nordic investors' high preference for ESG by increasing demand until high ESG stocks are bought for a premium. If the relationship instead is neutral, this would imply a substantial presence of Type-A investors, driving up demand for high ESG stocks until overall market performance leading to no sacrifice of financial performance.

When reviewing standard deviation for the out-of-sample period, only one portfolio exhibits lower standard deviation than the market, specifically ‘G high’ with 17,5% versus the Nordic index with 17,6%. Since the results are close, it is reasonable to assume they are in line with one another. All portfolios show a higher standard deviation than in-sample, this is to be expected due to the optimization method specifically minimizing standard deviation. None of the portfolios display a concerningly high standard deviation, all ranges between the short interval of 17,5-23,2%. The standard deviation for portfolios ‘ESG high’, ‘E high’ and ‘G high’ and lower than their low rated portfolio counterpart. This alludes to the fact that a high ESG rating lowers risk, in line with previous research discoveries.

Looking at risk adjusted returns in the form of Sharpe-ratio there is only one portfolio performing superior relative the index, namely ‘E low’. This could indicate high investors' preferences for environmentally responsible companies, resulting in decreasing demand for highly polluting companies. This decreases the price of low E companies' stocks, leading to higher risk-adjusted

returns for investors. Again, providing possible evidence for the presence of Type-M investors in the Nordics market. Comparing the Sharpe ratio for high rated portfolios against low rated, it is notable that for E- and ESG optimized portfolios the low portfolios outperform the high ones; the opposite result is true for S- and G optimized portfolios. This supports the conclusion that Nordic investors prefer high E and ESG, however, are not willing to sacrifice returns for high S and G stocks. High S- and G stocks outperform their low equivalents, pointing towards investors not valuing S- and G- factors as high. Assuming the ratings being true indicators of ESG value, this would be a Type-U investor who does not consider ESG information. Since it is a small difference in Sharpe ratio, it is possible that Type-U investors are transitioning into type-A investors, which evens out the differences to a neutral relationship. Consequently, all types of investors are present in the market with a notable high share of Type-M investors.

All high rated ESG portfolios were overperforming the market index on E-, S-, G- and ESG scores, regardless of which ESG factor the portfolio was optimized on. The opposite can be said for the low-rated portfolios, they all still performed worse than the market index. This shows that the ESG-ratings are slow-moving, giving some strength to their validity through time. Therefore, optimizing on high ESG today would likely lead to a higher ESG portfolio in the future as well.

To summarize, multiple indications point to the Nordic market having a substantial presence of Type-M investors, leading to a neutral or slightly negative relationship between high ESG and financial performance. This results in better risk-adjusted returns for low E-stocks and slightly higher returns for low G-stocks. The neutral relationship indicates Type-A investors being present as well. It is evidently also Type-U investors in the market resulting in a small positive relationship for high S portfolios. It is important to note that this result holds for the specific conditions of this thesis, meaning it may not be applicable for all ESG-rating agencies and time periods in the Nordic market.

5.2 Descriptive portfolio analysis

5.2.1 Asset allocation analysis

Table 5: Asset allocation distribution including quantity, weight and overlap of all portfolios.

Portfolio	Number of assets	Assets included in portfolio	Average weight (%)	Largest weight (%)	Smallest weight (%)	Asset overlap with other portfolios
ESG all	149	30	3,3%	13,4%	0,19%	90%
ESG high	37	11	9,1%	20,9%	0,12%	91%
ESG low	38	14	7,1%	20,7%	0,17%	86%
E high	38	11	9,1%	21,8%	0,07%	73%
E low	37	12	8,3%	23,4%	1,07%	92%
S high	38	13	7,7%	31,2%	0,07%	69%
S low	37	9	14,3%	60,5%	0,08%	33%
G high	37	14	7,1%	13,7%	1,30%	50%
G low	38	11	9,1%	23,2%	0,16%	36%

Table 5 lists the number of assets in respective portfolios as well as the weight distribution and overlap with each other. 20-38% of the total number of assets were included when optimized, leaving a range of 9-30 assets in the optimized portfolios. According to Statman (1987) a portfolio requires at least 30 or 40 stocks, depending on investor type, to achieve the full risk reduction benefits of diversification. For all portfolios except ‘ESG all’ this will likely have increased the risk higher than necessary in the out-of-sample period. This might have a negative effect on the Sharpe-ratio of the portfolios, especially on ‘S low’ with only 9 assets, indicating that the Sharpe-ratio can be improved with better diversification.

Further Table 5 presents the weight distribution of all assets. Portfolios with fewer included assets also display a higher average weight per asset, further corroborating the diversification issues. Portfolio ‘S low’ has the largest asset weighted with 60,5%, making it highly dependent on the financial performance of a single company. Remaining portfolios range between 13,4-31,2% as largest weight for a single asset. ‘ESG all’ and ‘G high’ perform reasonable low weights for the largest weighed asset with 13,4% and 13,7%, respectively. This indicates better diversification for these portfolios, likely reducing their standard deviation.

The overlap between the portfolios is high in most portfolios, indicating a stronger correlation between them. Portfolio 'S low', 'G high' and 'G low' exhibits lower correlation with the other portfolios. This displays distinctions between E-, S-, G-, and ESG factors do matter when optimizing a portfolio. Consequently investors should, at least for S- and G-factors, identify what factors they believe are crucial in the future and optimize on them since only optimizing on ESG-ratings will probably not yield the same asset mix.

5.2.2 Region and size analysis

Table 6: Regional and market size distribution for all portfolios.*

Portfolio	Average market capitalization (mEUR)	Sweden	Norway	Denmark	Finland	Iceland
Nordic market	1 894	54%	20%	12%	13%	1%
ESG all	11 211	23%	32%	32%	13%	0%
ESG high	25 085	18%	36%	18%	27%	0%
ESG low	6 678	36%	36%	29%	0%	0%
E high	17 971	36%	27%	27%	9%	0%
E low	6 706	25%	33%	42%	0%	0%
S high	17 495	31%	23%	23%	23%	0%
S low	16 493	33%	22%	44%	0%	0%
G high	22 981	7%	57%	14%	21%	0%
G low	2 470	45%	18%	18%	18%	0%

** The regional allocation is based on the number of firms rather than being proportionally weighted by market capitalization.*

Table 6 identifies the average market capitalization of the portfolios and the Nordic market as whole, which gives an idea of the size of the companies included in each portfolio. Further, it lists the geographical allocation on portfolio basis, compared to the Nordic market.

The Nordic market has approximately 1 521 stocks with an average market size of mEUR 1 894, indicating a rather large portion of the market consisting of mid- to small sized companies. Mid-smaller companies are often in a growth phase which indicates a higher expected return, potentially with a higher risk-adjusted return. All portfolios exhibit a noticeable market capitalization bias, gearing towards bigger companies which is in line with previous research by Dobrick et al. (2023) and Drempetic et al. (2020). This originates from larger companies having the financial ability to continuously sustainability report as well as compensate ESG rating agencies for rating them. However, it is reasonable to assume that small companies potentially have a great ESG profile but

lacks ESG rating, thus excluding potentially a higher Sharpe-ratio portfolio with equal ESG-effect. Therefore, because of the market size bias of the ESG ratings the ratings may not be a great proxy for true ESG value which may skew the results of the research in a negative or positive direction.

Table 6 presents the regional distribution compared to the Nordic market as whole. Around half of the market is Swedish companies, however, in all portfolios the proportion of Swedish companies are lower. 'ESG All' illustrates a different regional mix for the portfolio optimized on all the sample assets. When assessing the portfolios in comparison to 'ESG all,' distinct regional patterns emerge. Sweden exhibits an overrepresentation of high E and low G companies, while Denmark shows an overproportion of low E and low S stocks. Norway, in contrast, overproportions high G companies, and Finland leans towards overrepresentation in high ESG, high S, and high G categories. These regional variations highlight a diversity in ESG profiles across Nordic countries, emphasizing the importance of considering local nuances in sustainable investment strategies. None of the portfolios have included Icelandic stocks. They only represent 1% of the Nordics market, leading to it likely not having a negative effect on the portfolios.

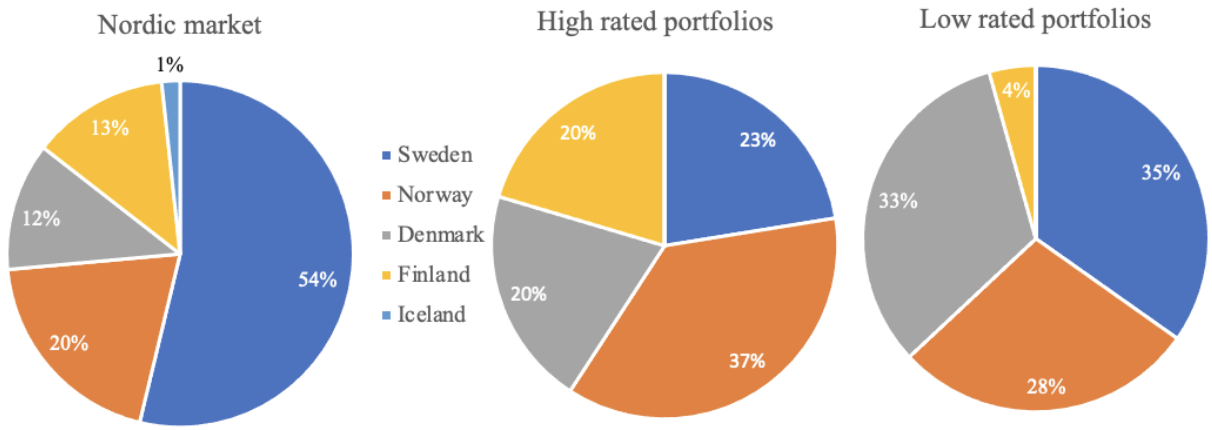

Figure 6: Geographical mix for Nordic market, High E-, S-, G- and ESG portfolios along with low E-, S-, G- and ESG portfolios.

Figure 6 illustrates the geographical mix of the market compared to all high rated portfolios and low rated portfolios combined. It is evident that both the high rated and low rated portfolios differ from the market mix. The high rated portfolio displays a more even geographic distribution where Norway, Denmark and Finland are overweighed, and Sweden is underweighted compared to the overall Nordic market. This indicates that despite Norway, Denmark and Finland representing a

smaller portion of the market, they still have a large portion of highly rated ESG companies with good financial performance.

Low rated portfolios display, compared to the high rated portfolios, a poorer geographical mix. This is mainly due to the low occurrence of Finnish companies with bad E-, S-, G- and ESG-ratings relative to the other Nordic countries. Additionally, the low rated portfolio exhibits a higher degree of Danish and Swedish companies, indicating that these countries have more companies with lagging ESG ratings.

Whilst a regional bias is visible it is likely not a big risk factor due to the portfolios still showing a reasonable regional diversification and the strong similarities between the Nordic countries. It does, however, influence currency risk. One problem with holding any of these portfolios in practice is since all Nordic countries have their own currency, you will face a currency risk. Thus, holding any of the portfolios' performance will also be affected by exchange rates which increase risk exposure.

5.2.3 Sector diversification analysis

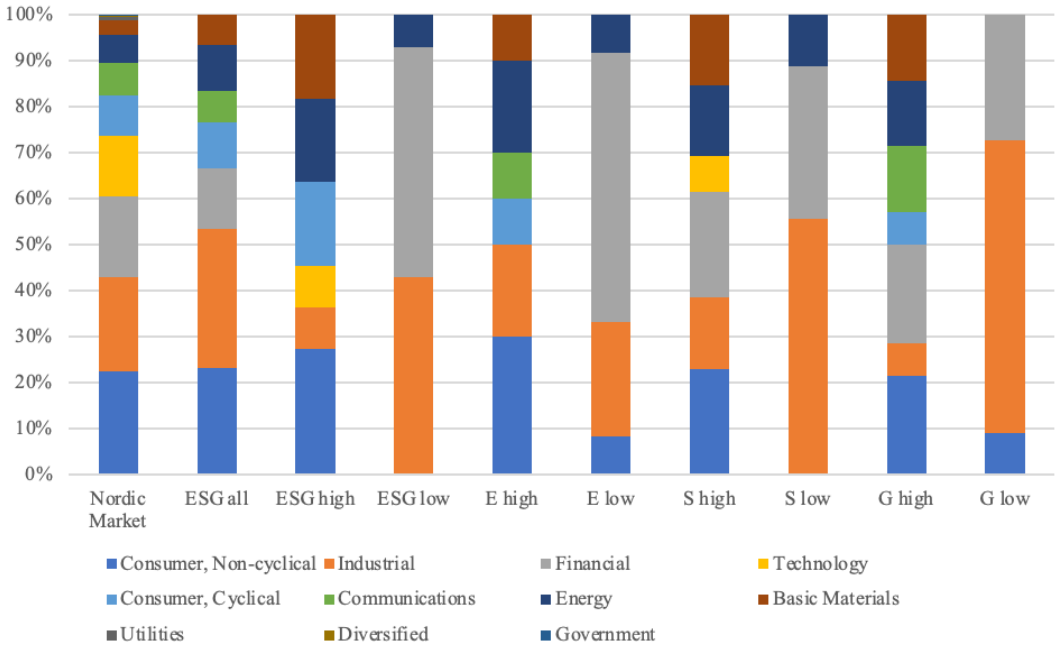

Figure 7: Sector diversification of all portfolios and the Nordic market as whole.

Figure 7 illustrates the sector mix per respective portfolio. All portfolios display a different sector mix than the market index, thus indicating a sector bias. However, it is not so surprising

considering all portfolios contain less assets than the market index. Portfolios 'ESG all', 'ESG high', 'E high', 'S high' and 'G high' all display a diversified sector mix whereas the remaining portfolios are more concentrated, containing only 3-4 sectors. Overall 'ESG all' seem to be closest to the market index, only missing sector Technology. A part of the explanation is likely the higher quantity of assets, helping to diversify the sector mix. Another explanation is a sector bias occurring when optimizing ESG companies, in line with what previous empirical research such as Alessandrini and Jondeau (2020b) suggests.

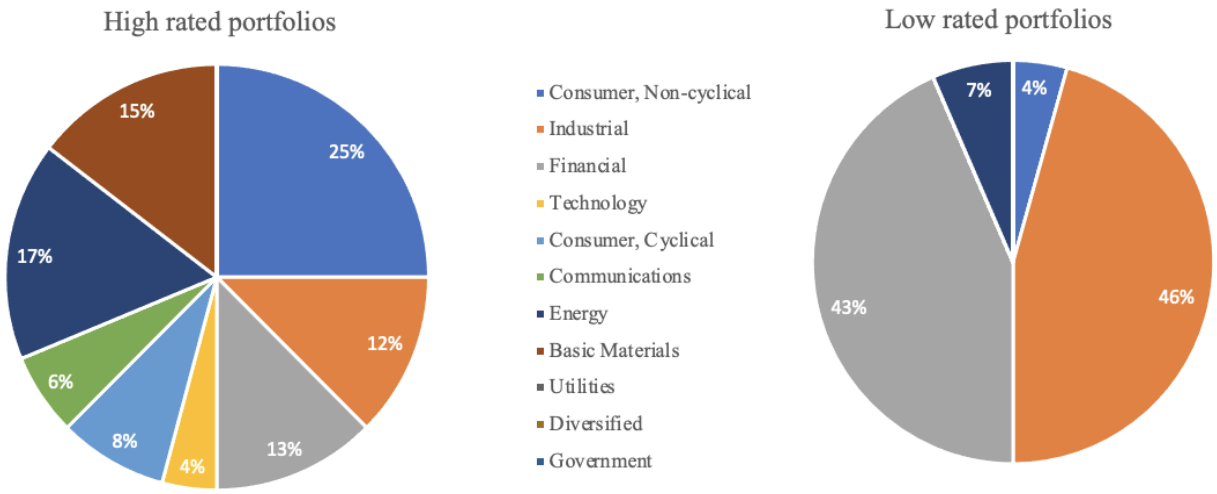

Figure 8: High E-, S-, G- and ESG portfolio's sector mix versus low E-, S-, G- and ESG portfolio's sector mix.

Figure 8 shows the combined sector mix for low ESG portfolios as well as high ESG portfolios. There is a clear pattern between high and low ESG portfolios, indicating that level of ESG is relevant for sector bias. For a high ESG portfolio in the Nordics the general sector bias is small, meaning it likely has a minor or even insignificant effect on the portfolio. In contrast, a low ESG portfolio has a large sector bias which increases risk exposure. Mainly two sectors are overweighted in the poorly diversified low rated ESG portfolios: Financial and Industrial. This could be an indicator that these sectors are laggards.

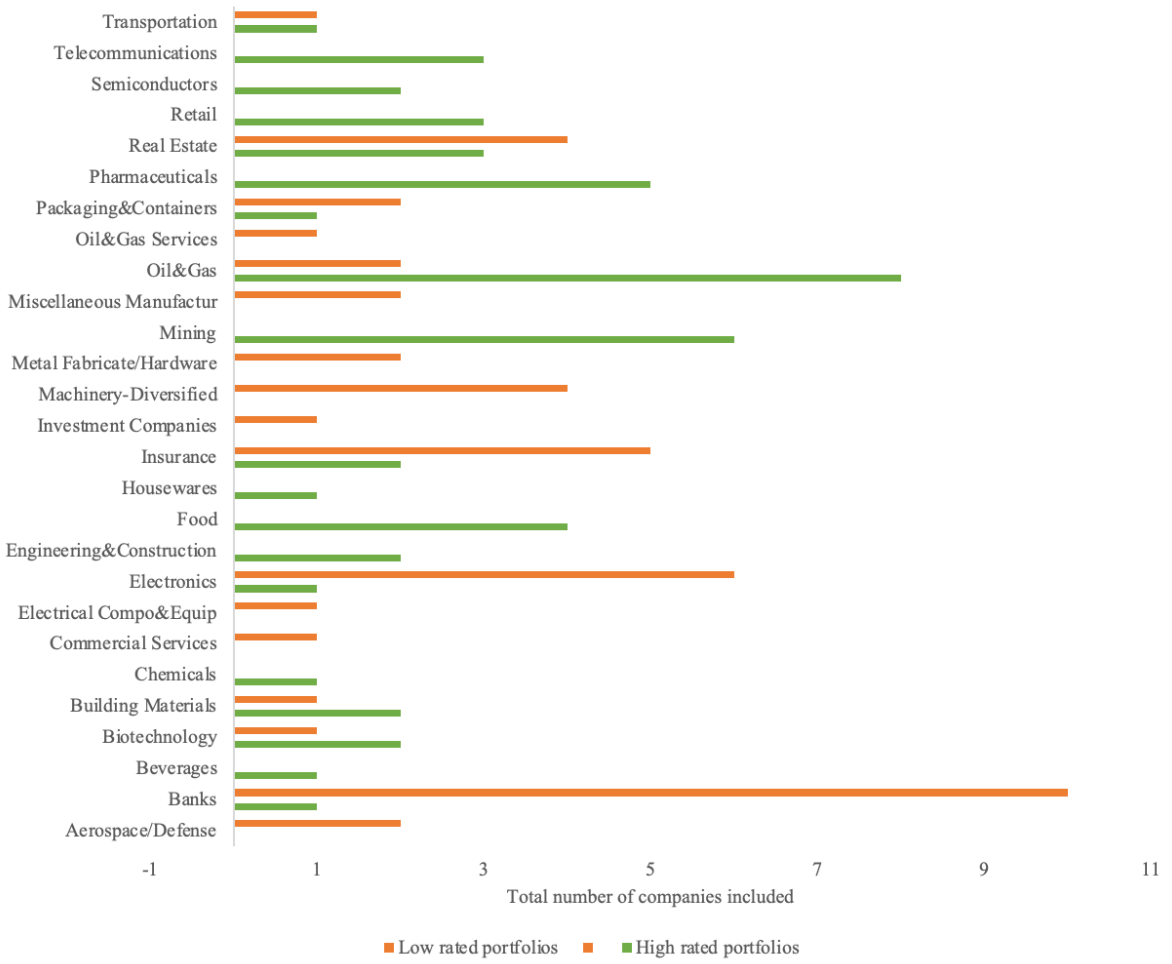

Figure 9: Subsectors of low E-, S-, G-, and ESG rated portfolios versus high E-, S-, G-, and ESG rated portfolios.

Looking closer at the subsectors of the companies in Figure 9, a variety of types are included. For low rated portfolios Banks, Electronics and Insurance are top industries and for high rated portfolios were Oil and gas, Mining and Pharmaceuticals. The expectation was that the sector mix for high rated ESG portfolios would reveal sector exclusion bias from polluting or ethically questionable sectors as suggested by Alessandrini and Jondeau (2020b). However, in high rated portfolios a substantial degree of the subsectors of Oil & gas and Mining are included, contradicting their conclusion. This again questions if ESG ratings are a good proxy for ESG value. One potential problem with ESG ratings is that the rating differs between agencies since there is no consensus on how to construct an ESG rating. According to Statista (2022) the correlation between ESG rating agencies was only 0.54 in 2017, indicating that ESG scores might largely vary between rating agencies. This fact might make it more interesting to look for the individual components of ESG value, rather than only focusing on ESG ratings.

6. Conclusions

In this study, the primary objective was to assess the impact of ESG considerations on portfolio performance in the Nordic region. The purpose was to investigate whether constructing portfolios based on high ESG scores or low ESG scores results in superior risk-adjusted returns compared to traditional approaches. The method employed involved mean-variance optimization, leveraging historical stock prices and ESG scores for companies in the Nordic stock market. ESG-filtered portfolios were constructed by including companies with the lowest ESG scores respective highest ESG scores and optimizing the remaining assets. An in-sample optimizing period was later compared against an out-of-sample period. The OMX40 Nordic index served as a benchmark for evaluating the relative performance of these portfolios.

Firstly, the overall relationship between ESG and financial performance in the Nordics is neutral or slightly negative, as high ESG portfolios do not consistently outperform low ESG portfolios. This interpretation, observed through the efficient ESG frontier, suggests a substantial presence of ESG-influenced investors in the Nordic market. This situation implies that ESG value is already priced in, or potentially slightly overpriced, in the Nordic stock market. Since many investors may not want to sacrifice returns for ESG value, this is an important insight for Nordic investors.

Secondly, the increasing preference for high E- and G-rated stocks in the Nordic market indicates a growing demand from Type-M investors. This shift has correspondingly reduced the demand for low E- and G-rated stocks, resulting in a decline in their prices.

Thirdly, ESG investing introduces regional, sector, and market capitalization biases that could impact risk exposure. High ESG portfolios exhibit a more diversified regional and sector mix than low ESG portfolios. However, they also tend to include larger companies to a greater extent. This suggests that investors should be mindful of potential biases in ESG investing, considering their implications for risk exposure and market dynamics. Additionally, policymakers may need to encourage greater diversification and address the impact of larger companies within high ESG portfolios to ensure a balanced and resilient investment landscape.

Lastly, ESG ratings may not be optimal to use as a proxy for ESG value due to the sector inclusion of controversial industries, such as oil, gas, and mining, in high ESG companies. This observation aligns with Drempetic et al.'s (2019) view that ESG ratings may not accurately reflect true ESG value. ESG rating agencies' lack of transparency regarding the composition of ESG ratings raises

questions, indicating an opportunity for lawmakers to establish clear criteria for what constitutes sustainable practices.

It is important to note that these results hold for these specific conditions and might differ which change of ESG rating agency. An interesting future research area is further separating ESG factors into individual drivers to identify exactly what factors that Nordic investors value today to identify which drivers that might be undervalued by the market. This could potentially lead to a better performing ESG portfolio out-of-sample. This would likely be possible soon, with the growth of sustainability reporting and ESG-ratings.

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Appendix

Table 7-9: All 149 assets that were screened and used as investment universe.

Table 7:

Company	Subsector	Company	Subsector
ABB	Electronics	Elisa	Telecommunications
Akastor	Oil & Gas Services	EnQuest PLC	Oil&Gas
AKER	Investment Company	Equinor	Oil&Gas
AKER BP	Oil & Gas	Ericsson A	Telecommunications
Alfa Laval	Miscellaneous Manufacture	Ericsson B	Telecommunications
Archer	Oil & Gas	Fagerhult Group	Electrical Compo&Equip
Assa Abloy B	Electronics	Fast. Balder B	Real Estate
AstraZeneca	Pharmaceuticals	Fingerprint Cards B	Electronics
Atlas Copco A	Machinery-Diversified	Fiskars	Housewares
Atlas Copco B	Machinery-Diversified	FLSmidth & Co	Machinery-Diversified
Autoliv SDB	Auto Parts & Equipment	Fortum	Electric
Beijer Ref B	Machinery-Diversified	Frontline	Transportation
Billerud	Forest Products & Paper	Genmab	Biotechnology
Boliden	Mining	Getinge B	Healthcare-Products
Borregaard	Chemicals	Gjensidige försikr.	Insurance
BW Offshore	Transportation	GN Store Nord	Telecommunications
Cargotec	Transportation	H Lundbeck	Biotechnology
Carlsberg	Beverages	Handelsbanken A	Banks
Carlsberg B	Beverages	Handelsbanken B	Banks
Castellum	Real Estate	Hartmann	Packaging&Containers
Citycon	Real Estate	Hexagon B	Machinery-Diversified
Copenhagen Airports	Engineering & Construction	Hexagon Composites	Metal Fabricate/Hardware
D/S Norden	Transportation	Hexpol B	Miscellaneous Manufactur
Danske Bank	Banks	Huhtamaki	Packaging&Containers
Demant	Healthcare-Products	Husqvarna A	Machinery-Diversified
DNB Bank	Banks	Husqvarna B	Machinery-Diversified
DNO	Oil & Gas	Industrivärden A	Investment Companies
DSV	Transportation	Industrivärden C	Investment Companies
Electrolux A	Home Furnishings	Indutrade	Miscellaneous Manufactur
Electrolux B	Home Furnishings	Investor A	Investment Companies

Table 8:

Company	Subsector	Company	Subsector
Investor B	Investment Company	Nordic semiconductor	Semiconductors
Jyske Bank	Banks	Norsk hydro	Mining
Kemira	Chemicals	Norweigian Air shut	Airlines
Kesko	Food	Novo Nordisk B	Pharmaceuticals
Kinnevik A	Investment Company	Novozymes B	Chemicals
Kinnevik B	Investment Company	Olav Thon Eiendoms	Real Estate
KONE	Machinery-Diversified	Orion	Pharmaceuticals
Konecranes	Hand/Machine Tools	Orkla	Food
Kongberg Gruppen	Shipbuilding	Orrön Energy	Electric
Lassila & Tikanoja	Environmental Control	Outokumpu	Iron/Steel
Latour B	Building Materials	Pandora	Retail
Lindab International	Metal Fabricate/Hardware	PGS	Oil & Gas Services
Lucara Diamond Corp	Mining	Ponsse	Machinery-Diversified
Lundbergföretagen B	Investment Company	PROSAFE	Oil & Gas Services
Maersk A	Transportation	Q-FREE	Electronics
Maersk B	Transportation	Rockwool	Building Materials
Metsa Board B	Packaging & Containers	Royal Unibrew	Beverages
Metso	Machinery-Constr & Mining	SAAB B	Aerospace/Defense
Millicom Int. Cellular SDB	Telecommunications	Sagax A	Real Estate
Modern Times Group A	Software	Sampo	Insurance
Modern Times Group B	Software	Sandvik	Machinery-Constr & Mining
MOWI	Food	Schibsted A	Media
Neste	Oil & Gas	SEB A	Banks
NIBE Industrier B	Building Materials	SEB C	Banks
NKT	Electronics	Securitas B	Commercial Services
Nokia	Telecommunications	Siem Offshore	Oil & Gas Services
Nokian Renkaat	Auto Parts & Equipment	Skanska B	Engineering & Construction
Nolato B	Miscellaneous Manufacture	SKF A	Metal Fabricate/Hardware
Nordea Bank	Banks	SKF B	Metal Fabricate/Hardware
Nordea Bank	Banks	Sparebank 1 SMN	Banks

Table 9:

Company	Subsector
Sparebank 1 SR-BK	Banks
Sparebanken Vest	Banks
SSAB A	Iron/Steel
SSAB B	Iron/Steel
Stora Enso	Packaging & Containers
Stora Enso A	Packaging & Containers
Stora Enso R	Packaging & Containers
Storebrand	Insurance
Subsea 7	Oil & Gas Services
Swedbank A	Banks
Swedish Orphan Biovitrum	Biotechnology
Tele2 A	Telecommunications
Tele2 B	Telecommunications
Telenor	Telecommunications
Telia Company	Telecommunications
TGS	Oil & Gas Services
TietoEVRY	Computers
Tomra Systems	Environmental Control
Topdanmark	Insurance
Trelleborg B	Miscellaneous Manufacture
Tryg	Insurance
Vaisala	Electronics
Vestas	Energy-Alternate Sources
Viking Supply Ships	Transportation
Volvo A	Auto Manufacturers
Volvo B	Auto Manufacturers
Wallenstam B	Real Estate
Wartsila	Machinery-Diversified
Yara International	Chemicals

Table 10: All assets included in the optimized portfolios and their respective subsector.

Company	***Subsector***	***Company***	***Subsector***
AKER	Investment Companies	NKT	Electronics
AKER BP	Oil&Gas	Nolato B	Miscellaneous Manufacture
Archer	Oil&Gas	D/S Norden	Transportation
AstraZeneca	Pharmaceuticals	Norsk Hydro	Mining
BORREGAARD	Chemicals	Orion	Pharmaceuticals
DNO	Oil&Gas	Orkla	Food
DSV	Transportation	Pandora	Retail
Electrolux A	Home Furnishings	Ponsse	Machinery-Diversified
Electrolux B	Home Furnishings	Rockwool	Building Materials
Elisa	Telecommunications	Royal Unibrew	Beverages
EQUINOR	Oil&Gas	Sagax A	Real Estate
Fagerhult Group	Electrical Compo & Equipment	Securitas B	Commercial Services
Fingerprint Cards B	Electronics	Siem Offshore	Oil&Gas Services
Fiskars	Housewares	Sparebanken 1 SMN	Banks
Genmab	Biotechnology	Sparebanken 1 SR-BK	Banks
H Lundbeck	Biotechnology	Sparebanken Vest	Banks
Hartmann	Packaging & Containers	Storebrand	Insurance
Huhtamäki	Packaging & Containers	Telenor	Telecommunications
Kesko	Food	Tomra Systems	Environmental Control
KONE	Machinery-Diversified	Topdanmark	Insurance
MOWI	Food	Wallenstam B	Real Estate
Neste	Oil&Gas		