ETHICAL INVESTMENTS

The cost of a clean conscience or opportunity to change the world?

Anders Nordbrandt
Abstract

Problem background: Swedish savings in mutual funds have increased by 53 times in 30 years, to a total of 3 837 billion kronor, whereof a large share is through the Swedish pension system. A growing share of this capital is invested in socially responsible investment products, where a popular approach is to use a negative screening to exclude companies based on ethical values.

Problem statement: Are there any effects in terms of risk and return when investments are made using a negative screening for unethical companies? Are there any differences during turbulent market conditions?

Theory: This study is using Modern Portfolio Theory, pioneered by Harry Markowitz. It will be used to optimize and identify efficient portfolio based on expected return and risk under the assumption of a risk averse investor. The key is to minimize portfolio risk through diversification with low correlated assets, for each level of return.

Methodology: I have used a deductive method with a quantitative approach. Using Bootstrap, a replication procedure with replacements, 4 000 optimal portfolios have been created from underlying holdings of OMX S30 Index and its corresponding ethical index, from two sets of market volatility. Paired sample t-tests have been performed to test for hypothesis significance.

Result: There is a significant difference of risk-adjusted return using negative screening, regardless of market volatility. The risk-adjusted return is relatively worse for ethical investments during high market volatility.

Conclusions: The reduction of asset through negative screening, is a loss of potential risk-adjusted return because of diminishing diversification opportunities. Adjustments made to optimize ethical portfolios can attain at least as high optimal return but are instead penalized with a relatively higher expected risk.
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1 Introduction

In this chapter the reader is introduced to Swedish investments in mutual funds, and more specifically in ethical investments. This is followed by the problem background, problem statement, and finally demarcations.

1.1 Swedish investments in mutual funds

All though savings in mutual funds begun in the 1950s in Sweden, it was not until the launch of the “allemans” funds in 1984 that it really took off. One key factor behind the success of “allemans” funds was that the investments were tax-free. Even though tax was introduced in 1991 people had become experienced in fund investments and continued even when subsidies were completely removed by 1997. In 1990 there were 1,7 million accounts for “allemans” funds. (Pettersson, Helgesson and Hård af Segerstad 2009, 7, 11f.) Another milestone for Swedish investments in mutual funds was the approval of a new pensions system in 1994. One component of the new state pension system was the Premium pension where 2,5% of the salary, with a cap of 7,5 income base amounts, would be invested in mutual funds. The savers could themselves choose the funds they wish to invest in. This was first implemented in year 2000. Furthermore, in the late 1990s and early 2000s the occupational pension system, where the employer can put away a portion of the salary in the employee’s name, was reformed with more individual choices such as investments in mutual funds. (Pettersson, Helgesson and Hård af Segerstad 2009, 15)

The amounts of money that Swedish citizens have invested in mutual funds have been increasing in a rapid pace. The last 30 years, from 1987 to 2017, it has multiplied almost 54 times, from 71,4 billion SEK to 3 837,2 billion SEK (Swedish investment fund association 2018a). By the end of the third quarter 2018, 1 214 billion SEK was invested through the
Premium pension system which was 28% of total fund volume. Same number for unit link products, which included occupational pension, was 1,035 billion SEK and 24%. (Swedish investment fund association 2018b).

A survey made by the Swedish investment fund association (2018c, 11, 19f, 34, 36), interviewing 1,000 persons between 18-76 years old, showed that 100% were saving in funds, if fund investments made through the Premium pension was included. If Premium pension was excluded the number would have been 76%. 47% were invested in mutual funds through occupational pension, whereof 68% had reallocated from the default fund. 38% were saving for their pension in private setups. Furthermore, 47% had a monthly saving in mutual funds, whereof 62% were saving more than 1,000 SEK per month.

Together this indicates a large and growing demand for fund investments which in turn attract more fund companies. Competition increased and during the first decade of the 21st century the number of funds in Sweden increased from 1,500 to 4,000 (Pettersson, Helgesson and Hård af Segerstad 2009, 14).

1.2 Ethical and socially responsible investments (SRI) in mutual funds
Before the 21st century one’s religious belief was often a part of the investment decision, where the investors’ ethical stand was part of the investment process. Although focus gradually has shifted from ethical to sustainable investments, the ethics is still important to many investors, especially more senior people. (Drakenberg 2018, 8, 22) SRI was initially mostly requested by retail investors, but since the 1980s the majority of investments are via institutional investors. Studies show that norm-constrained institutions such as pension plans avoid socially unacceptable stocks in a higher degree than regular mutual or hedge funds (Hong and Kacperczyk 2009, 15). In Sweden, the church is the main advocate for SRI, followed by several
in institutional investors and national pension funds (Scholtens and Sievänen 2013, 606,613). The concept of ethical investments has resulted in a formation of different forms of ethical mutual funds (Heinkel, Kraus and Zechner 2001, 431).

A study among Swedish citizens, made by Prospera (2018) showed that 24% had invested in ethical or sustainable funds, even though only 6% believed that the performance would be improved. Another study by the Swedish investment fund association (2018c, 38) indicated that 38% would choose an ethical or sustainable fund if they were to make a new investment today.

1.3 Problem background

Traditionally, ethical investors have been using a negative screening, meaning that specific businesses producing goods or services that are classified as unethical have been excluded from the investment portfolios. Although SRI has gradually matured when more investors have adopted the theory, the exclusion of harmful or controversial activities is still the most common SRI strategy (Trinks and Scholtens (2017, 195).

Markowitz modern portfolio theory would suggest a less optimal result using a portfolio with fewer companies to diversify the portfolio with, which is the case when using SRI strategies with negative screening to reflect the investors’ values and believes (Tinks and Scholtens 2017, 202). Any company that is eliminated should be consider one less opportunity for potential return, hence no socially responsible portfolio should qualify to be on the efficient frontier (Jednyak 2017, 3). This is supported by the traditional view on SRI, that investors accept a loss in financial performance but instead achieve different non-monetary gains related to the SRI attributes in their investments. On the other hand, it may be suggested that ethical companies by nature would perform better that unethical companies, because an ethical or sustainable way
of producing goods or services should be preferable by customers in the long run. In this sense, the SRI is a traditional profit-seeking part of the investment process with rigorous analysis that includes social and environmental consequences. (Derwall, Koedijk and Ter Horst 2011, 2137) Renneboog, Ter Horst and Zhang (2008a, 321) suggests that by using SRI screens, new and relevant information that could drive share prices could be unveiled, rendering an edge compared to traditional investors.

As shown in previous paragraphs, investments in mutual funds are vast and increasing. Also, more and more institutions and private investors are requesting SRI products (Tinks and Scholtens 2017, 193). Hence, a large part of people’s pensions and savings rely on the performance of these funds. For example, for someone saving 1 000 SEK per month for 50 years for their pension with an annual return of 5% will end up having 700 000 SEK more than if the annual return was 4%. That will result in a higher pension with almost 3 000 SEK per month if taken out over a 20-year period. Even a small difference of 0,1% (5,0% instead of 4,9%) in annual return on 4 trillion SEK is going to make a difference of 2,1 trillion SEK in 50 years! This is why it is so important to try to estimate the implications of this movement, to be able to make informed decisions, both on a personal level but also to be able to project long term strategical directions for humanity in a cost-effective way.

In this thesis, the effects on expected risk and return by investing in an asset portfolio using negative screening that excludes unethical companies will be examined. Since a higher expected risk also can mean a higher expected return, the effects on risk-adjusted return will also be investigated by analyzing the Sharpe ratio. To find out if the result is different depending on market volatility, since it has been argued that sin-stocks are recession-proof investments (Siegfried 2004, 939), the same investigation will be performed using two different market climates.
1.4 Problem statement

To find an answer to these problems, the following problem statement have been formulated:
Are there any differences in expected return, risk or Sharpe ratio when unethical investments are excluded from the investable universe? Also, are the results any different during normal market volatility compared to more volatile markets?

1.5 Demarcations

This study will only investigate the effects of the Swedish equity market and will use the OMXS30 Index as investment universe when constructing portfolios, as well as the corresponding ethical index, both produced by Nasdaq. This means that the wider term of SRI not will be include, nor will the positive screening approach, where “good” companies are rewarded with a higher portfolio weighting and “bad” companies punished by a lower weight but not necessary excluded from the investable universe, be investigated. The selection approach will be binary, either it is ethical and included or unethical and excluded, based on the product or service itself, without regards if it is produced in a sustainable manner or not.
2 Theory

This chapter explains the terms SRI and ethical investments and the different screening approaches available within this area. It also goes through results of previous studies in this subject. Finally, it explains some necessary mathematical expressions and useful definitions of portfolio risk and return as well as the theoretical framework of modern portfolio theory and criticism against it.

2.1 Socially Responsible Investing, SRI

SRI is a collective term for investments that are considered socially responsible due to the nature of the business the company conducts. SRI uses environmental, social, and corporate governance (ESG) criteria to generate long-term, competitive financial returns and at the same time have a positive impact on the society. That is, instead of using traditional investing where investment decisions are formed only of expectations of risk and return, SRI combine both financial goals and social responsibility by limiting their investment alternatives to asset where the product or the company’s actions are considered socially acceptable. Socially responsible investors might for example avoid investment in companies that produce or sell addictive substance or products such as tobacco, liquor, or gambling and rather look for companies engaged in environmental sustainability and alternative energy (Baker and Nofsinger 2012, 3).

“The aftermaths of the Vietnam War, the peace movement, civil rights, anti-nuclear, and environmental pressure groups (largely triggered by accidents such as Chernobyl and the Exxon Valdez oil spill) contributed to the rising recognition of SRI”. (Broadhurst, Watson and Marshall 2003, XIII). In more recent years issues such as global warming and community investing has gained significant attention (Renneboog, Ter Horst and Zhang (2008b, 1740). Just as there is no single approach to SRI, there are a variety of different terms to describe it. Depending on their emphasis, investors use labels such as: community investing, ethical
investing, green investing, impact investing, mission-related investing, responsible investing, socially responsible investing, sustainable investing and values-based investing, (US SIF 2018). Since there are no common standards for SRI, there are different organizations attempting to formulate their own standards. For example, PRI, Principles for Responsible Investments (UN PRI 2018), is an independent organization supported by the United Nations, that sets up principles for responsible investments. A similar European forum is Eurosif (2018a) and the Swedish forum, Swesif (2018) that both attempts to share information, support asset owners and lobby for regulatory changes to support the developments of SRI.

2.2 Ethical investments

The term ethical investment belongs under the broader term of SRI since some sort of ethical consideration is being made when selecting what companies to invest in. The definition of what is ethical or unethical varies from individuals as well as institutions. Therefore, one ethical screening may not necessarily reflect all the investors’ values and moral orientations (Trinks and Scholtens (2017, 195). An ethical investment is a portfolio of holdings where certain companies that are producing goods or services that are considered unethical traditionally are excluded. The beginning of ethical investments can be traced back to various religious movements, such as the Quakers in the 18th Century who were avoiding those companies involved in the slave trade. It evolved later by investors avoiding what were to be called “sin” stocks, which was companies involved in gambling, alcohol production, prostitution and tobacco. One example is the Methodist church who by 1920 started to use a negative screening approach in their investments by avoiding companies involved in gambling or alcohol. The movement continued to take off in 1970 by avoiding companies investing or working under the apartheid regime in South Africa and in 1971 the first mutual fund that avoided companies profiting from the Vietnam War was launched. (Broadhurst, Watson and Marshall 2003, XIIif.)
2.3 Positive and negative Screening

When implementing SRI strategies, the asset manager or asset owner can do this using different approaches. A summary by Renneboog, Ter Horst and Zhang (2008b, 1728) separate these methods into four different categories. The first and the most common is the negative screening (exclusionary screening), which means that the investor excludes companies that don’t meet the specified criteria. The decision is binary, either the company is ethical and investible or unethical and non-investible. Some investors use a threshold and exclude companies from the universe when a certain amount of revenues comes from questionable business while others also includes branches or suppliers. After the negative screening, portfolios are created using traditional financial selections. A survey by Eurosif (2018b, 12, 92, 107) showed that more than €9.5 trillion of assets used the negative screening in 2017, twice the amount of the second most popular approach. Tobacco was the most popular feature to exclude. In Sweden €720 billion in assets are using negative screening.

The second most popular approach is positive screening where companies are ranked based on how they perform on ESG performance. Most commonly, positive screens focus on corporate governance, labor relations, the environment, sustainability of investments and the like. These screens sometimes use a “best-in-class” approach, meaning that companies are ranked within each market sector and can be rewarded with a higher portfolio weight. The third strategy is an integration of the first two. It is often called “sustainability” and is based on economic, environmental and social criteria with a focus on People, Planet and Profit. The forth approach is similar to the third but with the addition of shareholder activism. This means that investors by different means try to influence companies to be more ethical (Renneboog, Ter Horst and Zhang 2008b, 1728). The forth holistic approach has increased in popularity in Sweden in recent years (Eurosif 2018b, 107).
2.4 Corporate responsibility

An article by Milton Friedman (1970), takes a clear stand against the “social responsibility” from a corporate perspective. He claims that a company doesn’t have a social responsibility, but that individuals might. An employer should not spend the company owner’s money in any other way than to maximize profits within the basic rules of the society, without deception or fraud. Individuals have the right and opportunity to do right by their own social or ethical believes, but only at their own expense. However, the company owner can freely spend his money as he or she wishes. Actions justified as social responsibility can have a self-interest in achieving long-term gains, for example an expenditure such as goodwill, why the action no longer should be considered a “social responsibility”. He argues that the allocation of scarce resources should be dealt with through political mechanisms, not market mechanisms. If this cannot be attained, it is considered undemocratic to impose these costs upon corporations, since the majority have not been convinced of its importance. And by imposing too many regulations, the free market will be turn into a government bureaucracy and the idea of freedom for individuals and voluntary among corporations would be limited. It would create a society of conformity instead of a collection of individuals.

These views have been challenged by, for example, Mulligan (1986). Although he agrees that social responsibility is a cost to the company, he declares that moral obligations and social responsibilities can have a place in an open and free market, that this can be embedded and agreed upon in the whole organization without a single executive imposing a sort of taxation against the shareholders will. He continues that it is reasonable that politicians through regulations ensure clean air and drinkable water and that it is part of a democratic system and not a pure socialistic matter.
Mulligans views is partially supported by the Stakeholder Theory, which suggest that the beneficiaries of a company should be changed from stockholder to stakeholders. Stakeholders are different key groups that the company has a relationship to, such as customers, employers, suppliers, communities, financiers, and others interest groups that are necessary to make the company attain its goals. The objective for the manager of the company is to balance the need of all stakeholders, to keep their support and maximize their interests. (Freeman and Phillips 2002, 333) This implicates that the stakeholders must participate in the decision making and be part of determining the direction of the future of the company in which they have a stake. This way different ethics such as fair contracts, feminism, ecological principles and so on becomes integrated to the firm if they are part of the stakeholders’ preferences. Business is a kind of human conduct where good and bad exists, and separating ethics from business is absurd, according to Stieb (209, 404f, 410). Jones, Harrison and Felps (2018, 388) show that a firm’s close relationship with a stakeholder can even be a sustainable, competitive advantage. They show that the cost of developing and maintaining these relationships are exceeded by the benefits and that the strategy is valuable since it is hard to imitate.

2.5 Effects of SRI in previous studies

Many attempts have been made to evaluate the effects on performance and risk from SRI strategies. Renneboog, Ter Horst and Zhang (2008b) investigated the effects of SRI funds across the world. Their findings were that SRI funds underperformed their domestic benchmarks by -2,2% to -6,5%. When comparing SRI funds to traditional funds, the risk-adjusted return was not statistically different, with a few exceptions. For example, Swedish SRI funds showed inferior risk-adjusted return compared to both benchmarks and traditional funds.
Jedynak (2017) investigated a collection of previous studies with the hypothesis that SRI strategies give better, worse or equal risk-adjusted return. The result in most studies showed no significant differences in risk-adjusted returns. This is consistent with similar studies where the majority of SRI strategies showed no effect and the rest showed an equal split between over- and under performance. Jedynak (2017, 11) suggest in-depth analysis of the difference of for example negative and positive screening, which was not separated in his own study.

Trinks and Scholtens (2017) focused more on the negative screening aspect of SRI. They claim that most research indicate that sin-stocks have performed better, while other studies have been unable to confirm this, and conclusions should be made with caution. Terminology within social and ethical investments is somewhat subjective and together with “informational complexity, large differences in measuring methods, and a lack of clarity and transparency on specific methodologies” (Trinks and Scholtens 2017, 195), make it difficult to draw conclusive conclusions. Depending on one's ethical belief or sense of social tolerance when investing, these values give different effects on the outcome. Some studies argue that negative screening only has limited impact on both the number of investments objects and on market impact, while other show that it does has a large impact, depending on the market and the screen (Trinks and Scholtens 2017, 203). For example, screens for alcohol and nuclear power have a large impact on both the number of shares and market capitalization excluded from the investable universe, while adult entertainment, fur and stem cells have a low impact on number shares and market capitalization excluded. Their own study shows that controversial companies significant outperform the overall market and the negative screening results in a significant underperformance and can be considered an opportunity cost. Similar result comes from another study by Renneboog, Ter Horst and Zhang (2008a, 321f) who found that the use of additional screens significantly reduces annual return. They draw the conclusion that the screening constrains the risk-return optimization and is of no help for fund managers to find
undervalued stocks. Their hypothesis is that SRI investors’ aversion to unethical corporate behavior make them willing to pay the price of reduced return. There is a trade-off between moral believes versus financial return and up to the investor to decide whether the cost is worth it. This implies that controversial business must yield a higher return to keep attract investors.

This corresponds to the finding by Hong and Kacperczyk (2009, 15) who suggest that controversial businesses yield a higher return, partly due to higher risk of litigations, but primarily because these companies are less covered from analysts in the absence investors, limited by their norms. If enough ethical investors exclude a certain sin-stock it will cause the share price for the stock to lower, hence raising their cost of capital. If the higher cost of capital is greater than the cost of reforming, the company will make the necessary reforms and become ethical. This way negative screens can make business become socially responsible. According to estimations by Heinkel, Kraus and Zechner (2001, 431) more than 25% green investors are necessary to make a polluting firm to reform. There is however, yet no empirical evidence to prove if companies with higher ESG scoring have a lower cost of capital because of the rising demand for SRI (Renneboog, Ter Horst and Zhang 2008b, 1728).

By including factors, others than maximizing return for any given level of risk, it indicates that the goal for SRI is not only to achieve the best possible performance, but instead to prioritize other non-monetary goals that reflect the investors’ moral believes (Derwall, Koedijk and Ter Horst 2011, 2137). This suggests that the traditional theory of rational investors making decisions from expectations based on risk and return might not hold, since the role of social norms actually seems to effect economic behavior (De Bondt and Thaler 1995, 389). This would mean that the underlying assumption in Markowitz theory never are met in reality (Jednyak 2017, 3). Jensen (1993, 870) challenges the modern portfolio theory by arguing that other psychological factors can play a role in investment decisions and criticizes the finance
professionals for rarely investigating how investment decisions actually are made, but instead focus on how investment decisions should be made.

2.6 Definitions

This subsection will first explain the concepts of ex-post and ex-ante calculations and the formulas for arithmetic and geometric average. It will be followed by a couple of definitions and mathematical formulas related to risk and return for assets and portfolios.

2.6.1 Ex-post, ex-ante

When making assessments of for example risk or return, two different calculations methods can be used. Ex-post measure the historical risk or return after the event, saying how much risk or return there has been in the past. Ex-ante is forward looking and makes assumptions about the future using the instruments current status and correlations. (Bacon 2012, 5)

2.6.2 Arithmetic and Geometric average

There are different ways to calculate an average. Two of the most common methods are arithmetic and geometric calculations. These following are ex-post calculations with the following formulas for calculating the mean of \( n \) number of returns \( r \):

\[
Arithmetic \ mean \ of \ \bar{r} = \frac{1}{n} \sum_{i=1}^{n} r_i
\]

\[
Geometric \ mean \ of \ \bar{r} = \left( \prod_{i=1}^{n} r_i \right)^{1/n}
\]

The geometric calculations include the compounding return and is more useful when calculating multiple periods of return data. (Bacon 2012, 7f)
2.6.3 Portfolio risk

Risks can be found almost whatever we do. Usually risk is explained as uncertainty of an event and its consequences. To manage risks, we try to seek definitions and different way to measure them, quantifying and analyzing to be able to make rational decisions. There are numerous potential risks when investing in a fund portfolio and different ways to quantify these risks. (Tapiero 2010, 1,5f) For example compliance risk, operational risk, liquidity risk, counterparty risk and portfolio risk (Bacon 2012, 1f). I will highlight two potential risks, the systematic risk and unsystematic risk, one way to measure portfolio risk, the standard deviation, and show how to calculate estimated portfolio risk.

Systematic risk

Systematic risk, also called “market risk” is a potential loss associated to factors that influence the overall performance of the financial market that the investor is involved in. It is the minimum level of risk that can be created through diversification using all available assets. This risk cannot further be reduced by diversifications since the whole market in focus for the investor is affected. (Fabozzi and Peterson Drake 2010, 456). Examples of market risks are interest rate changes, energy price changes, large scale whether changes etcetera, that can impact the whole market or certain regions or sectors, for better or for worse (Nimalathasan and Pratheepkanth 2012, 2)

Unsystematic risk

Unsystematic risk, also called “idiosyncratic risk”, “diversifiable risk”, “company-specific risk” or “unique risk”, is a unique risk associated with one specific asset, such as a stock (Fabozzi and Peterson Drake 2010, 456). This risk depends on internal factors and can be minimized by rearranging the portfolio by increased diversification (Nimalathasan and
Pratheepkanth 2012, 2). Figure 1 shows how the unsystematic risk is reduced by increasing the number of assets, while the systematic risk cannot be eliminated.

*Figure 1. Systematic and unsystematic risk*

Standard deviation

A quantitative method to define the risk of an investment is by using a statistical method, the standard deviation, where calculations are based on historical return. The standard deviation measures the dispersions of the single observations around the average. While the average is used as the expected value, a higher risk means more dispersion around the expected value, giving a more uncertain outcome. In this case we are measuring the historical performance of a portfolio where each data point indicates a monthly return. The formula for the standard deviation $\sigma$, for $n$ observations of monthly returns; $r_1, r_2, \ldots, r_n$, where the mean of observations is $\bar{r}$, is: (Svenning 2003, 241)

$$
\sigma = \sqrt{\frac{1}{n-1} \sum_{i=1}^{n} (r_i - \bar{r})^2}
$$
It is an ex-post, arithmetic calculation. In order to annualize standard deviation into annual volatility, \( \nu \), the following formula is used:

\[
\nu = \sigma \sqrt{t} \quad \text{where } t = 12 \text{ for monthly data}
\]

**Estimated portfolio risk**

When calculating the estimated portfolio risk, or estimated portfolio standard deviation, with \( i \) number of investments, the following ex-ante formula is used:

\[
\sigma_p = \sqrt{\sum_{i=1}^{n} w_i^2 \sigma_i^2 + \sum_{i=1}^{n} \sum_{j=1}^{n} w_i w_j \sigma_i \sigma_j \rho_{ij}}
\]

Where \( w \) is portfolio weighting, \( \sigma \) is the ex-post standard deviation of an asset and \( \rho_{ij} \) is the ex-post correlation coefficient between the return on assets \( i \) and \( j \).

\[
\rho_{ij} = \frac{\sigma_{ij}}{\sigma_i \sigma_j} \quad \text{where covariance } = \sigma_{ij} = \sum \{[r_i - \bar{r}_i] [r_j - \bar{r}_j]\}
\]

The covariance is a statistical measure that indicates the direction of the relationship between two random variables. It is positive when the two variables tend to move in the same direction and negative when they move in opposite direction. It does not say anything about the magnitude of the association. The correlation coefficient is derived by dividing the covariance by the product of the standard deviation of the two variables. The correlation coefficient is a number between: \(-1 \leq \rho_{ij} \leq +1\). A value of +1 indicates a perfect positive correlation, meaning the variables move in the same direction at the same time, while -1 indicates that the variables have a perfect negative correlation and move in opposite directions. A value of cero indicates no correlation. (Francis and Dongcheol 2013, 18f)
2.6.4 Portfolio return

Performance is for many investors the main reason for making an investment. This is measured by return. It is one thing to calculate historical, ex-post return for one single period and make assessments in hindsight whether it was good or poor. But before we invest, we wish to create the best possible portfolio. To make these optimizations we need to have estimations regarding future return, of which we have no knowledge. Therefore, assumptions must be made. Markowitz (1959, 3) mentions one source of information as past performance and a second source of information the beliefs of security analysts. When past performances are used as inputs, the output will be portfolios with securities that performed well in the past. When security analysts are used as inputs, the output will be portfolios that reflects the analyst’s beliefs. Since systematic and unsystematic risks can arise any moment, such as extreme weather, the health of the president, international tensions etcetera, which potentially can affect the whole markets or a particular security, this is considered beyond the capability of analysts to foresee. For this thesis, I will use past performance as estimate for future returns.

Asset return

Estimated return can be formulated using different estimates depending on the degree of uncertainty. A common way to deal with uncertain estimates is using historical data as proxy for future return. Assume the following monthly return $R$ for a stock with $n$ number of returns: $R_1, R_2, \ldots R_n$. Let $r_1$ be the expected value of $R_1$, $r_2$ be the expected value of $R_2$ and so on. Then use the following formula: (Francis and Dongcheol 2013, 20; Markowitz 1959, 106)

$$\tilde{r}_i = \frac{1}{n} \sum_{i=1}^{n} r_i$$

Where $\tilde{r}_i$ is the expected return on asset $i$ and $n$ is the number of historical observations. This is an ex-post, arithmetic mean, used as a forward-looking estimate, where the past average and the expected value are identical (Markowitz 1959, 49).
**Portfolio return**

To calculate the expected return, $r_p$, on a portfolio of $i$ number of holding, the following formula is used:

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

Where $r_i$ is the return on asset $i$ and $w_i$ is the weighting of asset $i$ and where the weighted sum of $n$ different asset is 100%:

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

To annualize monthly return, the geometric formula is being used;

$$\hat{r} = \prod_{i=1}^{n} \left( 1 + r_i \right)^{\frac{t}{12}} - 1$$

Where $\hat{r}$ = annual return and $t = 12$ for monthly data. Using geometrical calculations will give an equal or lower average return compared to arithmetical calculations since compounded return has been taken into consideration, which better reflect the actual performance. (Bacon 2012, 8)

### 2.6.5 Sharpe ratio

The Sharpe ratio was developed by William Sharpe in 1966, which he by then called the reward-to-variability ratio, as an attempt to evaluate the performance of mutual funds. By looking at the return subtracted by the pure interest rate he retrieved the investors reward for bearing risk. Dividing that by the annual standard deviation of the annual rate of return gives the quotient of the reward per unit of variability. The formula is:

$$\text{sharpe ratio} = \frac{\bar{r}_p - r_f}{\sigma_p}$$
Where $\bar{R}_p$ is the expected portfolio return, $r_f$ is the risk-free rate and $\sigma_p$ is the portfolio standard deviation of the portfolios excess return. (Shape 1966, 123). When calculating the Sharpe ratio, annualized return and annualized risk-free rate used in the numerator should be retrieved using geometric methods to include the compounding return of the performance (Bacon 212, 46).

By normalizing reward for risk, it is possible to compare two risky investments, regardless of the level of risk taken, simply by comparing what investment is yielding the highest return for each unit of risk. For example, a Sharpe ratio of 1 means that the return above the risk-free rate is 1% for every percent unit of volatility. The greater the value, the more attractive is the risk-adjusted return. (Muralidhar 2015, 6).

2.7 Modern Portfolio Theory

Modern Portfolio Theory was pioneered by Harry Markowitz in 1952. Even though it has been challenged it is still used and a popular approach when creating a portfolio of multiple holdings. According to Markowitz (1952, 77) the investor should maximize expected return, consider expected return a desirable thing and variance of return an undesirable thing. The creation of portfolios is therefore based solely of the expected rate of return, standard deviation of return for each investment and the correlation coefficients between all pairs of assets in the investment universe. The basic assumptions of the theory are that returns have a normal distribution and the investor is risk averse, meaning that for any given level of risk the investor prefer higher to lower return. This also implies that the investor will only take on more risk if compensated by higher expected return. (Francis and Dongcheol 2013, 3, 22, 53,166)

By combining multiple investments, the risk of the portfolio can become less than the risk of individual holdings, which is the benefit of diversification. But it is not just about increasing the number of assets, or naïve diversification strategies such as “not putting all your eggs in
one basket” or “spreading your risk”, but rather by combining assets with low covariance. The less correlated the underlying holdings are to each other the greater will the benefits of diversification be. A common misconception is that the only way to reduce risk is by adding lower yielding assets to the portfolio, such as bonds. This can reduce the risk but also the expected return, while increased diversification can maintain the same expected rate of return while reducing portfolio risk. (Francis and Dongcheol 2013, 41, 120, 123) Correlations between equities are generally high, but not perfect, which make diversification possible. With a perfect correlation all equities would move in the same direction and diversification could not reduce risk. If a hundred stocks moved in unison, they would not reduce risk more than owning a single stock. However, the larger the investible universe is, the more possible combinations can be made and possibly creating more optimal combinations of risk and return, again, given that the assets have a low correlation. The more assets a portfolio contains the more its behavior in terms of risk and return will correlate to the overall market, reducing idiosyncratic risk (Fabozzi and Peterson Drake 2010, 457), explained in figure 1, above. A single stock adds little to the variability of a large portfolio. The more assets, the lower the risk of them all moving in the same direction at the same time. Also, return of stocks within the same sector correlate more than stocks in unrelated sectors, (Markowitz 1959, 5f, 102) why a portfolio would benefit from investing in multiple sectors.

For all possible combinations of all the risky assets a vast number of theoretical portfolios can be made. The expected returns and expected risks of these portfolios can be plotted as a space on a diagram. This shape is called the opportunity set, or feasible set, see figure 2, below. The upper boundary on this shape is called the efficient frontier and offers portfolios with the best possible return for each level of risk, or conversely, the lowest risk for any given return. The efficient frontier begins at the minimum variance portfolio (MVP), which is the combination of risky assets that generates the portfolio with lowest risk. From there, the efficient frontier
can be generated by identifying the weighting of the assets that minimize the portfolio variance for various levels of expected return beyond the MVP. Portfolios on the efficient frontier are called efficient portfolios. The shape of the efficient frontier is concave toward the end, which is a covariance effect. Due to a reduced number of securities to combine further out on the risk axis, it gives a diminishing marginal return to risk. (Francis and Dongcheol 2013, 37, 91, 123)

The task of creating the efficient frontier is solved by minimizing portfolio standard deviation \( \sigma_p \) subject to three constraints; a given level of portfolio return, \( r_p \), the sum of all asset weights equals one and all weights are larger or equal to zero; written as:

\[
\text{Minimize } \sigma_p = \sqrt{ \sum_{i=1}^{n} w_i^2 \sigma_i^2 + \sum_{i=1}^{n} \sum_{j \neq i}^{n} w_i w_j \sigma_i \sigma_j \rho_{ij} }
\]

subject to: \( \sum_{i=1}^{n} w_i r_i = r_p \) and \( \sum_{i=1}^{n} w_i = 1 \) and \( w_i \geq 0 \) for all \( i \)

The output of the task gives the weighting of the assets that gives the lowest portfolio standard deviation for the chosen rate of return. The same problem is then solved repeatedly for a desired range of expected returns. The combinations of portfolio returns and standard deviations then constitutes the efficient frontier. The derivation of these calculations can be solved using vector and matrix differentiation and Lagrangian objective function. For multiple assets this require computer power and the full mathematical deduction will not be presented in this thesis.

By combining a risk-free asset to the risky assets, through a straight line that tangent the efficient frontier, the Capital Market Line (CML) is created. On this line, combinations of an optimal portfolio (the Tangency portfolio, T in figure 2) and risk-free rates can be made. Portfolios with less risk than the Tangent portfolio have a positive portion of both risk-free rate
and the tangent portfolio. Portfolios created with higher risk than the Tangent portfolio along the CML is a leveraged portfolio. The linear equation for the CML is:

\[ R_p = r_f + \left( \frac{r_t - r_f}{\sigma_t} \right) \sigma_p \]

Where \( r_f \) is the risk-free rate of return, \( r_t \) is the optimal rate of return in the tangent portfolio, \( \sigma_t \) is the standard deviation of the tangent portfolio and \( \sigma_p \) is the standard deviation of portfolio \( p \). (Francis and Dongcheol 2013, 36f, 129) The slope of the linear equation, \( (r_t - r_f) / \sigma_t \) has the same expression as the Sharpe ratio of the tangent portfolio and \( r_f \) gives the interception on the y axis. At the tangent point the slope of the CML is the highest possible. This specific portfolio offers the best risk-adjusted performance, hence the highest Sharpe ratio, along the efficient frontier.

In this study, I will investigate the Tangency portfolios, where 100% of the capital is allocated in a combination of risky assets and use its expected return and expected risk in my calculations of Sharpe ratio. No short selling or leverage allowed.

Figure 2. Efficient frontier
The optimal portfolios never offer a permanent solution. Input data; expected return, expected risk and correlations will change over time, why this is a never-ending process. The length of input data gives some indication of the investment horizon. (Francis and Dongcheol 2013, 105).

2.7.1 Criticism of Modern Portfolio Theory

There are numerous objections to mean-variance optimizations. For example, risk is measured by the variance that includes return above the mean, which has been argued not to be considered a risk. Also, the assumption that asset return is normally distributed. Even though a diversified equity portfolio and market index return are reasonably symmetric, their distribution is not necessarily normal. Another critique is that the optimizations are based on a single-period of data. By using a short time period, it may not give sufficient data to provide necessary statistical significance which may be risky for long-term investors with a long investment objective, such as pension plans. But by increasing the length of historical data the relevance of the estimates for the forecast period may diminish (Michaud and Michaud 2008, 34-36) since the nature of the underlying market may have changed. Furthermore, input data are expected values, such as expected risk, return and correlations. These are often generated by historical data and such expectations fail to take into account new circumstances, especially extreme, low probability events. (Bacon 2012, 4f)

This make it important to analyze the individual asset data before proceeding to the portfolio analysis, since the output will never be better than the input statistics. Many problems regarding mean-variance optimization is the worry of over-fitting data. However, there are rarely any useful alternative and the robustness is often unappreciated (Michaud and Michaud 2008, 18f, 105).
3 Methodology

This chapter presents the methods used to finding answers to the problem statements. This includes a brief author background, choice of subject, methods and selection of sources of literature. It also goes through the statistical framework, data collection and practical approach as well as reflections upon the robustness of these methods.

3.1 Author background and perspective

When making a study, it is important for the author to be aware of its own knowledge and experience, not to influence the result in an unintentional way (Johansson-Lindfors, 1993, 25f). It also makes it easier for the reader to process the information with some background information about the author. Depending on the author’s background, such as social background, education, practical experience, he or she can have a need to justify the problem statement. For example, the mission of the author can be to challenge previous research or simply make supplements, which the author should make clear to the reader at an early stage. (Bjereld, Demker and Hinnfors 2018, 12) Different people have different opinions on the society. Since any subject can be analyzed from different perspectives it is important to be clear from what point of view the author makes its assumptions. Depending on the perspective, the problem can be formulated differently, which in turn effect the way the data will be collected. (Svenning 2003, 22f).

After studying the International Business Programme, with focus on economics, I have been working as a portfolio manager for 11 years. I have mostly managed different global allocation funds with macroeconomic top-down processes, both in forms of fund-of-funds and through direct investments in equities and fixed income, including different derivatives. I have also been leading manager for a Swedish equity fund, with a combined strategy of tactical beta
allocation and stock-picking. My own previous knowledge within the area covered by this thesis comes from both my academical background but also from 11 years of practical work in asset management. This means that I first of all is using the perspective of an investor, mostly professionally, but also as a citizen planning my pension. Although I have not strictly been investing in optimized mean variance portfolios, I have partially used the same techniques in risk management purpose, before adding or removing assets to or from a portfolio, such as calculating correlations between assets and simulating estimated ex ante risk and return of the portfolio.

3.2 Choice of subject

My experience is that fund clients are requesting more and more ethical and sustainable funds. I wish to examine the consequences of this change in demand and supply to form a better theoretical understanding of its effects. As a manager of a traditional actively managed fund, the objective is usually to outperform a specific and relevant benchmark. Often more specific goals are specified, either externally and or internally, such as how big the outperformance should be, over what timespan the outperformance should be attained, if it should be reached within a relative risk to benchmark and so forth. From experience, I find it important that the clients have a reasonable understanding of what the fund manager wish to accomplish so that the expectations of risk and returns are equivalent between clients and fund managers. When expectations other than pure risk-adjusted returns are in question, it makes it even more important for the portfolio manager and the clients to understand each other. Is it reasonable to assume a lower return or higher risk for an ethical fund? By how much? What part of SRI is most important, and in what way do the clients expect to be compensated in terms ethical or social preferences? A large institutional investor can specify a detailed, custom made investment portfolio that completely corresponds to their interest. But how about the average investor in a mutual fund, saving for the pension? In order to even begin discussing these
questions, is has to be established whether there are any significant differences in risk or return at all, hence this thesis.

I find there are two ways to approach the analysis. The first is an ex-post approach, where realized risk-adjusted historical performance data from mutual funds are analyzed, which are the results of analysts and managers skill in combination with all systematic and unsystematic risks. The second is an ex-ante approach which is performed by creating theoretical, hypothetical, portfolios based on historical data for the underlying assets, where the expected risk-adjusted figures of the outcome will be evaluated. There has been a lot of research on this subject. Many studies have been comparing actual realized risk and performance data. The outcome of these studies can partially be the result of manager skill, skewed sector tilts due to manager philosophy or screening preferences. I hope to contribute to the other studies with a theoretical approach where I simulate the fund market performance by a stochastic generation of optimal portfolios. In addition, I wish to examine if the effects on risk-reward is different under different market volatility, to see if the expectations should be different market regimes.

3.3 Choice of method
When researchers are investigating a topic two approaches can be used to test and verify a theory. A deductive method uses the existing theory at hand and formulate a problem statement. The next step is to perform an empirical study to verify whether the theory holds or not. An inductive method starts by performing empirical tests, that evolves to new studies that eventually can formulate general conclusions of a certain phenomenon and from this establish a new theory. (Svenning 2003, 55f) In this study I will perform a deductive method where I use the Modern Portfolio Theory, developed by Markovitz, described under the theory chapter. When collecting basis to analyze a scientific problem, it can be done by using either quantitative or qualitative data, or a combination of both. A quantitative method is best suited
when data consists of numbers and when analyzing averages, variations and relations. (Eriksson and Wiedersheim-Paul 2011, 87) A quantitative approach has the feature of generating numeric measurements for simple and effective comparison, selections and rankings. It can establish quantifiable norms and lead to repeatable processes and is favored if the decisions require economic justification. (Thamhain 2014, 4) Since I am investigating economic data and creating models using databases, I will use a quantitative approach.

3.4 Literature

When conducting research, it is important to go through the literature to establish what is already known in the subject, both to get a background but also to justify the own study (Bryman 2018, 130). It increases credibility in the specific area but can also provide support for the own argumentation. Therefore, it is important to always analyze and have a critical approach when reading literature (Bryman and Bell 2015, 101, 103).

Saunders, Lewis and Thornhill (2012, 82ff) separate sources into three categories, primary, such as reports and thesis, secondary such as journals, books and newspapers and tertiary such as indices, databases, encyclopedias etcetera. They highlight the need of using primary sources to not lose detailed information. The use of secondary sources is important to retrieve the current thinking as far as possible but with the risk of being dated. Tertiary sources are mainly to find introduction to a topic. I have as far as possible used primary sources but followed up with criticism and current analysis from secondary sources. I have used Business Source Premier, available through Umeå University Library, and recommended by Bryman and Bell (2015, 112) to search for peer reviews academic journals, which are detailed, written by experts and evaluated by other experts. For background studies, I have used keywords such as; Ethical investments, PRI investments, Modern portfolio theory, Sharpe ratio etcetera. To some extent I have used tertiary sources, mainly for financial data, but also as a source to explain certain
definitions. I have used books, primarily to be introduced to the subjects and guidelines for structuring the thesis.

3.4.1 Source Criticism
Source criticism is a collection of methods used to find out what is true, or at least probable. This is important since all knowledge comes from a source. Thurén (2013, 5-8) mentions four criteria; authenticity, time relationship, independence and tendency freedom (meaning the source should not be giving a false picture due to personal, financial or political interests). By using academical articles labeled “peer reviewed” the authenticity, independence and tendency freedom should somewhat be handled. Bryman (2018, 159) advise to be cautious when using secondary sources, especially regarding theories or research results, since they can give a deceptive picture of the primary source. The same goes for books, there is always a risk of books being dated, even when they are printed (Saunders, Lewis and Thornhill 2012, 88). I have strived to solve this by looking at the most recent research to manage time relationship.

The strength of the Internet is that it provides information quickly, easily and freely. It is however also associated with a weakness, that it is hard to know what information is reliable. The information can be too commercial or opinionated and even misleading or incorrect. Consequently, it is important to be selective when using the internet as a source for a research project (Bryman and Bell 2015, 115). Because of this I have avoided using internet as source when possible.

3.5 Data
For this project I am using secondary data, public data from Bloomberg database. I am using the holdings of the OMX Stockholm 30 Index, ISIN SE0000337842 (Nasdaq 2018a), the 30
most liquid Swedish stocks, and OMX GES OMXS30 Ethical Price Index, ISIN SE0002209304 (Nasdaq 2018b), where the second index is the ethically screened version of the first\(^1\). Any portfolio created using OMX Stockholm 30 Index will from here on be called a Standard portfolio, and portfolios created using OMX GES OMXS30 Ethical Index will be called an Ethical portfolio.

For this study I will use the Index members that existed in the Index by 2017-12-29. At this point of time there were 31 holdings in the OMX Stockholm 30 Index. The reason for this was Essity AB, a spin off from SCA AB, that was launched on the exchange in June 2017. Due to the lack of historical performance for this company, it is excluded from both indices in this study. Also, both A-shares and B-shares of Atlas Copco AB are in the index. Due to the high correlation between them and since UCITS regulations only allow a maximum of 10% for both A- and B-shares combined, the A-share is excluded from the portfolio universe. To calculate expected return for the risk-free rate I have used the OMRX Treasury Bill Index, ISIN SE0001356700 (Nasdaq 2018d), a short-term debt obligation backed by the Swedish government with data provided by Nasdaq.

Holdings vary over the years which gives a survivor bias. However, since this is true for both indices my assumption is that any skewed effect will be the same for both indices. The companies that are excluded at this point of time due to the ethical screening is Kinnevik AB, Swedish Match AB, Tele 2 AB and Telia co AB. By excluding both Tele 2 AB and Telia co

\(^1\) The OMX GES OMXS30 Ethical Index is an ethically screened version of the popular OMX Stockholm 30 Index. The population of OMXS30 is screened by GES Investment Services, a leading research and service provider for responsible investments. Companies that do not comply with the GES Global Ethical Standard and GES Controversial are removed. This means that the population can include less than 30 constituents. The screening is conducted twice a year in connection with the review of OMXS30. (Nasdaq 2018c)
AB, the communications Services sector is eliminated, providing a sector tilt in the ethical index. The total list of the securities in both indices and the number of assets in each sector can be found in Appendix 1.

As mentioned in the problem statement, I will do the same analysis for two different time periods. The first one for a longer period, 15 years, between year 2003 and 2017, later called normal market volatility. The second will be for a shorter period, 5 years, with higher market volatility, between year 2007 and 2011, which includes the financial crisis. I will call this high market volatility. Monthly standard deviation during the period 2003-2017 is 4,7% which gives an annual volatility of 16,2%. For 2007-2011 the respective numbers are 6,5% and 22,4%, that is, 38,7% higher. Market volatility and OMX S30 index performance in depicted in figure 3, below. The raw data will consist of monthly total return for all equities and indices. Gross dividends are used. Data source is Bloomberg and the data field is called “Total Return Index (Gross Dividends)”, code RT116.

*Figure 3. Monthly standard deviation*
3.6 Hypothesis testing

When performing a deductive research, it is important to have a hypothesis about the reality, usually formulated as a statement, in order to empirically test the theory. The purpose of the research is then to determine the correctness of the hypothesis. The basic principle is to create a null-hypothesis (H₀) and an alternative hypothesis (Hₐ). When testing a hypothesis it is the null-hypothesis that is tested. The hypothesis is testing the expected value as the status quo, how things have been or currently are. By rejecting the null-hypothesis the alternative hypothesis is consequently accepted. (Svenning 2003, 35, 55,78) The Alternative hypothesis can either be a one-tailed hypothesis or a two-tailed hypothesis. A one-tailed hypothesis is specifying whether the parameter of the test is indicating either a value less than mean (≤) or alternatively greater than (≥) the mean. A two-tailed hypothesis simply states that the parameter is not equal (≠) to the mean, without specifying whether it is smaller or greater than the mean. (Naghshpour 2012, 147)

When making a hypothesis test to compare two means, µ₁ and µ₂ of two populations the null-hypothesis can be written:

\[ H₀: µ₁ - µ₂ = d₀ \]

It is usually assumed that the means are the same until proven otherwise, which would give the following: (Körner and Wahlgren 2005, 139f; Naghshpour 2012, 145):

\[ H₀: µ₁ = µ₂ \]

An alternative way to express that there is no difference between the two means, gives: d₀ = 0

The null-hypothesis is rewritten:

\[ H₀: µ₁ - µ₂ = 0 \]

And the alternative hypothesis:

\[ Hₐ: µ₁ - µ₂ ≠ 0 \]
If, however, we have a strong belief that for example $\mu_1$ is greater than $\mu_2$ the alternative hypothesis can be written as:

$$H_A: \mu_1 > \mu_2 \text{ alternatively, } H_A: \mu_1 - \mu_2 > 0$$

Since the generation of an optimal portfolio without unethical companies can have both higher or lower values of expected risk and return than a standard portfolio, these tests will be performed with an alternative hypothesis such as: $H_A: \mu_1 - \mu_2 \neq 0$. But since the efficient frontier for ethical portfolios at best can be equal to, or to the right, of the efficient frontier for standard portfolios, the hypothesis for Sharpe ratio will be using: $H_A: \mu_1 - \mu_2 > 0$.

The hypotheses for this study are formulated accordingly, where:

$S =$ Standard portfolio, $E =$ Ethical portfolio, $R_i =$ Risk, $R_e =$ Return and $S_h =$ Sharpe

$$H_{01}: \mu_{S.e} - \mu_{E.e} = 0: \text{ There is no difference in expected portfolio return when unethical investments are excluded.}$$

$$H_{A1}: \mu_{S.e} - \mu_{E.e} \neq 0: \text{ There is a difference in expected portfolio return when unethical investments are excluded.}$$

$$H_{02}: \mu_{S.r} - \mu_{E.r} = 0: \text{ There is no difference in expected portfolio risk when unethical investments are excluded.}$$

$$H_{A2}: \mu_{S.r} - \mu_{E.r} \neq 0: \text{ There is a difference in expected portfolio risk when unethical investments are excluded.}$$

$$H_{03}: \mu_{S.sh} - \mu_{E.sh} = 0: \text{ There is no difference in expected Sharpe ratio when unethical investments are excluded.}$$

$$H_{A3}: \mu_{S.sh} - \mu_{E.sh} > 0: \text{ The Sharpe ratio is greater for standard portfolios compared to ethical portfolios.}$$
I will also investigate whether there are any differences in outcome during periods of more volatile markets. To do that I will repeat the hypotheses above for the two different sets of data, with normal volatility and high volatility.

3.7 Statistical significance

When the relationship between two variables are statistically significant it means that the relationship is so strong that it cannot be a coincidence, and that the relationship actually exists. Similarly does a statistically significant difference indicate a difference that is so strong that it cannot have been generated by random. When conducting a statistical test, we can never be 100% sure that the result is true, it is rather an expression of probabilities for different outcomes. (Carlsson and Rönér Douhan 1993, 45) There is always a risk of rejecting a true hypothesis, called type I error. This probability is set beforehand by the researcher by setting a level of significance, called Alpha or simply $\alpha$. A common level on $\alpha$ is 5% which indicate a 95% probability of a relationship between the variables tested. Another risk, called type II error, is to accept a false null-hypothesis. These two risks are interdependent. By reducing type I error, the risk of type II increases. (Körner and Wahlgren 2005, 122) The only way to reduce both type I and type II errors is by increasing sample size. (Naghshpour 2012, 155).

3.8 Paired sample t-test

The next step is to decide what statistical method to use for testing the correctness of the hypothesis. The best way to find out if there is a significant difference between the means of two sample groups with dependent data is to perform a paired sample t-test. The samples are dependent since for each data sample there are two optimal portfolios with different characteristics, one including unethical companies, and one excluding unethical companies. When conducting a t-test it is important that the sample has a normal distribution (Carlsson...
and Rönér Douhan 1993, 53) which I will assume due to the many resampling’s made from bootstrapping, see below. For the alternative hypothesis \( H_A: \mu_1 - \mu_2 = 0 \) I will use a two-tailed t-test. For a two-tailed t-test with significance level (\( \alpha \)) 5% and 1 000 observations (n) the critical region is from -1,96 to +1,96. For a t-value within this region, the null-hypothesis holds, and there is no significant difference between the two means. If the t-value is outside of this interval the null-hypothesis is rejected and the alternative hypothesis is accepted. For the alternative hypothesis \( H_A: \mu_1 - \mu_2 > 0 \) a right-tailed t-test will be performed. At \( \alpha \) 5% the critical t-value is 1,65. A t-value greater than 1,65 gives support to reject the null-hypothesis.

The formula for a paired sample t-test is the following:

\[
t = \frac{\bar{x}_D}{\frac{\sigma_D}{\sqrt{n}}}
\]

Where \( \sigma_D \) is the sample standard deviation and n is the sample size and \( \bar{x}_D \) is the mean difference between the samples:

\[
\bar{x}_D = \frac{\sum (x_1 - x_2)}{n},
\]

Another way to investigate whether the hypothesis holds is by calculating the probability value (p-value). It shows the probability of finding a value, equal or more extreme, than was actually observed in the test. Its maximum probability is equal to the probability of type I error. The smaller the p-value the greater support for the alternative hypothesis. A p-value less than 0,1 indicates a support of rejecting the null-hypothesis. (Carlsson and Rönér Douhan 1993). For this thesis, an even stricter rejection rule of 0,05 will be used.
3.9 Confidence interval

With some knowledge of the population we can predict the probability for different possible outcome of a random selection (Körner and Wahlgren 2005, 100). For a large sample the formula for a confidence interval of a population is:

$$\bar{x} \pm t \frac{\sigma}{\sqrt{n}}$$

where n is the sample size, $\bar{x}$ sample mean and $\sigma$ the sample standard deviation. $t$ is determined by the normal distribution table. For a two-sided test with 95% level of significance, $t = 1.96$.

When performing a confidence interval for two dependent samples new variables of the differences are calculated by:

$$\bar{x}_D = \frac{\sum x_1 - x_2}{n}, \quad \sigma_D = \sqrt{\frac{\sum (x_1 - x_2 - \bar{x}_D)^2}{n-1}}$$

This gives:

$$\bar{x}_D \pm t \frac{\sigma_D}{\sqrt{n}}$$

By using a significance level of $\alpha = 5\%$ we can create a confidence interval where the population mean will be included 95% of the times a resample is being made. In this case the mean difference between standard and ethical portfolios regarding return, risk and Sharpe ratio.

3.10 Bootstrap

One way to investigate the difference in risk and return for a standard and a corresponding ethical portfolio would be to simply do two optimizations and compare the statistics of the portfolios. But with few data points it would be hard to validate the outcome. I have solved this by using Bootstrap.

The word bootstrap comes from the expression “lifting oneself by one’s own bootstrap” with the meaning of relying on your own resources, in this case of the selection you already have.
(Vejde and Leander 2000, 31f). More specifically “the Bootstrap is a replication procedure that creates replicates by selecting samples with replacement from the original sample” (Fuller 2009, 271). By making a large number of repetitive calculations out of the same sample it is possible to estimate the shape of a statistics sampling distribution and make inference about populations parameters (Körner and Wahlgren 2005, 131). The most common method to do this is through the development of confidence intervals of the population mean and the parallel test of hypothesis (Mooney and Duval 1993, 30ff).

Assume $x$ is one of the assets. For all data points for asset $x$ in my sample and where $n$ is the number of monthly data points, I have the following time series:

$$[x_1] [x_2] \ldots [x_n]$$

By bootstrapping the sample mean, I will randomly pick one data point at a time from the sample, with the possibility of the same value being selected more than once. The procedure will be repeated $n$ number of times. This gives the first bootstrap sample:

$$[x_1^*] [x_2^*] \ldots [x_n^*]$$

The average of the bootstrap sample, $\bar{X}_1^*$, can then be calculated:

$$\bar{X}_1^* = \frac{1}{n} \sum_{i=1}^{n} x_i^*$$

One bootstrap resample doesn’t add much information, so the above procedure is repeated a large number of times, $N$, giving the following expression:

$$[\bar{X}_1^*] [\bar{X}_2^*] \ldots [\bar{X}_N^*]$$

Through these many repetitions we will produce a sampling distribution of $\bar{X}^*$. It is assumed to have a normal distribution from which statistical inferences can be made and compared to the original population. Provided that the sample is reasonably large, and the repetition is being made many times, the estimated distribution of the standard error of the sample mean can be a good approximation of the standard error of the population mean. (Freedman 2009, 155ff)
For this thesis I set $N = 1000$, meaning a resampling of the historical return of equities and index 1000 times, which is considered a very large number of repetitions (Fuller 2009, 274). From that data I have generated 1000 optimal standard portfolios and 1000 optimal ethical portfolios using normal volatility data and the same exercise using high volatility data. Since expected return is assumed to be normally distributed and I am resampling the same amount of data points as the sample size (number of months) I will perform a parametric bootstrap (Freedman 2009, 167).

3.11 Practical approach and Portfolio Construction

Data was downloaded from Bloomberg to excel. No calculations or manual manipulation of the raw data were made. The operations were performed in two steps, using the two different data time sets for normal and high market volatility. For each step, data was retrieved from an Excel spreadsheet to MATLAB where all calculations were performed. To identify mean-variance efficient portfolios, different methods can be used depending on number of restraints, number of assets etcetera. When an optimization includes linear inequality constraints and multiple assets “quadratic programming” is preferred, which allows maximization of expected return and minimization of the variance. (Michaud and Michaud 2008, 23) By using the bootstrap formula, a new time series for each stock and index were generated and calculations for average risk and return, correlation coefficients and optimization were performed. The optimization restrictions where integrated in the code. The assumptions where that the sum of all holdings equals 100%, no leverage, no short positions and a cap where no single holding could be larger than 10%. No considerations were made to the hypothetical capital size of the portfolio and all market impact such as spread cost were assumed to be zero. From this, two optimal portfolios were being made, one standard and one ethical. Data for expected return and expected risk for these optimal portfolios were gathered in a new field. Thereafter, the risk-free rate was subtracted from the expected return and divided by the standard deviation, generating
the Sharpe Ratio. This resulted in 3 data points for the standard portfolio; expected return, expected risk and Sharpe Ratio, and the same for the ethical portfolio, a total of 6 data points. This procedure was bootstrapped 1 000 times collecting a total of 6 000 data points. After this, a new operation using high market volatility data was performed, doubling the total amount of output data. Data was then transferred back to excel were t-tests were executed, confidence intervals calculated as well as output graphs being made, which are presented under results and formed the base for the conclusions.

3.12 Validity

Several factors can challenge a scientific study. Validity is a concept aiming to validate the findings, that the study actually was measuring what it intended to. Internal validity concerns the projects itself and decision on its design (Svenning 2003, 64f). There must be a conformity between the definitions and the measurable outcome (Eriksson and Wiedersheim-Paul 2011, 60). I have for this study used quantitative data which makes it easier to achieve internal validity. The definitions of expected risk and return as well as theories of portfolio optimizations are well defined. However, under demarcations and data selection I have mention a couple of decisions, where other decisions theoretically could create different results.

Construct validity is about the whole theoretical foundation of the study (Svenning 2003, 65). The measured value from an operational definition must be equivalent to the outcome in reality. The use of numbers can sometimes give a more precise impression than is actually the case. (Eriksson and Wiedersheim-Paul 2011, 61). Since input data are based on historical data there is a risk that the same expected values and correlations may not be accurate in providing future projections. Also, if choosing another time span, the indices might have different members and different assets might have been excluded for ethical reasons. Furthermore, this study is performed using an index with few holdings, where the exclusion of a number of holdings can
have great impact and possibly create stile tilts such as involuntarily sector allocations, due to high idiosyncratic risk, which in turn can affect the result. This means that the results from this study may not necessarily be applicable on index of other markets with more holdings. Also, the share of controversial stocks may vary between different geographical regions (Trinks and Scholtens (2017, 197). Moreover, general criticism of Modern Portfolio theory can challenge the overall theory used in this study. That is however true for all studies using this theory.

3.13 Reliability

Reliability within research methodology means that for a study to be reliable, two investigations with the same purpose and same methods should give the same result. (Svenning 2003, 67). I am using a random resampling method, Bootstrap, which in theory could generate different outcomes. But by doing this 1000 times this problem should be minimized.
4 Results

This chapter presents the results from all the optimizations and statistical tests. First, results of portfolio optimizations using unprocessed data before Bootstrap for two different volatility regimes will be presented. Next, the results using Bootstrap replications for normal volatility will be presented, followed by findings using high volatility market data and last a comparison between the two. For each subsection showing the results from Bootstrap optimizations the finding in terms of return, risk and Sharpe ratio are presented separately.

4.1 Optimizations without Bootstrap: Normal volatility

Before presenting the main results for the Bootstrap replications and the corresponding tests, I will present two optimal portfolios for each volatility regime, using unprocessed data. Figure 4 shows a plot diagram with the optimal tangent portfolios for standard and ethical portfolios under normal volatility, together with all assets. The efficient frontier for the ethical investment universe is positioned on the inside (east) of the efficient frontier of the standard portfolio.

Figure 4. Efficient portfolios before bootstrap. Normal volatility
The ethical Tangent portfolio has a higher expected return, but also a higher expected risk than the standard Tangent portfolio. Since the slope of a potential line between the ethical Tangent portfolio point and the risk-free rate is less steep than the CML connecting the standard tangent portfolio with the risk-free rate, it indicates that the Sharpe ratio is lower for the ethical portfolio. We can’t however say anything whether the difference of the risk-adjusted returns of these portfolios are significant or not.

4.2 Optimizations without Bootstrap: High volatility

Figure 5 shows the optimal tangent portfolios for standard and ethical portfolios under high volatility, using unprocessed data before Bootstrap replications. Again, the efficient frontier for the ethical investment universe is on the inside (east) of the efficient frontier. Here, the ethical Tangent portfolio has a lower expected return, and a higher expected risk compared to the standard portfolio. With both higher risk and lower return, the risk-adjusted return is obviously worse for the ethical portfolio, but we can tell if the difference is significant.

*Figure 5. Efficient portfolios before bootstrap. High volatility*
4.3 Optimizations using Bootstrap: Normal volatility

Figure 6 shows a plot of all expected returns and expected risks for 1000 optimal standard tangent portfolios and 1000 optimal ethical tangent portfolios, created using 1000 Bootstrap replications based on normal volatility data. The dispersion of the plots appears similar and circle-shaped, which indicate a normal distribution of both return and risk. A simple visual inspection shows that the ethical portfolios in general are located further out on the risk axis, but not particularly different regarding the location in terms of expected return. To find out if there are any significant differences, we need to look at the t-tests.

Figure 6. Optimal portfolios 2003-2017, expected risk and return
4.3.1 Return

The following hypotheses were stated regarding expected return under normal volatility:

\[ H_{01}: \mu_{S,Re} - \mu_{E,Re} = 0 \]
\[ H_{A1}: \mu_{S,Re} - \mu_{E,Re} \neq 0 \]

When investigating the average annual return, see statistics in table 1, of the portfolios the ethical average is higher than the standard portfolio, 26.82% compared to 26.05%. The standard deviation of the return of ethical portfolios is 5.75% compared to 5.16% for standard portfolios. The paired two-sided t-test with 5% significance level shows a t-value of -18.84 and p-value 0.00. This suggests that we should reject the null-hypothesis and instead accept the alternative hypothesis. This mean that there is a significant difference of 0.76 percentage between the return of standard and ethical portfolio.

*Table 1. Statistics: expected return, normal volatility.*

<table>
<thead>
<tr>
<th>Statistics</th>
<th>Return standard</th>
<th>Return ethic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>26.05%</td>
<td>26.82%</td>
</tr>
<tr>
<td>St dev</td>
<td>5.16%</td>
<td>5.75%</td>
</tr>
<tr>
<td>Conf. Interval Lower</td>
<td>25.73%</td>
<td>26.46%</td>
</tr>
<tr>
<td>Conf. Interval Upper</td>
<td>26.37%</td>
<td>27.17%</td>
</tr>
</tbody>
</table>

Two-sided paired sample t-test. N=1000, df=999, t-critical 1.96

| t-value                     | -18.84          |
| p-value, two sided          | 0.000           |
| Mean difference             | 0.76%           |
| St dev difference           | 1.28%           |
| Conf. Interval Lower        | 0.68%           |
| Conf. Interval Upper        | 0.84%           |
4.3.2 Risk

The following hypotheses were stated regarding expected risk under normal volatility:

\[ H_{02}: \mu_{S,Ri} - \mu_{E,Ri} = 0 \]
\[ H_{A2}: \mu_{S,Ri} - \mu_{E,Ri} \neq 0 \]

When investigating the average portfolio volatility, see statistics in table 2, the average for the ethical portfolio is higher than for the standard portfolio, 17.25% compared to 15.71%. The results of the paired two-sided t-test with 5% significance level gives a t-value of -71.56 and a p-value of 0.00. This gives support to reject the null-hypothesis and instead accept the alternative hypothesis. This mean that there is a significant difference of 1.55 percentage between the expected risk of standard and ethical portfolios.

Table 2. Statistics: expected risk, normal volatility.

<table>
<thead>
<tr>
<th>Statistics</th>
<th>Risk standard</th>
<th>Risk ethic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>15.71%</td>
<td>17.25%</td>
</tr>
<tr>
<td>St dev</td>
<td>1.70%</td>
<td>1.80%</td>
</tr>
<tr>
<td>Conf. Interval Lower</td>
<td>15.60%</td>
<td>17.14%</td>
</tr>
<tr>
<td>Conf. Interval Upper</td>
<td>15.81%</td>
<td>17.36%</td>
</tr>
</tbody>
</table>

Two-sided paired sample t-test. N=1000, df=999, t-critical 1.96

| t-value                  | -71.56        |
| p-value, two sided       | 0.000         |
| Mean difference          | 1.55%         |
| St dev difference        | 0.68%         |
| Conf. Interval Lower     | 1.50%         |
| Conf. Interval Upper     | 1.59%         |
4.3.3 Sharpe ratio

The following hypotheses were stated regarding the Sharpe ratio under normal volatility:

\[ H_{03}: \mu_{s.sh} - \mu_{e.sh} = 0 \]

\[ H_{A3}: \mu_{s.sh} - \mu_{e.sh} > 0 \]

When investigating the average Sharpe ratio, see statistics in table 3, the average of standard portfolio is higher than for the ethical portfolio, 1.58 compared to 1.48. The results of the paired one-sided t-test with 5% significance level gives a t-value of 57.59 and a p-value of 0.00. This gives support to reject the null-hypothesis and instead accept the alternative hypothesis which says that the Sharpe ratio is significant greater for standard compared to ethical portfolios, with on average 0.1. The interpretation of his is that for each unit of risk, the standard portfolio will give 0.1% higher return than the ethical portfolio. 95% of the times the difference of the Sharpe ratio will be within the range of 0.097 and 0.104.

**Table 3. Statistics: Sharpe ratio, normal volatility.**

<table>
<thead>
<tr>
<th>Statistics</th>
<th>Sharpe standard</th>
<th>Sharpe ethic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>1.58</td>
<td>1.48</td>
</tr>
<tr>
<td>St dev</td>
<td>0.35</td>
<td>0.34</td>
</tr>
<tr>
<td>Conf. Interval Lower</td>
<td>1.56</td>
<td>1.46</td>
</tr>
<tr>
<td>Conf. Interval Upper</td>
<td>1.60</td>
<td>1.50</td>
</tr>
</tbody>
</table>

**One-sided paired sample t-test. N=1000, df=999, t-critical 1.65**

- t-value: 57.588
- p-value, two sided: 0.000
- Mean difference: 0.100
- St dev difference: 0.055
- Conf. Interval Lower: 0.097
- Conf. Interval Upper: 0.104
4.4 Optimizations using Bootstrap: High volatility

Figure 7 shows a plot diagram of all expected returns and expected risks for 1 000 optimal standard tangent portfolios and 1 000 optimal ethical tangent portfolios, created by performing 1 000 Bootstrap replications based on high volatility data.

A first visual inspection indicates that the dispersion of the plots appears similar and circle-shaped, which indicate a normal distribution of both return and risk. It also looks like that the ethical portfolios in general are located further out on the risk axis, but not particularly different regarding the location in terms of expected return. To find out if there are any significant differences, we need to look at the t-tests.

Figure 7. Optimal portfolios 2007-2011, expected risk and return.
4.4.1 Return

The following hypotheses were stated regarding expected return under high volatility:

\[ H_{01}: \mu_{S,Re} - \mu_{E,Re} = 0 \]
\[ H_{A1}: \mu_{S,Re} - \mu_{E,Re} \neq 0 \]

When investigating the average annual return, see statistics in table 4, of the portfolios the standard portfolios show a higher return compared to the average of ethical portfolios, 22.49% compared to 21.33%. The standard deviation of the return is however higher for the ethical portfolios, 11.50% compared to 10.02% for standard portfolios. The paired two-sided t-test with 5% significance level shows a t-value of 13.09 and a p-value of 0.00. This tells us to reject the null-hypothesis and instead accept the alternative hypothesis. This means that there is a significant difference in the return of 1.16 percentage between standard and ethical portfolios.

**Table 4. Statistics: expected return, high volatility.**

<table>
<thead>
<tr>
<th>Statistics</th>
<th>Return standard</th>
<th>Return ethic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>22.49%</td>
<td>21.33%</td>
</tr>
<tr>
<td>St dev</td>
<td>10.02%</td>
<td>11.50%</td>
</tr>
<tr>
<td>Conf. Interval Lower</td>
<td>21.86%</td>
<td>20.62%</td>
</tr>
<tr>
<td>Conf. Interval Upper</td>
<td>23.11%</td>
<td>22.04%</td>
</tr>
</tbody>
</table>

**Two-sided paired sample t-test. N=1000, df=999, t-critical 1.96**

- t-value: 13.09
- p-value, two sided: 0.000
- Mean difference: 1.16%
- St dev difference: 2.79%
- Conf. Interval Lower: 0.98%
- Conf. Interval Upper: 1.33%
4.4.2 Risk

The following hypotheses were stated regarding expected risk under high volatility:

\[ H_{02}: \mu_{S,Ri} - \mu_{E,Ri} = 0 \]

\[ H_{A2}: \mu_{S,Ri} - \mu_{E,Ri} \neq 0 \]

When investigating the average portfolio volatility, see statistics in table 5, the average for ethical portfolios is higher than for the standard portfolio, 21.27% compared to 18.83%. The results of the paired two-sided t-test with 5% significance level show a t-value of -52.65 and a p-value of 0.00. This gives support to reject the null-hypothesis and instead accept the alternative hypothesis. This mean that there is a significant difference in the expected risk of standard and ethical portfolios of 2.44 percentage.

Table 5. Statistics: expected risk, high volatility.

<table>
<thead>
<tr>
<th>Statistics</th>
<th>Risk standard</th>
<th>Risk ethic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>18.83%</td>
<td>21.27%</td>
</tr>
<tr>
<td>St dev</td>
<td>3.20%</td>
<td>3.45%</td>
</tr>
<tr>
<td>Conf. Interval Lower</td>
<td>18.63%</td>
<td>21.06%</td>
</tr>
<tr>
<td>Conf. Interval Upper</td>
<td>19.03%</td>
<td>21.49%</td>
</tr>
</tbody>
</table>

Two-sided paired sample t-test. N=1000, df=999, t-critical 1.96

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>t-value</td>
<td>-52.65</td>
</tr>
<tr>
<td>p-value, two sided</td>
<td>0.000</td>
</tr>
<tr>
<td>Mean difference</td>
<td>2.44%</td>
</tr>
<tr>
<td>St dev difference</td>
<td>1.47%</td>
</tr>
<tr>
<td>Conf. Interval Lower</td>
<td>2.35%</td>
</tr>
<tr>
<td>Conf. Interval Upper</td>
<td>2.53%</td>
</tr>
</tbody>
</table>
4.4.3 Sharpe ratio

The following hypotheses were stated regarding the Sharpe ratio under high volatility:

\[ H_{03}: \mu_{S.sh} - \mu_{E.sh} = 0 \]
\[ H_{A3}: \mu_{S.sh} - \mu_{E.sh} > 0 \]

When investigating the average Sharpe ratio, see statistics in table 6, the average of standard portfolio is higher than for the ethical portfolio, 0,94 compared to 0,75. The result of the paired one-sided t-test with 5% significance level gives a t-value of 55,89 and a p-value of 0,00. This gives support to reject the null-hypothesis and instead accept the alternative hypothesis which says that the Sharpe ratio is a significant greater for standard compared to ethical portfolios with on average 0,184. The interpretation of his is for each unit of risk, the standard portfolio will give 0,184% higher return than the ethical portfolio. 95% of the times the difference of the Sharpe ratio will be within the range of 0,177 and 0,19.

Table 6. Statistics: Sharpe ratio, high volatility.

<table>
<thead>
<tr>
<th>Statistics</th>
<th>Sharpe standard</th>
<th>Sharpe ethic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>0,94</td>
<td>0,75</td>
</tr>
<tr>
<td>St dev</td>
<td>0,50</td>
<td>0,47</td>
</tr>
<tr>
<td>Conf. Interval Lower</td>
<td>0,91</td>
<td>0,72</td>
</tr>
<tr>
<td>Conf. Interval Upper</td>
<td>0,97</td>
<td>0,78</td>
</tr>
</tbody>
</table>

One-sided paired sample t-test. N=1000, df=999, t-critical 1,65

<table>
<thead>
<tr>
<th>t-value</th>
<th>55,890</th>
</tr>
</thead>
<tbody>
<tr>
<td>p-value, two sided</td>
<td>0,000</td>
</tr>
<tr>
<td>Mean difference</td>
<td>0,184</td>
</tr>
<tr>
<td>St dev difference</td>
<td>0,104</td>
</tr>
<tr>
<td>Conf. Interval Lower</td>
<td>0,177</td>
</tr>
<tr>
<td>Conf. Interval Upper</td>
<td>0,190</td>
</tr>
</tbody>
</table>
4.5 Optimizations using Bootstrap: Normal versus high volatility

In this section I will highlight the similarities and differences between the outcome when using normal- and high volatility data. A plotted diagram of all the expected returns and expected risks from all 4 000 tangent portfolios can be found in Appendix 2.

4.5.1 Return

The average returns are higher for both normal and ethical portfolios under normal volatility compared to under high volatility. The standard deviation of returns is almost twice as high under high volatility. The average return for ethical portfolios is however higher than the standard portfolios under normal volatility and the opposite is true under high volatility.

4.5.2 Risk

The average risks are higher for both normal and ethical portfolios under high volatility. The risk is 20% higher under high volatility for standard portfolios (18,83/15,71) and 23% for ethical portfolios (21,27/17,25). As described under the data section in chapter 3, the market risk was 37,8% higher under high volatility compared to normal volatility. Furthermore, the average risks are higher for ethical portfolios compared to standard portfolios, regardless of market volatility.

4.5.3 Sharpe ratio

The Sharpe ratios are higher for both standard and ethical portfolios under normal volatility compared to high volatility. The Sharpe ratio is higher for standard portfolios compared to ethical portfolios under both normal and high volatility. This can be seen by a visual inspection in figure 8, showing histograms of all calculated Sharpe ratios. The shape for standard and
ethical portfolio under normal volatility is similar, but the mean of standard portfolios is slightly positioned to the right, indicating a higher mean for standard portfolios. The shape of standard and ethical portfolio under high market volatility are generally flatter and more spread out, indicating a higher standard deviation.

Figure 8. Sharpe ratio
5 Concluding Remarks and Discussion

This chapter analyzes the results, discusses the theoretical and practical implications of the findings and gives suggestions for future research.

5.1 Analyzing and concluding the results

As concluded under results, all null-hypotheses have been rejected. That means that there is enough evidence to support the alternative hypotheses, stating that there is a significant difference in expected return and risk and that the Sharpe ratios for the standard portfolios are greater than for ethical tangent portfolios, regardless of normal or high market volatility.

That return is higher and risk is lower for both standard and ethical portfolios under normal volatility compared to high volatility come as no surprise, since underlying data for high volatility calculations contains more negative performance data and higher standard deviation. We also saw that the change in portfolio risks were lower than for the overall market during the two different market climates. This is probably an effect of avoiding low performing, high risk stocks during the optimizations. Moreover, in both scenarios the average risk is higher for ethical portfolios, which corresponds to the theory with less opportunities of diversification. For example, the lack of investments in the Communications Service sector can potentially cause this. Companies within the same sectors move closer together since they can be affected similarly by the same external shock (good or bad), and by eliminating one sector completely a large part of the diversification benefits can be lost (Markowitz 1959, 6). Interestingly, the expected return is higher for the ethical portfolio during normal market volatility. This can be explained by a move northeast within the opportunity set, rendering both higher risk and higher expected return. When investigating the Sharpe ratios, we find that the Sharpe ratio is significant higher for normal portfolios compared to ethical portfolios, independent of market

52
volatility. This means that the ethical portfolios not have been enough compensated in terms of return for adding more risk. Since the efficient frontier is curved due to diminishing marginal return to risk it makes sense that by moving past the optimal portfolio, the Sharpe ratio will also decrease. This is intuitive since the efficient frontier for any portfolio with excluded investment opportunities should at best be equal to the efficient frontier without exclusions, or further out to the right. If it is to the right, the slope of the SML should be less steep and its tangent portfolio will consequently have a lower Sharpe ratio. This effect is explained in figure 9. Point T can be interpreted as the tangent portfolio for standard portfolios while A can be a proxy for the ethical screen during normal data and point C a proxy for the ethical screen during high volatility. Portfolio A shows a higher return \((r_A)\) but also a higher risk \((\sigma_A)\) and portfolio B shows lower return \((r_B)\) but higher risk \((\sigma_B)\) compared to portfolio T \((r_T \text{ and } \sigma_T)\). We can see by arrows a and b, that the CML has tilted and is flatter in A and B. Since the slope of CML is equal to the formula of the Sharpe ratio, we can tell that the Sharpe ratio is lower in point A and B, compared to T. We have through the t-tests showed that this difference is significant.

Figure 9. Efficient frontier and Sharpe ratio.
But if the return is higher for an ethical portfolio in point A, won’t that give a higher pension for the investor even if the risk is higher? The answer is no. By using the same risk, $\sigma_A$, we can find a new portfolio on the Standard efficient frontier, north of point A, with a higher return, and even better Sharpe ratio than A, but worse than for portfolio T.

The relative Sharpe ratio (average Sharpe ratio of ethical portfolio divided by average Sharpe ratio of standard portfolio) is much lower during high volatility, $0.80 (0.75/0.94)$ compared to $0.94 (1.48/1.58)$ for normal volatility. This means that the relative difference in risk-adjusted return is even worse for ethical portfolios during a more volatile market. This finding corresponds to arguments that SRI is more sensitive to recession. Excluding controversial companies from the portfolio gives a relatively higher risk and deteriorated risk-adjusted return in times of market turbulence. On occasions of recessions or events that has a negative impact on the overall financial market, correlations tend to move closer to 1. This can partially explain why the portfolio risk is that much higher, besides the obvious fact that the individual assets also have higher volatility, but it doesn’t explain the relative difference.

To conclude the findings in this thesis, there is a significant difference in the risk-adjusted return when ethical companies are removed from the investable universe. The investor is penalized in terms of risk and return when prioritizing his or hers moral believes. This effect is reinforced under more volatile market conditions.

5.2 Theoretical and practical implications

Although previous research within this topic is inconclusive, partly depending on large variations in terminology and methods, I find a tilt towards a reduced risk-adjusted return for SRI using negative screening, which is also the result of my own study. This can be interpreted as if there is an alternative cost for investments for a more moral and socially accepted society,
a cleaner environment and such. The basic assumption in modern portfolio theory is that the investor is rational; implying that its only concern when making investment decisions is the expected risk and return, is assumed to be risk averse and prefer higher to lower returns, meaning that for any given level of return, he or she wishes the lowest possible risk. By excluding certain companies for various SRI reasons and accepting a suboptimal portfolio in terms of risk and return, it shatters the basic assumptions and adds another argument into the equation. For a rational investor to make a deliberate decision like that, the cost of a negative screening must be compensated by other values besides risk-adjusted return, either objectively or subjectively. Similarly, if investors have an aversion towards unethical corporate behavior, they may require a lower rate of return from ethical companies. This raises another important issue. If the fund investor accepts a lower rate of return it might change the fund managers’ incentive to attain the best possible risk-adjusted return. How will economic efficiency be pursued if it is challenged by other factors and on what grounds will a fund manager be rewarded? (Renneboog, Ter Horst and Zhang (2008b, 1740f).

Friedman (1970) is discussing an interesting and important aspect of whose responsibility SRI is. My personal opinion is to have a broad legislation on universal issues which are formulated with a restriction of minimizing discrimination. It is important to make these rules universal in order not to distort competition. There is no gain of raising the cost of pollution in one country if another obeys other, less strict rules and will benefit from someone else’s shortfall. Also, penalties must be higher than the cost of violating the rules. Friedman (1970) and Mulligan (1986), agrees that this is a political responsibility, rather than a decision for individual corporations or company leaders. For other topics of more subjective character that corresponds more to one’s ethical believes I think this is best handled through ordinary supply and demand on a market with free competition. Heinkel, Kraus and Zechner (2001) shows that a company will change their way of doing business if enough investors avoid their stock.
Through knowledge and transparency, the power is in the hands of investors avoiding the stock and customers not buying the products or services. To facilitate this, I advocate stricter rules to make companies become more transparent to make it easier for investors and consumers to make informed decisions. A lot is happening, such as information of carbon footprint, but mostly for large investors that has the financial power and knowledge to tailor-make their investments. If the rising demand for SRI continues, it might even result in a self-fulfilling prophecy. If an investor expects other investors to take positions in SRI stocks, it might be a good idea to buy those stocks early, although the risk for bubbles must always be considered. With almost 4 000 billion SEK in mutual funds just in Sweden, it could potentially have a massive impact if allocated differently. I also think this requires a broad, diversified, and demand-driven fund industry, which is supported by the findings by Scholtens (2013, 614).

5.3 Future research

In the above note, one suggestion for further studies could be to investigate if the SRI fund market is picking up specific request, such as ethical preferences, from clients, or if it dutifully only provides a broad solution to profit on customer’s willingness to do good? Are the clients aware of the extra cost of their choice when saving for their pension, and are they fully compensated in terms of ethical and moral believes with the right portfolio for them? (Trinks and Scholtens (2017, 195). With regards to subjective preferences and variety of definitions, how can future product development facilitate for investors so that their values and moral orientations are matched with a suitable portfolio?

In this thesis I am investigating the tangent portfolios, which gives the best possible risk-adjusted return for any given investment universe. As we have seen, this gives room for a suboptimal portfolio with less holding to give a higher return, but at the cost of a relatively higher risk. It can also be of interest to investigate the extra amount of risk required for an
ethical portfolio to acquire the same amount of return as a standard portfolio. Or the other way around, how much loss of return must be accepted to maintain the same expected risk in an ethical portfolio, compared to a standard portfolio. A more quantifiable result like that could give the investor a more concrete answer of the potential loss of using SRI strategies. This is especially necessary when making long term strategic investment decisions, to decide whether the potential lack of return is tolerable for keeping the ethical and social morale intact. It also helps the fund manager accept the conflicting targets of maximizing return and at the same time creating suboptimal portfolios to attain other important values.

One demarcation in this thesis is the use of an index with 30 holdings. It can be interesting to expand the research and compare if there are any differences between a larger index where potentially more substitutes can exist. Markowitz (1959, 5) is however clear that it is not the number of assets that is most important, but rather their ability to contribute to diversification by a low correlation to the other assets.

SRI experiences a rapid growth around the world, and I expect this to continue. That is why more research is needed, to understand the impact on future savings but also to take into consideration the opportunity SRI has to make long-term impact on the world by creating other values than performance.
6 References


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Vejde, Olle and Leander, Eva. 2000. c, Borlänge: Vejde.
### 7 Appendices

#### 7.1 Appendix 1. Index constituents and number of assets per GICS sectors

<table>
<thead>
<tr>
<th>Standard</th>
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<td><strong>Communication Services</strong></td>
<td>(2)</td>
</tr>
<tr>
<td>Tele2 AB</td>
<td>x</td>
</tr>
<tr>
<td>Telia Co AB</td>
<td>x</td>
</tr>
<tr>
<td><strong>Consumer Discretionary</strong></td>
<td>(3)</td>
</tr>
<tr>
<td>Autoliv Inc</td>
<td>x</td>
</tr>
<tr>
<td>Electrolux AB</td>
<td>x</td>
</tr>
<tr>
<td>Hennes &amp; Mauritz AB</td>
<td>x</td>
</tr>
<tr>
<td><strong>Consumer Staples</strong></td>
<td>(2)</td>
</tr>
<tr>
<td>Essity AB</td>
<td>x</td>
</tr>
<tr>
<td>Swedish Match AB</td>
<td>x</td>
</tr>
<tr>
<td><strong>Energy</strong></td>
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</tr>
<tr>
<td>Lundin Petroleum AB</td>
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</tr>
<tr>
<td><strong>Financials</strong></td>
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</tr>
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</tr>
<tr>
<td>Skandinaviska Enskilda Banken</td>
<td>x</td>
</tr>
<tr>
<td>Swedbank AB</td>
<td>x</td>
</tr>
<tr>
<td>Svenska Handelsbanken AB</td>
<td>x</td>
</tr>
<tr>
<td><strong>Health Care</strong></td>
<td>(2)</td>
</tr>
<tr>
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<td>x</td>
</tr>
<tr>
<td>Getinge AB</td>
<td>x</td>
</tr>
<tr>
<td><strong>Industrials</strong></td>
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<td>Skanska AB</td>
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<td>Volvo AB</td>
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<tr>
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<tr>
<td>Telefonaktiebolaget LM Ericsson</td>
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</tr>
<tr>
<td><strong>Materials</strong></td>
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<tr>
<td>Boliden AB</td>
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<tr>
<td>SSAB AB</td>
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<tr>
<td>Svenska Cellulosa AB SCA</td>
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</tr>
<tr>
<td><strong>Total</strong></td>
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7.2 Appendix 2. Optimal portfolios, expected risk and expected return