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The Effect of ESG Screening on Risk, Reward, and Diversification

"Honesty is the best policy, when there is money in it"
Mark Twain

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Abstract

In the past decades, the interest in environmental, social, and corporate governance has grown immensely. An increasing part of investors is interested in the ESG performance of a company before investing in it through financial markets. Also, a great body of research has focused on the effects of ESG performance on financial performance of the firm, and on the financial performance of investing in those highly rated ESG companies. However, there still is a lack of consensus regarding the effects of investing in ESG companies on the return of investment. This thesis forms portfolios based on positive- and negative ESG screening and tries to capture the effects of those screening methods on risk, return and diversification. The findings indicate that both screening methods have no effect on the risk-adjusted return of a European portfolio for a retail investor. In line with prior research this thesis finds lower volatility of ESG screened portfolios, compared to the market portfolio. However, the idiosyncratic risk of the individual stocks in the portfolio is higher for the ESG screened portfolios, which is not as expected. Finally, ESG screening has a significant, but small, effect on the diversification of the portfolio. Overall, portfolios of retail investors in Europe, when well diversified, do not suffer from ESG screening.

Keywords: Investing, Environmental, Social, Governance, Socially Responsible Investing (SRI), Risk, Return, Diversification, European retail Investors.

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1. Introduction

In the last decades environmental, social and governance conduct of companies has become of increasing importance. Investors increasingly incorporate these factors in their portfolio construction process and are not only focused on financial gains, but also on the behavior of the companies they invest in. From 2016 to 2018 the market capital of socially responsible investments in the five major markets (Europe, The U.S., Japan, Canada, and Australia-New Zealand) increased with 34% (Global Sustainable Investment Alliance, 2018). This shows the extreme speed at which the socially responsible investment (SRI) market grows.

Even though the market grows at a high speed, consensus remains inexistent on whether SRI also serves an investor higher returns compared to conventional investing. For example, Galema, Plantinga, and Scholtens (2008) performed a study on the return and risk of socially responsible investing and compared it to conventional investing. They found no significant financial difference between the two. This is in contrast with results of the study of Fernandez-Izquierdo & Matallin-Saez (2008) who found that ethical mutual funds have a superior performance over conventional mutual funds. Also, Verheyden, Eccles, and Feiner (2016) formed portfolios of the best performing companies based on Environmental, Social, and Governance (ESG) ratings. They found that those portfolios deliver comparable investment returns, but the risk of the investment decreased. However, when portfolios are formed by excluding sectors that are active in controversial sectors (e.g., gambling or weapons) there are opportunity costs that arise in the form of lower risk-adjusted returns (Trinks & Scholtens, 2017). Finally, Humphrey & Tan (2014) used a screening method that excluded controversial sectors and a screening method that selects the best performing companies on ESG. They found that an investor neither gains nor loses in return and risk when using ESG screening. Another subject of investment performance is the diversification of a portfolio. Some studies claim that ESG screening methods significantly decrease the investment universe and, consequently, decrease the diversification opportunities (Rudd, 1981). Again, the conclusion that diversification levels decrease when using ESG screening methods is contested by multiple other studies. Hoepner (2010) developed a model where diversification is broken down into three components (number of stocks, intercorrelation, and idiosyncratic risk) and argues that ESG screening has opposite effects on those components. This results in the fact that diversification levels are not decreasing significantly. Besides, most studies are performed using a worldwide or U.S. collection of stocks or mutual funds while multiple studies show that European investors and fund managers have significantly different views on ESG investing (Amel-Zadeh & Serafeim, 2018; van Duuren, Plantinga, and Scholtens 2016).

The lack of consensus on the effects of ESG, together with the small body of research based on European investors raises the question why there are few studies that look at different screening methods in a European retail investment environment. Therefore, this study will attempt to answer the following research question:

What is the effect of ESG screening methods on risk, reward, and diversification for the European retail investor?

As a benchmark, the Euro Stoxx 50 is used in this study. This blue-chip stock index consists out of 50 companies from eight countries in Europe. Continuing from the benchmark, two different screening methods will be applied, based on ESG factors. The first screening

method is called best-in-class screening, which is a form of positive screening, and is applied by selecting the best performing companies from the Euro Stoxx 50 on the basis of their ESG rating. In this case, the best 75% of companies (based on their ESG score) are selected in the positively screened portfolio. The second screening method that is applied is negative screening. Using this method, companies are excluded from the portfolio based on their activities or sectors that they are active in. Companies active in the adult industry, alcohol, gambling, nuclear power, tobacco, and/or weapons are excluded from the portfolio.

The positive-, negative-, and benchmark portfolio are compared on three levels: portfolio risk- and return, stock-level risk, and portfolio diversification. On a portfolio level, the risk-adjusted return is evaluated by the Sharpe Ratio. The portfolio risk is measured by estimating the beta of the portfolio, which is a measure that shows the co-movement of the portfolio with the market. The stock-level risk is determined by calculating value at risk and drawing the 3-sigma distribution of the individual stocks in the portfolios. The 3-sigma distribution is calculated by taking all values that fall outside of three times the standard deviation from the mean. Finally, the diversification of the portfolios is evaluated. This is done by calculating the diversification ratio, which was developed by Choueifaty & Coignard (2008). This measure is calculated by dividing the summed weighted volatility of the individual stocks in the portfolios by the volatility of the portfolio itself.

This thesis contributes to existing research by extending the field of research regarding European retail investors. A small part of the existing research about the effects of ESG screening on investment performance is regarding the European investment universe. In addition, many studies construct portfolios that reflect a mutual fund structure with the number of holdings exceeding 1,000. A retail investor will have trouble to allocate their capital over so many holdings. Therefore, this study tries to replicate the investment universe for a retail investor by using a benchmark portfolio with 50 stocks and screening that portfolio to end up with less than 40 holdings. This could still be a realistic number of stocks for a retail investor. Also, this study compares two different screening methods to see which screening method is most beneficial for a retail investor that aims to invest not only for financial gain, but also to contribute to a better world. It extends existing research by focusing on the European investment universe and on retail investors.

The findings show that, in line with earlier research, there is no significant difference in risk-adjusted returns between conventional and ESG screened investment portfolios. Based on the Sharpe ratio of the three portfolios, it is shown that the differences are negligible and, after testing for statistically significant differences by using a two-sample t-test, no significance is found. The volatility of the portfolios, compared to the market portfolio is below one, based on daily stock returns. This indicates that the market risk is lower than the market itself, which is in line with prior research. Surprisingly, the individual stocks of the ESG screened portfolios show higher downside risk. Finally, it is found that the ESG screened portfolios suffer slightly but statistically significant on the subject of diversification. This could be caused by the substantially lower number of stocks or the correlation between the stocks in the portfolio.

The results imply that a retail investor that uses ESG screening to construct a portfolio does not suffer in risk-adjusted returns. He has slightly lower market risk, but has to pay attention to diversification. When a retail investor diversifies his portfolio sufficiently, he does not have to suffer on overall investment performance, while contributing to a better world. Finally, the results show no superior ESG screening method. This indicates that retail investors can choose the screening method of their preference.

The remainder of this thesis continues as follows. Section two discusses the existing literature and prior research. It shows the existing body of studies regarding the effects of corporate social performance on financial performance, the value for investors, and screening methods that are used by experts in the investment field. Section three describes the research method that is used in this thesis. The screening methods and the statistical measures that are used to compare the ESG portfolios with the unscreened portfolio are discussed. Section four presents the results. First, the portfolio risk and return are discussed. Secondly, the results on the stock-level risk are shown, and, finally, the effects of ESG screening on the diversification of the portfolios are discussed. Finally, section five concludes and discusses the results and their implications.

2. Literature Review

The relationship between the financial- and social performance of a company is studied extensively. Waddock & Graves (1997) were initiators in this field of interest by studying the relationship using two theories: good management theory and slack resources theory. The first theory argues that better social performance leads to better financial performance because good management improves the relationship with all stakeholders. The slack resources theory considers the opposite relationship: better financial performance leads to abundant resources which are then available for investment in social performance. Waddock & Graves (1997) construct a corporate social performance index and find a high correlation between social performance and financial measures. On the other side of the spectrum, they find a high correlation between financial performance and social performance. Based on these findings, they conclude that there is a simultaneous relationship between the two, where causation might move in both ways. This finding was partly confirmed when Zhao & Murrell (2016) replicated the study of Waddock & Graves (1997). They used an identical research method, but a larger sample period. The study confirmed the positive correlation between financial performance and subsequent social performance (slack resources theory), but it cast some doubt on the relationship between social performance and subsequent financial performance (good management theory). According to Melo (2012), the slack-resources theory is the least tested of the two. Therefore, he tests this theory and finds that prior financial performance positively affects social performance, which implies that the theory holds. Finally, Fauzi & Idris (2009) test both hypotheses simultaneously by performing a multiple regression analysis using financial- and social measures that were collected by means of a survey. Although the survey data has some subjectivity issues, the study shows that both the good management hypothesis and the slack resource hypothesis hold when considering the relationship between corporate financial performance and corporate social performance. The literature clearly shows a positive relationship between the financial and social performance of a company, but the direction of the causality is hard to establish.

Moving forward from the positive correlation between social and financial firm performance, this thesis tries to capture the relationship between environmental, social, and governance (ESG) performance and investment performance by constructing portfolios based on ESG measures. Based on the fact that a firm's financial performance improves when conducting a socially responsible business method, one would expect a positive relationship between ESG incorporation and investment returns (Fauzi & Idris, 2009). However, the existing literature is not conclusive on whether ESG investing yields a positive return compared to conventional investing (Revelli & Viviani, 2015). According to their meta-analysis of 85 studies and 190 experiments, there is no real benefit or downside detectable when it comes to ESG investing. If this is the case, one could argue that everyone should invest using ESG performance screening because there is no financial cost or benefit but you invest in companies that conduct their business socially responsible. Miralles-Quirós & Miralles-Quirós, (2020) compared investing in socially responsible exchange-traded funds (ETFs) to investing in ETFs consisting out of companies involved in alcohol, tobacco, and gambling. They did so by studying 60 ETFs in combination with the Fama-French five-factor model. The results indicated that investors focusing on a long-only strategy in socially

responsible funds obtained better risk-adjusted returns.[1] Bauer, Derwall, and Otten (2007) examined the performance of ethical and conventional mutual funds in Canada by developing a multi-factor model, following Carhart (1997). The results showed that the differences in financial performance between ethical mutual funds and conventional mutual funds were insignificant. This implies that investors in Canada can invest in ethical mutual funds without giving up on financial benefits. Galema et al,. (2008) construct portfolios themselves and try to capture the relationship between financial performance (book-to-market ratio and excess returns) and ESG factors. Their findings implicate that there is no excess return above the risk-free rate when investing responsibly. However, it does lower the book-to-market ratio. The empirical literature finds it hard to establish a direct effect of incorporating ESG factors on investment financial performance (Galema et al., 2008; Revelli & Viviani, 2015; Verheyden et al., 2016).

Giese, Lee, Melas, Nagy, and Nishikawa (2017) tried to develop a general framework on how ESG information translates to the company and investor value. According to their study, ESG information translates to the equity market through three channels: (1) the cash-flow channel, (2) the idiosyncratic risk channel, and (3) the valuation channel. Firstly, Firms that perform well on ESG factors are more competitive and generate higher returns because of a more efficient use of resources, better capital development and better use of innovations. Also, high ESG rated firms tend to have a longer-term business plan (Godfrey, Merrill, and Hansen, 2009). This leads to higher profitability and more value for investors. Secondly, Firms that have a higher ESG rating are better at managing risk because, typically, those firms have higher standards in risk control and compliance. These higher standards result in a decreased chance on a scandal or other severe incidents, which results in lower downside risk (Giese et al., 2017; Godfrey et al., 2009). Finally, firms that perform better on ESG factors have a decreased vulnerability to systematic risk. For example, a commodity- or energy efficient firm is less vulnerable to shocks in the prices of these commodities or energy sources. This results in a share price that is less dependent on those market factors and thus shows lower systematic risk. When a firm has lower systematic risk, the required return for investors is lower, following a CAPM framework. This lowers the expected cost of capital and increases the valuation of the company, following a discounted cash flow valuation method. In addition, the size of the investor base can explain a part of this transmission channel. Low ESG rated firms have a small investor base, compared to firms with high ESG ratings because risk-averse and socially conscious investors avoid low rated firms. Also, high ESG performing firms are generally more transparent, which decreases information asymmetry and attracts more investors (El Ghoul, Kwok, and Mishra, 2011; Giese et al., 2017; Hong & Kacperczyk, 2009). The results of Giese et al., (2017) supported the hypothesis that higher ESG rated companies were more profitable. This is also supported by the study of Gregory, Tharyan, and Whittaker (2014) who studied the source of the effect of social responsibility on firm value. Through regressions analyses and correlation matrices, they found that a better ESG rating leads to higher growth potential and improved profitability.

Giese et al. (2017) then focus on the idiosyncratic risk of a company. According to their results, especially tail risk is decreased for ESG superior companies. The study of Jo & Na (2012) is more detailed by arguing that the risk reduction mainly applies for companies in controversial sectors. However, Godfrey, Merrill, and Hansen (2009) performed an empirical

[1] In a long-only strategy, no short-selling is allowed.

test on the risk management hypothesis which states that firms performing better on ESG, are better at risk management. Their results showed that firms with a high ESG rating experience an insurance-like protection against negative events. This would decrease the downside risk substantially.

Finally, Giese et al. (2017) test the valuation channel. Their results show that companies with high ESG ratings are less vulnerable to systematic risk and also have less volatile earnings. This is also supported by the study of Dunn, Fitzgibbons, and Pomorski (2017) who researched the relationship between ESG performance and risks. They found that low ESG rated companies tend to have higher idiosyncratic risk, but also a higher beta, which shows increased systematic risk, compared to high ESG rated companies. The lower systematic risk also increases the number of investors, resulting in a lower cost of capital and a higher valuation (Giese et al., 2017). The number of investors increases because also risk-averse investors are willing to invest in the company. For example, pension funds, which are restricted in taking risk by their legally binding mandates, are now willing and allowed to invest in the highly rated companies. This is also in line with prior research of El Ghoul, Guedhami, Kwok, and Mishra (2011) who studied the effect of social performance on the cost of capital of a company. They also found that investing in social performance significantly contributes to lowering the cost of capital.

The risk of an investor's portfolio can be decreased by diversifying the portfolio. According to Hoepner (2010), diversification can be broken down into three main drivers. Firstly, the higher the number of stocks in a portfolio, the more diverse the portfolio is. Risk can be divided into systematic risk and idiosyncratic risk. According to economic theory, investors are rewarded for taking systematic risk, but not for idiosyncratic risk because this part can be diminished through diversification. The number of stocks that are optimal when an investor searches to diminish risk is studied extensively. A frequently quoted study is that of Chen & Li (2011) according to whom the optimal number of stocks is 30. Above this number, adding more stocks would not benefit the diversification of the portfolio. Other studies claim that the number of stocks to diminish idiosyncratic risk is above 60 (Surz & Price, 2000).

The second driver of diversification is the correlation between the stocks. When the stocks in a portfolio are perfectly positively correlated, no diversification benefits arise. However, when they are perfectly negatively correlated a loss of stock A gets compensated by a gain of stock B. Diversification benefits arise when the stocks in a portfolio are not perfectly positively correlated.

The final driver of diversification is the average specific risk of the stocks, which can be measured by the standard deviation of the individual stocks. According to Hoepner (2010), the incorporation of ESG factors negatively affects the first and second drivers of diversification and positively affects the final driver of diversification. ESG screening decreases the number of available stocks because the screened portfolio is a subset of the initial universe of stocks. Negative ESG screening methods, where certain industries or activities are excluded, show a higher correlation between the assets in a portfolio. In contrast, when a portfolio is positively screened (e.g., 75% best-in-class) the correlation between assets is quite comparable with an unscreened portfolio (Hoepner, 2010). Finally, the specific risk of the assets would be lower when they are selected on ESG performance. Therefore, ESG screening positively affects this last driver of diversification.

Verheyden, Eccles, and Feiner (2016) studied the effects of ESG from the investor's point of view. They study three channels through which ESG screening influences

investment performance. The risk and return on a portfolio level (1), the idiosyncratic risk of the individual stocks (2), and the diversification of the portfolio (3). They constructed worldwide and developed market portfolios, which were then separated into an unscreened portfolio, a 90% best-in-class portfolio, and a 75% best-in-class portfolio. The final two are formed by excluding the worst 10% and 25%, based on their ESG rating. The portfolios were empirically compared on return, risk, and diversification, comparable with the general framework of Giese et al. (2017). Across all portfolios, there was a high correlation in returns, which is as expected according to the meta-analysis of Revelli & Viviani (2015), where ESG performance did not significantly affect investment returns. The beta of the screened portfolios ranged between 0.98 and 1. This indicates that ESG screening slightly decreases systematic risk compared to the market average. In other studies, the risk-decreasing effect of ESG screening was more substantial (Jo & Na, 2012; Godfrey et al., 2009). However, the analysis on an individual stock level did indicate that the downside risk was significantly decreased by screening on ESG metrics (Verheyden et al., 2016). Based on daily stock returns, return distributions were drawn and the statistical 3-sigma tail limits were calculated.[2] The analysis showed a reduced 3-sigma tail limit, which indicates lower downside risk for the ESG screened portfolios. Finally, they assessed diversification on the three main drivers proposed by Hoepner (2010) and found that ESG screening decreased the number of stocks, increased the correlation between the stocks slightly, and decreased the specific risk in the portfolio (Verheyden et al., 2016). The results indicated that ESG screening did not harm the diversification of the portfolio substantially. In addition to comparing the portfolio diversification based on the three separate drivers, it would be convenient to use a general quantitative measure that reviews the level of diversification of a portfolio. Choueifaty & Coignard (2008) developed the diversification ratio which serves with an overall measurement of the diversification benefits a portfolio experiences. Verheyden et al. (2016) gratefully use this measure to give an overall consensus on the effect of ESG screening on diversification. The diversification ratio is calculated by dividing the sum of the weighted standard deviations of the individual assets in the portfolio by the standard deviation of the portfolio. When the ratio is high, an investor benefits from diversification because the summed weighted standard deviations of the individual assets are substantially higher compared to the portfolio standard deviation. Verheyden et al. (2016) show that the unscreened portfolios have a higher diversification ratio compared to the positively screened portfolios, although the differences are very small.

Previous research shows the effects of ESG screening on risk, return, and diversification, but how do professional investors use this information in their investment process? According to Amel-Zadeh & Serafeim (2018), the information is mostly used to apply a negative screening method. This type of screening excludes certain sectors or activities of companies. For example, companies that produce alcohol or weapons are excluded from the investment universe. Amel-Zadeh & Serafeim (2018) performed their research by means of a survey, conducted with U.S. and European professional investors. They found the general tendency in the results that European investors have a more widespread belief in the materiality of ESG information. European investors are also more optimistic about the value of ESG screening methods in general. They found that negative screening is applied most often, but is decreasing in popularity. This is in line with an earlier study of Eccles, Kastrapeli, and Potter (2017) who conducted a survey finding that

[2] This statistical measure is extensively discussed in section 3.3: Method of Analysis.

exclusionary screening is used by 47% of the respondents. Both studies find the same barrier for using ESG information. According to the respondents, the lack of ESG reporting standards results in difficulties when investors want to compare stocks on their ESG performance. Both studies are performed shortly before the activation of a new non-financial reporting standard by the European Commission (European Parliament, 2014). It could well be that European investors nowadays consider the lack of comparability as less of a barrier. European and US investors predict that positive screening and active ownership will become the main ESG strategies in the future, while negative screening will become of less importance. This makes it interesting to take a closer look at the differences between those screening methods in this thesis.

In the earlier mentioned study of Verheyden et al. (2016) positive screening was used by applying a threshold of 10% and 25%. This implies that only the best 90% and 75% are selected for the portfolio. In general, positive screening is the selection of assets for their good performance. In contrast, negative screening excludes companies based on their bad performance. Trinks & Scholtens (2017) mainly focus on negative screening and the opportunity costs that come along with it. By conducting a comparative mean-variance analysis on multiple controversial themes they find that negative screening results in a significant loss in the size of the investment universe and, consequently, in lower diversification possibilities. So, negative screening has a significant effect on diversification, but they do mention that it also depends on the strictness of the screening method that is employed. In addition, they find that investing in controversial stocks comes with additional returns. This also adds up to the opportunity costs of negative screening because returns are missed by excluding those controversial stocks. The study of Humphrey & Tan (2014) constructs portfolios using both negative- and positive screening. They aim to capture the impact of different screening methods on the risk and return of the portfolios. By using the Carhart four-factor model and the S&P 500 as the unscreened portfolio, they estimated the excess return and the beta of the screened portfolios and the unscreened portfolio. The results showed no significant difference in the return and risk segments. This is contrary to earlier studies that found a disadvantage by earning lower returns when excluding controversial stocks (Adler & Kritzman, 2008; Fabozzi et al., 2008; Trinks & Scholtens, 2017). In the study of Humphrey & Tan (2014), positive screening significantly decreases the number of stocks compared to the unscreened portfolio. However, negative screening does not significantly impact those number of stocks. This is again a confirmation that the effect of negative screening on diversification is largely dependent on the strictness of the screening method. A commonly used selection of sinful sectors or activities is "The Sextet of Sin", consisting out of six controversial sectors.[3] This screen is also used in the study of Lobe & Walkshäusl (2011) where also no significant financial downside to negative screening is found, in accordance with Humphrey & Tan (2014).

Revelli & Viviani (2015) performed a meta-analysis on 275 studies of which a major part focuses on a U.S. investor's view (130 studies), while fewer studies focus on the effects of ESG screening in Europe (26 studies). However, according to Amel-Zadeh & Serafeim (2018) and van Duuren et al,. (2016), there are significant differences in the views on ESG investing between investors and fund managers in the U.S. and Europe. Both studies conducted a worldwide survey on fund managers and found out that U.S. fund managers are more skeptical about the effects of ESG on investing performance. According to Amel-

[3] Adult Entertainment, Alcohol, Gambling, Nuclear Power, Tobacco, and Weapons

Zadeh & Serafeim (2018), investors in Europe see ESG information as more material. That finding is confirmed by the study of van Duuren et al. (2016) which states that U.S. fund managers have a less strong belief in the positive relationship between ESG and investment performance, in contrast with their European peers. This thesis tries to fill the gap of European-focused research on the effect of ESG screening methods on the main subjects of investing.

Following existing research on the effects of ESG screening on investment returns, there is no significant effect established. The results are largely dispersed across regions and research methods. Also, positive and negative screening don't seem to differ significantly in financial returns. These inconclusive findings result in the following hypotheses regarding portfolio risk-adjusted returns:

Hypothesis 1a: *Positive ESG screening has no effect on risk-adjusted portfolio return.*
Hypothesis 1b: *Negative ESG screening has no effect on risk-adjusted portfolio return.*

The effect of ESG screening on the risk of the stocks and the risk of the portfolio is also extensively studied. Based on the general tendency in the results of those studies, this thesis forms hypotheses on the portfolio- and stock-level risk. The portfolio risk is measured by the beta of the portfolio, while the stock-level risk is measured by the standard deviation of the separate stocks, calculating the value at risk, and by drawing the three-sigma distribution.

Hypothesis 2a: *Positive ESG screening leads to lower portfolio risk.*
Hypothesis 2b: *Negative ESG screening leads to lower portfolio risk.*

Hypothesis 3a: *Stocks in the positively screened portfolio show lower downside risk.*
Hypothesis 3b: *Stocks in the negatively screened portfolio show lower downside risk.*

Economic theory argues that the ESG screened portfolios suffer from diversification losses, mainly because the investment universe decreases in size. However, Hoepner (2010) breaks diversification down into three main drivers where ESG negatively influences diversification with the first two drivers and positively influences diversification with the third driver. In this thesis, the diversification of the portfolios will be measured using the diversification ratio by Choueifaty & Coignard (2008). Based on the existing research, the following hypotheses are formed:

Hypothesis 4a: *Positive ESG screening leads to a lower diversification ratio.*
Hypothesis 4b: *Negative ESG screening leads to a lower diversification ratio.*

All hypotheses are formed for the positively screened portfolio and the negatively screened portfolio. The expectation is that the screening method does not affect outcomes, but it could well be that the results differ between the two screening methods. In the next section, the method of testing those hypotheses is described extensively.

3. Research Method

This section will describe the research method of this thesis. In section 3.1, the variables and the procedure in collecting them will be described. Section 3.2 describes the formation process of the portfolios. The threshold for positive screening and the terms for the exclusion of stocks for the negative screening are discussed in this section. Section 3.3 describes the method of analysis for all three transmission channels of ESG: return, risk, and diversification.

3.1 Data sample description

To study the effects of ESG screening on a retail investor's performance, a comparative analysis will be performed on three levels. First, the portfolio return and risk will be compared between three portfolios: the benchmark portfolio, the positively screened portfolio and the negatively screened portfolio. Second, the individual stock risk will be evaluated and, finally, the portfolio diversification will be analyzed. This method is comparable to earlier a prior study of Verheyden et al. (2016). To perform the analysis on the portfolio return and risk, monthly stock return data will be retrieved from the Eikon database. In addition, ESG ratings are collected to positively screen the portfolio. To negatively screen the portfolio, the activities of the companies are retrieved from the Eikon database.

Eikon is a database for financial data which covers data on more than 400 stock exchange- and over-the-counter markets. It serves real-time data but also historical data, which is used for this study. It is one of the most used databases for financial professionals and represents 99% of the global market capitalization (*Refinitiv® Eikon*, 2019). The financial indicators available include pricing data, fundamental data, and industry-specific estimates going back at least 65 years. Access to the database is granted by the Radboud University. The database will be used to collect return data, market capitalization data, and ESG data on the Euro Stoxx 50. This index will be the benchmark portfolio in this study. Using this index as a starting point, ESG portfolios will be constructed. This index is used because it is a good reflection of the European investment universe for retail investors. This thesis aims to evaluate the effect of ESG on investing for European retail investors. The average asset portfolio of Dutch households was € 110,000 in 2019 (CBS, 2020), which makes it realistic that a European retail investor can allocate his funds over 50 stocks, therefore the Euro Stoxx 50 is used for this thesis.

The Euro Stoxx 50 is a leading blue-chip index in the Eurozone and contains 50 stocks of 8 Eurozone countries.[4] The index was initiated in 1998 and is rebalanced once every year (STOXX, n.d.). First, a list of constituents of the index from 2004 until 2018 is retrieved from Eikon, which results in a list of 77 companies. In Appendix A: Constituents Euro Stoxx 50, all constituents over time are listed. Secondly, the constituent list per year is collected from the same database. This list shows the composition of the index in each year starting in 2004. Then, the return and ESG data of all 77 companies are collected for the whole sample period. In order to only use the return- and ESG data of a company that is a part of the index in a particular year, a dummy variable is created. The dummy variable is equal to one when the company is part of the constituents list at a particular date and the variable is equal to zero when it is not. By deleting all data that is connected to the dummy value of zero, only

[4] Belgium, Finland, France, Germany, Ireland, Italy, the Netherlands, and Spain.

relevant data remains in the dataset. The companies in the Euro Stoxx 50 are weighted by free-float market capitalization. This method only considers the share of the market capitalization of a stock that is available for trade. For example, locked-in shares are not taken into account. The maximum weight each stock can have in the original index is 10%, to make sure the index stays diversified. If during the year a company is deleted due to stopping its activities, it is immediately replaced by a different company to keep the number of constituents at 50. When one of the companies goes through a merger or acquisition, the old stock gets replaced by the new stock. To perform the financial analysis, monthly returns are retrieved for all stocks in the Euro Stoxx 50 over time. This is in line with earlier studies that also used monthly return data (Trinks & Scholtens, 2017; Verheyden et al., 2016). Unfortunately, the free-floating market capitalization is not available in the subscription of the Radboud University. This thesis will use the regular market capitalization, available from Eikon. The regular market capitalization takes in account all outstanding shares of the company.

In addition to financial data, non-financial data in the form of ESG scores are retrieved from Eikon. The ESG score that will be used to positively screen the Euro Stoxx 50 is the overall ESG score which is developed by Refinitiv. This ESG score is calculated by capturing over 450 company-level measures. These measures are sorted into 10 categories that are allocated to the three pillars: Environmental, Social, and Governance. The three pillar scores are summed up and reflect the overall ESG score. In Appendix B: ESG Score Process, a graphical representation of the ESG Score calculation is shown for further clarification. Refinitiv calculates a score for the environmental performance of a company, the social performance, and the governance performance separately. Finally, the overall ESG score is the sum of those three pillars and ranges between 0 and 100. The lowest ESG score in the sample is 2.86 and belongs to Volkswagen in 2011. This is the year that the European Commission found out that the levels of harmful nitrogen dioxide exceeded the maximum emission according to the laws in the European Union (Clean Energy Wire, 2017). The highest ESG rating (94.64) belongs to Daimler in 2013, which is also a car manufacturer, but one who has a long-standing reputation in environmental focus (*Daimler Sustainability*, 2020). The mean ESG rating is 71.5 across all companies in all years from 2004 till 2019. The ESG ratings are used to perform a positive screening method on the Euro Stoxx 50. Section 3.2 elaborates on this screening method. To construct a negatively screened portfolio, particular companies are excluded from the benchmark portfolio (Euro Stoxx 50). The screen that is used is called the “Sextet of Sin”. To perform this screening method, activities and sectors of the companies in the Euro Stoxx 50 are retrieved from the Eikon database. The Euro Stoxx 50 excludes companies that are active in controversial weapons and tobacco, on their initiative (STOXX, 2021). Therefore, the negative screen just has to be broadened. In section 3.2, this screening method is further discussed.

As stated earlier, the used sample period is 2004 till the end of 2018. This period is chosen to make subsample periods. The subsamples that will be formed are 2004 – 2008, 2009 – 2013, and 2014 – 2018. All samples have the same length and represent a different economic situation in Europe. It is interesting to see whether the economic environment influences the effect of ESG on investments. The period of 2004 – 2008 stands for the pre-crisis period. In September 2008 Lehman Brothers collapsed, which was a start sign for a global financial crisis. Following this collapse, the European sovereign debt crisis started, which persisted until around 2013 (Kenton, 2020). The period 2009 – 2013, therefore, shows the period of economic recovery. After 2013, the European economy could flourish

again and this is depicted by the post-crisis sample period of 2014 – 2018. In addition, for the chosen sample period all data is available for the companies in the Euro Stoxx 50 and no disturbing effects of Covid-19 are taken into the analysis, as this is no objective of this thesis.

3.2 Portfolios

The benchmark portfolio will be the unscreened Euro Stoxx 50. Every year there are 50 companies in this index from 8 European countries (Belgium, Finland, France, Germany, Ireland, Italy, The Netherlands, and Spain). The index has only one restriction regarding a company that is active in controversial weapons and tobacco. Euro Stoxx 50 excludes companies that are active in one of those sectors before constructing their index. As stated earlier, the weighting method of the Euro Stoxx 50 is based on the free-float market capitalization. To be able to compare the portfolios, all portfolios are weighted using the market capitalization which is made available through Eikon. This type of stock weighting is in line with an earlier study of Kaiser & Welters (2019) who also used the market capitalization in combination with a Euro Stoxx index. According to Bhattacharya & Galpin (2011), constructing portfolios based on market capitalization is an often used weighting method, which is predominantly used in developed markets. A retail investor could have a portfolio with different stocks that all have a particular weight in the portfolio. If the weight of one company is 50%, the stock price movement of that company's stock has a very large influence on the overall portfolio value. To benefit from diversification and to be less dependent from a particular company, the portfolio is weighted using the market capitalization. In that way, a market portfolio can be replicated because in the market the stocks are also weighted by their market capitalization. In this thesis, the market capitalization is used as the weighting factor by dividing the company's market capitalization by the market capitalization of the total market. One other criterion is that the maximum weight of a company is 20% to make sure that the portfolio is not too sensitive to stock price movements of one particular company.

The positively screened portfolio will be constructed using a best-in-class method. As the name indicates, the best-performing companies on ESG are selected from the index. In this thesis, a threshold of 75% will be used. This implies that only the 75% best-performing companies with respect to the ESG-score are selected every year from the original Euro Stoxx 50 index. This means that 37 companies are left in the portfolio (rounded downwards). If two companies on the 37^{th} and 38^{th} place have the same ESG score, there will be a subsequent comparison on another ESG score from Refinitiv. The score that will be used is the ESG Combined Score. This score is also calculated by Refinitiv and is constructed by combining the overall ESG score with their ESG Controversies Score. This score is calculated by looking at 23 ESG controversy topics during a year. If a scandal occurs, this negatively affects the score, which ultimately harms the ESG Combined Score. The company that performs best on this score (in case of a tie) will be selected in the portfolio.

A negative screening method will exclude companies or sectors from the portfolio. In this case, the sextet of sin is used as the collection of activities that are prohibited in the negatively screened portfolio. The sextet of sin consists out of the following sectors: the adult industry, alcohol, tobacco, gambling, weapons, and nuclear energy. This is a broader definition than that is used by the Euro Stoxx 50 itself. Both methods exclude tobacco, but the Euro Stoxx 50 excludes controversial weapons, while the sextet of sin excludes weapons in general. Four other sectors are added to the negative screen: Alcohol, Nuclear Power, Adult Entertainment, and Gambling.

3.3 Method of analysis

This section describes the method of analysis. The analysis is separated into three parts, based on the transmission channels of ESG to a company according to Giese et al. (2017). They describe the cash-flow channel, the idiosyncratic risk channel, and the valuation channel. Firms are more competitive when they perform better on ESG, which generates higher earnings. Also, high-performing companies are better at managing company-specific risk, which leads to lower downside risk on an individual stock level. Finally, the valuation channel shows that high-performing companies are less vulnerable to systematic risk. These transmission channels are translated into an investment universe by using the study of Verheyden et al. (2016). This thesis follows the analysis of their study by looking at the universe risk and return, the stock-level risk, and diversification. In this way, the cash-flow channel, the idiosyncratic risk channel, and the valuation channel are all evaluated.

Universe risk and return

The universe risk and return are evaluated by calculating the Sharpe ratio and the beta of the portfolios. The Sharpe ratio is a measure of risk-adjusted return and is calculated by subtracting the risk-free rate from the return of the portfolio and dividing the outcome by the standard deviation of the portfolio. This is shown in equation (1).

$$Sharpe\ Ratio = \frac{r_p - r_f}{\sigma_p} \quad (1)$$

Where:

$r_p =$ Return of the portfolio

$r_f =$ The risk-free rate

$\sigma_p =$ The standard deviation of the portfolio

The return of the portfolio is calculated by aggregating the weighted returns of the separate stocks in the portfolio. The weighting will take place by using the market capitalization of the companies and the standard deviation is calculated using statistical programs. A risk-free rate is the rate that investors receive by investing, but taking no risk. Most often, government bond yields are used as a proxy for this rate because the chance of default on the loan is minimal. In this thesis, the risk-free rate is equal to the 3-month Euribor rate. This is an often-used proxy for the risk-free rate in a European investment universe.

The portfolio risk is determined by estimating the beta of the portfolio. The beta of a portfolio is a measure of systematic risk and it shows the co-movement of the portfolio with the market. When beta is equal to one, the portfolio perfectly follows the market and when the beta is equal to zero it has no co-movement with the market. The beta of the portfolios is estimated by regressing the return of the ESG screened portfolio to the benchmark portfolio, which is the Euro Stoxx 50. By definition, the benchmark portfolio obtains a beta of one because it is equal to the market portfolio. Beta is estimated by means of a regression analysis using equation (2):

$$R_t^p = \alpha + \beta * (R_t^m) + e \quad (2)$$

Where R_t^p is the monthly return of the negatively or positively screened portfolios at time t. The intercept is denoted by α, β denotes the market risk of the portfolio at hand and R_t^m denotes the return of the market portfolio (the Euro Stoxx 50) at time t. Based on the earlier study of Verheyden et al., (2016) the expectation is that the beta will be slightly lower or equal to the market portfolio beta. A beta higher than one implicates that the

portfolio moves more extremely than the market portfolio. In this thesis, the beta is estimated based on monthly returns. Earlier studies show that beta can be estimated using daily, weekly, or monthly returns. The most precise way of estimating is by using daily returns, but given the large sample period in this thesis (14 years), monthly returns are useable as well according to Levendis & Dicle (2017). In case of spurious results, a robustness check will be performed by using daily return data. Given the study of Verheyden et al., (2016), the beta of both the negatively and positively screened portfolios is expected to be around one.

Stock-level Risk

The second subject of analysis is the stock-level risk. According to Giese et al. (2017), companies that conduct a stable and qualitative ESG strategy are better at managing risks inside the company which would decrease the risk for investors. Also, Verheyden et al. (2016) find that their unscreened portfolio (the equivalent of the Euro Stoxx 50 in this thesis) shows lower downside risk compared to their positively screened portfolios. The returns of the screened portfolios were slightly higher, while the standard deviation was slightly lower.

The stock-level risk is measured by the 3-sigma limit. This is a statistical measure that is constructed by aggregating the standard deviation of the daily returns of the separate stocks in the portfolios and multiplying that number by three. In statistics it is approximated that, with data that is normally distributed, 99.73% of all observations fall within three standard deviations below and above the mean. This is why the 3-sigma limit is often used to predict the lowest and highest expected value with a high level of certainty. In the thesis at hand, stock returns are analyzed. In many studies, the assumption is made that stock returns are normally distributed which makes it easier to perform statistical analyses (Peiro, 1999). However, individual stock returns are typically positively skewed, while aggregated stock returns, comparable to the return of a portfolio, are typically negatively skewed (Albuquerque, 2012). This positive skewness results in having more observations to the left of the mean. In other words, the chance of a loss is larger because a stock with positive skewness shows frequent small losses and a few extreme gains. This thesis uses the frequently used assumption of normally distributed stock returns. The focus is placed on downside risk because an investor mainly cares about the risk of losing and not about the risk of gaining. By collecting the daily returns of the separate stocks in the portfolios, the standard deviation can be calculated using statistical programs. This standard deviation is then multiplied by three and averaged across the portfolio. By comparing the outcomes of the portfolios, a conclusion can be drawn regarding the downside risk. In addition, the 95% value at risk and the conditional value at risk are calculated. These measures show the minimal loss in the worst 5% of observations and the average loss, given the fact that an observation falls in the worst 5%. The portfolio with the stocks that have the highest conditional value at risk, are evaluated to have the highest stock-level risk. The expectation is that the downside risk is slightly lower, based on earlier studies (Godfrey et al., 2009; Jo & Na, 2012; Verheyden et al., 2016).

Diversification

The third part of the analysis focuses on the effects of ESG screening on the diversification of the portfolios. According to Hoepner (2010), diversification consists out of three drivers: (1) the number of stocks, (2) the correlation between the stocks, and (3) the specific risk of

the separate stocks. By increasing the number of stocks, diversification benefits arise. However, above a quantity of 30 stocks, the benefits are negligible (Chen & Li, 2011). The number of stocks is, by definition, lower when screening for ESG because the screened portfolio is a smaller subset of the market portfolio. Secondly, when the correlation between the stocks is high, they move in the same direction which results in larger losses because they all intensify their effect. So, a diversified portfolio consists out of largely uncorrelated stocks. ESG screening is expected to negatively influence the correlation between the stocks because ESG-focused companies are generally more correlated with each other (Hoepner, 2010). Finally, the specific risk in a portfolio that is screened on ESG ratings is expected to be positively influenced. This is in line with the analysis of the stock-level risk of Verheyden et al. (2016) and derived from the results from Giese et al. (2017) regarding the idiosyncratic risk channel of ESG. To summarize, ESG screening is expected to negatively influence diversification through the first- and second drivers and positively through the third driver. This could deliver insignificant results because of the opposite effects of the separate drivers of diversification, which would make it difficult to come to a conclusion. Therefore, this thesis uses an overall measure of diversification which was developed by Choueifaty & Coignard (2008). They constructed the diversification ratio, which can be used to evaluate the overall diversification benefits that a portfolio experiences. It is calculated by dividing the summed weighted volatility of the separate stocks in the portfolio by the volatility of the portfolio itself. This is shown by equation (3).

$$Diversification\ Ratio\ (DR) = \frac{\sum w_i^2 \sigma_i^2}{\sigma_p^2} \quad (3)$$

Where:

w_i^2 = The squared weight of asset i;
σ_i^2 = The squared return volatility of asset i;
σ_p^2 = The squared return volatility of the portfolio.

The reason that this ratio shows the benefits of diversification is that it evaluates the volatility of the separate stocks in comparison to the definitive portfolio. A high diversification ratio implies that the volatility of the portfolio is significantly lower compared to the individual stocks and it indicates that an investor benefits from the imperfect correlation between the stocks. A diversification ratio above one indicates that the portfolio experiences diversification benefits.

4. Results

In this section, the results will be discussed. First the results of the risk and return analyses of the portfolio will be shown. The positive- and negative ESG screened portfolios are compared to the benchmark portfolio based on the Sharpe ratio and the beta. Secondly, the stock-level risk is discussed and, finally, the diversification of the portfolios is evaluated.

4.1 Universe Risk and Return

4.1.1 Summary Statistics

In Appendix C: Summary Statistics, the statistics of the portfolios are shown. The benchmark portfolio consists out of 50 stocks. The positive and negative portfolios are a subset of the benchmark portfolio and the number of stocks for each year is dependent on the outcome of the screening process. For the positively screened portfolio, the 75% highest ESG rated companies are selected. This results in an average of 37.6 stocks in the portfolio, with a minimum of 37 and a maximum of 38 stocks. For every year the same screening criteria are applied, which results in a quite stable number of stocks with a standard deviation of 0.48. The negatively screened portfolio has a larger standard deviation of 2.26. This is caused by the screening method because all companies that are active in at least one of the controversial sectors (adult industry, alcohol, gambling, nuclear energy, tobacco, and weapons) are deleted from the portfolio. The number of companies that are active in these sectors can vary by year. This causes the number of stocks to deviate more, compared to the positively screened portfolio where a standard fraction of stocks is selected into the portfolio. For the negatively screened portfolio, the average number of stocks is 39.54 with a minimum of 35 and a maximum of 43.

Another important aspect of the portfolios is the weighted total return they earn. The portfolios are weighted by dividing the market capitalization of a company as of the first month of the year by the total market capitalization of all companies as of that same date. The Euro Stoxx 50 has an average weight per stock of 2%. The minimum weight is 0.4% and the maximum weight is 7%. The maximum allowed weight in the index is 10%, to make sure one company does not impact the overall return too much. The companies in the negatively screened portfolio have an average weight of 2.5% with a maximum weight of 7.5% and a minimum weight of 0.6%. The standard deviation of the weights is slightly higher compared to the benchmark with 0.013, compared to 0.011. The positively screened portfolio has a slightly higher average weight, which is caused by the lower number of stocks in the portfolio. The average weight is 2.67% and the maximum weight is 7.8%. The minimum weight in the portfolio is 0.7%. The monthly returns of the three portfolios are quite comparable. The Euro Stoxx 50 has the highest average return of 0.32 on a monthly basis. The positively screened portfolio follows with 0.307 and the negatively screened portfolio finishes last with 0.302. The differences in the standard deviation of the returns are comparable with the differences in the returns themselves. The statistics show that the negatively screened portfolio has the lowest and the highest return over time with a loss of 19% and a gain of 14.7%. The positively screened portfolio has a maximum loss of 17% while it has a maximum gain of 13.7%, which is comparable with the benchmark portfolio.

Finally, there is a significant difference in the ESG ratings of the three portfolios. Only the positively screened portfolio is constructed based on that rating, which is also shown in the statistics. The minimum ESG rating for the whole sample period is 48.86 (out of 100), while for the benchmark portfolio and the negatively screened portfolio the minimum is

2.86. the maximum ESG rating stands at 94.64 for all three portfolios. Surprisingly, the negatively screened portfolio is very comparable to the benchmark portfolio, even though the portfolio is screened on controversial activities. The average ESG rating for the positively screened portfolio is 79.5, while for the benchmark portfolio and the negatively screened portfolio the averages are 74.5 and 75.7, respectively. This indicates that negative screening does not improve the average ESG rating of the portfolio.

Overall, the portfolios are quite comparable on their monthly returns and the weighting of the companies. The number of stocks deviates because of the screening methods and the positively screened portfolio stands out on the ESG rating.

4.1.2 Risk-Adjusted Return

In this section, the risk-adjusted return is compared between the Euro Stoxx 50, the positively screened portfolio, and the negatively screened portfolio. The risk-adjusted return is calculated by subtracting the risk-free rate from the portfolio return and dividing the result by the standard deviation of the portfolio return. The result is called the Sharpe ratio. The ratio is compared on the total period of 2004 – 2018 and three smaller sample periods (2004 – 2008; 2009 – 2013; 2014 – 2018). In this way, the effect of different economic situations can be shown.

In Figure 1: Sharpe Ratio 2004 – 2018, the Sharpe ratio over the whole sample period is shown. There are minimal differences between the three portfolios and they all follow an almost identical pattern over time.

Figure 1: Sharpe Ratio Results 2004 - 2018

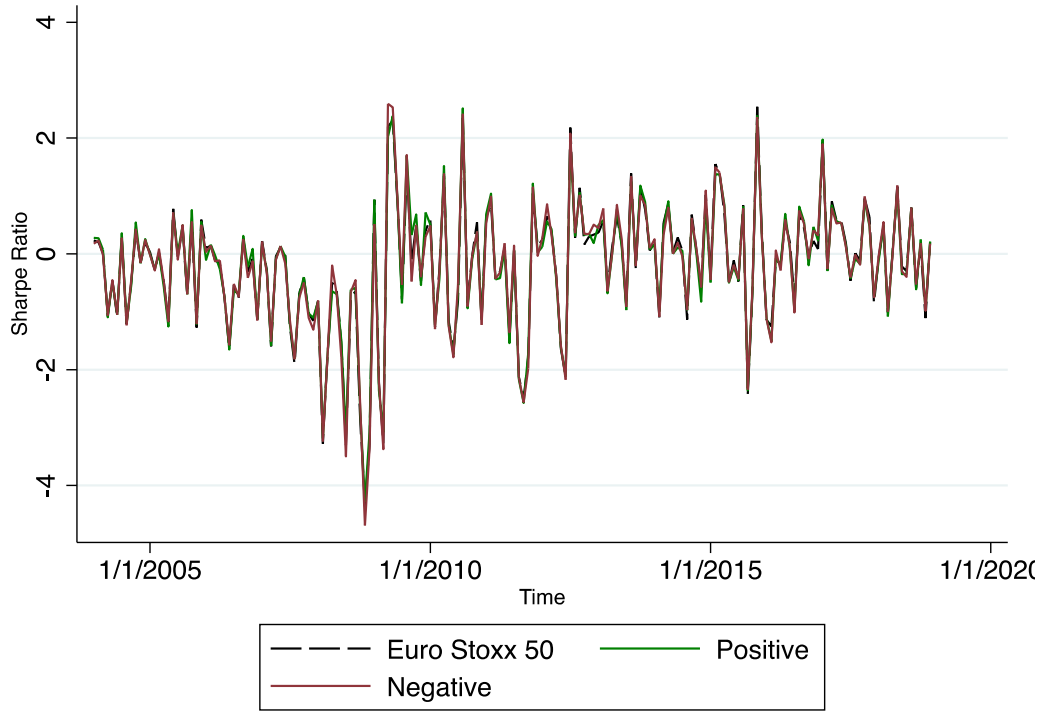


Figure 1 shows the Sharpe Ratio for all three portfolios over the period 2004 – 2018. The Euro Stoxx 50 is the benchmark portfolio. Positive stands for the positively screened portfolio, based on the ESG score of a company. Negative stands for the negatively screened portfolio, where companies active in controversial sectors are excluded.

It shows that for all portfolios, the volatility in the Sharpe Ratio was small from 2004 onwards till around 2007 when the financial crisis started. The large downward shift in the

Sharpe Ratio was in 2008 but reached its maximum point in the whole sample in 2009. The differences in the risk-adjusted return for the portfolios are negligible. In Table 1: Sharpe Ratio Results, the mean ratio over the whole sample and the separate sample periods is shown, alongside with the minimum and maximum ratios for the portfolios. What stands out is that the negatively screened portfolio has the lowest and the highest Sharpe Ratio over the whole sample. This could indicate that the negatively screened portfolio has more variability in its returns which is a sign of increased risk for investors.

Table 1: Sharpe Ratio Results

Sharpe Ratio 2004 – 2018					
Variable	Obs	Mean	Std. Dev.	Min	Max
Euro Stoxx 50	9000	-.204	1.092	-4.362	2.54
Positive	9000	-.201	1.085	-4.282	2.514
Negative	9000	-.206	1.11	-4.69	2.591
Sharpe Ratio 2004 – 2008					
Variable	Obs	Mean	Std. Dev.	Min	Max
Euro Stoxx 50	3000	-.691	1.045	-4.362	.779
Positive	3000	-.669	1.019	-4.282	.757
Negative	3000	-.7	1.061	-4.69	.714
Sharpe Ratio 2009 – 2013					
Variable	Obs	Mean	Std. Dev.	Min	Max
Euro Stoxx 50	3000	-.02	1.199	-3.268	2.352
Positive	3000	-.012	1.218	-3.076	2.514
Negative	3000	-.009	1.24	-3.372	2.591
Sharpe Ratio 2014 – 2018					
Variable	Obs	Mean	Std. Dev.	Min	Max
Euro Stoxx 50	3000	.099	.83	-2.436	2.54
Positive	3000	.079	.823	-2.358	2.393
Negative	3000	.091	.816	-2.337	2.365

Table 1 shows the numeric results of all three portfolios in three different time samples. The differences are very small based on the mean, while the negative portfolio stands out with the lowest- and highest Sharpe Ratio of the sample.

An important test of whether the results in the Sharpe Ratio are statistically different from each other is the t-test. In this test, the hypothesis is tested that the means of the portfolios are different from each other. The t-test assumes that the data is normally distributed and therefore it is necessary to check whether the data is normally distributed. In this case, normality is checked by plotting the histograms of all three portfolios. In Appendix D: Normal Density Functions, the histograms of the portfolios are shown. In addition, a normal plot is graphed over it, to easily evaluate the normality of the data. The data of all portfolios are comparable and are not perfectly normally distributed. However, the data does show a tendency of approaching normality. In this case, the assumption is made that the data is normally distributed in order to perform the t-test. This is an often-made assumption in empirical stock return studies. The outcomes of the t-test show what already seems in the Sharpe Ratio results. There is no statistically significant difference in the Sharpe ratio between the portfolios. The null hypothesis of the test is that the difference is zero, while the alternative hypotheses are that the difference is below zero, above zero, or both (two-sided test). For the positively screened portfolio compared to the benchmark portfolio, all alternative hypotheses can be rejected. For the negatively screened portfolio, compared to the benchmark portfolio, the same applies, and also between the two ESG screened portfolios, there is no difference in the mean of the Sharpe ratio over time. This is as expected and in line with earlier studies. For example, Verheyden et al. (2016) found that between the ESG screened portfolios and the benchmark portfolios, there was a very high correlation in returns and the Sharpe Ratio was almost unchanged after

screening for ESG. However, the result in this thesis is against expectation when compared to the study of Teti, Dell'Acqua, Etro, and Andreoletti (2015) who found a significant positive effect of selecting top-performing companies (on ESG ratings) compared to a portfolio which consisted out of bad-performing companies (on ESG ratings) from a European viewpoint. They also found a significant difference between the positively screened portfolio and the unscreened portfolio. It could well be that by comparing best-in-class companies with lowest-in-class companies similar results could be obtained. However, in this thesis, best-in-class companies are compared to unscreened companies. Finally, following the meta-analysis of Revelli & Viviani (2015), the results, in this thesis, are as expected, because previous research finds no significant effect of ESG screening on investment performance.

4.1.3 Market Risk

In this section, the market risk of the positively- and negatively screened portfolio is evaluated. The market risk is measured by the beta of the portfolio, which is estimated by performing a regression analysis of the monthly returns. The dependent variable is the return of the ESG screened portfolio and the independent variable is the return of the unscreened portfolio, which is the Euro Stoxx 50.

The expectation based on earlier studies is that the beta is slightly lower for ESG screened portfolios compared to conventional portfolios. In this study, the beta is estimated using monthly returns for the whole sample period and the three subsamples separately. In this way, the effect of different economic situations can be evaluated. Table 2 shows the correlation between the returns of the different portfolios over the whole sample period. As expected, the correlation is very high because the ESG screened portfolios consist out of a subset of companies from the benchmark, the Euro Stoxx 50.

Table 2: Monthly Return Correlation Matrix

Variables	(1)	(2)	(3)
(1) Euro Stoxx 50	1.000		
(2) Positively Screened	0.994	1.000	
(3) Negatively Screened	0.994	0.990	1.000

Table 2 shows the correlation between the returns of the unscreened Euro Stoxx 50 and the two ESG screened portfolios. The return data is based on monthly frequency.

Table 3: Positively Screened Portfolio Beta

VARIABLES	Return positive portfolio (04 – 18)	Return positive portfolio (04-08)	Return positive portfolio (09-13)	Return positive portfolio (14-18)
Return Euro Stoxx 50	1.025***	1.004***	1.043***	1.015***
	(0.00116)	(0.00151)	(0.00205)	(0.00234)
Constant	-0.0233***	0.00315	0.00731	-0.0939***
	(0.00573)	(0.00705)	(0.0121)	(0.00962)
Observations	9,000	3,000	3,000	3,000
R-squared	0.989	0.993	0.988	0.984

*Table 3 shows the regression output from the analysis with the positively screened portfolio return on a monthly basis as a dependent variable and the monthly return of the Euro Stoxx 50 as the independent variable. It shows a beta >1, which indicates a higher risk for the positively screened portfolio, compared to the market. The standard errors are in parentheses. *** p<0.01*

Table 3 shows the regression output for the positively screened portfolio. As discussed, the portfolio has an average number of stocks of 37.6 after performing the positive ESG screening method. The regression output shows a surprising result with a beta above one. For the whole sample period, the beta is 1.025. This implies that the positively screened portfolio has a higher level of systematic risk, compared to the market. When the market portfolio moves with 1 unit, the positively screened portfolio moves with 1.025 units. Based on the study of Verheyden et al. (2016), the expectation was that the beta of the portfolio would be slightly below 1, indicating lower systematic risk. One explanation of the higher beta in this study is that the portfolio consists out of 37 or 38 stocks over the years. The study of Verheyden et al. (2016) used an average of 1,388 stocks for their positively screened portfolio, using a 75% best-in-class screening method. Their unscreened portfolio consisted out of 2,267 stocks on average. These numbers are substantially higher and perhaps the number of stocks in this study is too low to substantially decrease the market risk. What stands out is the beta in the period of 2004 – 2008 which is almost equal to 1, which indicates almost no increased market risk. In the period of recovery after the Financial Crisis (2009 – 2013), the positively screened portfolio exhibited higher market risk, compared to other sample periods. Although the expectation of very slight differences in beta was right, the differences had a different sign than expected in the positively screened portfolio.

The negatively screened portfolio has an average number of stocks of 39.5. This is slightly higher compared to the positively screened portfolio. However, the results of the regression analysis with the monthly return of the negatively screened portfolio as a dependent variable and the monthly return of the Euro Stoxx 50 as the independent variable show a comparable market risk as the positively screened portfolio. Over the whole sample period, the beta of the negatively screened portfolio is 1.048. This also indicates a slightly higher market risk. When the market portfolio changes by 1 unit, the negatively screened portfolio moves with 1.048 units.

Table 4: Negatively Screened Portfolio Beta

VARIABLES	(1) Return negative portfolio	(2) Return negative portfolio (04-08)	(3) Return negative portfolio (09-13)	(4) Return negative portfolio (14-18)
Return Euro Stoxx 50	1.048***	1.050***	1.062***	1.011***
	(0.00126)	(0.00193)	(0.00226)	(0.00214)
Constant	-0.0622***	-0.161***	0.00676	-0.0303***
	(0.00620)	(0.00899)	(0.0132)	(0.00878)
Observations	9,000	3,000	3,000	3,000
R-squared	0.987	0.990	0.987	0.987

*Table 4 shows the regression analysis results with the negatively screened portfolio monthly returns as the dependent variable and the monthly return of the Euro Stoxx 50 as the independent variable. The beta is slightly above 1, which indicates a higher market risk for the negatively screened portfolio. The standard errors are in parentheses. *** p<0.01.*

According to earlier research, ESG performance only decreases the systematic risk in environmentally sensitive sectors. For example, oil producers that perform well on ESG measures can significantly decrease their market risk (Sassen et al., 2016). In this thesis, the controversial sectors are excluded from the portfolio in the negative screening method and

the best ESG performing companies are included in the positive screening method. This could influence the results regarding the systematic risk in this case. Also, Humphrey & Tan (2014) found that positive- and negative screening methods did not impact performance and risk significantly. They conducted their study by replicating mutual funds. Typically, a portfolio in a mutual fund consists out of a higher number of stocks compared to this study.

To summarize, the portfolio beta for both the positively- and negatively screened portfolio is above 1. This indicates a higher risk compared to the market. The negatively screened portfolio has the highest market risk of the two ESG screened portfolios. The number of stocks in this analysis is lower compared to prior research, which could explain the unexpected result of higher market risk for ESG screened portfolios. In addition, most studies use a smaller sample period with daily returns instead of monthly returns. To check whether the results in this thesis on systematic risk are robust, an extra analysis is performed. In addition to the previously discussed results, a robustness check using daily returns is conducted. The sample period will remain the same, being from 2004 until 2018. The same weights as in the initial analysis are appointed to the companies in the portfolio and the same screening procedure is used to screen the companies on ESG factors. Based on earlier research, the ESG screened portfolios are expected to have lower systematic risk, which is the case when the beta is below one. The use of daily returns is more in line with existing research, however, the sample period is longer compared to a study like Verheyden et al. (2016). Table 5 shows the correlation between the daily returns of the Euro Stoxx 50, the positively screened portfolio, and the negatively screened portfolio.

Table 5: Daily Return Correlation Matrix

Variables	(1)	(2)	(3)
(1) Euro Stoxx 50	1.000		
(2) Positive	0.987	1.000	
(3) Negative	0.974	0.978	1.000

Table 5 shows the correlation between the returns of the Euro Stoxx 50 and the two ESG screened portfolios. The returns data is based on a daily frequency from 2004 until 2018.

Comparable to the monthly return data, the daily returns are highly correlated. This is as expected because the positive- and negatively screened portfolios are a subset of the original Euro Stoxx 50. To estimate the beta of the ESG screened portfolios, a regression is performed with the daily returns of the ESG screened portfolio as the dependent variable and the daily return of the Euro Stoxx 50 as the independent variable. Table 6 shows the regression results for both portfolios.

Table 6: Daily Return Beta Estimation

VARIABLES	(1) Positive	(2) Negative
Euro Stoxx 50	0.926***	0.924***
	(0.000341)	(0.000486)
Constant	0.000549	0.00442***
	(0.000445)	(0.000635)
Observations	198,250	198,250
R-squared	0.974	0.948

Standard errors in parentheses
*** p<0.01

Table 6 shows the regression analysis results based on daily returns of the Euro Stoxx 50 and two subsets of the Euro Stoxx 50. The positive- and negative screened portfolio returns are the dependent variables and the Euro Stoxx 50 returns are the independent variable. The beta below one indicates lower systematic risk, compared to the market.

The results are opposite to the regression using monthly returns. The betas are close but slightly below one, which indicates lower systematic risk after screening for ESG factors. This is in line with the existent body of research that mostly finds decreased systematic risk when screening for ESG factors. The robustness analysis shows that the earlier retrieved results are not robust. On a monthly basis, the returns of the ESG screened portfolios show more systematic risk. However, on a daily basis, the opposite is true. The systematic risk of the portfolios is below one, which indicates that when the market (The Euro Stoxx 50) moves by 1%, the positively- and negatively screened portfolios move by 0.926% and 0.924%, respectively. A larger body of research uses daily returns to estimate the beta of portfolios. Therefore, this thesis will use the results of the daily return beta for the evaluation of the hypotheses. Based on the daily return analysis, ESG screening decreases the systematic risk of a portfolio. This slight decrease in market risk is in line with the expectations. The differences between the two ESG screened portfolios are not significant which implies that no preferable screening method can be appointed from this analysis.

4.2 Results: Stock-level Risk

In this section, the second part of the analysis will be discussed, the stock-level risk. This is evaluated by calculating the standard deviation of the daily return of the companies in the Euro Stoxx 50, the positively screened portfolio, and the negatively screened portfolio. Table 7 shows the key figures for the daily return distribution for the whole sample and the distribution of all returns in the three-sigma (3-σ) distribution. This last distribution is formed by the returns that are at least three standard deviations away from the mean.

Table 7: Stock-Level Return Statistics

	Euro Stoxx 50	Positive Screen	Negative Screen
Full Return Statistics			
# Observations	301,378	226,238	254,410
Standard Deviation	1.976	1.941	2.005
Mean Return	0.027	0.025	0.025
Minimum	-77.57%	-77.57%	-77.57%
Maximum	123.73%	123.73%	123.73%
5-percentile (95% VaR)	-2.80	-2.78	-2.83
CVaR (95%)	-3.88	-4.46	-5.37
3-σ Tail Statistics			
# Observations	4,786	4,150	4,004
% Of Total	1.59%	1.83%	1.57%
Standard Deviation	9.76	9.38	10.02
Mean Return	0.401	0.334	0.428
Minimum	-77.57%	-77.57%	-77.57%
Maximum	123.73%	123.73%	123.73%

Table 7 shows the statistics of the Euro Stoxx 50 and the two ESG screened portfolios. The positively screened portfolio shows a lower standard deviation, but the screened portfolios had the same worst daily return as the benchmark portfolio.

In the top part of the table, the full return distribution is shown with all observations of the portfolios. The average returns of the companies in the three portfolios are very similar to each other, in line with the results in section 4.1. However, the standard deviation is slightly lower for the companies in the positively ESG screened portfolio in comparison to the Euro Stoxx 50 and the negatively screened portfolio. What stands out is that the companies in the negatively screened portfolio show the highest standard deviation, which would indicate that the risk of the stocks is higher in that portfolio, compared to the other two portfolios. The minimum- and maximum return over time is equal for all three portfolios, which indicates that ESG screening does not eliminate the largest loss as was the case in the study of Verheyden et al. (2016). The highest loss of all portfolios comes from Ageas in October 2008, which is an international insurance group. The highest return comes from Volkswagen, also in 2008. It shows that the volatility was very high in 2008, around the financial crisis.

For the full return distribution, also the 0.05 percentile is calculated. This is the margin below which the 5% lowest returns are observed. On the other side, 95% of all observations are higher than this return. The positively screened portfolio has the highest return in this case. This means that the downside risk is lower because 95% of the time the return is higher than -2.78, while for the benchmark portfolio this is -2.80. Another description of the 0.05 percentile is the value at risk (VaR). This indicates that there is a 5% chance the loss of the companies in the portfolio on a given day is -2.8% for the Euro Stoxx 50, -2.78% for the positively screened portfolio, and -2.83% for the negatively screened portfolio. This is calculated by sorting all aggregated daily returns of the companies in ascending order and taking the return on the 5% margin of observations. This number shows the return an investor receives in the 5% worst case scenario, but it does not show how severe the average loss is when such a situation prevails. To evaluate what the average loss would given the fact that a 5% worst case occurs, the conditional value at risk (CVaR) is calculated. Table 7 shows the CVaR for all three portfolios and, surprisingly, the benchmark portfolio has the lowest conditional value at risk. Would a 5% worst case occur, the average

loss an investor experiences is -3.88%. Compared to the positively screened portfolio (-4.46) the difference is 0.58%. With an average amount of € 110,000 invested by for example Dutch households, this would result in an extra loss of € 638. The negatively screened portfolio shows the highest average loss in the 5% worst-case scenario with -5.37%.

The 3-σ tail distribution shows the distribution of observations that are at least three standard deviations from the mean. The companies in the positively screened portfolio have the highest percentage of observations from the total distribution that fall into this category, with 1.83%. This indicates that a larger percentage of observations fall outside of three standard deviations from the mean of the total distribution. The mean return of the 3-σ tail distribution is quite comparable between the portfolios. The mean of the positively screened portfolio stands out in this area with the lowest mean return. However, the standard deviation is also the lowest of all three portfolios in this case.

Overall, the stock-level risk is not decreased by screening for ESG factors. In the positively screened portfolio, the 75% best ESG-rated companies are selected and in the negatively screened portfolio, companies in controversial sectors are excluded. This decreases the number of stocks, but it does not decrease the risk of the stocks. Compared to the study of Verheyden et al. (2016), this is unexpected. They found a decreased stock-level risk for ESG screened portfolios. High ESG-performing companies theoretically have better risk control policies and are more compliant with regulation, which decreases the chance of experiencing scandals. This would lead to lower downside risk for stocks of high ESG-rated companies (Giese et al., 2017). However, this can't be concluded from the results in this thesis because the ESG screened portfolios show a higher conditional value at risk while having the same minimum and maximum return. However, Jo & Na (2012) find that corporate social responsibility only pays off in controversial sectors. For instance, when a company in the tobacco sector improves its CSR strategy, its risk is decreased. When a company that produces green energy improves its CSR strategy, its risk remains unchanged. In this thesis, companies from those controversial sectors are excluded completely in the negatively screened portfolio. This could imply that the risk reduction found by Jo & Na (2012) would have no standing in this case. The results indicate no decreased risk for the individual stocks in the portfolios. This leads to the rejection of the formed hypotheses. For both the positively- and the negatively ESG screened portfolios the stock-level downside risk is higher, compared to the unscreened portfolio, the Euro Stoxx 50.

4.3 Results: Diversification

In this section, the diversification of the ESG screened portfolios will be evaluated and compared with the unscreened portfolio. Firstly, a small recap is done regarding the number of stocks and the specific risk of the stocks in the portfolios. Secondly, an overall measure of diversification is calculated. This is calculated by dividing the weighted standard deviation of the individual stocks by the standard deviation of the portfolio. If the diversification ratio is above one, there are diversification benefits. This is because all the stocks separately would have a higher standard deviation, compared to the portfolio, which indicates that the portfolio benefits from an imperfect correlation between the stocks.

In section 4.1.1, the summary statistics have been described. Those statistics showed the average number of stocks in the ESG screened portfolios. The positively screened portfolio had a mean number of 37.60 stocks, while the negatively screened portfolio had a mean number of 39.54. This is substantially lower compared to the benchmark portfolio (The Euro Stoxx 50) with 50 stocks. On average the positively screened portfolio consisted

out of 75% of the benchmark, while the negatively screened portfolio existed out of 79% of the benchmark. According to Hoepner (2010), ESG screening has a negative impact on the number of stocks because the ESG screened portfolio is always a smaller subset of the unscreened portfolio. Secondly, the specific risk of the stocks is expected to be lower for ESG screened stocks because those companies are expected to have superior risk management skills (Giese et al., 2017). In this thesis, the decreased specific risk was not observed. There are no significant differences found in the specific risk section, except for the 95% conditional value at risk, which was higher for the positively and negatively screened portfolio. This indicates that the risk for the portfolios was higher, based on the individual stocks' return distributions. Finally, Hoepner (2010) finds that the correlation between the holdings in an ESG screened portfolio is higher. This has negative consequences for the diversification of the portfolio because the stocks will have similar price movements. For example, when two companies are perfectly correlated and one companies' stock price has a loss of 5%, the other company will follow. This increases the risk of the portfolio.

To assess the effect of ESG screening on the diversification of a portfolio on an overall level, the diversification ratio is calculated. The diversification ratio is calculated for each portfolio separately. The standard deviation of an individual stock is multiplied by the weight the stock receives, which was already calculated in section 4.1.2. This number is then divided by the standard deviation of the portfolio return over time. Figure 2 presents the diversification ratio for all three portfolios over time. It shows that all three portfolios follow a comparable pattern. The positively screened portfolio has the lowest average diversification ratio. This could be caused by the lower number of stocks in that portfolio, compared to the other two portfolios. An interesting period is around the financial crisis. As figure 2 shows, the diversification ratio of all portfolios increases from 1.5 at the lowest point to 1.7 at the highest point, an increase of 13.3%. This indicates that more diversification benefits arise in times of economic distress. In the period from January 2007 until December 2008, the negatively screened portfolio showed the highest diversification ratio. This indicates that negative ESG screening did benefit a retail investor in this period. The negatively screened portfolio had a ratio of 1.645, while the unscreened Euro Stoxx 50 had a ratio of 1.624. This increase in the diversification ratio could be explained by higher stock volatility for certain sectors. In the financial crisis of 2007, financial companies suffered a great loss, while consumer retail companies still thrived (Duggan, 2016). When a portfolio holds both types of companies in a portfolio, the loss of one company gets corrected by the gain of the other company. In times of economic stability, the stock volatility will be lower which could result in a lower diversification ratio. In the final focus period (2014 – 2018), all portfolios show a lower and more stable diversification ratio and the positively screened portfolio showed substantial improvement, almost equaling the Euro Stoxx 50 while having 25% fewer companies in the portfolio. This period shows the more stable stock-level volatility in times of economic stability.

Figure 2: Diversification Ratio

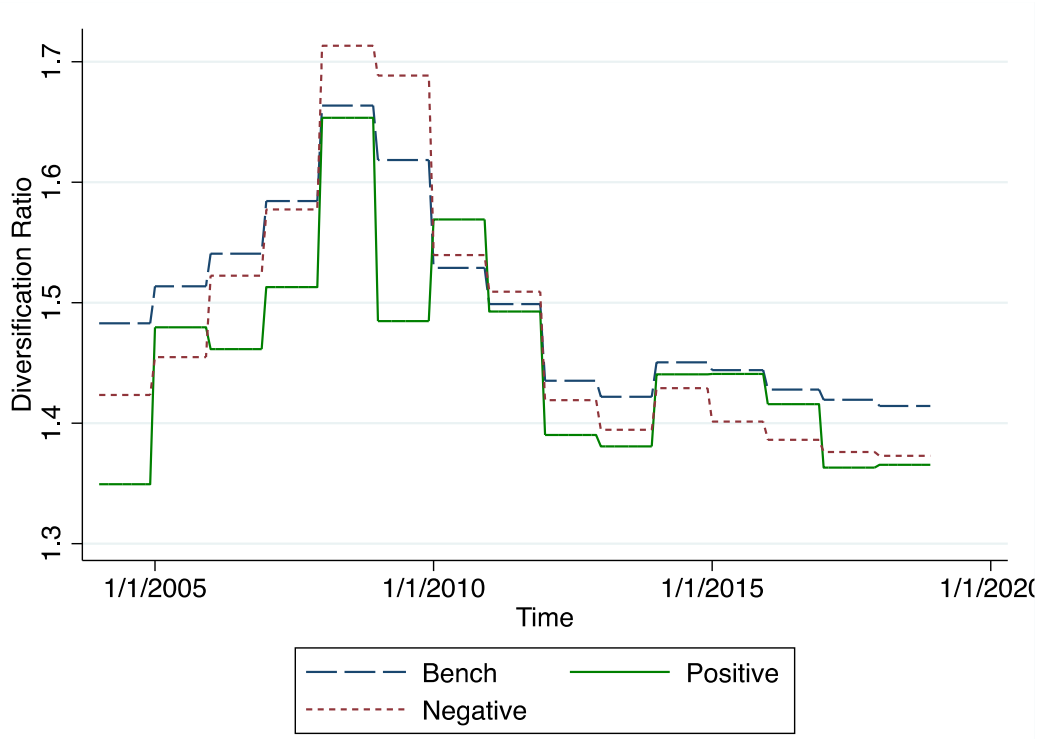


Figure 2 shows the diversification ratio for the Euro Stoxx 50 and the two ESG screened portfolios. The period from 2007 shows an increase of around 13% which shows the impact of the financial crisis.

Towards the period of recovery from the financial crisis, the diversification ratio decreases for all three portfolios and tends to stabilize at around 1.4. This implies that the volatility of the separate stocks is approximately 40% higher than the volatility of the portfolio, which shows the diversification benefit from building a portfolio. Appendix D: Statistics Diversification Ratio shows the statistics of the diversification ratio for all portfolios across the entire time sample, the three focus periods, and specifically the period of the beginning of the financial crisis. The highest diversification ratio was reached in 2008 in the negatively screened portfolio with 1.713. The minimum diversification ratio is found in the positively screened portfolio in 2004 (1.349). The statistics show that the Euro Stoxx 50 is the most stable regarding the diversification ratio, ranging from the minimum of 1.414 to the maximum of 1.664. The average diversification ratio for the Euro Stoxx 50 is 1.496 over the entire sample period. The negatively screened portfolio takes second place with 1.481, and the positively screened portfolio has the lowest average of 1.453. To check whether the differences between the unscreened portfolio and the ESG screened portfolios are significant, a paired t-test is performed to compare the means. The results indicate that the difference in the diversification ratio is significantly different from zero. This implies that the Euro Stoxx 50 does have a significantly higher diversification ratio, compared to the negatively- and positively ESG screened portfolio, based on a t-test to compare the means.

Considering the fact that the ESG screened portfolios have a substantially lower number of stocks, the diversification ratio does not seem to suffer so substantially. The study of Verheyden et al. (2016) showed that positive ESG screening on average did not significantly hurt diversification. They constructed portfolios of more than 1,000 stocks over a shorter time horizon and concluded that there was no significant difference in the diversification ratio between an ESG screened portfolio and an unscreened portfolio. The

results in this thesis show that there is a significant difference in the diversification ratio, but taking into account the substantial decrease in the number of stocks, the effect of ESG screening on diversification is minimal. The results are, strictly speaking, not in line with the study of Hoepner (2010) where ESG screening did not impact diversification of the portfolio because of the opposite effects of the different components of diversification. The number of stocks, by definition, decreases the diversification of the portfolio. In this thesis, the number of stocks is around 25% lower after performing the ESG screening method. This decreases the possibilities for diversification. However, the diversification ratio is not enormously lower for the ESG screened portfolios, especially for the negatively screened portfolio which is over the whole sample on average 0.015 lower, compared to the unscreened portfolio. The positively screened portfolio is on average 0.043 lower, compared to the unscreened portfolio. The overall small effect on diversification could be explained by the opposite effects of the different components of diversification (number of stocks, specific risk, and correlation between the stocks).

5. Discussion & Conclusion

Across the world, there is an exponential growth of interest in sustainability, corporate governance, and social conditions. Every entrepreneur increasingly has to consider the effects of his activities on these three pillars and about how he wants to integrate them into the daily business. This shift of interest towards corporate social responsibility has also found its way towards investing in financial markets. There is a growing body of research regarding socially responsible investing. Many studies focus on the effects of incorporating environmental, social, and governance factors into investing. However, there is still no consensus on the fact whether ESG investing benefits financial performance for investment professionals and retail investors. Regarding investment risk, there is more of a consensus. ESG investing would decrease the downside risk of a portfolio and of the individual stocks it holds. Finally, some studies claim that diversification of a portfolio would suffer from ESG screening processes. Other studies, however, claim that there is no up- or downside effect. This thesis has tried to find the effect of two different ESG screening methods on the risk and return of a portfolio of a European retail investor. Based on prior research, hypotheses were formed on all of these areas. This section will go over those hypotheses again to check whether they lived up to the expectation. This section also concludes this thesis. Firstly, the results will be summarized, discussed, and interpreted by going over the hypotheses and their outcomes, including their implications. Secondly, the results are compared to prior research results of studies that are already mentioned in the literature review, and to other studies. Also, new developments in the light of ESG investing are discussed. Finally, the contributions and limitations of this thesis are discussed and interesting subjects for future research are considered.

5.1 Discussion and interpretation of the results

The results show that ESG screening methods do not affect risk-adjusted returns. Based on a comparison of the Sharpe ratio, which is a measure of risk-adjusted return, there was no significant difference between the Euro Stoxx 50, the positively ESG screened portfolio, and the negatively ESG screened portfolio. The positively screened portfolio was screened by a best-in-class method which meant that the 75% best performing companies on ESG ratings were selected in the portfolio. The negatively screened portfolio was formed by excluding companies that are active in at least one out of six controversial sectors. The hypotheses were separated for both screening methods and stated that the expectation was that no difference could be found. This was based on the already existent lack of consensus on the effect of ESG screening on financial investment performance. The graph of the Sharpe ratio over the whole sample period showed an almost identical curve. The graph did show an interesting pattern in different periods. From the beginning of the sample period (2004) till roughly around 2008 the Sharpe ratio showed minimal volatility, which increased enormously during the financial crisis. All portfolios followed the same pattern, but the negatively screened portfolio showed the highest and lowest value for the Sharpe ratio. This could indicate the slightly higher volatility in risk-adjusted returns for a negatively screened portfolio. However, the differences over time with the other portfolios were not statistically significant. This results in the fact that the hypotheses can't be rejected for both ESG screened portfolios. The results imply that there is no up- or downside in the long run of ESG screening on risk-adjusted returns. Given the fact that investors find it increasingly important to invest while taking into regard non-financial factors, the results are valuable. It

indicates that retail investors don't have to suffer financially if they want to take ESG factors into account. One could say that when there is no real financial downside to investing responsibly, everyone should invest responsibly to improve worldwide corporate social responsibility.

Another important factor in investing is risk. When equal returns are being earned, but the risk is significantly lower, an investment is evaluated as more efficient. To measure the portfolio risk, the portfolio beta was estimated through a regression analysis of the ESG screened portfolio returns on the benchmark portfolio return. Based on earlier studies, the beta is expected to be below one for ESG screened portfolios, which would indicate that the ESG screened portfolio moves less heavily, compared to the market portfolio. First, the analysis was performed using monthly return data for all portfolios. The results indicated a higher volatility for the ESG screened portfolios compared to the market. This is quite surprising, given the large body of research that found otherwise. When the beta of an ESG screened portfolio is above one (i.e., market risk is higher), this would have significant consequences for the retail investment market. One would have to take into account additional risks while receiving similar results. Following modern portfolio theory, an investor mainly cares about risk and return. When there is a more efficient portfolio (e.g., a portfolio with similar returns and lower risk), investors will invest in that portfolio. If ESG screening comes with higher market risk and similar returns compared to an unscreened portfolio, investors will not use ESG screening as much. It could be possible that there are investors who find the non-financial contribution of their investment more important than the financial characteristics. Those investors would continue to use ESG screening.

The correlation between the returns was very high (99%) for both ESG screened portfolios and the Euro Stoxx 50. This is as expected because the ESG screened portfolios are a large subset of the Euro Stoxx 50. The beta was 1.025 for the positively screened portfolio and 1.048 for the negatively screened portfolio. This is not a very significant difference but it is against expectation, based on earlier studies. To test whether these results were robust, another analysis was performed regarding the portfolio beta. The daily returns of the portfolios were collected and regressed against the Euro Stoxx 50's daily returns. The daily returns are a more often used data frequency in empirical studies and therefore they are well suited to perform a robustness check. The results using daily returns came out as expected. The beta of the positively screened portfolio was 0.926 and the beta for the negatively screened portfolio was 0.924. This indicates lower volatility of the ESG screened portfolio compared to the market. Given that the daily return analysis is used more often in empirical studies, those results were used to test the hypotheses in this thesis, which stated that ESG screening leads to lower portfolio risk. In this case, the hypotheses can't be rejected because the results indicate the ESG screening does lead to lower portfolio risk, measured by the beta. This implies that investors are benefitting from ESG screening when constructing a portfolio. Combined with the lack of effect of ESG screening on financial returns this shows that ESG screening could have a positive effect on investment performance. Going back to modern portfolio theory, the ESG screened portfolios in this thesis show similar returns (via the Sharpe ratio) with lower systematic risk, compared to the market. Thus, the ESG screened portfolios are more efficient.

In the second part of this thesis, the stock-level risk was evaluated. This was done by drawing the return distribution of all portfolios over the whole sample period and, among other statistics, calculate the value at risk. Based on earlier studies, the expectation was formed that ESG screening leads to lower stock-level downside risk. High-performing ESG

companies are expected to be more adhering to regulation and compliance and are therefore less vulnerable to scandals and other negative events. This would decrease the downside risk of the stocks of those companies. The results in this thesis showed otherwise. The minimum and maximum returns on a stock level were the same for the unscreened- and screened portfolios. The 95% value at risk was comparable for all portfolios, but the conditional value at risk was not. The conditional value at risk shows the average loss, given the fact that a return falls in the 5% worst scenarios. The negatively screened portfolio showed the highest conditional value at risk with an average loss of -5.37%. This is significantly higher compared to the benchmark portfolio with -3.88%. In addition, the 3-sigma tail distribution was drawn by collecting all returns that fell outside of the range of 3 standard deviations from the mean return. The positively screened portfolio stood out by having 1.83% of the total observations in this 3-sigma distribution, compared to only 1.59% for the Euro Stoxx 50. This resulted in the fact that the hypotheses were rejected. In this thesis, the stock-level risk was higher for the ESG screened portfolios compared to the Euro Stoxx 50. This implies that investors who have no diversified portfolio and, for example, have too much weight towards one stock could suffer from higher idiosyncratic risk. Fortunately, the idiosyncratic risk can be decreased to a minimum by properly diversifying an investment portfolio.

The level of diversification of ESG screened portfolios for retail investors is evaluated in the final part of the results. This is done by calculating the diversification ratio by dividing the weighted stock-level standard deviation by the portfolio standard deviation. A ratio above one indicates that there is a benefit of diversification. The ratio over the entire sample period is quite comparable for the screened- and the unscreened portfolios. Similar to the movements over time with the Sharpe ratio from the first results section, the diversification ratio shows higher levels in times of economic depression and a more stable level after the recovery of that depression. Around the period of the financial crisis, the diversification ratio shows an increase, indicating more benefits from diversification. From around 2012 and onward, the ratio was quite stable and around 1.4. The negatively screened portfolio shows the maximum observation for the entire sample in 2008, but it also shows the most volatility in this ratio. This is comparable to the results from the Sharpe ratio in the first section where the negatively screened portfolio also showed the most volatility. According to earlier studies, the level of diversification of ESG screened portfolios should not decrease substantially. The multiple drivers of diversification (number of stocks, specific risk, and correlation between the stocks) work against each other, which would lead to no significant difference, compared to an unscreened portfolio. The results in this thesis show that the unscreened portfolio has a statistically significantly higher diversification ratio, based on a two-sample t-test. The hypotheses regarding the effect of ESG screening on diversification stated that there is no effect. Based on the diversification ratio, the hypotheses are rejected. The ESG screened portfolios have a significantly lower diversification ratio. Taking into account the substantially lower number of stocks in the portfolio, the level of diversification of the portfolios suffers not so much. It would be interesting to perform a comparative study with portfolios containing a higher number of stocks. Overall, the diversification ratio leads to the rejection of hypotheses 4a and 4b, but the lower number of stocks indicates that retail investors would not suffer severely when screening for ESG factors in larger portfolios.

Finally, Table 8 gives an overview of the results and the effects of ESG screening on the different transmission channels of investing. The risk-adjusted return was not affected

by ESG screening while the portfolio risk, measured by the beta, was positively affected by ESG screening. Surprisingly, the stock-level risk was negatively affected by ESG screening, as was the diversification ratio. Table 8 also shows that there is no preferable ESG screening method in this thesis because both show the same effects.

Table 8: Overview of the Results

	Positive ESG screening	Negative ESG screening
Portfolio Return	=	=
Portfolio Risk	+	+
Stock-level Risk	-	-
Diversification	-	-

Table 8 shows an overview of the results for all sections. The equal sign (=) indicates that there is no significant difference between the unscreened portfolio and the ESG screened portfolio. The minus and plus sign (resp. – and +) indicate that ESG screening has a negative or positive effect on the subject.

5.2 Comparison of the results with prior research

In this section, the previously discussed results are compared to prior research in the same areas of ESG investing. This will be done in the same sequence as the results sections. Moreover, newly published studies and news articles will be discussed to put the results in a contemporary light.

Following the largest meta-analysis in the field, the results in this thesis regarding investment returns were comparable. Revelli & Viviani (2015) found no significant effect of ESG investing on the returns of those investments. They compared a large body of prior studies and could not establish a consensus. Some studies show an increase in investment returns (Fauzi & Idris, 2009), and other studies find a positive effect in risk-adjusted returns (Miralles-Quirós & Miralles-Quirós, 2020). Many studies conduct a worldwide comparative analysis on ethical mutual funds or construct portfolios consisting out of more than 1,000 stocks. This is one of the first studies that is focused on a European retail investor. On average, a retail investor is not financially able to construct a diversified portfolio with more than 1,000 stocks. Therefore, this thesis has constructed an unscreened portfolio of 50 stocks and screened based on ESG afterwards. The results indicate that even a retail investor that desires to make his own decisions in buying and selling stocks does not suffer from ESG screening methods, based on risk-adjusted returns. La Torre et al. (2020) also studied the effects of ESG screening on investment performance in the Euro Stoxx 50. They found no general effect of ESG performance on financial performance, only for specific sectors like the energy and utility sectors. They did not screen for ESG factors but constructed an ESG index to perform a correlation analysis between ESG and financial performance. The findings in this study are in line with the study of Humphrey & Tan (2014) who also found no significant difference in return between unscreened, positively screened, and negatively screened portfolios. They used the S&P 500 as their unscreened universe, which consists out of a considerably higher number of stocks. In addition, they used a less strict negative screening method, only excluding stocks in tobacco, alcohol, gambling, and weapons. They constructed portfolios of 100 stocks, which comes quite close to the constructed portfolios in this thesis. Therefore, their portfolio construction method is quite similar, as are their results. They found no significant evidence for ESG screening (positive- and negative) to alter investment returns. The main lesson regarding risk-adjusted returns is that, even for retail investors, ESG screening does not affect the financial performance of investing. Previous studies mainly focused on professional investors or mutual funds and

found no significant in- or decrease in returns for various screening methods, but this thesis shows that the lack of effect can be extrapolated to average retail investors.

Regarding the effect of ESG screening on portfolio risk, measured by the beta, the robustness results are in line with expectations. According to an earlier study by Giese et al. (2017), companies that have a strong ESG profile tend to be less vulnerable to systematic market shocks and thus have a lower beta. This study shows that, even though the number of stocks is quite low compared to prior studies regarding ESG screening, the systematic risk of a portfolio decreases by positive- and negative ESG screening. Sassen et al. (2016) studied the effects of ESG on idiosyncratic, systematic, and total risk. The results in this thesis are contrary to those results because they find that systematic risk only decreases in environmentally sensitive sectors like the oil sector. The difference in results could be caused by the exclusion of controversial companies in the negatively screened portfolio.

The effect of ESG on stock-level risk was, surprisingly, negative. According to earlier studies and financial theory the idiosyncratic risk of high-performing ESG companies would be lower (Giese et al., 2017; Jo & Na, 2012; Verheyden et al., 2016). However, this thesis found a higher conditional value at risk for the stocks in the ESG screened portfolio. The level of risk was measured on an individual stock level for all three portfolios separately, following a similar method as Verheyden et al. (2016). Other studies found that only environmental- and social performance had affected the systematic risk of a company. It could be possible that companies in the ESG screened portfolios in this thesis performed very well on governance factors and less on environmental and social factors. This would result in the idiosyncratic risk remaining unaffected, according to Sassen et al. (2016). This thesis shows that in the long run, European retail investors would suffer slightly from increased idiosyncratic risk. However, by diversifying their portfolio sufficiently, this idiosyncratic risk can be diminished to a minimum.

The results regarding diversification are somewhat in line with earlier studies. According to Hoepner (2010), ESG screening has no overall negative effect on the diversification of a portfolio. The three drivers of diversification (the number of stocks, the correlation between the stocks, and the specific risk of the stocks) would work against each other because the specific risk would be lower for high-performing ESG stocks. However, in this study, it is already shown that the idiosyncratic (specific) risk is higher for the stocks in the ESG screened portfolios. Therefore, the diversification levels show a slightly but statistically significant lower diversification ratio for the ESG screened portfolios. The general belief is that above 30 stocks, the diversification benefits are minimal (Chen & Li, 2011). However, Surz & Price (2000) claim that the diversification effect can be diminished by using the entire market and, when an investor holds 30 stocks, only 86% of diversification benefits are obtained. Verheyden et al. (2016) also found a slightly higher diversification ratio, even while their study used portfolios consisting out of 1,000 stocks or more. This could imply that the diversification ratio would not be affected by using a higher number of stocks as the starting point in this thesis. Overall, the diversification of the ESG screened portfolios is slightly lower, but the number of stocks in the ESG screened portfolios is at least 25% lower compared to the unscreened portfolio. This could imply that with a slight increase in the number of stocks in the ESG screened portfolio, the diversification ratios would be even more comparable between the ESG screened- and unscreened portfolios.

During the time of writing this thesis, a new non-financial reporting directive was adopted by the European Commission (*New EU Corporate Sustainability Reporting Directive*, 2021). This package of measures is expected to have a significant impact on companies in

the European Union. If a company is currently not subject to the non-financial reporting directive but is considered large enough by the European Commission, that company will from now on fall under the new directive. In addition, subsidiaries of companies that are already subject to the directive will also fall under the new directive. One large drawback of ESG investing was considered the lack of comparability between companies (Amel-Zadeh & Serafeim, 2018; Eccles et al., 2017). This standard directive will have positive consequences on this issue and make it easier for retail investors to consider ESG in their portfolio. In the U.S., there is still no reporting standard from the Securities and Exchange Commission (SEC) (Group, 2021). The SEC has stated that companies must file all information that is material to investors, but this remains a subjective description that does not obligate companies to report on their ESG performance. This could put European investors on an advantage in responsible investing, as they have more and better information and can better compare companies based on their ESG performance.

5.3 Conclusion & Contribution

This section discusses the contributions and limitations of this thesis. Also, interesting research topics are described and the thesis is concluded.

This thesis contributes to the existing body of research because it focuses on European retail investors. By filling the gap regarding European-focused research, more knowledge can be gathered regarding the effects of ESG in Europe. Professional European investors are more prone to invest socially responsible (Amel-Zadeh & Serafeim, 2018) while a great part of prior research has a worldwide or U.S. focus (Revelli & Viviani, 2015). In addition, many studies replicate mutual funds with at least 100 stocks in a portfolio or replicate a market portfolio with over 1,000 stocks (Verheyden et al., 2016). A retail investor in the Netherlands has an average private capital of €110,000. It is unrealistic to expect retail investors to allocate their capital over 1,000 stocks in a portfolio. Therefore, this thesis contributes to existing research by mimicking a retail investor situation with a benchmark of 50 stocks and two ESG screened portfolios of 37 to 39 stocks. In 2020, the number of households in the Netherlands that invest in financial markets has increased by 17% (Motké & Rotteveel, 2020). This makes it important to not only understand the effects of ESG on professional investors but also on retail investors so they can also invest socially responsibly. By considering not only the return or risk of the investment universe, this thesis gives a better understanding of the effects of ESG screening on investment performance on an overall level. Moreover, by using two different screening methods, the difference in screening methods can be shown for all subjects of investment performance. The results showed no significant overall preference for one of the screening methods. This provides insight for retail investors because some might want to exclude certain sectors and some just want the best-performing companies on ESG ratings, no matter the sector they're in. Because there is no significant difference between the screening methods, investors can choose their preferred method.

A possible drawback of this thesis is the use of the Sharpe ratio instead of the estimation of a Capital Asset Pricing Model (CAPM), which is often used in prior studies. In this way, the excess return could be estimated, which indicates whether a fund under- or overperforms. At the start of this thesis, a considered choice has been made to use risk-adjusted returns, comparable to the study of Verheyden et al. (2016). However, I think the comparison of the ESG screened and unscreened portfolio based on a CAPM estimation could improve this study. In addition, to give a more thorough overview of the returns of a

retail investor, received dividends could be incorporated to improve this study. Besides the paper returns received from the price movements of the stocks, it could well be that the ESG screened portfolio pays out substantially more dividends. This could alter the results. In this thesis, an overall view of investment performance has been studied and therefore the choice is made not to include dividends, but to look at more than just returns.

Another improvement of this research could be to further zoom in on the diversification of the portfolios. By calculating the diversification ratio, an overall measure is used to compare the unscreened portfolio, consisting out of 50 stocks, and the ESG screened portfolios, consisting out of 37 to 39 stocks. It would be interesting to further look at the correlation between the stocks in those portfolios and give a single measure of correlation for the whole portfolio. Also, the number of stocks is quite low, compared to mutual funds. It could be an improvement to start with an unscreened universe consisting out of 100 stocks and perform multiple ESG screening methods thereafter. Perhaps, the diversification ratio could be improved for the ESG screened portfolios by using more stocks. However, this would make it harder to simulate the investment situation of a retail investor.

Partly following from the limitations, there are some interesting topics for future research. One of them would be to look at the returns for investors from a CAPM estimation, including dividend payments of the stocks. This would serve with a more complete picture of the returns of retail investors. Another interesting topic would be to study the effects of Covid-19 on the effect of ESG on investing. During the previous financial crisis around 2008, a substantial effect could be established in the risk-adjusted returns, the beta, and the diversification ratio. It would be interesting to see whether those statistics react comparably to a completely different crisis. In Europe, investors are more interested in socially responsible investing, compared to the U.S. In addition, this interest has grown over the past decades to unknown heights. It would be interesting to see whether the grown interest in ESG investing has resulted in demand differences, compared to conventional stocks. A higher demand for particular stocks could result in higher prices, which would decrease the returns from price changes. It is exciting to see whether these demand differences exist and whether they have an effect on the attractiveness of ESG investing. This could be combined with a study concerning the effects of the new non-financial reporting directive from the European Commission.

This thesis showed that the overall effects of two different ESG screening methods are small, compared to an unscreened portfolio. The risk-adjusted return is comparable, the systematic risk is lower, while the individual stock risk was found to be slightly higher. Finally, the level of diversification of the portfolio suffered to some extent, but not tremendously. Retail investors that want to invest socially responsible in Europe are able to and, if they diversify well, will not suffer from doing it.

6. References

Adler, T., & Kritzman, M. (2008). The Cost of Socially Responsible Investing. *The Journal of Portfolio Management*, *35*(1), 52–56. https://doi.org/10.3905/JPM.2008.35.1.52

Albuquerque, R. (2012). Skewness in Stock Returns: Reconciling the Evidence on Firm Versus Aggregate Returns. *Review of Financial Studies*, *25*(5), 1630–1673. https://doi.org/10.1093/rfs/hhr144

Amel-Zadeh, A., & Serafeim, G. (2018). Why and How Investors Use ESG Information: Evidence from a Global Survey. *Financial Analysts Journal*, *74*(3), 87–103. https://doi.org/10.2469/faj.v74.n3.2

Bauer, R., Derwall, J., & Otten, R. (2007). The Ethical Mutual Fund Performance Debate: New Evidence from Canada. *Journal of Business Ethics*, *70*(2), 111–124. https://doi.org/10.1007/s10551-006-9099-0

Bhattacharya, U., & Galpin, N. (2011). The Global Rise of the Value-Weighted Portfolio. *The Journal of Financial and Quantitative Analysis*, *46*(3), 737–756.

CBS. (2020). *StatLine—Vermogen van huishoudens*. https://opendata.cbs.nl/statline/#/CBS/nl/dataset/83834NED/table?ts=1620890209056

Chen, J., & Li, Z. (2011). *A Comparative Research of Average Risk of Portfolio on Different Strategies and Risk Diversification—《Journal of Shanghai Jiaotong University》2011年12期*. https://en.cnki.com.cn/Article_en/CJFDTotal-SHJT201112015.htm

Choueifaty, Y., & Coignard, Y. (2008). Toward Maximum Diversification. *The Journal of Portfolio Management*, *35*(1), 40–51. https://doi.org/10.3905/JPM.2008.35.1.40

Clean Energy Wire. (2017, July 31). *Dieselgate*. Clean Energy Wire. https://www.cleanenergywire.org/factsheets/dieselgate-timeline-car-emissions-fraud-scandal-germany

Daimler Sustainability. (2020). Daimler. https://www.daimler.com/sustainability/

Deloitte. (2021). *New EU Corporate Sustainability Reporting Directive*. Deloitte Netherlands. https://www2.deloitte.com/nl/nl/pages/risk/articles/new-eu-corporate-sustainability-reporting-directive.html

Duggan, W. (2016). *The Best And Worst Stocks Of The 2008 Crash: What We Learned*. https://finance.yahoo.com/news/best-worst-stocks-2008-crash-205844396.html

Dunn, J., Fitzgibbons, S., & Pomorski, L. (2017). *Assessing Risk through Environmental, Social and Governance Exposures*. https://www.aqr.com/Insights/Research/Journal-Article/Assessing-Risk-through-Environmental-Social-and-Governance-Exposures

Eccles, R. G., Kastrapeli, M. D., & Potter, S. J. (2017). How to Integrate ESG into Investment Decision-Making: Results of a Global Survey of Institutional Investors. *Journal of Applied Corporate Finance*, *29*(4), 125–133. https://doi.org/10.1111/jacf.12267

El Ghoul, S., Guedhami, O., Kwok, C. C. Y., & Mishra, D. R. (2011). Does corporate social responsibility affect the cost of capital? *Journal of Banking & Finance*, *35*(9), 2388–2406. https://doi.org/10.1016/j.jbankfin.2011.02.007

European Parliament. (2014). *DIRECTIVE 2014/95/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL - of 22 October 2014—Amending Directive 2013/34/EU as regards disclosure of non-financial and diversity information by certain large undertakings and groups* -. 9.

Fabozzi, F. J., Ma, K. C., & Oliphant, B. J. (2008). Sin Stock Returns. *The Journal of Portfolio Management*, *35*(1), 82–94. https://doi.org/10.3905/JPM.2008.35.1.82

Fauzi, H., & Idris, K. M. (2009). The Relationship of CSR and Financial Performance: New Evidence from Indonesian Companies. *Issues In Social And Environmental Accounting*, *3*(1), 66. https://doi.org/10.22164/isea.v3i1.38

Fernandez-Izquierdo, A., & Matallin-Saez, J. C. (2008). Performance of Ethical Mutual Funds in Spain: Sacrifice or Premium? *Journal of Business Ethics*, *81*(2), 247–260. https://doi.org/10.1007/s10551-007-9492-3

Galema, R., Plantinga, A., & Scholtens, B. (2008). *The stocks at stake: Return and risk in socially responsible investment*. 9.

Giese, G., Lee, L.-E., Melas, D., Nagy, Z., & Nishikawa, L. (2017). Foundations of ESG Investing: How ESG Affects Equity Valuation, Risk, and Performance. *The Journal of Portfolio Management*, *45*(5), 69–83. https://doi.org/10.3905/jpm.2019.45.5.069

Global Sustainable Investment Alliance. (2018). *Global Sustainable Investment Review*.

Godfrey, P. C., Merrill, C. B., & Hansen, J. M. (2009). The relationship between corporate social responsibility and shareholder value: An empirical test of the risk management hypothesis. *Strategic Management Journal*, *30*(4), 425–445. https://doi.org/10.1002/smj.750

Gregory, A., Tharyan, R., & Whittaker, J. (2014). Corporate Social Responsibility and Firm Value: Disaggregating the Effects on Cash Flow, Risk and Growth. *Journal of Business Ethics*, *124*(4), 633–657. https://doi.org/10.1007/s10551-013-1898-5

Group, G. L. (2021). *International Comparative Legal Guides* (United Kingdom) [Text]. International Comparative Legal Guides International Business Reports; Global Legal Group. https://iclg.com/practice-areas/environmental-social-and-governance-law/usa

Hoepner, A. G. F. (2010). Portfolio Diversification and Environmental, Social or Governance Criteria: Must Responsible Investments Really Be Poorly Diversified? *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.1599334

Hong, H., & Kacperczyk, M. (2009). The price of sin The effects of social norms on markets. *Journal of Financial Economics*, 22.

Humphrey, J., & Tan, D. (2014). Does it Really Hurt to be Responsible? *Journal of Business Ethics*, *122*(3), 375–386. https://doi.org/10.1007/s10551-013-1741-z

Jo, H., & Na, H. (2012). Does CSR Reduce Firm Risk? Evidence from Controversial Industry Sectors. *Journal of Business Ethics*, *110*(4), 441–456. https://doi.org/10.1007/s10551-012-1492-2

Kaiser, L., & Welters, J. (2019). Risk-mitigating effect of ESG on momentum portfolios. *The Journal of Risk Finance*, *20*(5), 542–555. https://doi.org/10.1108/JRF-05-2019-0075

Kenton, W. (2020). *Learn About the European Sovereign Debt Crisis*. Investopedia. https://www.investopedia.com/terms/e/european-sovereign-debt-crisis.asp

La Torre, M., Mango, F., Cafaro, A., & Leo, S. (2020). Does the ESG Index Affect Stock Return? Evidence from the Eurostoxx50. *Sustainability*, *12*(16), 6387. https://doi.org/10.3390/su12166387

Levendis, J., & Dicle, M. F. (2017). *Calculating a Portfolio's Beta* (SSRN Scholarly Paper ID 3042996). Social Science Research Network. https://papers.ssrn.com/abstract=3042996

Lobe, S., & Walkshäusl, C. (2011). *Vice vs. Virtue Investing Around the World* (SSRN Scholarly Paper ID 1089827). Social Science Research Network. https://doi.org/10.2139/ssrn.1089827

Melo, T. (2012). Slack-resources hypothesis: A critical analysis under a multidimensional approach to corporate social performance. *Social Responsibility Journal*, *8*(2), 257–269. https://doi.org/10.1108/17471111211234879

Miralles-Quirós, J. L., & Miralles-Quirós, M. M. (2020). Who Knocks on the Door of Portfolio Performance Heaven: Sinner or Saint Investors? *Mathematics*, *8*(11), 1951. https://doi.org/10.3390/math8111951

Motké, S., & Rotteveel, M. (2020, December). Corona zorgt voor explosieve stijging aantal particuliere beleggers. *FD.nl*. https://fd.nl/beurs/1366971/corona-zorgt-voor-explosieve-stijging-aantal-particuliere-beleggers

Peiro, A. (1999). *Skewness in ®nancial returns*. 16.

Refinitiv® Eikon. (2019). 8.

Refinitiv. (n.d.). *ESG Scores*. Refinitiv ESG. https://www.refinitiv.com/en/sustainable-finance/esg-scores

Revelli, C., & Viviani, J.-L. (2015). Financial performance of socially responsible investing (SRI): What have we learned? A meta-analysis. *Business Ethics: A European Review*, *24*(2), 158–185. https://doi.org/10.1111/beer.12076

Rudd, A. (1981). Social Responsibility and Portfolio Performance. *California Management Review*, *23*(4), 55–61. https://doi.org/10.2307/41164931

Sassen, R., Hinze, A.-K., & Hardeck, I. (2016). Impact of ESG factors on firm risk in Europe. *Journal of Business Economics*, *86*(8), 867–904. https://doi.org/10.1007/s11573-016-0819-3

STOXX. (n.d.). *EURO STOXX 50®—Qontigo*. Retrieved March 7, 2021, from https://www.stoxx.com/web/stoxxcom/index-details?symbol=sx5e

STOXX. (2021). *Stoxx Index Guide*.

Surz, R. J., & Price, M. (2000). The Truth About Diversification by the Numbers. *The Journal of Investing*, *9*(4), 93–95. https://doi.org/10.3905/joi.2000.319444

Teti, E., Dell'Acqua, A., Etro, L. L., & Andreoletti, L. B. (2015). Corporate social performance and portfolio management. *Journal of Management Development*, *34*(9), 1144–1160. https://doi.org/10.1108/JMD-04-2015-0062

Trinks, P. J., & Scholtens, B. (2017). The Opportunity Cost of Negative Screening in Socially Responsible Investing. *Journal of Business Ethics*, *140*(2), 193–208. https://doi.org/10.1007/s10551-015-2684-3

van Duuren, E., Plantinga, A., & Scholtens, B. (2016). ESG Integration and the Investment Management Process: Fundamental Investing Reinvented. *Journal of Business Ethics*, *138*(3), 525–533. https://doi.org/10.1007/s10551-015-2610-8

Verheyden, T., Eccles, R. G., & Feiner, A. (2016). ESG for All? The Impact of ESG Screening on Return, Risk, and Diversification. *Journal of Applied Corporate Finance*, *28*(2), 47–55. https://doi.org/10.1111/jacf.12174

Waddock, S. A., & Graves, S. B. (1997). The Corporate Social Performance–Financial Performance Link. *Strategic Management Journal*, *18*(4), 303–319. https://doi.org/10.1002/(SICI)1097-0266(199704)18:4<303::AID-SMJ869>3.0.CO;2-G

Zhao, X., & Murrell, A. J. (2016). Revisiting the corporate social performance-financial performance link: A replication of Waddock and Graves. *Strategic Management Journal*, *37*(11), 2378–2388. https://doi.org/10.1002/smj.2579

7. Appendices

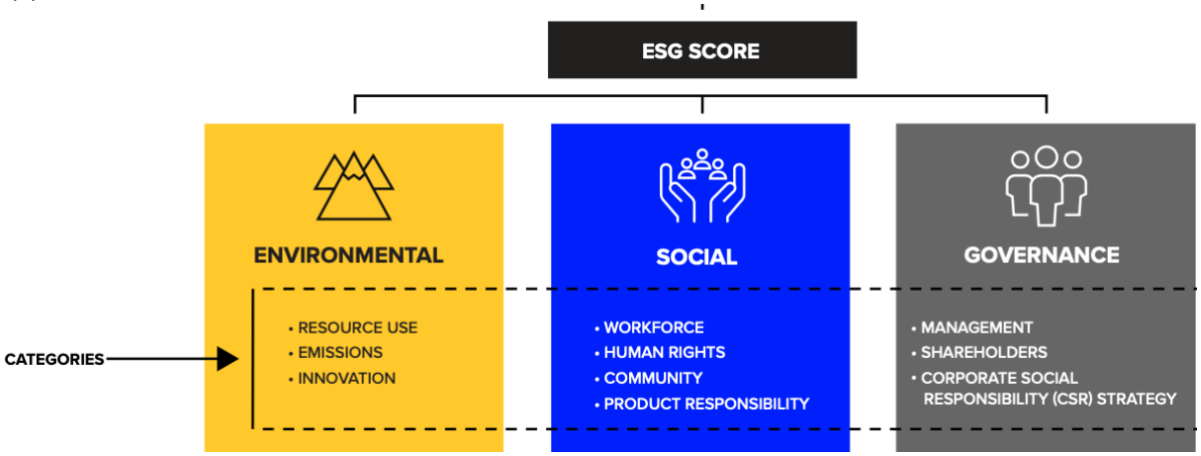
Appendix A: Constituents Euro Stoxx 50

NAME	ISIN	SAINT GOBAIN	FR0000125007
ABN AMRO HOLDING	NL0000301109	SAN PAOLO IMI	IT0001269361
AEGON	NL0000303709	SANOFI	FR0000120578
KONINKLIJKE AHOLD DELHAIZE	NL0011794037	SAP (XET)	DE0007164600
L AIR LQE.SC.ANYME. POUR L ETUDE ET L EPXTN.	FR0000120073	SIEMENS (XET)	DE0007236101
ALCATEL-LUCENT	FR0000130007	SUEZ(ROMPUS)	FR0000120529
ALLIANZ (XET)	DE0008404005	TELECOM ITALIA	IT0003497168
ASSICURAZIONI GENERALI	IT0000062072	TELEFONICA	ES0178430E18
AXA	FR0000120628	TELECOM ITALIA MOBILE	IT0001052049
BASF (XET)	DE000BASF111	TOTAL	FR0000120271
BAYER (XET)	DE000BAY0017	UNICREDIT	IT0005239360
BBV.ARGENTARIA	ES0113211835	UNILEVER DUTCH	NL0000009355
BANCO SANTANDER	ES0113900J37	VIVENDI	FR0000127771
BNP PARIBAS	FR0000131104	AIB GROUP	IE00BF0L3536
CARREFOUR	FR0000120172	RENAULT	FR0000131906
CREDIT AGRICOLE	FR0000045072	ARCELORMITTAL	LU1598757687
DAIMLER (XET)	DE0007100000	INTESA SANPAOLO	IT0000072618
DEUTSCHE BANK (XET)	DE0005140008	SCHNEIDER ELECTRIC	FR0000121972
DEUTSCHE TELEKOM	DE0005557508	VINCI	FR0000125486
E ON N (XET)	DE000ENAG999	ALSTOM	FR0010220475
ENDESA	ES0130670112	DEUTSCHE BOERSE	DE0005810055
ENEL	IT0003128367	ENGIE	FR0010208488
ENI	IT0003132476	VOLKSWAGEN (XET)	DE0007664005
FORTIS (AMS)	BE0974264930	ANHEUSER-BUSCH INBEV	BE0974293251
ORANGE	FR0000133308	ARCELORMITTAL	IE0001827041
DANONE	FR0000120644	CRH	DE0005190003
SOCIETE GENERALE	FR0000130809	BMW (XET)	FR0013326246
IBERDROLA	ES0144580Y14	UNIBAIL RODAMCO WE STAPLED UNITS	DE000A1KRND6
ING GROEP	NL0011821202	DEUTSCHE BOERSE	ES0148396007
L'OREAL	FR0000120321	INDITEX	DE0007664039
LAFARGE	FR0000120537	VOLKSWAGEN PREF. (XET)	NL0010273215
LVMH	FR0000121014	ASML HOLDING	FR0000121667
MUENCHENER RUCK.	DE0008430026	ESSILORLUXOTTICA	DE0005552004
NOKIA	FI0009000681	DEUTSCHE POST (XET)	NL0000235190
PHILIPS ELTN.KONINKLIJKE	NL0000009538	AIRBUS	DE0005785604

REPSOL YPF	ES0173516115	FRESENIUS (XET)	FR0000073272
ROYAL DUTCH SHELL A	GB00B03MLX29	SAFRAN	DE000A1EWWW0
RWE (XET)	DE0007037129	ADIDAS (XET)	ES0109067019
		AMADEUS IT GROUP	FR0000121485
		KERING	DE000A2E4L75

Appendix A shows the constituents of the Euro Stoxx 50 from 2004 until 2018. There are 77 companies listed in those years. Starting from this constituents list, the negative and positive ESG screening methods are applied.

Appendix B: ESG Score Process



Source: (Refinitiv, n.d.). Appendix B shows the process of the construction of the ESG score of Refinitiv. 10 categories are evaluated and give three pillar scores. Those three pillars are put together in the ESG score.

Appendix C: Descriptive Statistics

Euro Stoxx 50

Variable	Obs	Mean	Std. Dev.	Min	Max
# of Stocks		50	0	50	50
Monthly Return	9000	.324	4.922	-16.736	12.691
Weight		0.02	0.011	0.004	0.07
ESG Rating	9000	74.467	13.23	2.86	94.64

Negatively Screened Portfolio

Variable	Obs	Mean	Std. Dev.	Min	Max
# of Stocks		39.54	2.264	35	43
Monthly Return	7117	.302	5.096	-19.167	14.699
Weight		0.025	0.013	0.006	0.076
ESG Rating	7117	75.703	12.7	2.86	94.64

Positively Screened Portfolio

Variable	Obs	Mean	Std. Dev.	Min	Max
Avg # of Stocks		37.60	0.481	37	38
Monthly Return	6769	.307	5.081	-17.025	13.671
Weight		0.027	0.013	0.007	0.078
ESG Rating	6769	79.546	9.302	48.86	94.64

Appendix C shows the descriptive statistics of the three portfolios. The Euro Stoxx 50 is used as the benchmark portfolio. The negative ESG screening method is applied by excluding companies in controversial sectors and the positive ESG screening method is applied by selecting the highest 75% ESG rated companies.

Appendix D: Portfolio Density Functions

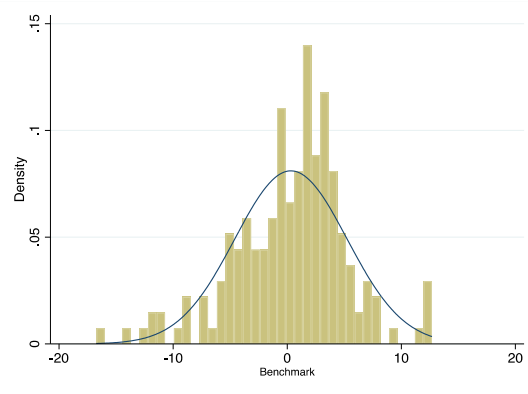


Figure 2: Benchmark Portfolio Density Function

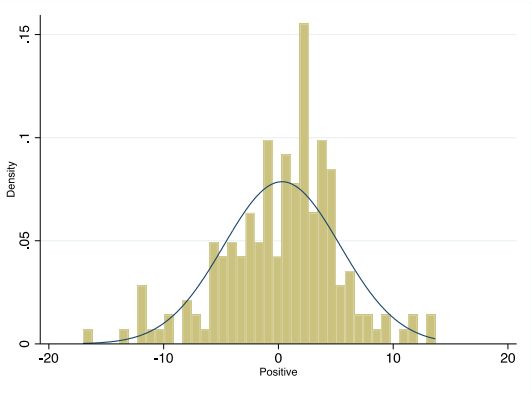


Figure 3: Positive Portfolio Density Function

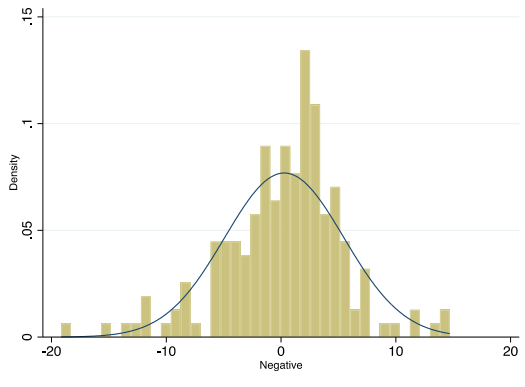


Figure 4:Negative Portfolio

Appendix D shows the histograms of the Euro Stoxx 50 and the two ESG screened portfolios. The histograms show that the returns of the portfolios resemble a normal distribution to some extent. Following other studies, the assumption is made that the distributions are normal, aiming to perform t-tests.

Appendix E: Descriptive Statistics Diversification Ratio

Variable	Mean	Std. Dev.	Min	Max
Descriptive statistics 2004-2018				
Euro Stoxx 50	1.496	.076	1.414	1.664
Positive	1.453	.081	1.349	1.653
Negative	1.481	.106	1.373	1.713
Descriptive Statistics 2004-2008				
Euro Stoxx 50	1.557	.063	1.483	1.664
Positive	1.491	.098	1.349	1.653
Negative	1.538	.103	1.423	1.713
Descriptive Statistics 2009-2013				
Euro Stoxx 50	1.501	.071	1.422	1.618
Positive	1.463	.07	1.381	1.569
Negative	1.51	.104	1.395	1.689
Descriptive Statistics 2014-2018				
Euro Stoxx 50	1.431	.014	1.414	1.45
Positive	1.405	.035	1.363	1.441
Negative	1.393	.021	1.373	1.429
Descriptive statistics 2007-2008				
Euro Stoxx 50	1.624	.04	1.584	1.664
Positive	1.583	.07	1.513	1.653
Negative	1.645	.068	1.577	1.713

Appendix E shows the diversification ratio for all portfolios in different sample periods. First, the whole sample is described. The diversification ratio is a measure of the diversification benefits a portfolio is subjected to. Secondly, the three focus periods are described and, finally, a particular year is described because it stands out from the other periods.