Copenhagen Business School

The Growing Role of ESG in Investment Decisions- Investors' Preference

Low sustainability High Returns?

Master's Thesis

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Abstract

This Thesis studies the effect of Environmental, Social and Governance considerations in European investor's portfolio performance between 2009-2019. More specifically, it constructs low-ranked portfolios by selecting the 250 worst performers in each of the metrics. By applying well-known models in financial theory, the results suggest that low-ranked portfolios significantly underperform the market and have a tendency for small capitalization value stocks with bad momentum. The results are constant along the portfolio implying that there is no significant difference between metric considerations. The research suggests that the European profit-driven investor is penalized for engaging in a ''worst-in-class'' strategy and that portfolio performance does not seem to benefit from low-sustainability criteria.

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1. Introduction

The introduction of ethical considerations in the investment decisions has seen an exponential growth over past decades. There is an increasing number of investors that show concerns regarding the sustainable policies of the companies they invest in. This type of investment is called Responsible Investing. Nowadays the investors not only the investors invest considering the financial return only, but also consider the possible effect that the investment might have on the society. This concept means investing within some responsibility framework, which usually addresses environmental, social and governance issues. Unlike the conventional types of investments, Socially Responsible Investments apply a set of investment screens to select and exclude stock based on environmental, social or governance criteria. The trend continues to grow as the sustainability issues continue to appear worldwide.

In recent years this area of investment attracted a lot of attention from the scholarly world. Most research seeks to understand whether integrating these considerations in the investment process has an additional financial cost or whether it affects portfolio financial performance. Empirical results to answer these questions are dependent on the type of screens applied, investment horizon and data comparison method applied by the researcher (Revelli and Viviani, 2015). Furthermore, studies show that it is possible to create sustainable portfolios that can earn abnormal returns (David Diltz, 1995; Kempf and Osthoff, 2007). However, integrating these non-financial factors into investment decision-making contradicts the traditional finance theories. Incorporating these criteria limits the investment universe and theory suggest that limiting the differentiation of the portfolio should increase its risk and decrease its return, when compared to well diversified portfolio (Markowitz, 1959). A prominent issue within the field of responsible investing is then how the investor can use non-financial in their own benefit.

This thesis contributes to this area of research by investigating if introducing ESG criteria in the investment process increases the European investors performance over the period of 2009-2019. It is desirable to provide evidence whether investments based on ESG criteria create abnormal returns. This study adds to existing literature because previous studies tend to select stocks of companies with decent corporate social responsibility and the portfolios created for the purpose of this study aim towards the stocks from companies with bad social responsibility. By studying this less common approach the author intends to provide the profit seeking investors more empirical evidence on all possible ESG strategies and which metric should be focused in the portfolio construction process. Finally, as most of the past empiric research focused the US market, this paper selects the European market to study the relationship between ESG criteria and portfolio performance.

1.1 Problem Statement

Responsible Investing is a trending segment in the financial market.

In the last couple of years, ESG research and academic studies have grown in number, and there is evidence of correlations between strong investment performance and ESG factor integration which helped the investment community to continue to align their values with their portfolio selection. The aim of this thesis is to support existing theory suggesting that ESG investing can be a reliable portfolio strategy.

As an investor, the focus is the financial performance of one's portfolio. And in a utopic financial world, the relationship between responsible investing and financial performance would present solid grounds to convince future investors that this area of investment deserves their investments. Yet, even with all the developments in this area, there is still some resistance from the mainstream investment community.

With most of development made in this area being in the United States, my focus is drawn to the European market due to the lack of studies in this region.

The main question that to answer in this thesis is:

''Do investors experience increased portfolio performance when pursuing a pure ESG strategy in Europe?''

There are a number of academic and industry studies looking into this question and although studies find that returns are very similar to traditional strategies(Bauer, Koedijk and Otten, 2005), previous literature suggests that ESG lowers the risk of portfolios in the long run(JP Morgan, 2016). However, most of these studies follow strategies that praise High ESG ratings and exclude or diminish poor performers. Investors either tend to avoid certain questionable stocks or follow a unique strategy to build a portfolio where the fundamental target is to outperform the market. These are the two segments of existing investors. The Value driven investors and the profit driven investors. The Ethical conscious investor, or value-driven investor, tends to limit themselves when excluding stocks regarded as non-ethical (Derwall, Koedijk and Ter Horst, 2011). Common financial theory reasons that limiting the differentiation of the portfolio should increase its risk and decrease its return, when compared to well diversified portfolio (Markowitz, 1959).

This paper attempts to extend the scope of previous academic work on the ESG portfolio strategy by studying a less common approach in the European market. The results of this strategy provide us with analytical groundwork to form a supported clarification for the main question of this study. To help answer this question, the following sub-question is solved:

''How does a worst-in-class Strategy perform in the European market?''

Studying this strategy is interesting because from a theoretical perspective, the portfolio filtering is less than the usual ESG strategies and, to some extent, goes more in line with the modern portfolio theory due to a possible higher level of diversification. From a practical perspective, it is of relevance for the investor to have more empirical evidence on all the imaginable approaches he can take in his portfolio investment decision process.

It is also of relevance to know if focusing on a specific metric adds value to the portfolio. It gives the investor an overall perspective of ESG focused portfolio, especially which sustainable factor is of the most value in the portfolio construction process. From this, a second sub-question is formulated:

''Is the Investor rewarded or penalized when constructing a portfolio based on the poorest performers in an individual metric?''

The followed strategy and consequent methodology will provide the grounds to make a supported argument for the main question of this thesis as well as providing insight on how the poor ESG performances influences the returns on the investor's portfolio. For this reason, this study is only relevant to the profit-driven investors segment since Ethical conscious investors exclude poor ESG performers from their scope.

1.2 Delimitations

This thesis is limited to investigate the portfolio performance when following an ''worst-in-class'' ESG strategy from an individual investor's point of view. Moreover, the portfolios will be constructed with companies strictly located in Europe. Therefore, the results of this thesis may not be applicable to different regions in the globe. Only companies that fulfil the minimum requirement set forth in the thesis are included in the sample. For each portfolio a group of companies will be selected based on sustainable attributes and market, using the information available in Eikon Thomson Reuters. The analyses rely heavily on the ESG-scores provided by Eikon Thomson Reuters. Scores are assumed to reflect the true sustainability engagement of each company. Furthermore, the theory selects and explains commonly used financial models to determine the portfolio performance. Basic financial principles are not described in detail. The reader of this thesis is expected to have basic knowledge within financial theory. Focus on the theory section aims to explain the relations between the models. Basic knowledge of statistics for time-series and regression is also assumed.

1.3 Thesis Overview

This section gives a brief description of the content and purpose of each chapter in this paper.

The Chapter 2 ''Defining Responsible Investing'', describes the financial field of Responsible Investing. It distinguishes the main categories of Responsible Investing and introduces the different approach an investor can possible follow. Chapter 3 ''Modern Portfolio Theory'', presents the performance measurements and financial models used to study the portfolios performance. Chapter 4 ''Literature Review'', introduces the existing academic literature on the relationship between ESG criteria and equity portfolio performance. Chapter 5 ''Methodology'', defines and details the reasons to select the database and stock sample. Moreover, this chapter clarifies the methods applied to calculate the models described in Chapter 3. Chapter 6 ''Results and Analysis'', provides the results of the portfolio calculations and analysis. Chapter 7 ''Discussion'', debates the results and consequent implications and its limitations. Chapter 8 ''Conclusion'', render the answer to the problem statement and possible future research.

2. Defining Responsible Investing

Given the growing importance of Responsible Investing it is surprising that defining it is a very difficult task as an investor. However, according to Mansley & Bright, 2000, Responsible Investment can be broadly defined as ´´Investment where social, ethical or environmental factors are taken into account in the selection, retention and realization of investment, and the responsible use of the rights that are attached to such investments´´. To rephrase, it is a strategy used by the investors where they try to consider the social, ethical and environmental aspects in their decision-making process.

It is a term often referred to in existing academic literature as Socially Responsible Investing, Sustainable Investing or ESG investing.

Responsible Investing, can be divided into three main categories, Impact Investing, Socially Responsible Investing and ESG Investing, (Caplan, Griswold and Jarvis, 2013). Each of these categories differ on their purpose. As such, they will be defined separately in the following sections.

This chapter will also introduce the Responsible Investing strategies that investors use to ensure that their investment do no harm, both financially and non-financially.

The following section will elaborate on the three aforementioned categories and provide a conclusion as to which term is the focus of this thesis and why it was chosen.

2.1 Impact Investing

Impact investing is the fastest growing sub-set of the Responsible Investment Sector.

Here, the investor aims to have a positive impact both socially and environmentally, without forgetting the financial return of their investment. It is commonly mistaken as a term which refers only to micro-finance (small loans to entrepreneurs in developing countries). However, investors that are prepared to sacrifice their financial return in order to have a positive social and environmental impact, are considered impact investors. One can look at these investors as philanthropic individuals.

Impact investing is often encouraged by governments who can also take part in the investment and are able to attenuate the risk incurred, organize these opportunities and ensure solid financial returns.

By partnering with the government, Impact Investors are considered to be battling the world´s most pressing issues while earning financial returns that they require.

This area of Responsible Investing is not used throughout this thesis. It is referenced and explained to provide a stronger overview on the definition of Responsible investing, and the differences between its three categories.

2.2 Socially Responsible Investing

Socially Responsible Investing (SRI), is the largest segment of Responsible Investing.

Scholtens, 2014, defines Socially Responsible Investing, also known as sustainable investing, as equivalent to Responsible investing. SRI is an investment process that seeks to integrate non-financial factors into the investment decision-making or in the construction of portfolios. This type of investment is made when the investor has the objective to not only affect their own financial reward, but also takes into consideration how the investment will affect the surrounding community and environment. The decision making of these individuals is considered a "mix of money and morality", (Hill et al., 2007). These investors tend to avoid industries such as Tobacco, Alcohol or Gambling due to the associated negative social stigma.

Socially Responsible Investors have the same objective as those who follow the conventional investment practice. These investors find investment opportunities that give the investor the best return within any relevant constraints (Hudson, 2006).

Quoting John Schultz, former president of the Social Investment Forum, Socially Responsible Investment ´´Involves reallocating scarce financial resources among competing investment opportunities, with the objective of maximizing financial and social well-being for the investor and the underlying corporation´´.

Due to the unfortunate increase in climate change events, corporate scandals and humanitarian crises, the social awareness of the investors will continue to contribute to the steady growth of this area.

2.3 ESG Investing

ESG Investing, the third category of Responsible Investing, is the focus throughout this thesis.

ESG stands for Environmental, Social and Governance and it is a term frequently used in the other two Responsible Investing categories. It can be said that considering ESG factors is both the backbone and the starting point for Responsible investing.

Although ESG investing is thought to be the same as SRI, it is its own class of investing.

SRI attempts to exclude from the portfolio construction process investments in assets or industries which don not follow ethical guidelines. Conversely, ESG investing involves integrating the Environmental, Social and Governance factors into the fundamental investment analysis with the main objective of improving the investment performance. As such, it allows the investors to construct a portfolio that is aligned with his values.

In 2006, The United Nations promulged the six Principles for Responsible Investment (PRI) to integrate sustainability into the investment process and develop a more sustainable financial system (Barclays, 2016).

This thesis defines ESG investing according to MSCI ESG Research. ESG investing is the consideration of environmental, social and governance factors along with financial factors in the investment decision-making process. Integrating Environmental, Social and Corporate Governance (ESG) criteria into investment analysis and portfolio construction across a range of asset classes is a key strategy of Sustainable and Responsible Investing. By incorporating economic, social and governance (ESG) factors into investment decisions, the investor aims to better manage risk and generate sustainable, long-term returns. Note that by nature, the Governance metric differs from the Environmental and Social, as the investors may have their own priority in ranking these, (MSCI, 2018).

The following section provides an individual analysis of each metric and discusses the main issues considered by ESG rating agencies when making their best evaluation.

2.3.1 E, S and G

ESG metrics provide measurable attributes of a corporation that may be used in the investor's decision-making process to measure the sustainability of their investments.

E stands for Environmental. This metric measures the contribution that the company makes to climate change through greenhouse gas, along with waste management and energy efficiency. With the continuous rise of global warming, the way in which corporations cut their carbon emissions is has a significant importance in this metric. (Barclays, 2016)

S stands for Social. This metric reflects the way that the corporation takes care of its human capital. The metric rises if the company is well integrated in the local community having a ''social license'' to operate with consent. (Barclays, 2016)

Both Environmental and Social metrics incorporate the exposure and opportunities specific to an industry or activity of the corporation. Therefore, the link between these metrics and future performance is indirect. (Barclays, 2016)

Finally, G stands for Governance. This metric will provide the investor with an evaluation on how well-governed the corporation is. It is a measure of management quality and how essential it is for the corporation to protect shareholders interest. Studies say that this metric has a direct link to financial performance. (Barclays, 2016)

The Figure below identifies the main issues that each metric focuses on.

3 Pillars	10 Themes	37 ESG Key Issues	
Environment	Climate Change	Carbon Emissions Product Carbon Footprint	Financing Environmental Impact Climate Change Vulnerability
	Natural Resources	Water Stress Biodiversity & Land Use	Raw Material Sourcing
	Pollution & Waste	Toxic Emissions & Waste Packaging Material & Waste	Electronic Waste
	Environmental Opportunities	Opportunities in Clean Tech Opportunities in Green Building	Opp's in Renewable Energy
Social	Human Capital	Labor Management Health & Safety	Human Capital Development Supply Chain Labor Standards
	Product Liability	Product Safety & Quality Chemical Safety Financial Product Safety	Privacy & Data Security Responsible Investment Health & Demographic Risk
	Stakeholder Opposition	Controversial Sourcing	
	Social Opportunities	Access to Communications Access to Finance	Access to Health Care Opp's in Nutrition & Health
Governance	Corporate Governance*	Board* Pay*	Ownership* Accounting*
	Corporate Behavior	Business Ethics Anti-Competitive Practices Tax Transparency	Corruption & Instability Financial System Instability

** Corporate Governance Theme carries weight in the ESG Rating model for all companies. In 2018, we introduce sub-scores for each of the four underlying issues: Board, Pay, Ownership, and Accounting.*

Figure 1: MSCI ESG Key Issue Hierarchy

Source: MSCI ESG Research Executive Summary, April 2018(MSCI, 2018)

In the following Chapters, these metrics will be analysed separately to identify which one brings more value for the investor in terms of portfolio performance.

2.4 Responsible Investing Strategies

As a concept ESG is not new. However, the way that the investors consider various strategies is new and is both changing and growing quickly. Investors depend on themselves to choose their own strategy and tend to select the one that best matches their own believes and motivations. As there is there is no established approach on how to practice Responsible investing investors try and create their own personal investment strategy.

Based on the European Sustainable and Responsible Investment Forum, Scholtens, 2014, suggests that, theoretically, there are seven possible strategies: Sustainability themed investments; Best in Class Investment Selection; Norms-based Screening; Exclusion of Holdings from investment Universe; Engagement and Voting on sustainability matters; Integration of ESG factors in financial analysis; and finally, Impact Investing.

Since the global financial crisis of 2008, all seven strategies have experienced higher growth than the broader European asset management market. Exclusions, more commonly known as negative screening, is the most used strategy applied to investment portfolios.

Each one of these strategies can be applied simultaneously and in an increasing number of possible combinations. Different mutual funds will use different criteria and strategies for selection. The same is applicable for institutional investors.

From the seven strategies, Hudson, 2006, describes four as the most used for a Portfolio approach. Exclusion or Negative Screening, Positive Screening or Best-in-class Investment Selection, Integration of ESG factors in financial analysis and Engagement.

Since the focus of this thesis is the integration of ESG metrics in the investment decisions process and portfolio selection, the last strategy considered by Hudson will not be studied here. Even though it is related to ESG investment, it is a strategy that occurs continuously by the active engagement of the investor, seeking to influence the corporations he or she invested in to address ESG and to encourage better practice. Therefore, when considering the time frame of the investment process, this strategy occurs later than the aim of this study.

The following provides a detailed review of the definitions of these three strategies for a better understanding on the portfolio approaches that an investor can take.

2.4.1 Negative Screening

Exclusion of Holdings from investment Universe is the strategy most frequently used by ESG investors and portfolio managers. Investors believe that this strategy is the easiest and most convenient to carry out on an existing investment framework (JP Morgan, 2016). This is one possible explanation of why it has experienced consistent exponential growth throughout the years, (Eurosif, 2016).

When following Exclusion strategy, the investor deselects from the investment universe of a portfolio, specific sectors, companies and even countries suspected to have questionable business practices or product. Companies in which their revenues are prevenient from one of these sectors are also excluded (Renneboog, Ter Horst and Zhang, 2008b).

Sectors involving alcohol, tobacco and gambling fit perfectly in this category (Berry and Junkus, 2013). Other frequently applied negative screens are on weapons manufacturers and nuclear power producers. Investors might take a step further and look at the corporate behaviour of the companies. In this case, companies that breach human rights and violate labour norms will be avoided. All the industries specified above, are related to products universally believed to be harmful and to violate ethical morals and religious standards.

By eliminating these companies, the investor aims to communicate with the general public and not invest in controversial business areas that can compromise his investing reputation.

Another form of negative screen is a strategy referred to as ''Norm-based Screening''. Considered a sub-category of negative screening, this approach involves the exclusion of companies that fail to meet internationally accepted standards and norms such as those developed by the OECD, UN, UN Agencies or industry initiatives and codes.

As mentioned, negative screening reflects investors' values. Exclusion will mostly be based on what the investor or asset manager believes is morally correct. Therefore, it is important to consider the subjectivity of this strategy. The screens are made in such way that the investor wants to ensure that he does not profit from issues that do not comply with his ethical principles. Consequently, it is hard to estimate the size of exclusions.

Combined with the absence of transparency in investors with respect to their investment process, the estimation of what is really lost from the investors' portfolios is an exaggeration. Essentially, this is because of the various screens that the investor might use, resulting in the possibility of double counting (Scholtens, 2014).

Lastly, by filtering out some companies from their investment universe, institutional investors will have a smaller investment set, which can cause an alteration of the geographical and sectors allocation and reduce risk-return benefits of portfolio diversification (Renneboog, Ter Horst and Zhang, 2008b).

2.4.2 Positive Screening

Positive screening is viewed as a strategy followed in the investment process, where the investor intends to integrate companies with responsible business practices and good integration of ESG considerations in their portfolio. Furthermore, companies which have business potential due to the product's positive contribution to society or strong evidence of the use of renewable energy, are also a target of positive screens (Renneboog, Ter Horst and Zhang, 2008b).

Transparency is key for a positive screening process. In following this strategy, investors first look into non-financial information before measuring the financial performance of a company, (Robins and Krosinsky, 2008). As this information important for the decision-process of the investor, it is certainly an incentive for the companies to provide it. On top of this, positive screening does not filter out companies as the Exclusion strategy does. Investors only evaluate how a company ensures that it is regulating/reducing their negative externalities, encouraging companies to engage in such actions. A tobacco company drawing measures to reduce their carbon emissions or making sure their workers are maintained in proper working conditions, are two examples of how a company can improve their ESG score. These are also the types of information that the responsible investor searches for when making a decision.

STOXX Global ESG Leaders is an example of an index that investors use to select a portfolio with leading companies in terms of ESG criteria based on ESG metrics, provided by Sustainalytics (Barclays, 2016).

Positive screening can also a have a best-in-class approach. Meaning that the investor will only focus on a specific sector/industry, with no exceptions and insure that the resulting portfolio is balanced across industries (Kempf and Osthoff, 2007).

With this approach, investors limit their investment universe by investing in companies that are, for example, within the top 25% of their industry when evaluating for their ESG score. The percentage may vary from investor to investor. There is no reliable source saying otherwise (Scholtens, 2014).

More frequently than in positive screening, the best-in-class approach reduces the exclusion of companies perceived as harmful for the society. When compared within their sector, these same companies can be considered best performers. Therefore, when evaluated only on their ESG scores inside their sector/industry, these companies are preferred by the investors.

The Dow Jones Sustainability Index (DJSI), created in September 1999, is one way to illustrate the use of this strategy, where the top ranked 10% of performers in each industry group is included in the Index and subject to annual review (Cerin and Dobers, 2001).

2.4.3 ESG integration

The third and final strategy is one that became part of the vocabulary of the mainstream investment community during the last decade: Integration of ESG factors in financial analysis.

Integration can be considered an autonomous Responsible investing strategy. Scholtens, 2014 defined it as ‘’The explicit inclusion by asset managers of ESG risks and opportunities into traditional financial analysis and investment decision such as asset allocation and individual asset selection based on systematic process and appropriate research sources’’. Simply put, investors that combine their conventional investment analysis with the three ESG metrics are considered to follow this growing investment process.

Investors have, as motivation, both the will to avoid the implications of the changing world, but also the financial and social impact that this strategy has in the long run. However, they are still faced with two big challenges. Since Integration is considered by many a stepping-stone for positive and negative screenings, the challenges that investors and asset managers face, can be associated with the remaining sector.

First, the apprehension with regards to how ESG factors can bring financial performance to investors is a question that remains to be answered. Specially, this is attributed to the fact that there is no established method that investors can use to calculate the value added from ESG activities (Mckinsey Global Survey, 2009). This means that there are difficulties translating ESG information into monetary terms.

The second challenge involves the lack of company transparency in sharing their ESG information. Despite the growing number of companies already providing their extra-financial information, there is still room for improvement. The need for this information is growing. Companies are beginning to be forced to take a position with regards to each of these three factors, and ultimately improve their environmental, social and governance scores so they do not fall behind companies that already do. It is also important to note that it is still very difficult to compare the integration approach between managers due to the many variables that remain unnoticed in the practice of integration. Eurosif's, 2016 study concluded that this concept is hard to define because the ESG criteria is used differently both across the globe and across responsible investors.

Integration is then considered the most suited quantitative approach to ESG investing.

3. Modern Portfolio Theory

Modern Portfolio theory is formed essentially by the Markowitz Portfolio Theory (Markowitz, 1952), and William Sharpe's studies on the financial asset price formation theories, that is nowadays known in the financial world as, the Capital Asset Pricing Model (Sharpe, 1964). More specifically Modern Portfolio theory can be defined as the investment framework to select and construct an investment portfolio that maximizes its expected returns and minimizes the subsequent risk (Fabozzi, Gupta, & Markowitz, 2002).

This Chapter explains the theory behind key financial concepts and mathematical formulations that are the foundation to this framework. These theories and concepts are used to provide useful assumptions and conclusions about this Master Thesis.

It will start by a section that reviews the concept of risk and return and briefly talk about how the core concept of Modern Portfolio Theory, diversification, properly executed, can minimize the risk of the portfolio. It is followed by the illustration of the efficient frontier notion, important for Portfolio Selection purposes.

Besides the efficient frontier, modern portfolio theory offered portfolio performance measurements used in the real world such as the Sharpe Ratio, Treynor Ratio and Jensen's alpha. These measurements feature an important role in this study since it will help to make further conclusions about the portfolios created.

Finally, the chapter ends with sections that describe models created to analyse the relationship between expected return and risk of investing in a specific portfolio. This model is known as The Capital Asset Pricing Model. However, the model alone might be unrealistic in the real world, and with some theoretical framework refuting it, further risk factors need to be introduced.

Fama-French model, besides incorporating the market risk factor when testing the relationship of risk and return, it also considers the effect of size and book-to-market values (Fama and French, 1993). Moreover, Carhart extended the model and added the momentum effect. Academical literature proposes that this model has a higher explanatory power over this relationship and is better suited to measure portfolio performance (Carhart, 1997).

3.1 Mean-Variance Analysis

''The optimal portfolio for any investor must be efficient in the sense that no other portfolio with the same or higher expected return has lower dispersion of return'' (Fama and MacBeth, 1973).

When investing in a portfolio, risk and return are two very important measures that will influence investors decision. As a matter of fact, Markowitz argued that under certain conditions, an investor's portfolio selection can be reduced to adjust two crucial concepts: expected return of the portfolio and the risk of the portfolio.

Each portfolio has risk-return characteristics of its own. But before moving on to the relationship of these two concepts, it is explained how the concepts are calculated individually.

Portfolio Expected Return refers to the gain or loss expected by the investment made by the investor. It is defined as the sum of the weighted average of each asset expected return.

Considering a portfolio of N assets, it can be calculated as:

$$E\left[R_p\right] = \sum_{i=1}^{N} w_i * E[R_i]$$

Formula 1: Portfolio Expected Returns

Where w_i is the weight of asset i, and $E[R_i]$ is the expected return of the individual asset.

Portfolio risk is the variance that an investor should expect based on historical data of the assets used to construct the portfolio. More simply, variance is the basic risk measure of a financial asset.

Again, considering the same portfolio of N assets, the formula to calculate it is:

$$Var\left[R_p\right] = \sum_{i=1}^{N} w_i * Cov\left(R_i, R_p\right)$$

Formula 2: Portfolio Variance

Where w_i is the weight of assets i, and $Cov\left(R_i, R_p\right)$ is the covariance between expect return of asset i and and the portfolio expected return. The covariance is a statistical measure of the degree to which two variables (financial assets in this case) move together.

This equation states that the Variance of a portfolio is equal to the weighted average covariance of each asset with the portfolio. An alternative formula can be derived from the equation above, where the variance of the portfolio is equal to the sum of the covariances of the returns of all pairs of stocks in the portfolio multiplied by each of their portfolio weights. The equation will then be:

$$Var[R_p] = \sum_i \sum_j x_i x_j . Cov(R_i, R_j)$$

Formula 3: Portfolio Variance 2

Note: The covariance is a statistical measure that shows how two variables (financial assets in this case) tend to move together. And the strength of the variables relationship is given by the correlation of the assets.

From this note it is possible to deduce that portfolio risk depends more on how the financial assets in it are related to one another than their individual riskiness. Hence, conclusions can be made that a portfolio with individually risky assets can still be one of low risk as long as the assets have low relationship between them.

Understanding these concepts individually is crucial to better understand the relationship between the both.

After several studies made on this relationship, Portfolio theory assumes that Risk-Return has a positive correlation. This means that, the greater the risk taken by the investor, the higher the return. Or the opposite being also true, lesser risk gives the investor lower returns.

These two variables are related, and the investors must understand that they are correlated. When investing in a portfolio, investor ought to consider both.

Markowitz formulated the fundamental theorem of mean-variance portfolio. For a rational investor the optimal portfolio will be the one where he maximizes its level of return for a given level of risk or minimizes its level of risk for a given level of return. Furthermore, Markowitz defends that one shouldn’t look to the stock individual characteristics (its return and risk).

This leads to one of the most important rules of investment. Diversification.

Diversification enters in Portfolio theory as a solution to low risk portfolios. Investors choose their financial assets depending on their relationship. If the co-variance between the assets is low, the investor, by introducing one more asset, can gain from diversification, lowering the whole portfolio volatility.

Thus, theory suggest that as an investor, to achieve the optimal portfolio one should not only look to the individual asset level of return and risk. It is important to see how the assets depend on each other.

The lower this level of dependence, also known as co-variance, the higher the chance the investor benefits from diversifying, translating into lowering the risk of the portfolio, (Markowitz 1952, 1959).

3.2 Efficient frontier

Applying the fundamental theorem of the mean-variance portfolio seen above, and the rule of diversification shown in Markowitz 1959, he, through a set of mathematical calculations, was able to calculate a set of theoretical optimal portfolios, known as the Efficient Frontier.

It is the modern Portfolio theory tool that depending on the type of risk profile the investor has, finds him the best possible expected return subject to the highest level of risk he is willing to take. Therefore, the main idea surrounding this concept is, that for any risk level, the investor interest is only in the portfolio that gives him the highest expected return.

Although this concept is in practice more academical, it is important to understand it.

It is now presented an illustration of these mathematical calculations.

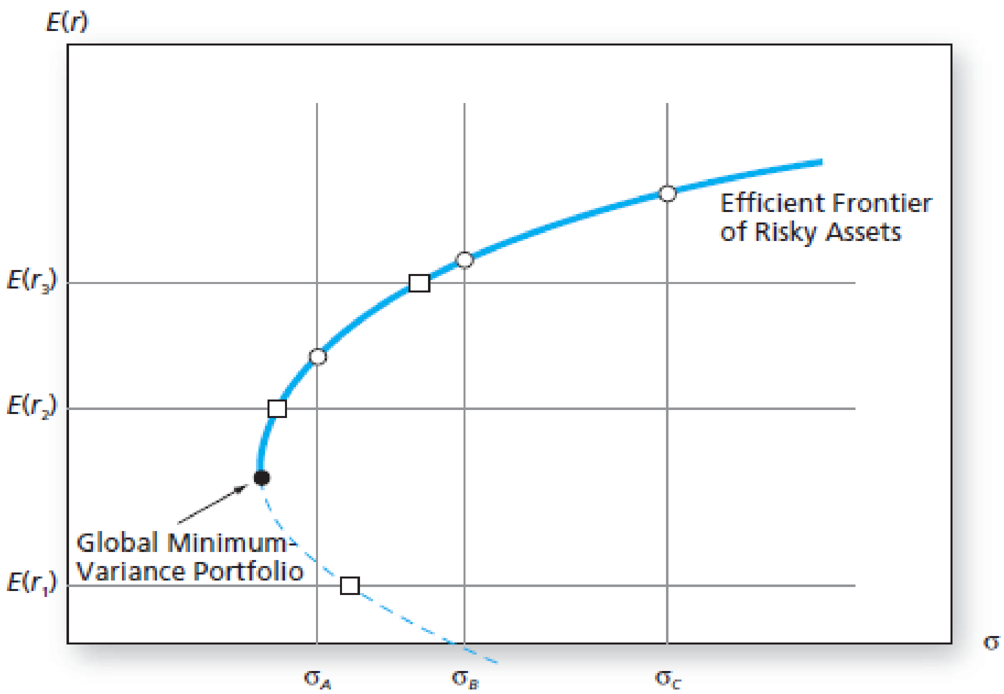

Figure 2: Efficient Frontier

Source: (Bodie, Kane and Marcus, 2014)

Along the efficient frontier calculated in the graph, the investor will find a set of efficient portfolios. The efficient portfolios are defined has the ones that offer the highest expected return for a defined level of risk or the lowest risk for a given level of expected return (Markowitz, 1952). Such portfolios cannot further expand in order to increase their expected return without boosting their risk. Similarly, it is not possible to decrease portfolios exposure to risk without decreasing their expected return.

As observed in Figure 2 there are two methods of computing the efficient set of portfolios.

The first method is to draw horizontal lines at the level of required expected returns (Ex: E(r_2)). Then, the lowest standard deviation that each level of required return gives is selected, in order to find the minimum-variance portfolio. Repeating this for several levels of required expected return result in the points marked by squares and it will shape the Efficient Frontier. Note there is no efficient frontier below the global minimum-variance portfolio since for that level of risk we can have a higher expected return. In other words, any portfolio below that level is inefficient so we disregard that half of the frontier. In the second method, a standard deviation constraint represented by the vertical lines is drawn. Here, the highest possible expected return along this constraint is chosen, this is, the highest portfolio computed on this vertical line. Again, this procedure is followed for many different levels of volatility that will result in the circles that mark the superior side of the efficient frontier as seen in Figure 2.

The two methods combined are the solution to the optimization portfolio problem represent by the blue line that we call the efficient frontier. As already mention above, it calculates the optimal asset allocation, the optimal portfolio expected return and standard deviation.

Finally, any portfolio that it is not on the efficient frontier is inefficient. This is, below this line portfolios are sub optimal because the level of return doesn't match the level of risk. The interception of E(r_2) and σ_A is a good example of this inefficiency. On the other hand, a portfolio with E(r_3) and σ_A, that we find plotted above this curve, is impossible.

3.3 Portfolio Selection

As seen in section 1.1, based on Markowitz investor should choose the portfolio where it maximizes its return for a given level of risk or minimizes its risk for a given level of return. However, several authors developed mathematical equations that can better tell us how optimal our portfolio is. These performance measurements are Sharpe Ratio, Treynor Ratio and Jensen´s Alpha.

3.3.1 Sharper Ratio

In 1966 William F. Sharpe derived a measurement of risk-adjusted return of a financial portfolio that nowadays is known as Sharpe Ratio (Sharpe, 1966). Originally called "reward-to-variability" ratio, was first used to measure the performance of mutual funds. Sharpe Ratio measures how much excess return an investor receives for the extra volatility that he/she endures for holding a riskier asset. In other words, measures the investment ''reward'' per unit of risk. One intuition for this method is, if the investor engages in ''zero risk'' investment that the Sharpe Ratio will be zero.

To understand better how it works Sharpe ratio formula is explained in detail. For the purpose of this thesis the ratio will be expressed as ex-post (Sharpe, 1966):

$$SR = \frac{E(R_p) - R_f}{\sigma_p}$$

Formula 4: Sharpe Ratio

Where,

$E(R_p)$, expected return on the portfolio

R_f, return of the risk-free rate asset

σ_p, standard deviation of portfolio

The expected portfolio returns can be measured daily, weekly, monthly or annually, as long as they are normally distributed. It´s here that the weakness of the ratio is encountered because not all asset returns are normally distributed. Can be dangerous to use this method of performance measurement when returns are not normally distributed.

Risk-free rate is used to see if the investor is being fairly compensated for the additional taken risk. The risk free stated by Sharpe Ratio is a theoretical concept and doesn't really exist. But in practice it is Usually used as the risk-free rate of return is the shortest dated government T-bill or Libor rate.

After calculating the excess return of the portfolio, the excess return is divided by the portfolio standard deviation as we see in the formula. The higher the Sharpe Ratio the better the investment looks from a risk/return perspective, therefore, portfolio standard deviation, also referred as the total risk, has to be as low as possible.

There are of course some problems with this method. Sharpe Ratio uses the standard deviation of return in the denominator as its proxy of total portfolio risk, which assumes that returns are normally distributed. Evidence has shown that returns on financial assets tend to deviate from a normal distribution and may make interpretations of the Sharpe ratio misleading. By treating all volatility, the same, the ratio penalizes strategies that have upside volatility. In case of non-normal returns, the return can be skewed, and or have a fat tail. In these cases, the Sharpe Ratio underestimates the risk component (Sharpe, 1994).

After taking into consideration the limitations of this method, the Sharpe Ratio is illustrated to help determine the investment choice that will deliver the highest returns while considering the risk.

As said before, the higher the Sharpe Ratio is, the more return the investor is getting per unit of risk. The lower the Sharpe ratio is, the more risk the investor is shouldering to earn additional returns. Imagine that Investor needs to decide between 2 portfolios. Both portfolios have the same returns, but the Sharpe ratio is higher in Portfolio A than in Portfolio B. This means that portfolio A can achieve the same returns with less risk.

Now, two portfolios with different returns and different standard deviations are considered. Portfolio A has an expected return of 30% and a Standard Deviation of 15%. Portfolio B has an Expected Return of 25% and a standard deviation of 10%. Assume risk-free rate. By applying the Sharpe Ratio formula, Portfolio A has a Sharpe Ratio value of 1.93 and Portfolio B a value of 2.40. For an investor, this means that it is more earn more per unit of risk by investing in portfolio B. In this particular situation, this method shows that even though portfolio A enjoys a higher return, it is only a good investment if those higher returns aren't achieved with and excess of additional risk.

The Sharpe ratio, however, is a relative measure of risk-adjusted return. If considered in isolation, it does not provide much information about the performance (Sharpe, 1966, 1994). Therefore, Treynor Ratio and Jensen's Alpha are also calculated.

3.3.2 Treynor Ratio

Named after Jack L. Treynor, the Treynor ratio, sometime called the reward-to-volatility ratio, is a risk assessment formula that measures the volatility in the market to calculate the value of an investment adjusted risk. In other words, is a method that calculates the returns that exceed those that might have earned on a risk-less investment, per each unit of market risk. Treynor objective by formulating this ratio was to find a performance measure that all the investors could use, regardless of their personal risk preferences. As in the Sharpe Ratio, the higher the Treynor Ratio, the better the performance efficiency of the portfolio under analysis, this is, the investor generated high returns on each of the market risk that he took.

The Treynor ratio can be calculated with the help of the following formulas:

$$TR = \frac{E(R_p) - R_f}{\beta_p}$$

Formula 5: Treynor Ratio

Where:

$E(R_p)$, Expected Return of the portfolio

R_f, return of the risk-free asset

β_p, beta of the portfolio

Unlike Sharpe Ratio, Treynor used the systematic risk or the beta of the portfolio instead of the portfolio standard deviation, to measure volatility. Beta measures portfolio's sensitive to the market movement. Assets with a beta greater than one tend to increase and decrease value faster and more quickly than assets with beta less than one. It can be argued that the use of market index as a benchmark makes this performance measurement better suited to measure the outperformance of the market.

Here, Treynor introduced the concept of security market line. This line is commonly used by investors to evaluate whether the security offers a favourable expected return against its level of risk. The slope of the line measures the portfolio sensitivity to market movement or, as seen above, security market line slope is represented by Beta.

There are two main limitation that investors ought to consider to understand Treynor ratio. One of the limitations of Treynor Ratio is its backward-looking nature. This is, the investment made in the past are prone to perform differently in the future. Meaning that if a portfolio had a return of 10% in the past, is reasonable to expect a different return in the future. The efficiency of this ratio relies on the proper benchmark to calculate beta.

Another limitation, and like in Sharpe Ratio, Treynor ratio does not take into account any added value gained from active portfolio management. When using Treynor Ratio as a measure to compare portfolio, the portfolios considered need to sub-portfolios of a broader portfolio. If not the case, portfolios with identical market risk, but different total risk, have the same risk. On the contrary, the portfolio with higher total risk is less diversified and consequently has the higher risk, not priced in the market (Treynor, 1965).

Investors and analysts use this method to compare different investment opportunities' performance by eliminating the risk due to volatility component of each investment. By cancelling out the effects of this risk, investors can compare the financial performance of each fund or investment.

While Sharpe Ratio is suitable to use when evaluating single securities Treynor ratio only works if measuring portfolio performance. It is also argued that Treynor is proven to be a better measure because portfolio beta seems to be more consistent than the standard deviation. (Sharpe, 1966)

Finally, after Introducing Sharpe Ratio and Treynor Ratio, an alternative method of ranking portfolio management is Jensen's alpha, which quantifies the added return as the excess return above the security market line in the capital asset pricing model.

3.3.3 Jensen's Alpha

The main problem in Finance is evaluating a portfolio performance of risky investments.

Michael Jensen first used Jensen's Alpha as a measure of risk-adjusted performance of a security or portfolio, in 1968. According to '' The Performance of Mutual Funds in the Period 1945-1964'', Jensen was interested in both return and risk and found that at the time there was very little understanding on the nature and on how to measure risk (Jensen, 1968).

The foundations for this measurement are the CAPM model. Jensen's alpha will be the intercept of this model, which is the excess return on a portfolio after controlling of its exposure to the market (Bodie, 2009). The formula to calculate Alpha is as following:

$$\alpha = \left[E(R_p) - R_f\right] - \beta_p[E(R_M) - R_f]$$

Formula 6: Jensen's Alpha

Where:

$E(R_p)$, expected return of the portfolio

$E(R_M)$, expected return of the market portfolio

R_f, is the return of the risk-free asset

β_p, is the beta of the portfolio

As seen in the formula, Alpha depends on two key variables: the return on the benchmark and the beta. This indicator represents the part of the mean return of the fund that cannot be explained by the systematic risk exposure to market variations. In the case that the portfolio has an α of zero, the portfolio has no abnormal return, and the portfolio plots in the Security Market Line (mentioned in Treynor Ratio). In the other case where either the alpha is positive or negative, it means that either the portfolio out- or underperformed the market. Jensen's alpha is also considered as a measure of the portfolio manager ability to forecast security prices (Jensen, 1968).

Being an absolute measure, sometimes alpha does not reflect completely the risk of the fund. Moreover, the validity of the alpha depends on that the manager does not adapt his/her portfolio's weight according to the expectation on the future market variations.

Apart from this, between Sharpe Ratio, Treynor and Jensen's Alpha, the last is considered the most rigorous performance measure because not only addresses the adjusted returns for market risk, it also accounts for how much the portfolio outperforms the market beyond the risk-free rate.

In this thesis, as in most of the performance studies, Jensen's Alpha will be the measurement model that we will look at to assess the difference in the portfolio performance.

3.4 CAPM

Using the original framework from Markowitz (1952), Sharpe (1964), Lintner (1965) and Mossin (1966), introduced the Capital Asset Pricing Model. The CAPM is a single factor equilibrium model for expected return on risky assets.

This was created to help calculate the required rate of return of a portfolio and became a crucial element for the modern finance. This model describes the relationship between expected return and risk of investing in a particular portfolio. To be more specific, this model confirms if the expected return forecast calculated for a portfolio, matches the given risk (Bodie, Kane and Marcus, 2014).

According to Berk and DeMarzo (2013), the CAPM lies on 3 main assumptions. The first introduced by the Markowitz (1952), that says that ''investors can buy and sell all securities at competitive market prices (without incurring taxes or transaction costs) and can borrow and lend at the risk-free rate''. After, this model assumes that ''investors hold only efficient portfolios of traded securities- portfolios that yield the maximum expected return for a given level of volatility''. This last assumption summarizes the main goal of investing. It says that as a rational investor, the main goal is to maximize the expected return given a certain level of risk. This concept is repeated throughout a broad range of academic literature. Finally, this model assumes that ''investors have homogenous expectations regarding the volatilities, correlations, and expected returns of securities''. Meaning that, the estimate of any investor will end up with similar values because those estimates are based on the same historical data that is available to the public.

The formula for the capital asset pricing model is stated below and can interpreted as the expected return of a portfolio equals the risk-free rate plus risk premium based on the beta of the portfolio.

$$E(R_p) = R_f + \beta_p(E(R_M) - R_f)$$

Formula 7: CAPM Model

Where:

$E(R_p)$, represents the expected return of the portfolio.

R_f, represents the risk-free rate, which is the theoretical rate of return for an investment with zero risk.

β_p, illustrates the Beta of the portfolio and can be calculated as $\beta_p = \frac{Cov(p,M)}{Var(M)}$. More precisely, it is the portfolio sensitivity to market risk. It measures portfolio price fluctuations relative to the overall market. The larger the beta of the portfolio, the larger its expected return must be.

$E(R_M) - R_f$, simplifying, the expected return of the market minus the risk-free rate is also known as the market risk premium. The more volatile a market is, the higher the market risk premium will be.

For statistical testing it is most common to use the excess return form of the CAPM.

The graphical representation of this model produces the Security Market Line. The security market line is a useful instrument to help the investor decide if the considered portfolio gives an acceptable expected return given risk. CAPM suggests that the market portfolio is efficient, so theoretically, all portfolios must lie on the SML.

SML can be viewed as a benchmark to evaluate the performance of the investment. It illustrates expected return as a function of its beta with the market. Therefore it can also be perceived as a risk-reward equation (Bodie, Kane and Marcus, 2014).

The intercept is the risk-free rate and, for this case where Beta is 1, the slope is the risk premium of the market portfolio.

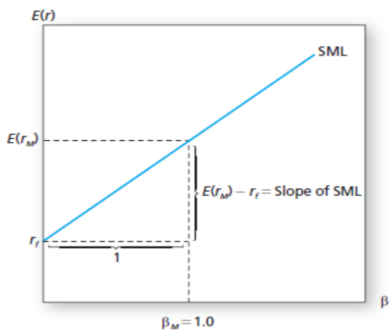

Figure 3: CAPM Model

Source: (Bodie, Kane and Marcus, 2014)

CAPM model can result in pricing errors and fail under some empirical tests. More specifically, (Banz, 1981) found that the variation on expected return is not related to the market beta.

To summarize, CAPM is an important model of risk and return but when applied to some real-world applications it might lead investor to inaccurate conclusions and further multi-factor models should be included in the test of portfolio performance.

3.5 Fama-French 3-factor Model

The three-factor model developed by Eugene Fama and Kenneth French on the paper ''Common risk factors in the returns of stocks and bonds'' (Fama and French, 1993), is one of the dominant approaches to study portfolios returns. Fama uncovered that a simple CAPM model does not fully explain the returns. More specifically, Fama identifies five common risk factors in the return on stocks and bonds that are not mentioned in the CAPM model. For the bonds, common risks are the unexpected interest rate movement risk factor (TERM) and a default risk factor (DEF). For the Stocks, apart from the market factor considered in the CAPM model, size and book-to-market variables need to be included to explain variability in stock returns. Portfolios constructed to mimic risk factors related to size and book-to-market equity ratio capture strong common variation in return, indifferent of the additional factors included in the time-series regressions. Fama and French (1993) argues that ''this is evidence that size and book-to-market equity indeed proxy for sensitivity to common risk factors in stock returns''.

The Fama-French three factor model can be estimated through the following equation:

$$R_i - R_f = \alpha_i + \beta_{iM}\left(R_M - R_f\right) + \beta_{iSMB}SMB + \beta_{iHML}HML + \varepsilon_i$$

Formula 8: Fama-French 3-Factor Model

Where:

$R_i - R_f$, Excess returns of the portfolio i

α_i, Intercept of the portfolio i, Jensen's Alpha

β_{iM}, Portfolio i sensitivity to market

$R_M - R_f$, market risk premium

β_{iSMB}, portfolio i sensitivity to SMB factor

β_{iHML}, portfolio i sensitivity to HML factor

ε_i, is the error-term, which incorporates the non-systematic risk of the portfolio i

The SMB factor is the factor that incorporates the size-effect. Is an Acronym for High minus Low. Essentially, this factor is calculated by the difference between the returns on small- and big stock portfolio with about the same weighted- average book-to-market equity, where small and big related to market cap. The HML factor tries to incorporate the value-effect. The High minus Low factor simulates the risk factor in returns related to book-to -market equity. Is it calculated by the difference between the return on a portfolio of stocks with high book-to-market ratio and the return on a portfolio of stocks with low book-to-market ratio (Fama and French, 1993).

Empirical research found two anomalies regarding these factors. First, the size anomaly. It was found a pattern of a higher average of return for stocks of small capitalization firms than the returns of large capitalization firms, Other things equal. In other words, Small stocks outperform large stocks (Banz, 1981). Finally, the value anomaly. Historically, value firms generated higher returns than growth firms. To be more precise, according to the empirical research developed by Stattman (1980) value stocks outperform growth stocks.

Moreover, Fama French argues that these factors are yet to be discovered as proxy for future unknown risk variables.

This multi factor model extension of the CAPM aims to incorporate common risk factors to improve the relationship between risk and return and that is why this model is important for further conclusions on this study.

3.6 Carhart 4-Factor Model

Apart from the anomalies already studied, Jegadeesh and Titman (1993) confirmed another inconsistency in finance. This inconsistency is the momentum factor. The authors found that stocks that have performed well in the past will outperform stocks that have performed poorly in the past, in the subsequent 3-12 months.

Although Carhart recognize the Fama-French model as a more precise model to determine performance, Carhart felt that the anomaly found by Jegadeesh and Titman (1993) was not explained through the model. Therefore, Carhart extended the model and included the momentum factor(Carhart, 1997).

The Carhart (1997) 4-Factor model is then formulated as below:

$$R_i - R_f = \alpha_i + \beta_{iM}(R_M - R_f) + \beta_{iSMB}SMB + \beta_{iHML}HML + \beta_{iMOM}MOM + \varepsilon_i$$

Formula 9: Carhart 4-Factor Model

Where:

$R_i - R_f$, Excess returns of the portfolio i

α_i, Intercept of the portfolio i, Jensen's Alpha

β_{iM}, Portfolio i sensitivity to market

$R_M - R_f$, market risk premium

β_{iSMB}, portfolio i sensitivity to SMB factor

β_{iHML}, portfolio i sensitivity to HML factor

β_{iMOM}, portfolio I sensitivity to the MOM factor

ε_i, is the error-term, which incorporates the non-systematic risk of the portfolio i

The factor consists in an equal-weight average of firms with the highest 30% eleven-month returns lagged one month, minus the equal-weight average of firms with the lowest 30% eleven-month returns lagged one month. The stock compiled for his test consisted of all stocks from NYSE, Amex and NASQAD re-formed monthly to get a rolling momentum factor (Carhart, 1997).

Carhart finds that, compared to the previous two models, his model returns a significantly lower mean absolute errors per month. Furthermore, the 4-factor model also eliminates all patterns pricing errors, indicating its appropriateness at describing the cross-sectional variation in average stock returns (Carhart, 1997).

Being the most widely used multi factor model in performance studies, this model is identified as the most appropriate model to evaluate this paper portfolio performance.

4. Literature Review

Much research and empirical studies have been done on the relationship between ESG scores and equity performance as this investment strategy gained popularity over the past years.

The following chapter presents and reviews a selection of papers dealing with this relationship. These papers give an overview of the empirical results and conclusions regarding Portfolio performance, performance implications of applying different strategies and possible regional differences. To facilitate an understanding of the empirical breakthrough of this area of finance, the papers are presented in chronological order.

At the end of this chapter, it will be possible to identify previous trends and applied methodology.

4.1 The Private cost of Socially Responsible Investing (David Diltz, 1995)

David Diltz wrote a paper that is very common to analyse when writing about the impact that ethical screening has on portfolio performance. This paper examines market models alphas and cumulative abnormal returns of 28 stock portfolios between 1989 and 1991 to provide an answer over this relationship.

It starts by comparing the estimated market model alphas for the various portfolios to determine any significant differences arise, controlling for portfolio systematic risk.

Study concludes that highly rated firms outperform corresponding low rated firms. More importantly, by estimating the Jensen's alpha, a high environmental scoring portfolio significantly outperforms the low environmental scoring portfolio at a level of 5%.

The methodologies applied in this study provided interesting findings. Analysing portfolios alphas between 1998-1991, conclude that certain ethical screens, such as environmental performance, can actually improve portfolio performance. The cumulative returns suggest that Social screening either increases or decreases portfolio performance. More specifically, it increases performance from environmental and charitable giving screens but decrease from family benefits screen.

The final remark of this study is that, at the time, David Diltz found that individuals and institutions should not be worried to introduce ethical screening in their portfolios since it neither benefits nor penalizes portfolio performance.

4.2 Eco-efficiency Premium puzzle (Derwall *et al.*, 2005)

This paper focus on the concept of eco-efficiency It can be defined as ''the economic value a company creates relative to the waste it generates.

Author explains that the sole purpose of this study is to examine the performance of Environmentally focused portfolios. Evidence of this relation is inconsistent and therefore, investigating if this strategy produces positive or negative abnormal returns is of interest.

First the author calculates the descriptive statistics of a high ranked environmental portfolio and a low ranked environmental portfolio over the period of 1995-2003. The basic statistics suggest that the high ranked portfolio performs better than the low ranked. Also, the low ranked substantially underperforms the market proxy in the Sharpe Ratio measure. Second, Derwall et al. estimates the CAPM model. Both portfolios do not differ significantly in exposure to the market factor. However, alphas suggest that the high ranked portfolio provided a higher abnormal return that its low rated counterpart, but the difference is not statistically significant at any level. In fact, the low rated portfolio estimated a negative insignificant abnormal return.

In the multifactor framework, adjusted R^2 increased, which confirms the incremental explanatory power of the model. Looking at the financial performance of the portfolios, the high-ranked portfolio is estimated to have a significant anomalous return of 3.98% where the low ranked portfolio maintained a negative insignificant alpha. Furthermore, the factor loadings are generally significant. Both portfolios find a negative significant SMB implying a tendency toward large cap stocks. The low rated portfolio finds a positive significant HML factor that means that the portfolio as a tendency for value stocks. From the last factor loading, Momentum, the negative coefficient and the high level of significance proposes that stocks with bad performance the previous year tend to have poor eco efficiency rankings. In theory, Derwall et all finds that picking stocks of high scoring performers in the environmental metric provide superior returns. The positive results are reasonably robust to variation to methodologies and so the results of the performance measurements applied to the portfolios corroborate that Environmentally responsible portfolios provide benefits to the investors.

Overall, the paper defends that portfolios with high environmental scores outperform the ones constituted by the low scoring firms by 6% annually between 1997 and 2003. The difference is not explained by the differences in the market sensitive investment style nor industry specific factors. But according to the author, might be explained by a constant underestimation of the environmental information by the stock market.

Using extra-financial information could help to improve portfolio performance, and so, by following the author suggestion, it is intended from this thesis that portfolio performance is measured when using extra financial information to construct them in a specific region, such as Europe.

4.3 The Effect of Socially Responsible Investing on Portfolio Performance (Kempf 2007)

This study examines how introducing social and environmental screens in investors investment process will affect their portfolio performance. Specifically, the author studies if applying socially responsible screens when building portfolios results in an increase on portfolio performance.

Like the portfolio screening strategy that used in this thesis, Kempf(2007) constructed a low-rated portfolio. The study shows that the low-rated strategy estimates an insignificant positive alpha of 2.02. When focusing on only low-rated companies in terms of environmental scores the portfolio achieved a statistically insignificant alpha of 0.59. Looking at the strategy where Kempf combines both Social and Environmental considerations, the results of the low rated portfolios have a negative insignificant alpha. Regarding HML and SMB factors, the estimation suggests that the high rated portfolio includes more growth stocks than the low rate portfolio. There is also a difference between the factor loading SMB across both strategies, but no systematic differences are captured. Table 2 from the study shows that following a strategy focused on negative screening policies does not calculate significant abnormal returns.

Kempf compared several screening strategies before reaching the conclusion that investors can increase risk-return by implementing a long-shot strategy, that goes long in stocks with high scores on ethical criteria, and short on low scores.

For the period of 1992-2004, Kempf finds six main points. First that investors can earn high abnormal returns when following this long-short strategy. This abnormal return can only be achieved only if using the positive screening approach or the best-in-class screening approach and not the negative screening strategy. More specifically, a best-in-class screening approach leads to a yearly return of up to 8.7%.

4.4 The stocks at stake: Return and risk in Socially Responsible Investment (Galema, Plantinga and Scholtens, 2008)

This paper studies the discrepancy between the results found in empirical literature and the estimates of the theoretical models by relating US portfolio returns, book-to-market values and excess stock returns to different dimensions of socially responsible performance.

Argues that this discrepancy is caused by using common multi-factor models. With the example of Fama-french, authors defend that SRI firms and non-SRI with equal risk levels may have different book-to-market ratios due to an excess demand for SRI stocks, implying that the exposure to the factor, that express the importance of the book-to-market factors, does not depend on the risk profile of the hidden returns. The second error arises from aggregating measures of SRI. Meaning that different dimensions of SRI might create different relations with expected returns.

To test the impact of Socially Responsible Investing, Galema, Plantinga and Scholtens(2008) use a very common strategy in the investment academic field, and create portfolio based on positive scores on the strength and concern screens of six SRI dimensions. Authors analyses the book-to-market ratio and conclude that stock returns are affected by SRI. SRI lowers book-to-market ratio but does not generate positive abnormal returns through the linear regression model. None of the portfolios constructed in this study provided a significant outperformance although, the authors mention that the adjustment factor has a large influence on this result. Portfolio estimations of the Fama-French 3-factor model show significant difference between both types of portfolios. This suggests that strength portfolios are more growth oriented due to significant less exposure to the HML factor. From all the portfolio dimensions, only the community strength portfolio outperforms its concern portfolio and displays an excess return of 3.4%, significant at the 10% level.

The key finding in this paper is that responsible investing impact stocks returns by lowering book-to-market ratio and not by generating positive alpha. Thus, explaining why so few studies are able to establish a link between alpha and Responsible Investing. The estimated results of the study are consistent with the hypothesis formulated. This is, Responsible Investing is reflected in demand differences between Responsible Investing and non- Responsible Investing Stocks.

4.5 The wages of Social responsibility (Statman and Glushkov, 2009)

Statman and Glushkov's investigates the returns of stocks rated on social responsibility between 1997 and 2007. The main goal of this paper is to provide a more clinical view over the returns associated with social responsibility characteristics, and over the returns related to controversial stocks overshadowed by Socially Responsible investors.

For this analysis, yearend portfolios based on KLD scores were created. The portfolios are equally weighted and follow a long-short strategy, going long on the top scorers in environmental characteristics and short on the bottom scores.

In general, study finds that companies with high social responsibility scores yield higher returns than the ones of low scores. The excess return of the portfolio created is positive and highly significant for all the common levels, on the dimensions of community, employee relations and environment characteristics. Human rights and governance characteristics are negative but non-significant. Then authors defined a ''top-overall minus bottom overall'' portfolio. The portfolio estimated positive and significant excess returns across all the models applied. The portfolio has a tendency for growth stocks and stock with high momentum but there is no significant tendency over large or small stocks. Also constructed a long-short portfolio of accepted and shunned (sin) stocks as of end of 1991 until 2007. The ''accepted minus shunned'' portfolio has a negative and significant excess return estimated by CAPM and the Fama French 3-factor model and insignificant when introducing the momentum factor. There is a tendency overgrowth stocks and no significant tendency was found towards the momentum stocks. The results of the models allowed to deduce that ''The effect on returns of the positive screen of tilting toward stocks of companies with high social responsibility scores offsets somewhat the effect on returns of the negative screen of excluding stocks of shunned companies''.

Overall, this study finds that between 1992 and 2007, socially responsible portfolios outperformed the conventional portfolios. It also supports the already existing evidence of the penalization that arises from shunning stocks out of the socially responsible portfolios. The final remark of this study, and the one related to this thesis, is that the best-in-class strategy outperforms the worst-in-class. Socially investors can do both good and well if adopting a best-in-class strategy, specially, if focusing its portfolio with high environmental scores.

4.6 A tale of values-driven and profit-seeking social investors (Derwall, Koedijk and Ter Horst, 2011)

The authors of this study pretend to evaluate the impact that values have on prices. It segments the sustainable investors in two segments. Value driven investors and profit driven investors. In the beginning of SRI history all the investors were perceived as value investors. Investors would accept to incur financial costs for non-financial utility derived from the sustainable attributes of the investment. Now, it is possible to follow this type of investment by pursuing the traditional financial goals. Overall, the main objective of this study is to prove that both controversial and Socially Responsible Stocks produce positive returns and that in the long run the abnormal returns of the Socially Responsible stocks disappear.

The authors, formulate two hypotheses: the first one, ''shunned hypothesis'' that says that ethically controversial stocks have superior returns because value driven investor ignore and therefore push their prices below those of responsible stocks, all else being equal. In contrast, the introduce the second hypothesis, the ''errors-in-expectation'' hypothesis, anticipates that Socially Responsible stocks have higher risk-adjusted returns because market takes time to acknowledge the positive impact that strong socially responsible practices have on companies expected future cash flows.

To examine both that the effect of errors-in-expectation will diminish over time while the shunned stock effect stays constant, the authors constructed two portfolios. The shunned-stock portfolio that returns on average 11.7% annually, between 1992-2008, and the strong-employee relations portfolio, that returns about 9.2%. This were not correct for the common risk factors. From the Fama-French and Carhart model, the estimation of abnormal returns and factor loadings of each portfolio based on monthly returns over the period 1992-2002. The regression of these models confirms a relation between abnormal returns and both socially responsible and socially controversial investments. Furthermore, the study also confirms that only abnormal returns on socially controversial stocks remain constant and significant as the timeframe of the investments are broadened while those of stocks that scored high on employee relations decrease considerably over time.

Finally, this paper concludes that the stocks that value driven investors screen out of their portfolios earn positive abnormal returns, supporting the shunned stock hypothesis. Derwall et al paper is of interest because suggests that value investors only seeking non-controversial and high scoring sustainable stock lose portfolio value because the stocks ignored produce positive returns. It also supports the choices of a long time-frame investment study with constant and significant abnormal annual returns for the shunned portfolio.

4.7 Financial Performance of SRI: What have we learned? A meta-analysis (Revelli and Viviani, 2015)

Christophe Revelli and Jean-Laurent Viviani study tests the link between SRI and financial performance. It determines whether introducing sustainability concerns in portfolio management outperforms the conventional investment policies.

The first difference to consider between the two approaches is portfolio diversification and cost of constructing portfolios. Through the filtering and screening needed to incorporate ESG criteria in a responsible portfolio, this category of investing reduces investment opportunities and the capacity to diversify the portfolio. The limitations result in a smaller universe of stocks and a lower performance due to the downshift of the efficient frontier. Theoretically, SRI investing comes with two costs. The Universe selection cost and the active management cost. These costs are advanced as an explanation to the underperformance of SRI. The authors agree with Bauer, Koedijk, & Otten(2005) and argues that SRI investing, compared to traditional investments, needs a wider time horizon to outperform. A longer horizon is also related to more robust and reliable results.

Study results conclude that SRI does not penalize or benefit the investor and the real question is what the real extra-financial performance of SRI in relation to its sustainability level is. However, the outcome strongly depends on the methodology chosen or the portfolio manager ability to generate portfolio returns.

4.8 The wages of social responsibility – where are they? A critical review of ESG investing (Halbritter and Dorfleitner, 2015)

This paper investigates and reviews the existent empirical evidence between the link of financial performance and corporate social responsibility.

The most common approach to examine this relationship is the construction of a portfolio based on the ESG ratings. According to the score available the previous year, they assigned the best(worst) performers in to a high(low) portfolio. To compare their performance, the authors followed the common long-short strategy where the investors goes long on the high portfolio and short on the low portfolio. To examine the portfolio performance, the Carhart 4-Factor model is applied. Comparing the results with precious studies, the authors found that ESG ratings have a lower impact on returns than previously documented. It also finds that the results of each study depend both on the rating approach from the database chosen and on the underlying company sample. Regarding the estimates from the model, there are evident changes between the exposure to HML factor. Higher scores, lower systematic risk, some of them significant. Furthermore, most of the portfolios witness a significantly different impact of the size effect between high and low score. High score is less exposed to size risk, both considering the overall ESG and single pillar portfolios. After validating the results, author find that the link between ESG score and return is insignificant. In summary, an ESG portfolio strategy does not suggest a relationship between financial performance and sustainable performance. The Carhart model does not show significant returns differences between both high and low portfolio.

Finally, through a cross-section analysis where the authors use overall ESG score and particular pillar as an explanatory variable, the results emphasize that this relationship is once again dependent on the sample and rating provider.

Overall, the takeaway from this study, is that the link between ESG ratings and returns is very questionable and dependent on the provider of the scores as well as the sample selected by the investor. Investor should not expect a long-short ESG portfolio strategy to be profitable anymore.

4.9 ESG Integration and the investment management process: fundamental investing reinvented (van Duuren, Plantinga and Scholtens, 2016)

This paper investigates the methodology conventional managers use to insert ESG factors in their investment process. It also examines the difference of these methodologies across US and Europe.

The author argues that ESG investing is very similar to fundamental investing except the focus asset managers have on stock specific information over the traditional financial dimensions, that serves as a screening method on the stock selection process. Results of the survey done proposes that ESG investing do not agree with the idea of being penalized for following ESG investing. Survey also proposed that a positive impact is expected, and it gets stronger as the level of the investor rises. In other words, the higher the commitment in ESG strategies from the investor, the higher is its expectation of positive impact. The most common approach of ESG investing, according to the survey, is the closely monitoring and or exclusion of controversy stocks. In terms regional differences, the authors observe that most of domicile manager across both regions are mainly focused on the governance factors, attributing environmental and social factors less significance. Is ultimately concluded that the impact of domicile of asset managers proposes that SRI cannot be understood in isolation of contextual factors

Overall, authors find hard to reach a single conclusion regarding the effect of ESG investing on performance. There is evidence of positive performance in long term, but the analysis is too narrow to provide a final conclusion. The paper also discovers that ESG investors tend to focus more on the governance factor, related to quality of management. US managers are more sceptical than the European of the benefits of following a ESG investing strategy but the striking resemblance between the two types of investing are even more compelling when observing the astounding belief of the asset manager own ability to create positive even though that did not happen in the past.

Agreeing Revelli & Viviani, 2015 the relationship between ESG and performance will vary between the methodology applied and the portfolio manager skill.

4.10 Do socially responsible investments pay? New international data (Auer and Schuhmacher, 2016)

This article studies the performance of socially (ir)responsible investments across the different regions of the globe.

Auer & Schuhmacher implement several portfolio screens on the industry level to reach further conclusions.

From the results, the low rated portfolios outperform their benchmarks more than half the cases. Specific to the region, the US observes a higher Sharpe Ratio when environmental social and governance screens are applied. Different from across the Ocean, in Europe, no outperformance of high over low rated portfolios can be detected. Compared to our study, the portfolios constructed with the different screening strategies, achieved the following results: Environmental portfolio averaged returns 0.65% and a standard deviation of 6.30%. The social Portfolio had a mean return of 0.95% and a volatility of 6.20%. Finally, the Governance portfolio returned 0.47% at a 5.59% level of standard deviation. The Sharpe Ratios are respectively 0.1, 0.15 and 0.08. It is important to mention that the portfolios created following this strategy incorporate the 5% worst stocks according to each specific criterion.

Furthermore, there are some cases where low rated portfolios outperform their high rated counterparts, but the outperformance is not high enough to also beat the benchmark. Precisely, these portfolios show very similar performance to the benchmarks selected except when social screen criteria in the financial sector is applied. Sharpe Ratio outperforms the benchmark. However, conclusions about neither underperformance nor outperformance can be done due to the lack of statistical significance according to the lw test. The environmental screening portfolio is seen to be consistently underperforming in the miscellaneous sector.

The study concludes that the outcome of an ESG based investment strategy and the employed ESG criteria is strongly correlated to geography and industry focus. For the purpose of this study, no evidence is found regarding the benefits of following an ESG based strategy in Europe. However, there is evidence that European investors pay a price to follow these strategies, resulting in significantly lower risk adjusted performance than the passive benchmark. It is therefore important to avoid some combinations of criteria's and industries when investing in Europe. The final remark of this study is that, if the primary objective of the investor is profit seeking, ESG based stock selection is, both for high and low rated stocks, not a good strategy to follow.

4.11 ESG Integration: Value, Growth and Momentum (Kaiser, 2018)

Lars Kaiser studies the financial effectiveness of combining ESG integration with traditional investment styles to demonstrate that US and European value, growth and momentum investors can improve the levels of sustainability in their portfolio without losing financial performance.

It constructs portfolios based on several measures. The first portfolio is regressed to measure value, growth and momentum. Secondly, Kaiser builds a portfolio based on aggregated ratings for the sustainability ESG pillars. Finally, Industry, timeframe, country and Size effects are introduced.

From the portfolios created based on Value, Growth, Momentum and ESG ratings, the study observes positive value and momentum premia for both US and Europe between 2003 and 2016, where the value premium in European markets depend on the observation period.

Then they sort portfolio by their sustainability pillars and find a tendency where higher scores are related to lower future returns although the difference in HML portfolio returns are not significant. However, higher sustainability performance benefits the level of risk. The shift from low to high ESG ratings portfolio, in both markets, witnesses a persistent decrease in standard deviation. Furthermore, differences in returns across the different sustainability pillars-based portfolios can, at some extent, be attributed to size effect since it was previously found a positive relationship between firm size and ESG ratings.

About momentum measure, the study finds that in US and Europe the stocks that are experiencing an upward trend in returns have a softer approach on their sustainability measures whereas stocks showing a downward trend have an increasing sustainability performance.

The study also evaluates the impact of ESG integration on the different portfolios. Adding ESG criteria to the portfolios, reduces its risk for both the US and European markets and for the strategies applied in the study with the one exception of the European Value portfolio.

Furthermore, the addition of ESG factors in the US markets, improves all strategies risk-adjusted return. On the contrary, this addition in the European market on benefit the growth investors. Results show that value investors should look for higher corporate governance scores whereas growth investors should look for high environmental and social scores.

In summary the results of the regressions done in this study allow us to understand how the different strategies react to ESG integration in the US and European market and how the different common risk factors are related to sustainability performance. Findings demonstrate that: firm size is positively related to sustainable performance; industry effects are strong across environmental and social sustainability measures; country and regional effects are bigger for corporate governance in Europe that industry effects. And finally, that there is a steady decrease of portfolio risk with the integration of these factors. Asset managers that use ESG considerations in their investment decision process are more focused on risk and long-term value than short-term financial performance.

The author concludes that in Europe, different from what happens in the US, the sustainability performance is already reflected in the firms' market value.

4.12 Summary

This section aims to summarize the findings of the papers previously studied. Here, theoretical trends are identified to better understand where ESG portfolio performance stands in the academic literature. Common methodologies applied on the studies are also identified in this section.

Overall, portfolio studies show an agreement on the financial models to use. The Fama-French and Carhart model, along with the traditional performance measurements are the most common measures applied to reach conclusions about portfolio performance. (Revelli and Viviani, 2015) (Halbritter and Dorfleitner, 2015) test the relationship between socially responsible investing and ethical concerns in portfolio management and reaches the conclusion that thematic approach, investment horizon and data comparison applied has a big influence on the final conclusion of each paper. The authors does not believe that the use of ESG criteria is neither a strength or a weakness compared to traditional investments and also, Halbritter and Dorfleitner(2015) finds no significant difference between high ranked portfolios and low ranked portfolios. On the contrary, studies such (David Diltz, 1995; Derwall et al., 2005; Kempf and Osthoff, 2007; Statman and Glushkov, 2009; Derwall, Koedijk and Ter Horst, 2011) find that high scored social and environmental focused portfolios are related to positive abnormal returns. The discrepancy between this results, can also be attributed to regional differences (van Duuren, Plantinga and Scholtens, 2016). Some studies are domiciled in the US and others in Europe. Evidence supports that high and low rated stocks do not provide an advantage against passive stock market investments, but in Europe, depending on industry and ESG criteria, investors may pay a price for Socially responsible Investing(Auer and Schuhmacher, 2016).

In similar manner to the former studies, this paper examines the link between poor ESG criteria and portfolio performance and how this link affects the profit-driven investor. It distinguishes itself from previous literature, as this study analyses are conducted on a different and more recent time period. Apart from time-horizon being more recent, the database where the ESG scores were collected is believed to have the most accurate methodology to rank the extra-financial information of the companies, has it will be explained in detail in the next section.

5. Methodology

This Chapter describes the data selection process and consequent strategy used in the analysis presented. It gives an overview of the methods applied in order to ultimately answer the questions made in the beginning of this study. Specifically, this chapter starts by briefly introducing the different ESG providers that exist and are mentioned in the literature review, and then, present the reasoning behind the choice of database. Subsequently, it is explained how the selected data providers collect and calculate the ESG Scores and how companies are ranked. Next, models and concepts for the construction of the Responsible investing portfolios are introduced as well as the portfolio calculations methods. Finally, this chapter presents the motivation behind benchmark and risk-free selection.

5.1 Database Selection

To select the universe of companies that are used in this study, ESG data is collected. This information is essential to this study since the portfolio selection is based on the ESG ratings of each company. As explained in Chapter 2, ESG data refers to three main metrics that measure the commitment level of companies on tackling Sustainable and ethical issues in their community. Until now, there are no legal obligations for the companies to provide this information. This means that all reporting is a voluntary initiative from each company and because of that, the databases used to collect this type of information does not cover the whole universe of stocks. However, many organizations and agencies that specialize in this matter are actively contributing for the development of decent ESG sources. Common databases like KLD Research & Analytics, Dow Jones Sustainability, EIRIS, Sustainalytics, MSCI ESG Research and Asset4 provide this information. Since these databases have different methodologies and consequently different scores, this thesis aims at selecting the database that is used most frequently in other empirical studies.

The following paragraph discusses the aforementioned databases. To begin with, KLD Research & Analytics is analysed. This database has records dating back to 1991. Now called MSCI ESG Research, it is the largest dataset for ESG and it is favoured in many studies. This database provides this information as binary information or, more simply, as a ´´dummy score´´. The companies will be classified with 1 for strengths or 0 for weaknesses along the different categories. The company total score will be assessed as the sum of these values. Studies examining this methodology find that the simple sum of the results is unsatisfactory and even recommend to disregard studies based on this method (Mattingly and Berman, 2006).

Next, the Asset4 database is presented, which was acquired by Thomson Reuteurs in 2009. It covers data since 2002 for over 1000 companies and was until recently the leading provider of ESG data. This database has in-depth ESG data on +4,300 global companies as well as coverage on indices such as: MSCI World, MSCI Europe, STOXX 600, NASDAQ 100, Russell 1000, S&P 500, FTSE 100, ASX 300 and MSCI Emerging Market. The figure below gives an overview on how the more than 750 data point and 280 key performance indicators are organized into 18 categories.

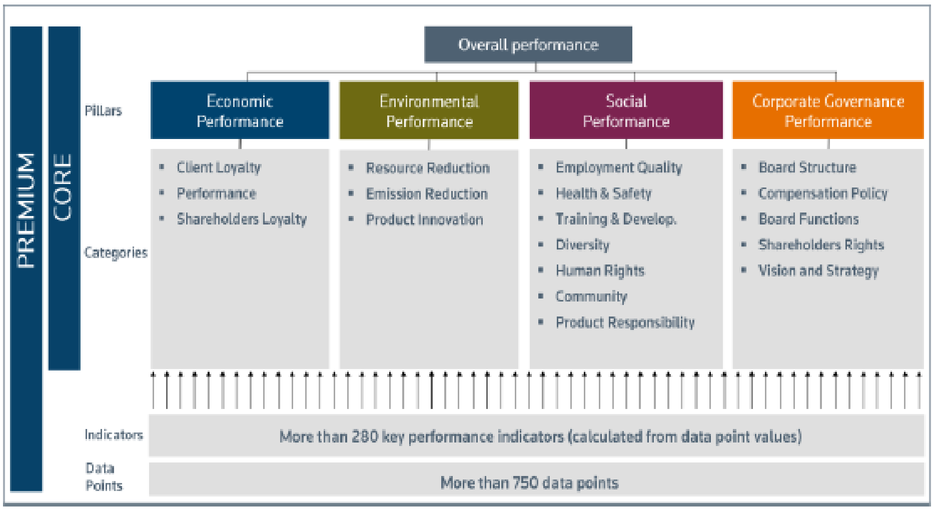

Figure 4: ESG Performance Indicators

Source: Thomson Reuters 2012

In this database, the binary response for a certain indicator is translated into a percentage by a z-scoring procedure. A standard score expresses the value in units of standard deviation from the mean value of all companies and produces a final percentage score for a particular company. The four pillars seen in the figure above are equally weighted throughout the process. Empirical studies using this database tend to disregard the Economic Performance pillar and assume that the final company ESG score is a weighted average of the three main pillars (Environmental, Social and Corporate Governance). Quantifying this qualitative data was a crucial step that made it possible to linking these scores with financial performance.

After having presented these databases, the author chooses to use Thomson Reuters Eikon as database for this thesis, since it offers the most sound and updated methodology and is discussed as most reliable database.

5.1.1 Thomson Reuters ESG

Therefore, this section presents Thomson Reuters in more detail. Thomson Reuters ESG differs from the old ASSET4 database and it is viewed as an enhancement and replacement for it. It reflects Thomson Reuters strategic ESG framework and are a robust, data driven assessment of companies' ESG performance and capacity where company size and transparency biases are minimal.

The key differences we can find between both databases are:

First, introducing an ESG controversies ESG overlay to enhance the impact of important controversies on the overall score. Next, uses Industry and Country Benchmarks at the data point scoring level – to facilitate comparable analysis within peer groups. Third, the use of data-driven category weights so it reflects data availability within each category that supports more precise differentiation across companies. And finally, to be able to eliminate hidden layers of calculations, they introduce a Percentile Rank Scoring methodology (Thomson Reuters, 2019).

Thomson Reuters ESG database contains 7000+ global companies, from which 1000+ are Europe based. It started by covering indexes like SMI, DAX, CAC 40, FTSE 100, FTSE 250, S&P 500, NASQAD 100, and overtime more indexes were included in its universe. To provide the most up to date data, Thomson Reuters reviews the constituents of these indices and adds any newly included companies every quarter. Most recently, it is working on adding all the Russel 3000 index companies to the covered universe.

From this Universe, Thomson Reuters captures and calculates more than 400 ESG metrics, that largely come from companies public reporting and global media sources. These measures are grouped into 3 pillars and 10 different ESG topics.

In the figure below, it is possible to see an illustration of how these measures are grouped.

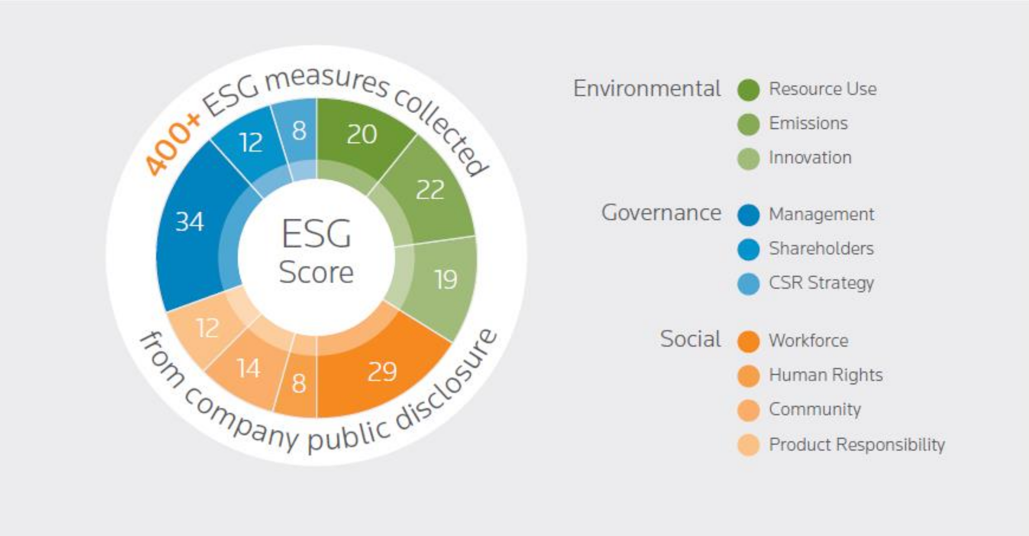

Figure 5: ESG Measures Organization

Source: Thomson Reuters, 2019

There are two overall ESG scores in this model. The Thomson Reuters ESG score that measures companies' ESG performance based on reported data in the public domain. The ESG Combined Score that overlays the Thomson Reuters ESG score with ESG controversies to provide a comprehensive evaluation on the company's sustainability impact and conduct (Thomson Reuters, 2019).

For the purpose of this thesis, the ESG combined (ESGC) score is applied, because it is the only dimension that reflects in their sustainable performance score, the companies involvement in controversies This means that if a company is involved in ESG controversies, the overall ESG combined score will be a weighted average of the ESG score and the ESG controversies score for a particular year. In case they are not, the ESG overall score and ESG combined score is the same.

To better understand this category, it is important to also understand the ESG controversies category. This score is calculated based on topics such as lawsuits, fines or ongoing legislation disputes. During the year of the scandal, the company is penalized, and this affects their overall ESG Combined Score and grading.

In addition to the combined scores, the individual metric scores are presented. This means that this thesis does not only look into the overall combined score, but also into the independent score for Environmental, Social and Governance pillars. After some developments in this database, more metrics inside of each pillar began to be reported.

The calculation of the scores is based on a percentile rank scoring methodology. This concept reflects how many companies have a worse value than the current one, how many have the same value and how many have a value at all.

Percentile rank score is based on the rank and therefore it is not very sensitive to outliers.

$$score = \frac{nº\ of\ companies\ with\ a\ worst\ value + \frac{nº\ of\ companies\ with\ the\ same\ value\ included\ in\ the\ current\ one}{2}}{nº\ of\ companies\ with\ a\ value}$$

Formula 10: Percentile Rank Scoring

Each category score is created based on the equally weighted sum of all relevant indicators for each industry. In this database, there are differences between the benchmark used for each pillar. To calculate Environmental and Social scores, TRBC Industry Group is used as the benchmark, as these topics are more important and identical within the same industries. It is also used for the Controversies Score. On the other hand, to calculate the Governance scores, country headquarters are used as a benchmark, because best governance practices are more consistent within countries (Thomson Reuters, 2019).

In summary, all the reasons stated above highlight that the methodology of the ESG scores provided by Thomson Reuters Eikon are based on a solid foundation to rely our Universe Selection on.

5.2 Stock Sample Selection

This study is only focused on the scores for the European ESG market. To limit the sample and only get European companies the command ´´LA4RGNEU´´ was used in Thomson Reuteur Eikon DataStream. The initial sample of 1200 companies were further filtered to receive the specific scores needed as explained above. Based on data availability, the time horizon is set from 2009 to 2019. Some companies that fail to provide ESG historical rating for this time period are not included in this universe which narrowed this sample down to around 1000 companies.

Furthermore, the chosen time frame to study the stock returns is 10 years. Hence, to be part of our sample, companies are required to have a price data history from January 2009 onwards, otherwise they would be separated from the final sample.

The selected period is particularly interesting, because it covers the recovery timeline of companies affected by the financial crisis. Moreover, it was from this point in time that companies´ shifted their attention to ESG policies, on the grounds that a flourishing relationship between ESG performance and Long-Term Value creation was being validated (KPMG, 2011), (Barnett and Salomon, 2006).

After shortening the universe to companies that provide both ESG score and were listed in the local stock exchange for the period between 2009 and 2019, we can now advance to the selection of our portfolio constituents.

For each equally weighted portfolio created, this study selects the bottom 250 E, S and G performers. The portfolio construction based on ESG scores is a straightforward strategy and this study aims for the companies that had a poor ESG performance.

The table below is an example of part of the Environmental Portfolio Constituents. No sector is excluded in this universe. In several studies, such as (Kempf and Osthoff, 2007), the author screens out companies related to controversial industries. Contradictory to previous literature, and following the evidence found by Hong and Kacperczyk (2009) that shunned-stocks produce high return, the choice of stock to incorporate the portfolio is purely based on the factor score of each company in the last year of activity.

Table 1: Environmental Portfolio Constituents

	Environment Pillar Score In the last 10 FY					
Company Name	**2018**	**31/01/2009**	**27/02/2009**	**31/03/2009**	**30/04/2009**	**29/05/2009**
Sofina SA	22.57	51.75	47.35	52.69	57.40	61.49
Technical Olympic SA	23.32	1.00	0.90	0.85	1.25	2.10
Intracom Holdings SA	26.35	1.17	1.00	1.03	1.99	2.89
Banca Carige SpA Cassa di Risparmio di Genova e Imperia	30.22	1.95	2.29	2.66	3.00	2.36
Bank of Greece	30.74	39.52	36.54	41.91	43.28	44.80
KBC Ancora CVA	31.31	6.37	3.73	6.10	11.60	8.66
Mediaset SpA	33.55	3.76	3.47	3.31	4.22	4.13
Groep Brussel Lambert NV	35.61	57.59	51.00	51.16	54.96	56.88
GEDI Gruppo Editoriale SpA	37.65	0.96	0.75	0.82	1.07	1.32
Permanent TSB Group Holdings PLC	37.94	158.27	60.43	105.51	185.12	323.25

It is important to mention that, since our focus is in Europe, the author decided to eliminate all possible currency movements by limiting the screening criteria to a single currency, EUR. Therefore, all price data from Datastream Eikon Thomson Reuteurs is downloaded in Euro currency. This price data was taken as form of Total Returns since the aim of this study is to give the best estimate that this portfolio strategy can bring to the investor.

5.3 Portfolio Calculations

This section introduces the calculations of concepts first seen in Section X.

In order to check if the objective was reached, monthly lognormal returns for each of the constituent of the portfolio in the given time horizon are calculated. Next, portfolio returns are derived to through Formula 1.

This Monthly return calculation method is selected for several reasons. First, it has a simple construction alternative and considers the compounded interests (Bodie, Kane and Marcus, 2014). Second, using simple returns to estimate returns over longer periods has been proven to be can be quite unsatisfactory. Finally, when normally distributed, produces normally distributed results, which indicates the investor what returns and risks to expect. However, the use of lognormal returns might mildly bias the results. Indeed, Hudson & Gregoriou, 2015 argue that logarithmic returns reduce the expected returns due to an unusual high variance, thus the expected returns of the Stocks can eventually be underestimated. While mean returns using logarithmic returns is lower than the mean calculated with simple returns, the variance is fairly similar between both methods.

The risk of the portfolio was calculated through a Variance-Covariance Matrix, created with help of VBA functions. Below we can see the function used to calculate portfolio risk.

```
Function VarCovar(rng As Range) As Variant
    Dim i As Integer
    Dim j As Integer
    Dim numcols As Integer
    numcols = rng.Columns.Count
    numrows = rng.Rows.Count
    Dim matrix() As Double
    ReDim matrix(numcols - 1, numcols - 1)

    For i = 1 To numcols
        For j = 1 To numcols
            matrix(i - 1, j - 1) = Application.WorksheetFunction.Covariance_S(rng.Columns(i), rng.Columns(j))
        Next j
    Next i
    VarCovar = matrix
End Function
```

Figure 6: Variance-Covariance Matrix VBA Functions

5.4 Risk-Free Selection

Risk-free rate is the theoretical rate of return of an investment with zero risk. Represents the interest an investor expects from a risk-free investment over a specified period. These rates are also important to calculate all the performance measurements mentioned in this thesis. In most studies, (Derwall et al., 2005) as an example, the most common risk-free rate is US 1-month T-bill because most of the studies are focused on the United States. With the intention of eliminating the currency movement risk, this risk-free is not suitable for a European based study. Therefore, the author decides to follow (Bauer, Koedijk and Otten, 2005) and (Renneboog, Ter Horst and Zhang, 2008a) that use 1-month interbank overnight rates as proxy for risk free deposits outside the United States.

More specifically, this thesis uses the overnight Euro LIBOR interest rate as a risk free in this study. In other words, it is the interest rate at which a panel of selected banks borrow euro funds from one another with a maturity of one month. The overnight Euro LIBOR interest rate is collected through Bloomberg as monthly rate to match the price data collected through Eikon Thomson Reuteurs Datastream.

5.5 Benchmark Selection

This section aims to advocate the benchmark selection. A benchmark is a measure that can be used to compare the risk and return of a given portfolio. Investors often use indexes like the S&P 500 that represent a designated segment of the American market. Therefore, it is necessary to draw a benchmark portfolio in order to put results in perspective to achieve better and more consistent conclusions. Furthermore, to estimate our portfolio performance measures such as CAPM and Fama-French multi-factor model, it is important to select a market index. This study selects MSCI Europe. This index captures large and mid-cap representation across 15 developed markets countries in Europe. It is established by 439 constituents and covers approximately 85% of the free float-adjusted market capitalization across these countries.

The most common benchmark selection in portfolio performance studies Is MSCI All country World index and S&P500, but for the purpose of this thesis there would be a bias originated by using all the funds and not only European focused. Even though this benchmark is considered because it was used in previous studies, our regional focus is Europe. It is also important to notice that having the same benchmark for all the portfolios calculations is crucial to maintain the direct comparability aspect of our portfolio results. not to mention the importance of having the same benchmark for all our portfolios calculations, important to maintain the direct comparability aspect of our portfolio results.

Ethical index MSCI Europe ESG leaders was also considered to be used to see how the portfolio performed against the best ESG performers in Europe. However, Bauer, Derwall and Otten (2007) study found that the difference between using an ethical index and a conventional one is statistically insignificant.

The total return of the index was collected over the same time-frame mentioned above.

Fama-French 3-Factor Model Factor Selections

Empirically confirmed by Fama and French (1993), this method benefits this study because it also controls for the presence of size and value versus growth, known to be financial factors that determine stock performance. It is important because of the mounting evidence that environmentally and socially screened portfolios tend to be biased toward large capitalization growth stocks (Derwall et al., 2005).

The task of creating these dynamic portfolios susceptible to changes dependent on time and the corresponding market caps for each stock is too great for this thesis.

For that reason, Faff (2003) creates useful proxies for the Fama and French factors. Following the paper, value and growth indices are good proxies for the factors in the Fama-French model.

Identical to (Faff, 2003), this thesis collects the monthly price data for the same time-frame in study for MSCI Europe Large Cap, MSCI Europe Small Cap, MSCI Europe Value and MSCI Europe Growth indexes through Bloomberg.

The monthly returns for each of the indexes are then calculated and the following equations are applied to determine the SMB and HML factors.

$$SMB = MSCI\ Europe\ Small\ Cap - MSCI\ Europe\ Large\ Cap$$

$$HML = MSCI\ Europe\ Value - MSCI\ Europe\ Growth$$

Faff also supports that it is possible to achieve similar results to those found in previous literature by creating Fama-French factors using off-the-shelf indexes. This sums up the main reason the same approach is applied in this paper to calculate these factors for Europe.

6. Results and Analysis

The following chapter presents the results from the applied models and theories reviewed in the previous sections. The chapter is divided in agreement with the models in study and each portfolio will be thoroughly analysed in accordance to the performance measures and asset pricing models.

6.1 Descriptive Statistics and Performance Measures

The Results and Analysis Section starts with a summary of the Descriptive Statistics and Performance Measures mentioned in Chapter 3. Each sub-section provides the monthly average returns, Standard deviation, Maximum and Minimum Return achieved during the period in study, followed but brief insights on the ESG scoring of each portfolio. Lastly, the results and logical interpretations of the risk-adjusted returns measures are bestowed.

6.1.1 Environmental Portfolio

Table 2: Environmental Portfolio Descriptive Statistics

	Monthly Average Return	Annual Average Return	Maximum Return	Minimum Return	Std Dev	Annual Std Dev
Environmental Portfolio	0.49%	5.867%	21.694%	-11.296%	4.59%	15.90%
MSCI Europe	0.49%	5.935%	12.557%	-11.019%	3.84%	13.30%

The above table provides the summary statistics of the Environmental Portfolio and MSCI Europe, the benchmark portfolio or market portfolio. Over the considered timeframe between January 2009 and January 2019, the portfolio focused on the poorest performers in the environmental metric had the highest return of 21.694% in April 2009 and the minimum return of -11.296% in August 2011. In terms of ESG scoring, specific to environmental criteria the maximum score was achieved by Logitech International with 67.35 and the poorest performer with an 8.91 score. The overall portfolio had an average of 52.38 Environmental points.

Following a mean-variance analysis a monthly average return of 0.49% is calculated. The correspondent annual return is 5.867%. From the table, it is possible to observe a yearly underperformance of 0.068% of the portfolio created when comparing to the returns of MSCI Europe index. It is also possible to observe that the environmental portfolio has a higher volatility of returns when compared to the market, which suggest to be a riskier investment.

To further evaluate the relation between risk and return, Chapter 3 introduces two reward-to-volatility ratios. Revising the concepts, Sharpe Ratio (Formula 4) measures how much excess return an investor receives for the extra volatility that it endures for holding a riskier asset and Treynor Ratio (Formula 5), a risk assessment formula that measures the returns that exceed those that might have earned on a riskless investment, per unit of market risk.

The below table allows to see that the risk return relationship found is worse when investing in the Environmental portfolio instead the market index.

Table 3:Environmental Portfolio Reward-to-Variability Ratios

	Sharpe Ratio	Treynor Ratio
Environmental Portfolio	0.086	0.0037
MSCI Europe	0.104	0.0040

After the mean-variance analysis done, where the market proxy achieved higher return with lower risk, it is possible to predict the market proxy to outperform the portfolio created in terms of risk-adjusted returns. Same as the Sharpe Ratio measure, it is observed an outperformance of 0.0016 from the Index selected when calculating the Treynor Ratio.

6.1.2 Social Portfolio

Table 4: Social Portfolio Descriptive Statistics

	Monthly Average Return	Annual Average Return	Maximum Return	Minimum Return	Std Dev	Annual Std Dev
Social Portfolio	0.35%	4.21%	21.24%	-11.25%	4.58%	15.86%
MSCI Europe	0.49%	5.935%	12.557%	-11.019%	3.84%	13.30%

The descriptive statistics and performance measures of the second portfolio created and our benchmark is now analysed.

Over the timeframe presented that goes from January 2009 to January 2019, the portfolio constituted with the bottom 250 companies with poor social engagement, had the highest return of 21.24% in April 2009 and the minimum return in June 2016. When looking at the ESG scores statistics summary, the portfolio aggregates a company that delivers a highest score of 65.42 and the lowest score of 6.88. The overall portfolio achieved a Social score of 49.76 points.

Doing a mean-variance analysis, the portfolio based on Social Scores delivered a monthly mean return of 0.35%. Comparing to the market proxy selected, the social portfolio had an annual underperformance of 1.725%. On the variance side of this analysis, the portfolio created poses a riskier investment when compared to the Index due to the higher volatility of returns.

As mentioned before, to have a better overview of the relationship between risk and return, the investor needs to use further performance measurements. Therefore, performance of the Social Portfolio with the concepts of Sharpe Ratio and Treynor Ratio is measured.

The table Below provides the results for both ratios.

Table 5: Social Portfolio Reward-to-Variability Ratios

	Sharpe Ratio	Treynor Ratio
Social Portfolio	0.056	0.0024
MSCI Europe	0.104	0.0040

Again, the portfolio created, this time based on poor Social factors performance, underperforms MSCI Europe in both Reward-to-Variability ratios.

6.1.3 Governance Portfolio

Table 6: Governance Portfolio Descriptive Statistics

	Monthly Average Return	Annual Average Return	Maximum Return	Minimum Return	Std Dev	Annual Std Dev
Government Portfolio	0.27%	3.20%	21.02%	-11.58%	4.75%	16.45%
MSCI Europe	0.49%	5.935%	12.557%	-11.019%	3.84%	13.30%

This sub-section investigates the portfolio created based on the Governance metric.

Between January 2009 and January 2019, the portfolio integrated by the worst Governance Performers, got a highest return of 21.02% in April 2009 and a minimum of -11.58% in August 2011. When investigating the constituents, we find the highest performer to have a score of 48.47 and the lowest scorer, Bank of Greece, to have a score of 8.67. Overall, the portfolio has an average of 32.86 points in the Governance Metric.

The table above also provides the results needed to illustrate the relationship between risk and return in our governance portfolio. The portfolio performed at a monthly average return of 0.27%. Annually, it achieved a return of 3.20% meaning that it underperformed the market proxy selected, by negative 2.735%. Furthermore, the risk of the Governance portfolio is investigated. Standard deviation tells us that the returns of our portfolio had a higher volatility than the Index. Meaning that investing in our portfolio is a risky investment.

Helping further interpretation on this risk-return relationship, the results of the reward-to-volatility ratios are illustrated in the table below.

Table 7: Governance Portfolio Reward-to-Variability Ratios

	Sharpe Ratio	Treynor Ratio
Government Portfolio	0.036	0.0015
MSCI Europe	0.104	0.0040

Compared to the index, our portfolio results in these ratios also underperforms which supports the first brief interpretation of the mean-variance analysis.

6.1.4 Combined Score Portfolio

Table 8: Combined Score Portfolio Descriptive Statistics

	Monthly Average Return	Annual Average Return	Maximum Return	Minimum Return	Std Dev	Annual Std Dev
Combined Score Portfolio	0.28%	3.40%	20.70%	-11.58%	4.67%	16.16%
MSCI Europe	0.49%	5.935%	12.557%	-11.019%	3.84%	13.30%

Concluding the first section of this chapter, the summary statistics of the last portfolio are presented.

This portfolio was created based on the overall score of all the metrics seen above (Environmental, Social and Governance). The methodology to calculate this score was seen in the previous Chapter 5.

Summary statistics and performance measures were calculated for the same interval as the preceding portfolios. Within this interval, the portfolio delivered a topmost return of 20.70% in April 2009 and a minimal return of -11.58% in August 2011. Examining the sustainability scores, the best performer scored 46.52 points and the worst performer 15.99. The Combined score portfolio averaged a total of 37.49 points.

The portfolio in study performed at monthly average return of 0.28%. Although it's positive, when the annual average return of 3.40% is compared to the benchmark returns, we witness an underperformance of 2.535%. Regarding portfolio risk, measured by Standard deviation of the portfolio, it is possible to make a preliminary conclusion that, when compared to the MSCI Europe Index, our portfolio has a higher volatility that can be translated into higher risk.

For a better assessment of this risk-return relationship, the reward-to-volatility ratio results are provided in the table below.

Table 9: Combined Score Portfolio Reward-to-Variability

	Sharpe Ratio	**Treynor Ratio**
Combined Score Portfolio	0.041	0.0017
MSCI Europe	0.104	0.0040

The results of both ratios confirm the preliminary assessment.

6.2 CAPM

Modern Portfolio theory suggests that a simple mean-variance analysis doesn't give us enough ground to make supported conclusions. This is said because this method of analysis doesn't account for exposure to certain factors that can drive investment return. Therefore, the CAPM model reviewed in Chapter 3, is used to determine the portfolios financial performance with exposure to market factor as the only source of systematic risk. The intercept obtained from the CAPM calculation represents the Jensen's alpha, another performance measure reviewed in Chapter 3. Jensen's alpha will measure the existence or non-existence of abnormal returns of the portfolios.

6.2.1 Environmental Portfolio

Table 10: Environmental Portfolio CAPM Model

Portfolio	**α**	**βMkt**	$\boldsymbol{R^2}$
Environmental	-0.1686%	1.0797***	0.8197

Where:

Alpha (α) represents the monthly abnormal rate of return not explain by the market

Beta Market (βMkt) is the exposure to the market factor

R squared (R^2) measures the proportion of the variance of returns explained by the model

**** indicates significance on a 1% confidence level*

*** indicates significance on a 5% confidence level*

**indicates significance on a 10% confidence level*

Applying the Capital Asset Pricing Model to our Environmental portfolio, it estimates a negative Jensen's Alpha of -0.169%. This indicates that the portfolio when considering for market risk, underperforms the market by an annual average of -2.02%. However, the portfolio alpha is not statistically significant with a p-value of 0.35, not allowing to reject the hypothesis that our portfolio has an alpha of zero, which suggests that the portfolio neither over nor underperforms the market. Note that non-statistically significant results ought to be interpreted with caution and final conclusions cannot be taken.

The exposure to the market factor exhibits a statistically significant estimate for all the significance levels. This estimation proposes that the Portfolio is 7.97% more volatile than the market that can be translated in positive exposure to market risk. In simple words, if the average return of the index increases(decreases) by 1%, the returns on the Environmental portfolio increases (decreases) on average by 1.0797%.

Furthermore, the estimated high R^2, 0.8197, says that the MSCI Europe has very high explanatory power and should be considered a good fit.

6.2.2 Social Portfolio

Table 11: Social Portfolio CAPM Model

Portfolio	**α**	**βMkt**	$\boldsymbol{R^2}$
Social	-0.1748%	1.0784***	0.8246

Where:

Alpha (α) represents the monthly abnormal rate of return not explain by the market

Beta Market (βMkt) is the exposure to the market factor

R squared (R^2) measures the proportion of the variance of returns explained by the model

**** indicates significance on a 1% confidence level*

*** indicates significance on a 5% confidence level*

**indicates significance on a 10% confidence level*

Estimating the CAPM on the portfolio based on Social scores, Jensen's Alpha takes the value of -0.1748%. The result suggests that when accounting for market exposure, the portfolio has an annual underperformance of -2.10%. With a p-value of 0.327, this estimation is not statistically significant at any significance level, and so it is not appropriate to make further conclusions about the model intercept.

On the contrary, the market beta (βMkt) is statistically significant for all the common significant level due to a low p-value. Therefore, it is possible to assume that the portfolio created is 7.84% more risky than the market. Interpreting the value of Beta, when the average return of the index increases (decreases) by 1%, the returns on the Social portfolio will, on average, increase (decrease) by 1.0784%.

In respect to the model of fitness, the results show that 82.46% of the social portfolio average monthly returns can be explained by the movement of the benchmark index selected.

6.2.3 Governance Portfolio

Table 12: Governance Portfolio CAPM Model

Portfolio	**α**	**βMkt**	R^2
Governance	-0.2814%	1.1326***	0.8406

Where:

Alpha (α) represents the monthly abnormal rate of return not explain by the market

Beta Market (βMkt) is the exposure to the market factor

R squared (R^2) measures the proportion of the variance of returns explained by the model

**** indicates significance on a 1% confidence level*

*** indicates significance on a 5% confidence level*

**indicates significance on a 10% confidence level*

With respect to our Governance Portfolio, the estimated intercept of our Capital Asset Pricing, commonly known as Jensen's Alpha, assumes a value of -0.2814%. Disregarding the statistical significance of this value, one can conclude that the portfolio, when capturing the market risk, underperforms the market by an annual average of -3.38%. But, with a p-value 0.113, the intercept is not statiscally significant for all the levels and further conclusions cannot be made.

Contradictory to the alpha, the Governance portfolio beta assumes a highly statistical significance that allows us to make robust conclusions about the portfolio sensitive relative to the market index. The portfolio created increases (decreases), on average, 1.1326% when MSCI Europe increase (decreases) by 1%.

In terms of goodness of fit, the coefficient of determination denoted by R^2, achieved a value of 0.8406. Interpreting the result, it is possible to conclude that 84.06% of the portfolio returns variability can be explained by the movement of returns of the market index selected.

6.2.4 Combined Score Portfolio

Table 13: Combined Score Portfolio CAPM Model

Portfolio	**α**	**βMkt**	$\boldsymbol{R^2}$
Combined Score	-0.2649%*	1.1347***	0.8790

Where:

Alpha (α) represents the monthly abnormal rate of return not explain by the market

Beta Market (βMkt) is the exposure to the market factor

R squared (R^2) measures the proportion of the variance of returns explained by the model

**** indicates significance on a 1% confidence level*

*** indicates significance on a 5% confidence level*

**indicates significance on a 10% confidence level*

Analysing the CAPM model for the last portfolio created, this one based on the Combined Scores of all three metrics, Jensen´s Alpha is valued at -0.265%. The p-value estimated equals 0.0809, making the intercept of this CAPM regression significant at a 10% confidence level. It is now possible to conclude that the portfolio underperforms the market index by -3.18%, annually.

Regarding the exposure of portfolio returns to the market factor, the beta is again positive and of highly statistical significance for all the common levels. The results reveal that our portfolio has high sensitivity to the market index returns fluctuations.

The high R squared measure suggest a high level of tracking of our portfolio towards the market.

6.3 Multi-factor Models

As explain in previous Chapters (Chapter 3), the CAPM model is not enough to make further conclusions on the portfolio performance relative to the market. Therefore, in this section we present the results estimated through the Fama-French 3-factor model and the Carhart 4-factor model. These models are extensions of the CAPM because it incorporates common risk factors such as the effect of size or the value effect (Fama and French, 1993), or in a more extended version, incorporates the momentum effect (Carhart, 1997)

6.3.1 Environmental portfolio

Table 14: Environmental Portfolio Fama French 3-Factor Model and Carhart 4-Factor Model

Portfolio	Model	α	βMkt	SMB	HML	MOM	R^2
Environmental	**Fama-French**	-0.5083%***	0.9767***	0.8181***	0.2385***		0.9585
	Carhart	-0.4537%***	0.9612***	0.7726***	0.1157**	-0.1195***	0.9640

Where:

Alpha (α) represents the monthly abnormal rate of return not explain by the market

Beta Market (βMkt) is the exposure to the market factor

SMB is the exposure to size effect

HML is the exposure to value effect

MOM is the exposure to the momentum effect

R squared (R^2) measures the proportion of the variance of returns explained by the model

*** indicates significance on a 1% confidence level

** indicates significance on a 5% confidence level

*indicates significance on a 10% confidence level

When using the Fama-French to explain the return of the Environmental portfolio, the alpha is negative and significant at 1% (-0.508%). This means that the environmentally focused portfolio underperforms the market proxy, MSCI Europe, by -6.1% a year, between the period of 2009-2019. The loading towards the market proxy is highly statistically significant. With a beta of 0.9767, there is positive relationship with the market. Comparing with the estimates of CAPM, both variables keep the same signs but now the intercept of the Fama-french model is significant. This means that this portfolio, when exposed to the market proxy, size effect and value effect, it significantly underperforms the market. More specifically, the intercept of the CAPM was -0.169% and with the Fama-French Factors is now -0.508%. Both factors introduced in the Fama-French are positive and significant at a level of 1%. This may imply that the portfolio in study is predominantly composed by both small-capitalization stocks and Value stocks.

In terms of explanatory power of the model, the coefficient of determination, when introducing the excess average returns of the portfolio to exposure to size and value, increased, meaning that these two variables add explanatory value to the model. Instead of the previous 0.8197 R-squared, the Fama-French explains 95.85% of the returns variability

Furthermore, theory suggests that a momentum effect should also be introduced. This is known in the world of finance as the Carhart Model (Carhart, 1997).

When estimating the Carhart Model all signals remain the same and with the same significance. Therefore, and including the momentum factor estimation, the environmental portfolio underperforms the market, and tilts toward small and value stocks. Finally, the negative and significant momentum factor tell us that the portfolio tends to stocks with low momentum.

6.3.2 Social portfolio

Table 15: Social Portfolio Fama-French 3-Factor Model and Carhart 4-Factor Model

Portfolio	Model	α	βMkt	SMB	HML	MOM	R^2
Social	Fama-French	-0.5095%***	0.9736***	0.8146***	0.2469***		0.9639
	Carhart	-0.4569%***	0.9279***	0.7279***	0.1391***	-0.1136***	0.9691

Where:

Alpha (α) represents the monthly abnormal rate of return not explain by the market

Beta Market (βMkt) is the exposure to the market factor

SMB is the exposure to size effect

HML is the exposure to value effect

MOM is the exposure to the momentum effect

R squared (R^2) measures the proportion of the variance of returns explained by the model

*** indicates significance on a 1% confidence level

** indicates significance on a 5% confidence level

*indicates significance on a 10% confidence level

Applying the Multi-factor models to the Socially focused portfolio, the alpha is estimated to be negative and significant at level of 1%. This tell us that the portfolio underperforms the market between the period of 2009 and 2019 by a yearly 6.11%. The Beta is again highly significant and describes a positive relationship between the portfolio average returns and the MSCI Europe. The intercept previously calculated with the CAPM model is now significant and the underperformance can now be confirmed. Furthermore, the Fama-French Factors are positive and highly significant, confirming a portfolio tendency to small and value stocks.

Comparing the coefficient of determination of both models, one can conclude that the introduction of the SMB and HML factors improve the explanatory capacity of the model, aggreing with the theory (Fama and French, 1993).

Then, the Momentum factor is introduced to regress the Carhart 4-factor Model. The results slightly change, but portfolio tendencies remain equal. Results suggest that the portfolio constructed has a tendency towards small and value stock, as well as stocks with small momentum which means that the portfolio is tilted to stocks with poor returns over the last three to twelve months.

With the momentum variable included, the coefficient of determination slightly increased, meaning that adding this variable improved the explanatory power of the model. Again, it agrees with the theory (Carhart, 1997).

6.3.3 Governance Portfolio

Table 16: Governance Portfolio Fama-French 3-Factor Model and Carhart 4-Factor Model

Portfolio	Model	α	βMkt	SMB	HML	MOM	R^2
Governance	Fama-French	-0.5116%***	0.9985***	0.7191***	0.3882***		0.9563
	Carhart	-0.4688%***	0.9864***	0.6835***	0.2919***	-0.0936***	0.9595

Where:

Alpha (α) represents the monthly abnormal rate of return not explain by the market

Beta Market (βMkt) is the exposure to the market factor

SMB is the exposure to size effect

HML is the exposure to value effect

MOM is the exposure to the momentum effect

R squared (R^2) measures the proportion of the variance of returns explained by the model

*** indicates significance on a 1% confidence level

** indicates significance on a 5% confidence level

*indicates significance on a 10% confidence level

Regressing the CAPM for the Governance portfolio estimated a non-significant underperformance and a significant positive relationship with the market. Introducing the Fama-French Factors to the CAPM model, boosted the R squared, meaning that the variables improved model estimations. The Fama-French estimates give a significant negative intercept of -0.512%. Same as estimated by the CAPM, the relationship with the market maintains positive and significant. the factor loading introduced by the Fama-French model, shows a tendency for small and value stocks. This can be seen through the positive and significant results estimated by the model.

Furthermore, the extension of the Fama French, Carhart model is also estimated. The introduction of the Momentum factor does not seem to influence the previous results obtained with the Fama-French. However, adding this factor increases the explanatory power of the model This can be concluded through the slight increase of the R squared estimation from 0.9563 to 0.9595.

The Cahart model, tell us that the Governance Portfolio has a significant annual underperformance of -5.63% towards the selected benchmark, MSCI Europe. It also reveals a portfolio tendency towards small and Value stocks. The added momentum factor result is significant for all the common levels of statistical significance and negative. This is interpreted as a tendency for stock that performed poorly in the last three to twelve months.

6.3.4 Combined Score Portfolio

Table 17: Combined Score Portfolio Fama-French 3-Factor Model and Carhart 4-Factor Model

Portfolio	Model	α	βMkt	SMB	HML	MOM	R^2
Combined Score	Fama-French	-0.4521%***	1.0186***	0.6028***	0.3406***		0.9654
	Carhart	-0.4053%***	1.0053***	0.5637***	0.2351***	-0.1026***	0.9694

Where:

Alpha (α) represents the monthly abnormal rate of return not explain by the market

Beta Market (βMkt) is the exposure to the market factor

SMB is the exposure to size effect

HML is the exposure to value effect

MOM is the exposure to the momentum effect

R squared (R^2) measures the proportion of the variance of returns explained by the model

*** indicates significance on a 1% confidence level

** indicates significance on a 5% confidence level

*indicates significance on a 10% confidence level

Finally, the portfolio based on the overall ESG scoring is addressed. The CAPM had already estimated a significant underperformance at a confidence level of 10%. Introducing the fama-french factors increases the significance of the intercept and decrease its value. Meaning that exposing the portfolio towards size and value effect steepen the underperformance relative to the market proxy. The relationship with market maintains highly significant at a confidence level of 1% and positive. Ceteris paribus, an increase(decrease) of 1% on the market index average return, will increase(decrease), on average, the returns of the portfolio by 1.0186%. Regarding the SMB and HML factors, the positive and statistically significant results allow us to determine that the Combined Score portfolio has a tendency towards small and value stocks.

The exponential increase of the coefficient of determination is important to confirm that these factors actually bring value to the estimation.

Finally, the author analyses how estimating the Carhart model changes the interpretation of the values estimated through the Fama-french model. The first argument that introducing the Momentum factor in the model adds explanatory power to it, is the slight increase on the R-square value. Then, it is possible to observe that there is no change on signals and significance when comparing it to the Fama-French model. This maintains the portfolio underperformance relative to the benchmark, and tendency for value and small stocks. However, the negative and significant signal of the momentum factor allow us to go further. The negative sign of coefficient suggests a tendency to stocks performed poorly the past three to twelve months. The statiscally significance level at 1% confirms this portfolio tendency.

7. Discussion

This section of the thesis debates the results reported in Chapter 6 ''Results and Analysis'' with respect to portfolio performance and the results found in previous literature on the link between portfolio performance and ESG criteria.

Research reveals that previous records of the relationship in study, rewards the investors. Moreover, (David Diltz, 1995; Derwall et al., 2005; Kempf and Osthoff, 2007; Statman and Glushkov, 2009; Derwall, Koedijk and Ter Horst, 2011) argue that social and environmentally focused portfolios are related to positive abnormal returns. However, both the social and environmentally focused created for the purpose of this study, achieved negative abnormal returns. Regarding the Governance focused portfolio, the results show that the portfolio significantly underperformed. Evidence show that this relationship is conflicting. Statman and Glushkov´s (2009) results show no statistically significant relationship between Governance and stock returns.

It is important to point out that the results may differ because of the different thematic approaches; the more recent investment horizon; and the data comparison (Halbritter and Dorfleitner, 2015; Revelli and Viviani, 2015). Another factor to consider is the domicile of the investor. Auer and Schuhmacher (2016) suggests that European investors, depending on industry focus and ESG criteria, tend to pay a price for socially responsible investments while US investors can still have a similar performance to the market. The results are therefore in agreement with Auer and Schuhmacher (2016). The portfolios created based on each individual metric showed a trend to underperform regardless of the preferred ESG criteria. The question ''Is the Investor rewarded or penalized when constructing a portfolio based on the poorest performers in an individual metric?'' addressed in the Problem Statement, is now answered. As a European Investor, a price is paid to selected stocks for investors portfolio based solely on the individual factors of Sustainability. Contrary to the descriptive statistics results and reward-to-variability ratios, where the Environmentally focused portfolio achieved the highest return and the most similar benchmark, after controlling for market effect, size effect, value effect and momentum effect, the portfolios significantly underperformed.

Furthermore, (David Diltz, 1995; Kempf and Osthoff, 2007) studied how screening affects the financial performance of the portfolios. The conclusion was reached by following a long-short strategy. The positive abnormal returns of this strategy suggest that portfolios with good ESG scoring outperform portfolios focused on bad ESG scoring. In a more recent study, Halbritter and Dorfleitner (2015), utilized samples from 1991-2012 and estimated the 4-Factor model developed by Carhart (1997). The author concluded that the investor should no longer expect abnormal returns following this strategy, which may be interpret as a non-existing difference between the high-ranked portfolio and low-ranked portfolio. The results obtain in the low-ranked portfolios in this thesis are very similar to the ones calculated in the above papers. It is important to note that these three papers differ from this thesis in regional, time frame and thematic aspects and so a comparison between the results may lead to different conclusions.

Motivated by the lack of diversification that ESG strategies might cause due to excessive filtering this study follows a ''worst-in-class'' strategy. Selecting the Carhart 4-Factor model because of the higher explanatory power than the other models estimated, the author interprets the findings.

The performance of the portfolios created for the purpose of this thesis revealed very similar results and tendencies. The Combined Scored Portfolio was the portfolio that performed better, indicating that if following a ''worst-in-Class'' Strategy, the European investor is less penalized when considering the overall Sustainability score of a company. The significant and negative intercept derived from the Carhart 4-Factor is consistent across all portfolios. This allows the author to answer the sub-question ''How does a worst-in-class Strategy perform in the European market?''. The strategy in study is believed to significantly underperform the market, meaning that as an investor, this strategy should be avoided in long-term. Conclusions about the short-term performance of the ''worst-in-class'' strategy are beyond the scope of this thesis.

Moreover, the research indicates a persistent, statistically significant and positive SMB factor. This suggests that the portfolios created have a tendency towards small stocks. One can argue that this tendency implies that small capitalization stocks, either are less transparent with extra-financial information or that, small size firms have a poorer sustainability performance. Findings also demonstrate that a portfolio following an ESG strategy does not seem to improve portfolio risk-adjusted return. Bauer, Koedijk and Otten (2005) find that environmentally and socially screened portfolios tend to be biased towards large capitalization growth stocks. The results of this study´s Carhart 4-Factor model exhibits exactly the opposite. The SMB and HML factor indicate a tendency towards small-value stocks. The results from both studies implies a relationship between high scores strategy and large capitalization growth stocks and on the opposite side, low scores strategy imply small capitalization value stocks. Finally, the again persistently negative and significant coefficient on the Carhart 4-Factor model Momentum Factor suggests a tendency for stocks that had a relatively bad performance over the last three to twelve months (Statman and Glushkov, 2009). Thus, based on the analysis of this thesis, it could be argued that Small-capitalization value stocks, that consistently underperform in the last three to twelve months, experience an overall poor sustainability performance.

It is important to note that sample selection bias cold arise based on industry categorization of the portfolios. The filtering of these companies was purely based on ESG criteria and therefore, over-representation might bias the results towards an industry, which might explain such a similarity in the results. In other words, industry classification might affect measures of performance beyond the effect of the four factors studied.

Furthermore, evidence of autocorrelation was found within the explanatory variables. However, autocorrelation does not cause the estimators to be biased. The only effect that autocorrelation has on the sample is that it will increase the estimator's variance, which might explain why some results are not statistically significant. Appendix II provides the results of the Durbin Watson test performed in order to examine for this statistical problem.

Finally, the small universe is believed to cause companies to over-lap within the different portfolios. This situation could explain the similarities of portfolio performance across the Sustainability criteria, which might limit the ability to make robust conclusions based on these results.

8. Conclusion

The final section provides a summary of the analysis and presents an overview of the obtained findings. Furthermore, the author comment on the future outlook.

The aim of this thesis was to analyse whether a pure ESG strategy increased the European investor portfolio performance between 2009-2019. It is desirable to provide evidence whether investments based on ESG criteria create abnormal returns and extend the lean amount of academic literature studying the relationship between ESG criteria and Portfolio performance in Europe.

In order to reach a conclusion, the following methodology was applied: First, relevant stocks were selected; secondly, portfolio were created based on ESG scores provided by the data Eikon Reuters database; and lastly, portfolio performance was evaluated based on the Carhart (1997) 4-Factor model.

For the stock selection, companies that did not provide extra-financial performance for the last ten years and were not listed in the local stock exchange for the same period were excluded from the initial universe. The author constructed four portfolios based on the ESG criteria of each of the companies presented in the filtered sample. Then the 250 worst sustainable performers for each of the metrics presented in Chapter 2 were selected.

The results from the application of the Carhart 4-Factor model show increase on R^2 relative to the other models in the study. This proves that the multi-factor model is superior to the performance measurement of portfolio financial performance and it further allows for a more coherent analysis of the performance contributing factors.

Using the calculations made to study the European based portfolios performance, the author observes that after controlling for size, book-to-market and momentum factors, the intercept of the model is statistically significant at a level of 1% and negative. It also indicates that the coefficient values of the factors introduced for size, book to market and momentum exposure, are all significant. To some extent, results demonstrate that the investor is penalized by following such strategy between the period of 2009-2019. The results also demonstrate that focusing on individual ESG considerations does not alter the results. Similar results are obtained across all portfolios.

Ultimately, considering the results of the analysis, a pure ESG strategy does not seem to increase portfolio performance.

However, financial performance of ESG portfolios varies with the types of social screens applied (Barnett and Salomon, 2006). Thus, the author believes that the ''worst-in-class'' strategy appears to result in inferior portfolio performance, while other ESG strategies may result in better portfolio performances.

Hence, this poses the question whether inferior stock performance is directly related to low ESG rankings or vis versa whether superior stock performance can be directly related to high ESG rankings. While the last point was extensively investigated in previous literature with specific focus on the US market, it is of interest for the responsible investing community to further investigate the relationship of the size, book-to-market and momentum factor with the ESG scores more in detail. Finally, Auer and Schuhmacher (2016) found that US and European Investors display different performances, hence the author advises conducting similar studies outside of Europe.

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APPENDIX I: Results Overview

Table 18: Descriptive Statistics and Reward-to-Variability Ratios Overview

	Monthly Average Return	Std Deviation	Sharpe Ratio	Treynor Ratio
Environmental	0.4889%	4.5908%	0.086	0.0037
Social	0.3511%	4.5787%	0.056	0.0024
Governance	0.2663%	4.7499%	0.036	0.0015
Combined Score	0.2836%	4.6657%	0.041	0.0017
MSCI Europe	0.4946%	3.8400%	0.104	0.0040

Table 19: Portfolio Results Overview

Portfolio	Model	α	βMkt	SMB	HML	MOM	R^2
Environmental	**CAPM**	-0.1696%	1.0797***				0.8197
	Fama-French	-0.5083%***	0.9767***	0.8181***	0.2385***		0.9585
	Carhart	-0.4537%***	0.9612***	0.7726***	0.1157**	-0.1195***	0.9640
Social	**CAPM**	-0.1748%	1.0784***				0.8246
	Fama-French	-0.5095%***	0.9736***	0.8146***	0.2469***		0.9639
	Carhart	-0.4569%***	0.9279***	0.7279***	0.1391***	-0.1136***	0.9691
Governance	**CAPM**	-0.2814%	1.1326***				0.8406
	Fama-French	-0.5116%***	0.9985***	0.7191***	0.3882***		0.9563
	Carhart	-0.4688%***	0.9864***	0.6835***	0.2919***	-0.0936***	0.9595
Combined Score	**CAPM**	-0.2649%*	1.1347***				0.879
	Fama-French	-0.4521%***	1.0186***	0.6028***	0.3406***		0.9654
	Carhart	-0.4053%***	1.0053***	0.5637***	0.2351***	-0.1026***	0.9694

Where:

Alpha (α) represents the monthly abnormal rate of return not explain by the market

Beta Market (βMkt) is the exposure to the market factor

SMB is the exposure to size effect

HML is the exposure to value effect

MOM is the exposure to the momentum effect

R squared (R^2) measures the proportion of the variance of returns explained by the model

*** indicates significance on a 1% confidence level

** indicates significance on a 5% confidence level

*indicates significance on a 10% confidence level

APPENDIX II: Durbin Watson Test Results

Table 20: Durbin Watson Test

	lag	Autocorrelation	D-W Statistic	p-value
Environmental	1	-0.08	2.16	0.37
Social	1	-0.06	2.12	0.51
Governance	1	0.01	1.97	0.85
Combined Score	1	-0.12	2.21	0.25

Alternative hypothesis: rho != 0

Commands used to perform the test in RStudio:

```
durbinWatsonTest(lm(formula = excEnv ~ mktrf + SMB + HML+ MOM, data = Book
1))

durbinWatsonTest(lm(formula = excSoc ~ mktrf + SMB + HML + MOM, data = Boo
k1))

durbinWatsonTest(lm(formula = excGov ~ mktrf + SMB + HML + MOM, data = Boo
k1))

durbinWatsonTest(lm(formula = excCS ~ mktrf + SMB + HML + MOM, data = Book
1))
```