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SRI Momentum

Examining a socially responsible momentum strategy

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ABSTRACT:
ESG-factors are theorized in earlier literature to improve financial performance of investment strategies. This paper examines the combination of these two phenomena together in the form of ESG-momentum and investigates the driving forces behind the possible positive returns provided by the ESG-momentum strategy. This paper's significance lies in the insights it brings into the field of ESG-rating related studies and socially responsible investing

An ESG-momentum portfolio is formed by ranking the absolute value changes of ESG-ratings received by companies of the S&P500 index. These portfolios are then measured with CAPM and multi-factor metrics, and the drivers of these returns are examined.

The regression testing conducted concludes that sorting stocks in the S&P500 index with ESG-ratings does not provide excess positive returns during the period of 2010-2020. It's also concluded that the portfolios do not have high levels of exposure to the factors of the Fama & French multi-factor models, apart from beta.

With the null hypothesis true, this paper offers contributions to ever growing literature about socially responsible investing and the strategies that it includes. Additional value brings the finding of levels of beta-exposure, which can in future be used to study possible implementations in strategies involving hedging.

KEYWORDS: Momentum, Socially responsible investing, Volatility, ESG, ESG-Momentum, CAPM, Multi-factor performance metrics, Behavioral finance

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TIIVISTELMÄ:
ESG-tekijöiden teoretisoidaan aiemmassa kirjallisuudessa parantavan sijoitusstrategioiden tuottomahdollisuuksia. Tästä syystä tässä työssä tarkastellaan näitä kahta ilmiötä yhdessä ESG-momentumin muodossa ja pyritään selvittämään, että tuottaako tämä strategia ylituottoa, sekä että mistä tämä tuotto johtuu. Tämä työ tarjoaa merkittävää lisätietoa vähän tutkittujen ESG-tekijöiden piiriin sekä ESG-momentumin että yleisellä tasolla vastuullisen sijoittamisen muodossa.

Portfolio luodaan sijoittamalla yhtiöt arvojärjestykseen absoluuttisten ESG-arvojen perusteella S&P500 indeksissä. Absoluuttisten arvojen muutoksia käytetään momentum -portfolion muodostamiseen ja näitä portfolioita tarkastellaan yksi- sekä moniulotteisten taloudellisten suoritusmittareiden avulla.

Regressiomallien löydökset viittaavat siihen, että ESG-arvojen perusteella järjestäminen ei tuota tilastollisesti merkittävää ylituottoa, eikä strategian avulla luodut portfoliot ole altistuneita Faman ja Frenchin viiden tai kolmen tekijän mallin tekijöille, beta poissulkien.

Nollahypoteesin jäädessä voimaan tämä työ tarjoaa merkittävää lisätietoa alati kasvavaan kirjallisuuteen vastuullisesta sijoittamisesta ja sen mukana tulevista sijoitusstrategioista. Lisäksi lisäarvoa tuottaa että portfolioista löytyi beta-altistumista. Tätä voidaan jatkossa käyttää lisätutkimuksissa esimerkiksi työkaluna suojautumisstrategioissa markkinoita vastaan.

AVAINSANAT: Momentum, Vastuullinen sijoittaminen, ESG, ESG-Momentum, CAPM, Moniulotteiset suoritusmittarit,Käyttäytymistaloustiede

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Abbreviations

SRI: Socially responsible investing
ESG: Environmental, social and governance
VIX: Volatility index
CAPM: Capital asset pricing model
PRI: Principles of responsible investing
CSR: Corporate social responsibility
SIF: Sustainable investing forum
SEC: Securities and exchange commission
MPT: Modern portfolio theory
CFP: Corporate financial performance

1 Introduction

In this paper the unison of momentum investing and the incorporation of environmental, social and governance factors are examined. Investors are always looking for new ways to make money while taking on less risk, and this is something that this paper will attempt to examine. Not that many decades ago Jegadeesh & Titman (1993) came up with an investment strategy that involves buying stocks that perform relatively well and selling stocks that perform relatively poorly. This strategy turned out to gain substantially high positive abnormal returns and caught the eyes of investors and research worldwide in an instant. Ever since momentum has both been used and studied extensively to completely understand the nuances behind the strategy, and turns out, it's mostly uncertain and uncertainty.

In recent literature, and in the general public, socially responsible investing has started to gain popularity because of the global warming and impeding destruction of earth. But additionally, it has also gained some attention because of the potential it has in providing financial gains to investors if used correctly. ESG-factors tend to promote longevity and healthy financials within companies and sometimes a very loyal customer-base. The success of momentum, added with the increasing popularity of ESG-factors is a combination that will be discussed in the following chapters. (EU SIF, 2016; US SIF, 2018)

1.1 Purpose and motivation

As global warming and greenhouse gas emissions are becoming a popular topic in mainstream media and politics, companies are shifting their strategies and practices towards a greener alternative. The rising popularity of social responsibility, renewability and recycling give rise to consumer awareness and thus consumers begin to look for companies with "greener" values and practices (EU SIF, 2016). This would lead to investors looking for companies that represent these values in hopes of capitalizing on this trend. ESG-factors are the direct outcome of this phenomenon and are widely used as proxies for companies that represent renewable and eco-friendly values and

processes. Another widely popular phenomenon amongst investors in the past decades has been momentum investing, and the plethora of strategies that involve momentum investing, or investing in the up- and downwards momentum of equities. This has been studied and tested rigorously throughout the years, and as mentioned earlier, may even provide excess returns. (Jegadeesh & Titman, 1993)

The question that rises from the implementation of ESG-factors is whether ESG-factors have value to customers and investors. That is, if investors consider a company with ESG-factors a better investment than something that does not have ESG-ratings or does not consider these values as important. The Eurosif states that socially responsible and sustainable investing is a long-term investment approach that incorporates ESG-factors into the investment regimen to help investors capture long-term returns and additionally, benefit the greater good by influencing the ways companies operate. In 2012 Fulton conducted a meta-review that in brief summary conducted that incorporating socially responsible, sustainable and renewable practices to company operations do lead to increased financial performance, and if Markovitz (1952) was right, and investors do not turn away from a profitable investment opportunity it would occur to one's mind that investors would also implement these factors in their investment strategies to increase the performance of their portfolios. Taking a closer look at the study conducted by Fulton would indicate that incorporating these factors does not present a strong correlation with underperformance in almost any of the cases, quite the opposite.

Some more recent literature presented by Nagy et al. (2013 & 2016) takes these ideas one step further by looking into the financial performance of investment strategies that have been modified to incorporate socially responsible investing into some of the more common strategies used by investors worldwide. One of these strategies is ESG-momentum, and the main the motivation of this paper. In their studies, Nagy et al. implement these strategies on a very theoretical level by using portfolios of several hundreds, if not thousands of stocks which is not even remotely applicable to real life investing. This paper draws its motivation from these papers but also considers the fact

that an effective cut-off point for selecting the stocks has to be established, and citing Jegadeesh & Titman in their 1993 paper, this cut-off point should be no higher than 20% or 20-40 stocks per portfolio considering that transaction costs and other liabilities may affect the financial performance of these portfolios.

An additional factor that may in the case of momentum investing affect the financial performance and should therefore be mentioned is uncertainty, or volatility. This was first considered by Jegadeesh and Titman in their 2001 study. Momentum returns are something that have been under heavy discussion and the widely accepted theory on this subject is that momentum returns are heavily influenced by behavioral biases which rise under conditions of informational unavailability (Zhang, 2006; Jian et al. 2005). These earlier studies investigate the effect of uncertainty or underlying volatility on momentum profits and conclude that increasing volatility affects the investors decision making regarding informational availability. When uncertainty is present, investors tend to make decisions based on heuristics and other biases that cause inefficient decision making. Ultimately this inefficient decision-making causes difficulty in valuing companies and therefore investors tend to increase the effects of initial underreaction and delayed overreaction, which are mentioned to be some of the driving forces of momentum. (Zhang, 2006; Jegadeesh & Titman, 2001)

The purpose of this paper can be drawn from some of the literature mentioned above. Examining the phenomena of environmentally friendly, socially responsible and renewable investing together with one of, if not the most common investment strategy both used by investors and studied by researchers of the modern age. The empirical findings of this paper contribute to the academic literature by studying the real-life applicability of an ESG-incorporating investment strategy and its possible financial performance. Additionally, the findings of this paper create interesting opportunities for future research in terms of tools for hedging strategies, and better understanding of socially responsible investing. One important note for the reader is that the point of this paper is not to compare momentum and ESG-momentum, but simply to study the

financial performance and applicability of an ESG-incorporating momentum strategy in the financial markets.

1.2 Research question and hypothesis formation

The rising phenomena and investors lust for returns lead to the question mentioned above. Can investors gain excess returns by utilizing ESG-rankings? Fulton (2012) concludes in his meta-study that there is very strong evidence suggesting that ESG-factors and socially responsible investing does indeed have a strong correlation with positive financial returns. Additionally, Nagy et al. also conclude that in a very academic framework, the ESG-momentum strategy would appear to be among the best ESG-incorporating investment strategies out there. To put it in other words, the research question of this paper is whether it's possible to utilize ESG-ratings as a proxy for momentum portfolio formation so that it's beneficial for the investor in terms of financial performance measures and real-life implementation. The aim of this paper is to reject the null hypothesis with statistical significance while also proving that ESG-momentum as an investment strategy is a viable option with capabilities of earning excess returns in the stock markets.

The hypotheses of this paper are as follows:

H0: ESG-momentum portfolios do not gain positive excess returns
H1: ESG-momentum portfolios gain positive excess returns

If the null hypothesis is rejected, it supports the assumption of ESG-momentum strategies gaining excess positive returns, as is stated in the alternative hypothesis. If the empirical testing results suggest that the ESG-portfolios do not gain excess positive returns, it's considered adequate proof for the null hypothesis to hold.

1.3 Structure of the paper

This thesis is written in 3 separate sections. The first large scale section is the introductory part of paper. This section includes introduction to the thesis and the research question at hand. The second section is the theoretical portion of the paper which includes the necessary theoretical knowledge to better understand the subject studied. The final portion of the paper is the empirical section. In this section the real research is planned, conducted and presented in detail. The final section includes the data and methodology, empirical testing and large-scale discussion and conclusions about the findings and other related subjects.

2 Socially responsible investing

Global warming and climate change are ever-increasing problems in today's world. Deforestation, fossil fuels, urbanization and other types of environmental abuse are causing the planet to overheat, and it is becoming alarmingly obvious that the planet cannot take much more. These phenomena have given rise to a completely new field called socially responsible investing (SRI), which is a type of investment strategy that involves taking environmental, social and governing factors (ESG) into consideration along with financial returns, when screening for possible investments (Hirst, 2017). In the next chapter SRI will be reviewed along with its development, implementations and different types of strategies. Some implementations for a momentum strategy are also considered for the sake of this paper.

2.1 What is socially responsible investing

Socially responsible investing, despite its popularity in the modern world, remains a mystery to many investors, possibly due to its nature of being a framework of values, and thus not having a strict guideline for what it stands for. Scientific literature is at a constant debate regarding terms like SRI, ethical investing, ESG investing, responsible investing, etc. The debate mainly focuses on whether the terms are synonymous or not, and mostly the differences are whether a strategy focuses on performance or not. For this paper, SRI will be used as a synonymous term for all types of ethical and responsible investing, unless otherwise specified. (Sparkes, 2001; Cowton, 1994; Scheuth, 2003; Hellsten & Mallin, 2006; Strong, 2010)

Before the explanation of socially responsible investing, the reader must acknowledge the meaning of the term sustainability. The World Commission on Environment and Development defined the term sustainability as follows: "Development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (World Commission on Environment and Development, 1987 : 43).

Socially responsible investing is an ethical investment strategy that considers social and environmental factors in addition with the regular risk and return factors of traditional portfolio theory. SRI seeks to unify the criteria to bring about positive change, however, the field faces a multitude of obstacles, including decreased performance in the eyes of investors (Hirst, 2016). Typically, SRI can be divided into strategies that avoid investing in companies that are perceived as having a negative impact, and strategies that screen and opt for companies that are perceived to promote positive activities (*Logue*, *Socially responsible investing for dummies*). As mentioned, these activities can be categorized under three separate factors: Environmental, social wellbeing and corporate governance. SRI strategies can also be divided into more specified categories, which will be discussed later. Ultimately, SRI can be seen as an investment activity that aims to please the aforementioned definition of sustainability, according to the individual investor's own priorities and beliefs (Brenkert, 2018).

Investment companies, SRI-related websites and funds often rank companies with an ESG-ranking, determining how good of an investment a company is based on ESG factors, however, there is ongoing debate whether these ESG rankings should be devised based on the proactive practices related to ESG factors, or whether negative screening is adequate (Domini, 2011). Additionally, the social and demographical background of the person defining the term also has a great effect on the priorities of the person in regard to ESG factors. This spurs a problem. ESG rankings have no unified code of standard and therefore are very difficult to compare to one another, especially, as some institutions do not provide rankings for companies of every country, only some of them. Another factor adding on to the piling mix of different definitions is that fund managers tend to define the terms slightly differently to differentiate funds from one another, creating "competitive advantage" (O'Rourke, 2003).

A big step in the right direction in the standardization of SRI, ESG and business sustainability, is the initiative of the United Nations to create the Principles of Responsible Investing (PRI, 2021). PRI is a framework that a market participant agrees to

follow, that aims to define sustainable investing and development as completely unique ESG-factor incorporating strategy for increasing efficiency and sustainability in economies. However, it is important to notice that socially responsible investing and responsible investing differ in terms of moral and ethical incorporation. With the initiative, six principles were developed to act as a guideline for investors and other market participants in their decision making. The principles are as follow: (Principles for Responsible Investing, 2021)

Principle 1: Incorporate ESG-factors into investment analysis and decision-making processes

Principle 2: Actively control investments and incorporate ESG-factors into ownership policies and practices

Principle 3: Seek appropriate disclosure on ESG-issues by the entities in which investments are made

Principle 4: Promote acceptance and implementations of PRI within the investment industry

Principle 5: Work together to enhance the effectiveness of implementing PRI

Principle 6: Be transparent and report activities and progress in implementing PRI

As is blatantly clear, socially responsible investing and its many forms are becoming ever more popular among investors, and a report shows by 2018 global sustainable investing had reached around 30,7 trillion US dollars and over a thousand ESG-related funds in the five major markets shown in Table 1 (Global Sustainable Investing Report, 2018). With a 34% increase in the last two years, these numbers can be expected to reach far higher in years to come.

Region	2016	2018
Europe	$ 12,040	$ 14,075
United States	$ 8,723	$ 11,995
Japan	$ 474	$ 2,180
Canada	$ 1,086	$ 1,699
Australia/New Zealand	$ 516	$ 734
TOTAL	**$ 22,838**	**$ 30,683**

Note: Asset values are expressed in billions of US dollars. All 2016 assets are converted to US dollars at the exchange rates as of year-end 2015. All 2018 assets are converted to US dollars at the exchange rates at the time of reporting.

Table 1. Global sustainable investing volumes

2.1.1 Development

The early stages of SRI may be dated back to the 18 th century. A religious society called the Quakers prohibited its members from participating and associating with slave trade. However, due to lack of evidence and certificates, this will be disregarded in this thesis.

The era of modern SRI is widely accepted to have begun during the late 1960s and the early 1970s, around the time when civil rights, equality and labor concerns started raising their heads (Ferruz et al., 2007). Socially responsible investors of the late 20 th century mainly focused their concerns on more topical issues like the Vietnam war or the efforts of late Dr. Martin Luther King, still mainly in the form of social movements and programs to raise awareness. Ultimately, growing concerns and awareness of the climate conditions along with human rights, finalized the roots of modern-day SRI. (Scheuth, 2003)

During the following decades political disturbances, climate change, violent conflicts and inequalities made SRI even more popular, and eventually lead up to becoming a trend in modern consumerism. Corporations started realizing that there are profits to be made

in implementing this “international private business self-regulation” regime, otherwise called corporate social responsibility (CSR). (Sheehy, 2015)

2.1.2 Corporate social responsibility

Again, as with earlier terms, CSR is defined mostly based on the person defining the term. A brief definition could be the corporate governance -equivalent for socially responsible investing. In a sense, CSR can be interpreted as a certain type of strategy in branding on organizational level, sometimes via following and abiding to general rules and regulations, while others may go as far as taking actions that further social well-being even if it’s not in the firm’s best interest. These companies often gain some levels of advantage in forms of customer support or other positive outcomes related to CSR actions. Ultimately, even if the company gains no direct advantage, they are still advancing their respective fields in terms of sustainable growth. (Johnson et al., 2018; McWilliams & Siegel, 2000; Johnson et al., 2019; Farrington et al., 2017)

As is the case with SRI, CSR has also been increasing in popularity greatly among investors and businesses alike, especially due to the recent outbreak of the novel coronavirus disease COVID-19. The pandemic forced companies to rethink their business models and at the same time consumers have become more aware of CSR issues due to increased online activity caused by worldwide quarantines. Additionally, socially responsible investors tend to seek out businesses that implement CSR in their business models, leading to ever increasing popularity of CSR in businesses. Whether these implementations contribute to financial performance is still under debate and contradicting results regarding the matter seem to pop up quite often. Some researchers state that implementing CSR distracts businesses from their economic targets, while others state that it is simply more beneficial to invest in CSR due to the positive image related to it. All in all, the consensus as of right now stands as such: businesses with good CSR profiles tend to outperform businesses with bad ones. (McWilliams & Siegel, 2000; Harjoto & Laksmana, 2018; Jeong et al., 2018)

2.1.3 ESG

As already mentioned earlier, ESG is roughly synonymous to SRI and other terms for sustainable investing that involves pursuing financial performance through technical and fundamental analysis while also taking environmental, social and governing factors into consideration.

ESG stand for three separate factors: environmental, social and corporate governance. All three of these categories represent a set of values that are to be considered when seeking investments. Environmental factors include taking into consideration the climate change, use of natural resources, pollution and finally the use of environmental opportunities in places like replacing raw ingredients with more environmentally friendly ones. The social category then includes factors like human capital in terms of child labor and working conditions, product liability which includes safety of usage and safety of production and finally controversial subjects like sourcing and social opportunities regarding philanthropism et cetera. The corporate governance category includes factors regarding the corporations governing organs like board diversity, accounting, ownership diversity, corporate ethics, tax transparency, corruption and instabilities. However, ESG factors are not standardized and the agents providing ESG-ratings for businesses often develop their own frameworks and standards. While the categories remain the same, the sub-categories are often different from one another. (Dorfleitner et al., 2015)

As is the case with SRI and CSR, ESG's link to financial performance has also been under debate for decades. Since the 1970s, different studies from all over the world have investigated the relation on financial performance and socially responsible investing, with contradicting results and methods that are incomparable. However, in 2015 Friede et al. published a large scale second-level review of over 2200 studies, finding that roughly around 90% of all studies find a nonnegative relation, while a large majority of them report a positive finding. Figure 1 below shows the relation of positive and negative findings from the studies.

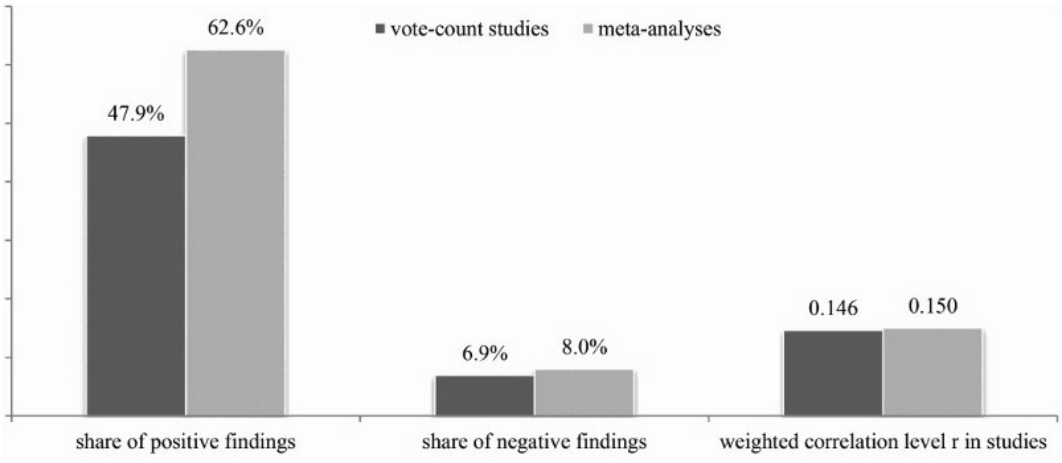

Figure 1. Relation of financial performance and socially responsible investing

Further results in the study report a significantly more positive ESG and financial performance relation in bonds and real estate, when compared to equities. Studies that analyzed bonds find more than 60% positive findings, and in the relatively new field of green real estate, roughly around 70% reported positive findings, as is shown in figure 2 below.

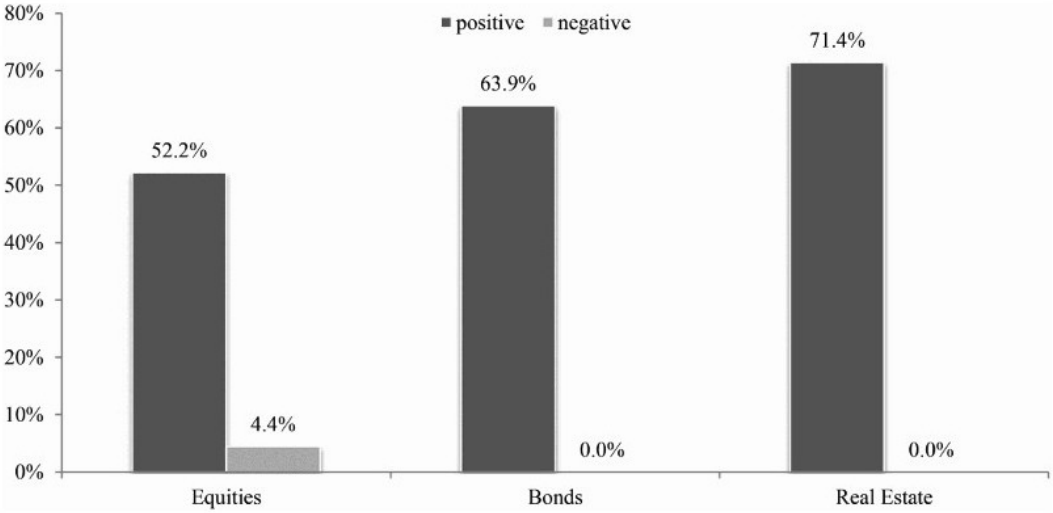

Figure 2. Financial performance of socially responsible investing in different asset classes

Finally, the study also investigated the separate categories of ESG, attempting to differentiate whether focusing on certain categories would provide a more positive change in financial performance. While some studies reviewed Friede et al. find differences in relations inside the sub-categories, the differences in the major categories of ESG are not very pronounced, as is shown in figure 3 below.

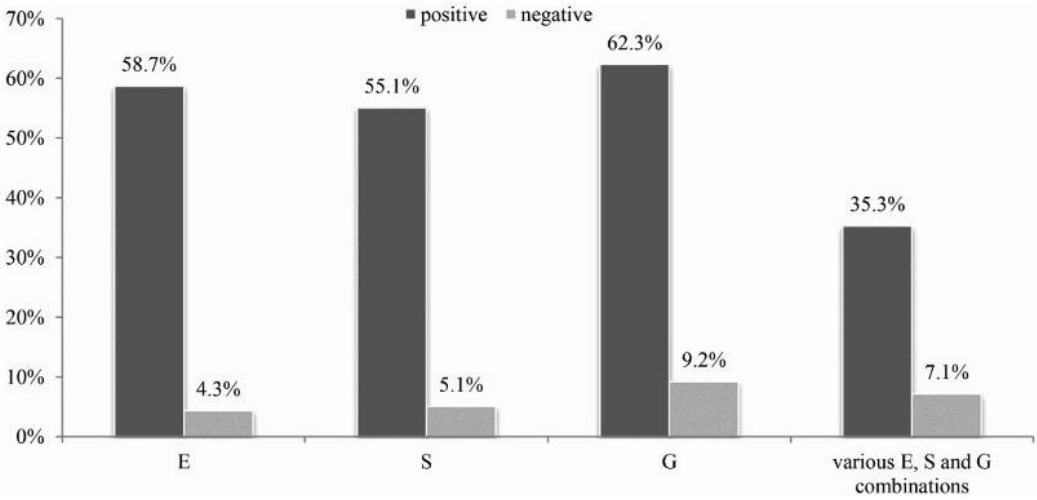

Figure 3. Financial performance of separate sub-categories of ESG

Based on the exhaustive evidence provided by Friede et al., it is safe to say that ESG seems to provide at least some level of positive change in financial performance, when implemented. This does come with an outlier. A study by Barnett and Salomon (2006) found that the relationship of ESG strategies and financial performance is curvilinear, meaning that at the beginning of sustainability efforts, the performance first declines and eventually builds up to improving. As there is no uniform standard or a robust framework for everyone to follow and use as a method of measuring their ESG-implementation, there is no right way to implement ESG into a corporation or investment strategy that has been proven to outperform other ways, if it is implemented. (Friede et al., 2015)

2.2 Motivation of SRI

The motivation for implementing SRI can be manyfold. Practical implementation of SRI can be done in many ways, and in theory, it adds to Markowitz's modern portfolio theory (Markowitz, 1952; 1959) by considering ethical and environmental factors in addition to risk and return. However, the personal reasons for implementing SRI into one's investment behavior can be divided into three separate categories. There are investors who seek the positive changes in their investing performance by implementing ESG-screened investments. While the implementation of ESG into one's investments and corporate governing has been proven to have a positive relation with financial performance, it is the case in many of the studies reviewed. This in turn means that investors do take on some level of risk in implementing these frameworks. The second group of investors match their investment profiles to their personal beliefs and ethics. They invest in accordance with their own beliefs by for example avoiding sin stocks and reflecting their own social responsibility and ethics into their investment portfolios, sometimes despite the risk of reduced performance. The third group of investors invest in a philanthropist way, attempting to create social welfare and environmental good with their investments. This could be done by investing in companies that plant trees for every bought item for example. (Scheuth, 2003; Beal & Phillips, 2005)

2.3 SRI strategies

So far, the absence of sound metrics and definitions in the field of SRI and CSR has become blatantly clear, which in turn forms a grave impediment in terms of adequate assessment of SRI strategies and their performance (Scholtens, 2014). However, there are only so many ways SRI can be implemented in one's investment regime, and for the sake of this paper, multiple sources will be reviewed in defining the most popular SRI strategies.

US SIF (2018) categorizes the strategies in to two broad types, ESG incorporation and shareholder advocacy, which have multiple segments in them. EU SIF (2016) on the other hand provides a slightly more comprehensive list of strategies involving ones that are fitted into the broad categories in US SIF. They are as follows: ESG integration, shareholder advocacy, impact investment, best-in-class investments, exclusion of holdings, norms-based screening and sustainability themed investments. In short, ESG incorporation stands for considering environmental, social and corporate governance issues and factors into one's investment analysis and portfolio construction. Shareholder advocacy on the other hand involves active partaking in publicly traded companies' annual meetings in the form of shareholder resolutions or proposals. These resolutions are a way to drive the company towards more sustainable solutions and to prevent unethical and unsustainable actions. (Eccles & Kastrapeli, 2017)

2.3.1 ESG incorporation

US SIF 2018 states ESG incorporation as one of the two major categories for SRI strategies. Into this broad category falls multiple segments that involve ESG implementation in financial analysis and portfolio construction. These segments are positive screening, negative screening, ESG integration, impact investing and sustainability themed investing.

2.3.1.1 Positive screening

Positive screening refers to incorporating certain ESG factors and metrics into investment analysis. Simply put, positive screening is selecting investments that outperform their peers in terms of ESG performance and ethical factors. This in turn also means avoiding companies that do not meet certain criteria. Sometimes positive screening is also called best-in-class investing, but these two are slightly different from one another, even if they do fall under the same category of SRI strategies being positive screening methods.

Best-in-class investing simply seeks to find the best ESG profiles within an industry, country or the whole investment universe. Best-in-class investors may for example have a portion of their portfolio invested in sin stocks, but they invest in the best ESG profile within the sin stock industry. Positive screening on the other hand tends to limit the universe of possible investments to a select group that meets the screening criteria, and excluding others, like the sin stock industry in this example. which causes a problem that will be discussed later. Positive screening is a relatively new phenomenon that grows through increasing awareness about environmental issues, rather than ethical issues. (US SIF, 2018; EU SIF, 2016; Colle & York, 2009)

2.3.1.2 Negative screening

Negative screening, sometimes referred to as exclusionary investment strategies, is basically the opposite of positive screening. Negative screening seeks to eliminate from the universe of possible investments, the ones that are within certain sectors, involved with certain sectors or certain activities deemed controversial or even unacceptable by the investor. (Trinks & Scholtens, 2017; US SIF, 2018; EU SIF, 2016)

Negative screening is by far the most popular and the oldest method of socially responsible investing, mainly for its simplicity and its adaptability to one's personal ethics and morale. The early roots of SRI have first developed all the way back when sin companies first started appearing (Scheuth, 2003). Along with the development of these

companies, came negative screening based on ethics and religions. The negative screening back then was basically done by excluding these controversial companies from one's portfolios, or in some cases, from one's shopping carts. Nowadays, negative screening involves more sophisticated methods and metrics in screening stocks. Often funds and investors tend to use ESG related metrics in their screens and as was the case with positive screening and best-in-class investing, with negative screening there is also something called worst-in-class investing (PRI,2019). Worst-in-class investing simply stands for avoiding companies that fall below a certain quantitative ESG-threshold. (Berry & Junkus, 2013)

2.3.1.3 ESG integration

ESG integration stands for systematically and explicitly adding ESG factors and metrics into financial analysis. So, in addition to fundamental and technical analysis with stocks, ESG integration adds a third level of ESG analysis to the mix. (US SIF, 208)

ESG integration differs from ESG incorporation slightly as incorporation is only a term used to describe the entirety of all strategies that implement ESG factors in investment analysis. ESG integration on the other hand is a more practical approach. Fund managers and investors explicitly consider ESG factors in a way so that ESG related issues may have either a positive or a negative impact on a certain aspect of regular fundamental and technical analysis. This effect in turn may affect the outcome of the investment analysis (enough negatives may results in the investment being bad after all). (EU SIF, 2016; US SIF, 2018)

2.3.1.4 Impact investing, community investing and sustainability investing

These three have all been put in the same category for this paper, as they are all very similar in terms of being investment strategies where investors have a certain theme or end-goal they wish to achieve with their investment choices. Additionally, all three of

these strategies are very similar to each other in terms of ethicality and environmental issues.

Community investing stand for investing that aims to transfer and provide capital to those communities that do not have the same kind of conventional access to it as others (Sheuth, 2003). This is typically done through a system called community development financial institutions, which are institutions in the same way investment banks are, but they allocate the capital to low-income communities with difficulties in accessing capital. Sparks (2001) identifies this strategy as something called ethical banking, or socially directed investing. Typically, investors engaging in activities like this have a lower expected return for their investments while regular socially responsible investors still pursue financial performance. (US SIF, 2018; Sparkes, 2001)

Impact investing is a broader term than community investing but it still pursues a similar goal. Impact investing stands for investments made with the intention of generating social and environmental welfare and is typically done in both developed and emerging markets with a varying range of expected returns. In a sense, impact investing is a term that combines philanthropist objectives with mainstream financial decision making (Höchstädter & Scheck, 2015). Community investing is sometimes seen as a segment of impact investing, and thus impact investing can be seen as a broad category for investing made with the intention of having a positive impact on ESG related issues, while still pursuing positive financial performance. (EU SIF, 2016; Louche et al., 2012)

2.3.2 Shareholder engagement

As a shareholder in a publicly traded company, one has the opportunity to present shareholder resolutions or propositions which are then voted on in the next annual meeting. These resolutions are an efficient way to have an impact on the ethical and environmental issues related to the actions of the company. Even if the resolution itself would not pass, it may still be enough to persuade management adapt at least a portion of the requested changes. (EU SIF, 2016; US SIF, 2018)

None of the strategies presented above are efficient on the short term. However, shareholder advocacy may just be the longest-term strategy there is, and it's certainly amongst the most hands-on approaches to tackling ESG issues. Often these ESG issues related to company activities are seen as a duty for shareholders and have been increasing in popularity in the recent years. Shareholder resolutions, however, are seen as slightly problematic on the large scale for the regulation they face by the SEC in the US and European Commission in the EU. These regulations are typically related to who may file the resolutions, what these resolutions may contain and to what extent do these resolutions have to be carried out. (Rehbein et al., 2004; Gillan & Starks, 2000; EU SIF, 2016)

2.3.3 The ESG integration paradox

An interesting point needs to be presented before moving further with SRI strategies. With the increasing popularity of ESG incorporation and SRI, comes a certain downfall. As mentioned earlier, implementing ESG factors into ones financial analysis adds to modern portfolio theory (MPT)(Markowitz, 1952) in a sense. It adds another factor in addition to risk and return. However, as stated in modern portfolio theory, optimal diversification can only be done with all possible investments of the investment universe at play. Because of the sometimes-extensive resources ESG mapping and measuring requires from a company, they refuse to disclose some of the ESG related information, thus leaving some stocks screened out (O'Rourke, 2003). This decreases the pool of potential investments in MPT. Additionally, the stocks that are screened out due to poor ESG performance also decrease the pool of potential investments. In accordance with MPT, forcing investors to choose from a smaller set of potential investments decreases the portfolio's ability to diversify firm-specific risk and thus, decreases the portfolio's long-term expected returns. (Markowitz, 1952; Asness, 2017)

2.3.4 ESG momentum

The theoretical framework of the momentum strategy will be discussed in more detail later. However, to put it briefly, momentum investing is an investment strategy in which the investor goes long in stocks that have performed well in the past and short in the stocks that have performed poorly in the past (Jegadeesh & Titman, 1993). The timeframes used in momentum strategy are typically 12 months, 6 months and 1 month.

As mentioned earlier, the relation of ESG scores and corporate financial performance (CFP) has been studied extensively, and it was found that in most cases there is a positive correlation with the two (Friede et al., 2015). With a proven correlation with positive returns and the increasing popularity of SRI and ESG, traditional investment strategies like the momentum, are being modified to face the ESG-issues of today. ESG-momentum is one of these modifications.

ESG-momentum is a relatively new concept, as is the whole field of socially responsible investing, yet it has already gained some attention in recent research. ESG-momentum is a sort of a hybrid that attempts to combine the best of both worlds in terms of a traditional investment strategy and the ESG-factors and scores increasing in popularity (Nagy et al., 2016). Nagy et al. state that by following the relative changes in ESG scoring and ratings, the strategy attempts to find potential winners (good past performance) and losers (poor past performance) before the absolute ESG scores are high enough for the prices to shoot up. The logic of the strategy lies in the relative ESG score changes, instead of the absolute scores themselves. When a company presents a change for the positive in terms of ESG scores, the absolute score itself may still be low and could thus be screened out in other strategies. This positive change in the ESG scores is interpreted as a signal of good future ESG performance, and thus a potential rise in the valuation when investors recognize this. Nagy et al. find that while the respective ESG ratings of the portfolios formed with this strategy may not be exactly *good*, they are still better than when not implementing ESG at all. It is also found that portfolios implementing the ESG-momentum strategy outperformed the global benchmark over the past eight years. It’s

also good to bear in mind, that due to informational efficiency of the stock markets the changes in ESG ratings are often reflected in the stock prices quickly, thus making the strategy a shorter-term one.

3 Uncertainty

Uncertainty typically refers to the amount of uncertainty regarding market information on a market at a given time. Typically, uncertainty is also considered synonymous with volatility and can thus be explained as such. A short explanation for volatility is that it depicts the uncertainty regarding changes in the price of a security. The higher the volatility the higher the dispersion of possible prices the security can take in a given timeframe and vice versa. In the following chapter the nuances of uncertainty are observed in more detail. Additionally, means to measure uncertainty and related subjects like information availability and investor heuristics are also examined to allow for a wider understanding of uncertainty as a subject given its important nature for the sake of this paper.

3.1 Volatility

Stock return volatility along with its various characteristics has been a prominent research subject throughout the history of financial market research and there are numerous studies that take a closer look into methods of measurement and the unique sub-categories of volatility depending on the different markets. (Engle, 1982; Bollerslev, 1986; Pagan and Schwert, 1990)

As mentioned above, stock market volatility is a measure of uncertainty on the stock market and it depicts the amount of risk related to a particular security. Typically, continuously compounded returns are used to calculate the variables and the time frame in these calculations is one year, which means that volatility can be regarded as the standard deviation of continuously compounded returns per annum. However, in financial risk management calculations a more precise approach is required for hedging calculations and thus returns are compounded on a daily level instead of yearly returns. Volatility can also be divided into two separate categories regarding the data that is used to calculate it: historical volatility that reflects the past and implied volatility or predicted volatility that is derived from expectations. (Hull, 2018; Hull, 2015)

Historical volatility, as the name suggests, is calculated using historical stock prices within a fixed time interval using the daily standard deviations of stock market returns. A good thing to note when calculating volatilities with different time intervals is the fact that the shorter the time interval, the higher the volatility due to the nature of variance in quantitative datasets. A simple formula for historical volatility calculation is presented in equation 1. (Hull, 2009; Sincich, 1992)

$$\sigma = \sqrt{\frac{1}{n-1}\sum_{i=n}^{n}(u_i - \bar{u})^2} \qquad (1)$$

Where:

$\sigma = Volatility$

$n = The\ number\ of\ observations$

$u_i = Single\ observation$

$\bar{u} = The\ mean\ of\ u_i$

Implied volatility on the other hand refers to volatility that is calculated using option prices. Options are priced based on the expected value they will have in the future, discounted with interest rates. The price of the option, in this case, withholds the expected risk, or variability of the price of the underlying stock. Additionally, implied volatility has been examined to provide more accurate estimations of volatility in comparison to historical values, which would hold true considering the notion of historical values not being able to provide future values. Implied volatility can be calculated using the Black-Scholes-Merton formula for call option pricing (Black & Scholes, 1973), given that other variables in the formula are known at the time, which again, should hold true given the notion of market efficiency. The formula goes as in equation 2. (Cuthbertson & Nitzsche, 2001; Fleming, 1998)

$$c = SN(d_1) - Xe^{-r(T-t)}N(d_2) \quad (2)$$

Where:

$$d_1 = \frac{\ln(\frac{S}{X}) + (r + \frac{\sigma^2}{2})(T-t)}{\sigma\sqrt{T-t}}$$

$$d_2 = d_1 - \sigma\sqrt{T-t}$$

$c = Price\ of\ a\ call\ option$

$S = The\ current\ stock\ price$

$X = Strike\ price\ of\ the\ option$

$r = Risk-free\ rate\ of\ interest$

$T - t = Time\ until\ maturity$

$\sigma = Volatility$

Pagan and Schwert studied volatility more extensively and found results indicating that volatility is indeed two-fold in the way that it has a predictable side and an unpredictable side that lead to more research and findings that could be interpreted as volatility having a time-variability factor. Meaning that stock market volatility has systematic time-varying variance leading to phases of relatively low volatility and phases of relatively high volatility disregarding factors like returns and announcements. Additionally, Malkiel & Yu (1995) found that volatility can indeed be divided into stock market volatility as a whole, and individual stock volatility for each outstanding stock. As is evident from these findings, volatility is a multi-fold phenomenon in the market and it being in the centrum of the risk-return relationship it has a massive effect on everything regarding the stock market. (French et al., 1987; Deng, 2008; Schwert, 1990; Shiller, 1991)

3.1.1 Metrics and indices

As mentioned, volatility is a complex phenomenon that affects the whole stock market and the effects of which change the way the market acts. The changing dynamic of the

stock market due to the underlying uncertainty causes investors to lose profits and would be best if they could be monitored somehow. While it's not the ticket to salvation, the Chicago board options exchange (CBOE) formulated an index that is widely accepted as "the fear index". This index monitors the changes in volatility reflecting the level of uncertainty financial markets by expressing the investors' expectations of stock market volatility in the short term. The expectations are derived from the implied volatility of a wide range of 30-day call and put options in the s&p500. The higher the value of the index is, the higher is the level of uncertainty on financial markets. Another use for the VIX index besides measuring uncertainty is that of betting on volatility. Volatility options and futures can be written based upon the VIX index much like regular stock indices. (Whaley, 2013; Whaley, 2009)

The VIX has also received plenty of criticism due to its relatively poor capabilities in terms of forecasting volatility and providing additional information in comparison to other volatility models. (Becker, Clements & White, 2007) As mentioned in the above chapters, implied volatilities are often derived from option-based formulas and tend to provide different estimations relative to ones derived from historical values. Some research even states that volatility estimation models using historical values tend to provide more accurate forecasts. (Canina, 1993)

3.2 Information availability and investor decision making

Investors make decisions based on the available information at the time. The accuracy of these decisions depends largely on the accuracy of the available information, which often times is not as accurate as one might think. The efficient market hypothesis (Malkiel, 1989) states that all market participants should have access to the same information, which should in an efficient market be as accurate as possible. However, as research and history has proven multiple times, this is not actually completely true. (See Malkiel, 2003) In several cases throughout history, the markets have been inefficient in depicting all available information and time to time this results in worst-case-scenarios like the financial crisis of 2008. Several studies have also taken notice of psychological

and behavioral factors that affect the efficiency of markets and through this, the uncertainty looming in the back of investors' heads. (See studies referenced in Malkiel, 2003)

As mentioned, investors make their decisions based on the current available information. However, when this information is not available or there is a lot of informational uncertainty surrounding this information, decision making becomes a lot harder. Even though financial models often assume rational decision making from investors, they often make irrational decisions even with years of experience. Some studies state that (quite naturally) the very biology of humans makes them commit errors in their decision making due to everyday factors like a good night's sleep or issues in relationships. Others prove that stock prices tend to move abnormal amounts on a daily basis even if their fundamentals do not. (See Ahmad et al., 2017) It's been proven that rising informational uncertainty forces investors to make more intuitive decisions, which are often irrational or otherwise made in error while decisions made based on available information and actual analysis tend to be more accurate and correct. (Kahneman, 1979; Tversky & Kahneman, 1992; Sarica, 2012)

When investors make decisions under uncertainty through intuitive decision making, they subject themselves to different behavioral biases that skew the logic of the given investor. These behavioral biases are widely known and studied in behavioral finance and will be discussed in the next chapter.

3.3 Heuristics, biases and phenomena

Heuristics, behavioral biases and other related phenomena refer to deviations from the normal cognitive functions and rationality of human beings (investors in this case). These biases and heuristics are systematic patterns that affect the judgement of a person and are often studied in psychology in addition to behavioral finance. (Thomas, 2018)

While Kahneman and Tversky in their prospect theory -related literature refer to only three common biases in investor decision making, there are hundreds. For the sake of this paper only some will be discussed, however, and for this reason the three biases presented by Kahneman and Tversky will do fine. They claim that under uncertainty the decision-making of investors is affected by representative bias, availability bias, and anchoring. However, with behavioral literature being studied more and more by the year, common biases and heuristics come up very often, and thus the list could be endless. Additionally, with behavioral finance evolving endlessly, the three biases presented by Kahneman and Tversky are only broad categories of biases which withhold multiple common heuristics like the illusion of frequency or the conservatism bias. (Sarica, 2012; Haselton et al., 2005)

3.3.1 Representativeness

The first error to be discussed is representativeness. Representativeness is a heuristic bias where the similarity between two uncorrelated things is mistaken for correlation. In other words, it is a cognitive bias which twists the way people expect the probabilities of different outcomes to be. An example of representativeness would be the law of small numbers where a small sample of data is taken as an indicator of a larger trend, while it may only be so that the sample is skewed. Tversky and Kahneman (1974) state that the human brain evaluates probabilities of different outcomes as functions of resemblance between different factors. If X resembles Y, there must be a correlation, when in truth, there may be none. They also describe that the representativeness bias has many aspects that all break the rules of statistics and logic. (Baker & Nofsinger, 2010)

Insensitivity to prior information refers to the tendency of people to neglect the existence of earlier information or base values regarding an event and relying solely on the representativeness of the event itself. Insensitivity to sample size is related to the law of small numbers and refers to the tendency of people to make assumptions based on the available information with no regard to the size and representativeness of the sample. Insensitivity to predictability refers to people making judgements based on the

available information with no regard to the validity of the information or the accuracy of the prediction or judgement they are making. Another aspect of representativeness is misconceptions related to random samples, which include biases like the gambler's fallacy and the law of small numbers mentioned above, which will be discussed in more detail later. (Baker et al., 2010)

3.3.2 Availability bias

The availability heuristic is quite simply what its name would suggest. The availability bias refers to the tendency of people overweight more recent information, that is more easily recalled and gathered, rather than information that is not as readily available or easily recalled. Kahneman and Tversky (1973) first studied the subject back in late 1960s and early 1970s and concluded that under uncertainty, investors tend to make decisions based on heuristics and biases that often rely on the personal experiences of the said investor. This in turn means that investors make decisions in error by relying on something that they can recall having happened multiple times in the past, rather than something that has only occurred, say, once. An example of this type of situation would be that stocks with higher levels of press coverage tend to underperform in the subsequent years following the news (Baker et al, 2010)

Some research has criticized the evaluation methods related to the subject as under certain testing conditions the subject may be manipulated into recalling certain events more easily than others, which then leads to uncorrelated test results. This is, however, subject to interpretation as when dealing with one's decision making, their judgement will always be subject to their own experiences and the things that first come to mind. (Kahneman & Tversky, 1973)

3.3.3 Anchoring

Once again, first theorized by Kahneman and Tversky (1973), anchoring is a heuristic where and individual makes decisions based on information unrelated to the subject.

The individual forms an arbitrary reference point based on something that they sub conscientiously form when relevant information is not as readily available. This reference point is then used as a comparison when making a decision, for example an investor might consider the buying price of a security as a reference point and then assume higher risk when holding the asset as they expect it to rise back to its original price. This also works in the other direction as investors that are in the money, more often than not, sell their assets as they assume that the investment has already made a lot of money when compared to the initial buying price. This leads to something called holding losers and selling winners (disposition effect), even though it is widely known that historical data is not very accurate in predicting future returns. (Malkiel, 1989; Baker et al., 2010)

3.4 Effects of uncertainty on momentum

As is already evident from earlier chapters, uncertainty has a grave effect on the decision-making process of an investor and causes irrational behavior that ultimately leads to the investor losing money because of inefficiency, rather than the market performing poorly. However, in some or even many scenarios the effects of uncertainty may ultimately cause increased performance because the investor unintentionally "dodges bullets" with inefficient decision-making.

Momentum is a widely known investment strategy that is used to capitalize on the momentum effect of stocks that have performed well while simultaneously challenging the semi-strong form of the efficient market hypothesis. In short, momentum investors buy stocks that have performed relatively well in a certain timeframe in the past and selling short stocks that have performed relatively poorly in a certain timeframe in the past. An example of this would be to go long stocks that performed the best in the past 6 months and to go short in stocks that have performed the worst in the past 6 months. Momentum will be discussed in more detail later, but for this chapter it is used to illustrate the point of inefficient decision making. (Jegadeesh & Titman, 1993)

Momentum, being a widely known strategy that challenges traditional ideas like the efficient market hypothesis, has been studied extensively and the context of uncertainty is not unknown. Several studies have been conducted on the effects of uncertainty on momentum strategies and most of them have found concluding evidence on informational uncertainty having an amplifying effect on the positive excess returns of momentum -strategies. One of these aforementioned studies (Zhang, 2006) investigated the effects of information uncertainty on the momentum phenomenon on a firm level and found that momentum strategies produce better results when investing in companies with higher levels of firm-level information uncertainty. Additionally, Jiang et al. (2005) add that informational uncertainty represents the difficulty of estimating a company's value, and as mentioned before, investors tend to make intuitive decisions in the face of missing information and more often than not, these decisions are inefficient and irrational. Jegadeesh and Titman (2001) revisit momentum in their study as they examine the reasoning behind the momentum profits. One of many reasonings provided by studies examined by them is that momentum profits have implications of behavioral biases in the form of initial underreaction and delayed overreaction. It's hypothesized that under uncertain conditions delayed overreaction to news announcements either due to heuristics or simply information moving slowly causes the past winners to exceed their long-term values. They also find that after the holding period, the delayed overreaction causes the stocks to revert to their fundamental values, being consistent with the hypothesis of behavioral implications.

Uncertainty gives rise to intuitive decision-making, heuristics and biases that cause investors to make irrational decisions. This could be, and often is, interpreted as a negative effect that uncertainty has on the market. However, as is evident from momentum research, uncertainty may also have a positive effect on the profits of certain investing strategies that rely on the behavioral fallacies of investors and could thus be used as a tool to increase portfolio performance.

4 Theoretical framework

To conduct and interpret empirical analysis, the theoretical framework for empirical financial analysis needs to presented next. In this paper, the performance of momentum portfolios formed on the basis of SRI factors is studied and interpreted. To efficiently measure portfolio performance in momentum strategies, some of the most commonly used methods will be presented to give a better understanding before the actual empirical analysis. Additionally, some of the core concepts related to the methodology and empirical analysis of this paper will also be discussed in this chapter. When reading this chapter, it's important to bear in mind that most of the theoretical framework of finance is assumed to be *ceteris paribus*, or all other things being equal. Additionally, finance theory assumes a rational investor that has no restrictions whatsoever and makes the most rational decisions with all of the information regarding the stock market, which he has readily available at all times. In earlier chapters it was mentioned that CSR and SRI investors may limit the pool of possible investments by having certain values by which they disregard certain stocks, like sin stocks. This in turn would cause an investor to make decisions that are not as rational as they could be. This obviously contradicts what is about to be presented in this chapter, but for the sake of this paper this contradiction must be disregarded for the duration of this chapter.

4.1 Modern portfolio theory (MPT)

Harry Markovitz (1952) theorized that investors can attune their levels of risk-aversion to the levels of return that they expect from their investments. He wrote a paper called portfolio selection, in which he pioneers the concept of modern portfolio theory. To put it bluntly, MPT is basically a theory of how investors can maximize their results with given levels of risk or minimize their risk with given levels of returns. In MPT an investments risk and return are not viewed as an individual stocks risk and return that need to be maximized, but rather as a part of a collective portfolio in which the risk and return levels of each individual stocks selected need to exhibit certain statistical values so that they maximize the performance (risk and return tradeoff) of the portfolio.

Expected returns in MPT are calculated as weighted averages of all the respective stocks in a portfolio. So, for an equally weighted 4-stock portfolio the expected return would be calculated by adding 25% of each asset's returns to one-another and thus obtaining a collective expected return. The risk, however, is a more complicated matter. To calculate the risk of a portfolio an investor must acquire the variation of each of the assets, and correlation values for each 2-stock pair. (Markowitz, 1952 & 1959)

MPT is a useful and simple tool for investors willing to diversify their portfolios with asset classes that have negative or close to zero correlation with stocks, thus decreasing the overall standard deviation of their portfolio and maximizing the risk-return tradeoff.

4.2 Momentum

Momentum has already come up a few times in the past chapters in the context of socially responsible investing influencing the profits of momentum strategies if implemented correctly, and behavioral anomalies and phenomena as momentum has been theorized to be caused by irrational investor behavior. According to Eugene Fama's efficient market hypothesis (1970), the stock market prices always portray all available information with no delay whatsoever. This in turn would mean that finding misvalued stocks should not be possible and thus strategies that exploit stock market inefficiencies should not be profitable. Among the most well-known anomalies lies momentum, which has been studied extensively with concluding evidence of it being a profitable strategy, while also contradicting the EMH. As mentioned in chapter 3.4, momentum profits are widely accepted to be caused by irrational investor behavior caused mostly by uncertainty in the decision-making process of investors. The uncertainty considering available information is often replaced with intuitive decision-making which in turn causes price overreactions and underreactions. These over- and underreactions then slowly move towards their actual values, thus making momentum a profitable strategy. (Malkiel & Fama, 1970)

Momentum as a strategy, however, was first presented by Jegadeesh and Titman (1993). To recap, momentum involves studying the profits of stocks in the past 3-12 months, and then buying the ones that have performed the best and selling the ones that have performed to worst. Jegadeesh and Titman studied the performance of this strategy in the US stock market and found concluding evidence of the strategy working. Additionally, they found that the 6-month time frame for performance following was the most lucrative strategy. They also retested their strategy with a later time period to test for robustness regarding sample bias. (Jegadeesh & Titman, 1993; 2001)

Momentum strategies can roughly be divided into two separate categories, and research has shown that one may outperform the other. The first type is the one that was described by Jegadeesh and Titman and is called cross-sectional momentum. Cross-sectional momentum strategies rank the stocks based on relative performance and a cut-off point is often implemented, which means that from a pool of 20 stocks an investor that implements cross-sectional momentum with a cut-off point of 20% would only go long the top 4 stocks and go short the bottom 4 stocks and ignore everything else. In time-series momentum the investor focuses on absolute performance of all the 20 stocks, meaning that if 10 of the stocks exhibit positive momentum the investor will go long 10 stocks and short the remaining 10 that exhibit negative momentum. The return profile of each respective strategy varies with market conditions and phenomena like up or down biases in market trends. As mentioned however, some recent research has suggested that due to not limiting the pool of possible investments (as MPT states) time-series momentum may actually outperform cross-sectional momentum. (Jegadeesh & Titman, 1993 & 2001; Bird et al., 2017)

The ESG-momentum strategy discussed earlier, is slightly different than the ones discussed in this chapter, and therefore it’s good to bear in mind that this may alter the empirical results greatly. The momentum strategies in this chapter are derived from past performance, while the ESG-momentum strategy frankly has nothing to do with

performance, but rather with ESG-performance, as the portfolios are formed through ESG-factors. This will be discussed in more detail later.

4.3 Risk and return

Risk is somewhat synonymous to volatility and uncertainty in the stock markets and has thus been covered in earlier chapters. However, while volatility and uncertainty do depict the riskiness of the stock markets, the risk discussed in this chapter is a little different. To put it shortly, in this case, the meaning of risk is that which the investor takes in pursuit of returns. In modern portfolio theory (1952) Markowitz discussed something called the risk-return trade-off. For a certain amount of risk, the investor receives a certain amount of return, as a compensation for the risk endured. Typically, this type of risk is not something that is discussed very often, because by the nature of markets, it is implemented in everything and is the very basis that asset markets function upon.

Risk is divided into two separate categories in this sense, with the first being the risk-free rate of return on the market, which basically represents the interest gained on an investment with zero risk. The other one is the risk premium assumed by the investor when investing in something risky. This risk premium is formed by multiplying the market risk premium with the Beta of an individual stock. The beta represents the sensitivity of an individual stock the volatility changes, in comparison to the rest of the market. (Markowitz, 1952)

The return the investor gains by holding a risky asset is formed by calculating the present value of each cash flow received by the investor plus the price difference when selling the asset. These cumulative cash flows are often referred to as holding period returns, which are often in finance literature calculated as logarithmic returns instead of absolute values. Log transformations make the returns continuous, thus allowing for more flexibility in comparing and adjusting returns to more suitable forms and time frames. The formula for the logged HPR goes as follows. (Jensen, 1968)

$$HPR = \ln\left(\frac{P_t + D_t}{P_t - 1}\right) \quad (3)$$

Where *P* stands for the value of the asset at time *t* and *t-1*. *D* stands for the cash flows of the asset at time *t*, and ln stand for natural logarithm.

4.4 Portfolio performance

4.4.1 Single-dimensional

Built based on modern portfolio (Markowitz, 1952) theory comes the capital asset pricing model, which is the first widely adopted pricing model presented by Treynor, (1961 & 1962) Sharpe (1964) and Linter (1965). Most of the single-dimensional pricing models discussed in this chapter are based on the core concept of the capital asset pricing model, with slight differences regarding the time frame. CAPM focuses on expected values while other measures like Sharpe ratio, Treynor ratio and Jensen's alpha focus on historical values.

4.4.1.1 The capital asset pricing model

In the risk and return chapter, the nuances of risk-return trade-off are briefly discussed, and the same idea is basically the core concept of the capital asset pricing model (CAPM). There's some debate as to who actually developed CAPM as there were multiple researchers who independently built on the earlier work of Markowitz's portfolio theory. Regardless of who came up with the idea, CAPM is among, if not the most commonly known asset pricing model in the finance world.

Similarly, to what was discussed in the risk and return chapter, CAPM, like the MPT, expects that investors act rationally and form their portfolios by minimizing risk while also maximizing returns. Simplified, the CAPM assumes that the expected rate of return

of an asset can be calculated as the product of risk-free rate of return, and the market premium multiplied by the individual assets beta, or equity risk premium. The beta for an asset is acquired by dividing the covariance of the asset's returns and the market's returns with the variance of the market's return. As mentioned in earlier chapters, this can be interpreted as the beta representing the sensitivity of the asset to changes in relation to the rest of the market, or put in other words, the volatility of the asset in relation to the rest of the market. (Sharpe, 1964)

The equation for obtaining an assets beta goes as follows:

$$\beta_i = \frac{Cov(R_i - R_m)}{\sigma^2(R_m)} \quad (4)$$

Where:

$\beta_i = Beta\ of\ asset\ i$

$Cov(R_i - R_m) = Covariance\ of\ asset\ returns\ and\ market\ returns$

$\sigma^2(R_m) = Variance\ of\ market\ returns$

Now that the beta of an asset is acquired, it can be used to determine the equity premium of the asset (beta multiplied with market premium). The formula for the CAPM is written as follows:

$$E(R_i) = R_f + \beta_i(\bar{R}_m - R_f) \quad (5)$$

Where:

$E(R_i) = Expected\ return\ of\ asset\ i$

$R_f = Risk-free\ rate\ of\ return$

$\bar{R}_m = Expected\ return\ of\ a\ market\ portfolio$

4.4.1.2 Sharpe ratio

Next in line with single-dimensional measures of portfolio performance lies the Sharpe ratio. As one of the engineers of the CAPM, Sharpe extended his contributions to the theory of finance by presenting his own ratio for portfolio performance measuring. The Sharpe ratio is basically a reward-to-variability -ratio which measures the reward received for each unit of risk taken, or in other words, the amount of excess return received for a given amount of variation in regard to the excess return. The basis of the ratio is very similar to CAPM, and the interpretation is also quite similar; The higher the ratio, the more attractive the risk-reward profile of the investment is. (Sharpe, 1966 & 1975)

The formula for Sharpe ratio is written as follows:

$$Sharpe\ ratio = \frac{R_i - R_f}{\sigma_{(R_i - R_f)}} \qquad (6)$$

Where:

$R_i = Return\ of\ asset\ i$

$R_f = Risk - free\ rate\ of\ return$

$\sigma_{(R_i - R_f)} = Standard\ deviaton\ of\ excess\ returns\ over\ risk - free\ rate\ of\ return$

4.4.1.3 Treynor ratio

A natural transition occurs as next in line with portfolio performance measures is the Treynor ratio, which was engineered the same year as Sharpe ratio, by Treynor and Mazuy (1966), quite by accident. Through examination of portfolio performance amongst funds, they stumbled upon a way to measure the performance of portfolios in a manner very similar to the CAPM. The only real difference between the Sharpe ratio and the Treynor ratio is that in the Treynor ratio, the standard deviation of excess returns

in substituted for beta. With this small adjustment the Treynor ratio only accounts for the portion of excess returns explained by the riskiness of the asset or the portfolio, rather than the entire market. Simply put, the Treynor ratio explains the returns gained for each unit of "excess risk" taken over the risk-free interest rate. (Treynor & Mazuy, 1966)

The formula for the Treynor ratio can be written as follows:

$$Treynor\ ratio = \frac{R_i - R_f}{\beta_i} \quad (7)$$

Where:

$R_i = Return\ of\ asset\ i$

$R_f = Risk - free\ rate\ of\ return$

$\beta_i = Beta\ of\ asset\ i$

4.4.1.4 Jensen's alpha

Another commonly known extension to the original CAPM is Jensen's alpha, perhaps the most used portfolio performance measurement tool in finance. Jensen's alpha is a measurement that compares the realized returns and expected returns as per calculated by the CAPM with given levels of risk. Jensen's alpha is a sort of a tool that is used to determine the ability of an investor or fund manager to exhibit abnormal returns (returns over expected returns) with stock selection and diversification. A portfolio with positive abnormal returns earns more reward for each unit of risk taken, and vice versa. (Jensen, 1968)

The equation for Jensen's alpha is written as follows:

$$Jensen's\ Alpha = R_i - (R_f + \beta_i(\bar{R}_m - R_f)) \quad (8)$$

Where:

$$R_f + \beta_i\,(R_f - (\bar{R}_m - R_f)) = Expected\ return\ of\ asset\ i$$

4.4.2 Multi-dimensional

Albeit the CAPM is an effective tool to measure portfolio performance and other related variables, it is only a single dimensional measurement tool, and often lacks the capabilities to explain empirical findings. For example, singe-dimensional measurements often fail to pinpoint the balance of risk-free interest rates and market premiums, thus skewing the results. (See Lintner, 1975; Groenewold & Fraser, 1997)

Finance in theory is quite simple when compared to actual returns and phenomena in the markets around the world, and for this reason multi-dimensional tools for portfolio performance measurement were developed to take more complex structures of risk and other variables into account. Some of these models include the Fama-French factor models, their extensions and the arbitrage pricing theory, which will all be briefly discussed in the following subchapters.

4.4.2.1 Fama-French 3-factor model

As one of the weak points of singe-dimensional asset pricing models was the weak explanatory power of market premiums (or betas), Fama and French (1992) came up with a multi-dimensional extension of CAPM that incorporates a “size factor” and a “value factor” to better explain abnormal returns. The reasoning for the selection of these particular factors lies in earlier literature by Banz (1981) and Stattman (1980). The former shows evidence of companies with lower market capitalization levels outperforming companies with higher market capitalizations. The latter study finds that on average, companies with higher book-to-market ratios tend to outperform companies with lower ratios. From the reasoning provided in these studies, comes the widely known

denotation of SMB and HML in the formula of the 3-factor model, which stand for small minus big and high minus low. The 3-factor model can be written as follows:

$$R_{it} - R_{ft} = a_i + \beta_i(\bar{R}_{mt} - R_{ft}) + S_i SMB_t + h_i HML_t + e_{it} \quad (9)$$

Where:

R_{it} = *Retur of asset i for time t*

R_{ft} = *Risk − free rate of return for time t*

a_i = *Jensen's alpha for asset i*

$\bar{R}_m$ = *Expected return of market portfolio*

β_i, S_i, h_i = *Factor sensitivity (multiplier) of asset i*

SMB_t = *Return difference of diversified portfolios consisting of small cap stocks and large cap stocks for time t*

HML_t = *Return difference of diversified portfolios consisting of high book − to − market value stocks and low book − to − value stocks for time t*

e_i = *Error term*

4.4.2.2 Fama-French 5-factor model

In a response to some criticism regarding the 3-factor models explanatory power, Fama and French take to improving their model by incorporating an operative profit factor and an investment factor into the formula to further better the explanatory power of the model. These two factors again are common denotations known as RMW which stand for robust minus weak, and CMA which stands conservative minus aggressive.

The formula for the 5-factor model is written as follows:

$$R_{it} - R_{ft} = a_i + \beta_i(\bar{R}_{mt} - R_{ft}) + S_i SMB_t + h_i HML_t + r_i RMW_t + c_i CMA_t + e_{it} \quad (11)$$

Where:

See equation 9 for annotations

SMB_t = *Return difference of diversified portfolios consisting of small cap stocks and large cap stocks for time t*

HML_t = *Return difference of diversified portfolios consisting of high book − to − market value stocks and low book − to − value stocks for time t*

RMW_t = *Return difference of diversified portfolios with robust and weak profitability for time t*

CMA_t = *Return difference of diversified portfolios consisting of low and hh*

e_i = *Error term*

5 Previous literature

The theoretical concepts surrounding the subject of SRI-investing, ESG-momentum and the general theory of finance has now been covered throughout the past chapters. What remains is a brief look into the previous literature and research regarding ESG-momentum strategy's performance and how uncertainty directly or indirectly affects the general performance of momentum strategy. As is mentioned, uncertainty may give rise to certain behavioral biases which in turn tend to have a positive effect on the momentum strategy. SRI-investing and ESG-momentum as topics are quite new fields in the theory of finance and thus only a few studies exist that can be used as an example in this chapter, following other examples presented in earlier chapters. While the literature on the subject remains scarce, it provides an opportunity for this paper to contribute to the literature surrounding ESG-momentum especially by providing another angle into the subject by incorporating the effects of uncertainty.

5.1 Nagy, Cogan & Sinnreich, 2013

In 2013 Nagy et al. conduct a study on the performance of three separate ESG-factor implementing strategies in an attempt to compare the performance of their strategies to a benchmark (MSCI World Index). They use a global multi-factor equity model called the BARRA Global Equity Model or the GEM3, provided by MSCI as an investment support tool for fund managers and institutional investors (MSCI, 2013). The three separate strategies tested were worst-in-class exclusion, ESG-tilt and ESG-momentum, but for the sake of this study, only the momentum portion will be examined more closely. All the three separate strategies gained significant alpha while the ESG-momentum performed the best by far. Nagy et al. used MSCI provided intangible value assessment (IVA) ESG ratings to rank the companies and rebalance the portfolio every 12 months according to the ESG-rating changes in a manner described earlier in this paper. Nagy et al. also find some evidence suggesting that ESG-implementation is a still a relatively new field of investing as investors tend to react stronger to downgrades in ESG-ratings than they do to upgrades. This could suggest that investors are still somewhat uncertain of

the long-term capabilities of ESG-implementation while also being more risk averse in the short term.

5.2 Nagy, Kassam & Lee 2016

In 2016 Nagy, Kassam & Lee pick up where Nagy et al. (2013) left off with their ESG-strategy related study. Nagy et al. (2016) focus solely on ESG-tilt and ESG-momentum strategies and examine their alphas with a prolonged time-period to further asses the effectiveness of these strategies in obtaining abnormal results. Using the exact same methodology as presented in the earlier chapter, Nagy et al. provide evidence aligned with earlier findings suggesting that ESG-tilt and -momentum do indeed gain positive abnormal returns, except for ESG-tilt gaining most of them in the final years of the prolonged time-period, which could with further examination be proven to have been caused by an anomaly or skewed data etc. Ultimately Nagy et al. (2013 & 2016) provide heaps of evidence suggesting that ESG-tilt and ESG-momentum both provide positive abnormal returns while also increasing the average ESG-score of one's portfolio, be it at the cost of further returns had the investor used a strategy like regular price momentum, for example.

5.3 Kaiser & Welters, 2019

Kaiser & Welters (2019) take a slightly different approach in examining ESG-incorporation and momentum performance. They use an ESG-constrained investment universe to examine the performance of momentum strategies under different types of ESG-conditions like a subset of high or low ESG-score stocks. They describe the purpose of their paper to be inspired by the risk mitigating effect of ESG-criteria.

Unlike Nagy et al. (2013 & 2016) Kaiser & Welters use a Thomson Reuters based Asset4 database for ESG-ratings and they form their momentum portfolios in the traditional manner of comparing cumulative stock returns of the past 2-12 months disregarding the last month, in exception to deriving the momentum portfolios based on ESG-ratings. The

idea behind this is that the momentum portfolios are formed like this with a limited ESG-constrained investment universe where for example the only available stocks to pick are ones with a (relatively) high ESG-rating. Kaiser & Welters find evidence suggesting the existence of a momentum premium, even with high and low ESG-score stocks. However, they also find that in a subset of high scoring stocks the premium tends to be significantly lower. Additionally, they state that ESG-incorporation may offer some risk mitigation as lower-end ESG-scoring portfolios tend to gain lower returns in times of momentum crashes.

5.4 Other related literature

The following studies are not so much concentrated on ESG-momentum or momentum profits but are still of some theoretical importance regarding the subject of this paper and will thus be presented. In 2016 Giese et al. study the possibility of ESG data being used as a similar performance factor as growth, value, momentum or size etc (Giese et al, 2016). Giese et al. use their personal peer group -methodology like the sigmoid function of standard z-scores to normalize the ESG-rating data from biases that may occur due to the scores being derived from a massive set of subfactors. They then move on to a process that is refined to obtain weights for factors that are more important than others. First, they use a LASSO estimator to mitigate the risk of data mining and thus overfitting the model with regressors. After this they move on to subsample the data in order to further increase the robustness of the results. The findings of the study conducted by Giese et al. indicate that this modified ESG-factor can indeed add value to a portfolio in a similar manner to other previously stated performance factors.

So far only positive ESG-related literature has been reviewed, so for the sake of neutrality, some criticism will also be considered. Gidwani (2020) noticed the ever-rising popularity of ESG integration and immediately noticed the caveat of human greed to search for alpha-generating factors. The main concern of Gidwani is that few investors know that ESG-scores tend to drift towards the mean on a longer timescale, which in turn could be

perilous to ESG-momentum strategies that use the relative changes of ESG-score values to form portfolios.

If Gidwani's estimations hold true, it means that particularly high and low ESG-scores tend to reverse towards the mean regardless of actual change in ESG-incorporation within the company itself. This can then cause investors using the ESG-momentum strategy to make more changes in their portfolios than necessary, increasing trading costs and causing additional work. Also, if ESG-scores tend to drift toward the mean regardless of the actual factors and values that derive them, are they really that good of an indicator to use to gain positive abnormal returns? This is something that will be discussed in the next chapter.

6 Data and methodology

In this chapter the data and methodology for the empirical section of the paper will be presented. ESG and stock market closing price data is provided by Refinitiv DataStream, and the CBOE Volatility index -scores will be provided by Yahoo Finance. As per the hypotheses of this paper, the performance of the ESG-momentum strategy in S&P500 will be evaluated for the time-interval of 2010 to 2020 via performance estimation models presented earlier and the effect of uncertainty on the performance of ESG-momentum is studied by checking for correlation in the VIX index.

6.1 Data

6.1.1 ESG-Scores

The first and most important piece of data in this paper are the ESG-Scores provided by Refinitiv, calculated from self-reported information which is used to then calculate the scores. There are multiple agencies providing ESG-Score rankings for companies around the world, but Refinitiv was chosen due to it having one of the largest databases available, in addition to being one of the oldest agencies in providing ESG-Score rankings (Refinitiv, 2021). One important note to bear in mind when conducting research on ESG-Scores is that the scores are derived from self-reported information from companies around the world. The quality of this information is difficult to standardize as the companies conduct business in different countries, and therefore have different values and weights on different pieces of information (Dorfleitner, 2015). Additionally, several studies have noted a bias regarding research with ESG-Scores (See earlier literature chapter). The information provided is not standardized and moreover, the methodology for calculating the ESG-Scores is not standardized. This causes concern about the differences in ESG-ratings both due to different types and sizes of companies providing different quantities and qualities of information, and the agencies using this information in different manners. The reasoning for choosing Refinitiv scores lies in uniformity as most of the earlier ESG-related studies have used the same scores. ESG-Scores calculated by Refinitiv

are calculated based of roughly around 500 separate criteria from which most of the weight is calculated by 178 criteria. Ten major categories are used to evaluate the three constituents of ESG (Environmental, Social, Governance). Presented below are some descriptive statistics for the ESG-data used. For this paper, only the absolute ESG-score is used, as some earlier studies have separated each of the three constituents. (Dorfleitner, 2015; O'Rourke, 2003)

6.1.2 Share price data

The second part of the data used in this paper are the weekly closing prices for companies listed in the S&P500 index. The formation of portfolios is conducted similarly to Nagy et al. (2016), with some motivation regarding the investment universe is also drawn from Kaiser & Walters (2019). A Weekly closing price time-series is used to calculate the returns for each company in accordance to the portfolio construction methodology presented in the next subchapter. To be as uniform as possible, the weekly closing price series are also provided by Refinitiv. The initial investment universe consists of S&P500 when forming the portfolios, but shares with no ESG-Data available in the 10-year period following 2010, are pulled from the sample, in addition to shares with no price data for the entire period (I.E companies that have listed during the period, not before it). Presented below is a table of the indices included along with the number of companies in the initial investment universe, along with a column for the number of companies after pulling the companies with no complete price or ESG-data for the time period.

6.2 Methodology

In this subchapter, the methodology for both the portfolio construction and empirical analysis are provided. Portfolio construction is based on studies presented in earlier chapters, in accordance with the theory of the ESG-Momentum investing strategy. Empirical analysis of portfolio performance is conducted in accordance with the general theoretical framework of finance presented in chapter 4.

6.2.1 Portfolios

The portfolio used in this paper is a long-short ESG-momentum (see earlier chapters) portfolio constructed of stocks within the S&P500 index. The shares will be chosen with weighted ESG-scores provided by Refinitiv (2021). The purpose of this paper is to investigate an ESG-momentum strategy that is possible to implement in real life by a real investor without accruing great amounts of transaction costs that would ultimately ruin the investment strategy's returns (Jegadeesh & Titman, 1993). The cut-off point for the purposes of this paper is chosen to be 10%, or the 10 th decile based on the reasoning regarding transaction costs. Some earlier studies including Bird et al. (2017) and Jegadeesh & Titman (1993, 2001) use similar methodology when selecting stocks for a momentum portfolio. Most of these studies use the bottom and top 10th deciles for forming the portfolio, resulting in a cut-off point of 20%. As mentioned earlier, the reasoning for the lower cut-off point is that a strategy with hundreds or thousands of transactions is not implementable in real life as the costs are too high. Considering the conclusions of MPT and following literature (Markowitz, 1952; 1959) stating that a portfolio of roughly around 24-40 stocks compared to an equally weighted portfolio of 500 stocks performed better both in terms of Sharpe ratio and standard deviation it's reasonable to assume that the 10% cut off point from a universe of 500 stocks is suitable for the purposes of this paper.

The portfolios are formed by placing the ESG-rankings in order and going long the top 5% and short the bottom 5%. The ESG-rankings are placed in order based on the absolute value change in the ranking during the past year. the year 2010 is ranked based on the absolute value change from the end of 2009 to the end of 2010. These selected stocks are then placed in a portfolio that is completely re-done at the end of next year, like in many of the earlier momentum -related studies (Jegadeesh & Titman, 1993 & 2001). The investment universe consists of the S&P500 index but certain stocks with no ESG-ratings available for the time-period are omitted from the universe.

Table 2, presented below, has the performance statistics of a long portfolio constructed from the S&P500 index. In this case, the long and short portfolios both have 25 stocks each year. As presented, the long portfolio gained a very large cumulative return of 425,29% during the sample period.

US Long	Annual return	Risk-free rate of return	Excess return
2010	18,310 %	0,140 %	18,170 %
2011	-6,020 %	0,050 %	-6,070 %
2012	21,665 %	0,090 %	21,575 %
2013	36,749 %	0,060 %	36,689 %
2014	11,721 %	0,030 %	11,691 %
2015	10,209 %	0,230 %	9,979 %
2016	19,695 %	0,320 %	19,375 %
2017	21,289 %	0,930 %	20,359 %
2018	-4,804 %	1,940 %	-6,744 %
2019	34,751 %	2,060 %	32,691 %
2020	23,837 %	0,370 %	23,467 %
Cumulative return	**425,290 %**		

Table 2. Performance statistics of the long portfolio

Table 3 below shows the performance of the short portfolio for S&P500. The portfolio gained a negative cumulative return of -66,445%.

US Short	Annual return	Risk-free rate of return	Excess return
2010	-17,267 %	0,140 %	-17,407 %
2011	-2,963 %	0,050 %	-3,013 %
2012	-6,512 %	0,090 %	-6,602 %
2013	-22,458 %	0,060 %	-22,518 %
2014	-11,176 %	0,030 %	-11,206 %
2015	0,489 %	0,230 %	0,259 %
2016	-15,463 %	0,320 %	-15,783 %
2017	-20,860 %	0,930 %	-21,790 %
2018	19,367 %	1,940 %	17,427 %
2019	-12,342 %	2,060 %	-14,402 %
2020	-7,724 %	0,370 %	-8,094 %
Cumulative return	**-66,445 %**		

Table 3. Performance statistics of the short portfolio

The annual returns for the entire portfolios for S&P500 are formed from the percentages presented in the tables above. The S&P500 portfolio with a 10% cut-off point (50 stocks per year) had a cumulative return of 129,623%. Table 4 below presents the performance statistics of the portfolio. A brief analysis of the numbers would suggest that the short portfolio performed quite poorly, and the long portfolio performed well. This could indicate that the underlying index has also been rising and accounts for a large portion of the performance regardless of ESG ratings. This will be discussed in more detail later.

US Portfolio	Annual return	Risk-free rate of return	Excess return
2010	1,043 %	0,140 %	0,903 %
2011	-8,983 %	0,050 %	-9,033 %
2012	15,153 %	0,090 %	15,063 %
2013	14,292 %	0,060 %	14,232 %
2014	0,544 %	0,030 %	0,514 %
2015	10,698 %	0,230 %	10,468 %
2016	4,232 %	0,320 %	3,912 %
2017	0,429 %	0,930 %	-0,501 %
2018	14,564 %	1,940 %	12,624 %
2019	22,409 %	2,060 %	20,349 %
2020	16,113 %	0,370 %	15,743 %
Cumulative return	**129,623 %**		

Table 4. Performance statistics of the ESG-momentum portfolio

Finally, in table 5 below are the descriptive statistics for the portfolio. The descriptive statistic table presents the mean, median, standard deviation and variance for the portfolio throughout the sample period, and these are used to assist empirical analysis. For simplicity's sake, descriptive statistics for long and short portfolios are not presented as they have no carryover for the empirical analysis.

	Mean	Median	Standard deviation	Sample variance
US	0,089	0,125	0,096	0,009

Table 5. Descriptive statistics of the ESG-momentum portfolio

Analyzing the descriptive statistics above tell us that the portfolio had a relatively good average annual performance of 8,945% with a standard deviation of 0,095 and a sample variance of 0,009. The portfolio performed well considering the portfolios size in relation to the variance of it. Some of the earlier studies mentioned related to the reasoning behind momentum profits would suggest that this smaller sample size would lead to more volatility and more uncertainty in the index due to less diversification. This increased volatility is a gauge for uncertainty in the index and uncertainty has been

proven to be one of the drivers of momentum profits (initial underreaction and delayed overreaction).

Below is figure 4 which visualizes the performance of the momentum strategy compared to the underlying index of S&P500. As is evident in the graph the US momentum strategy performed around twice as bad as the underlying index. This could, with further examination, be considered evidence supporting the claims of Malkiel & Fama (1970) stated earlier in this paper that uncertainty is a driving force of momentum and that there is a sweet spot when selecting the number of stocks in a momentum portfolio.

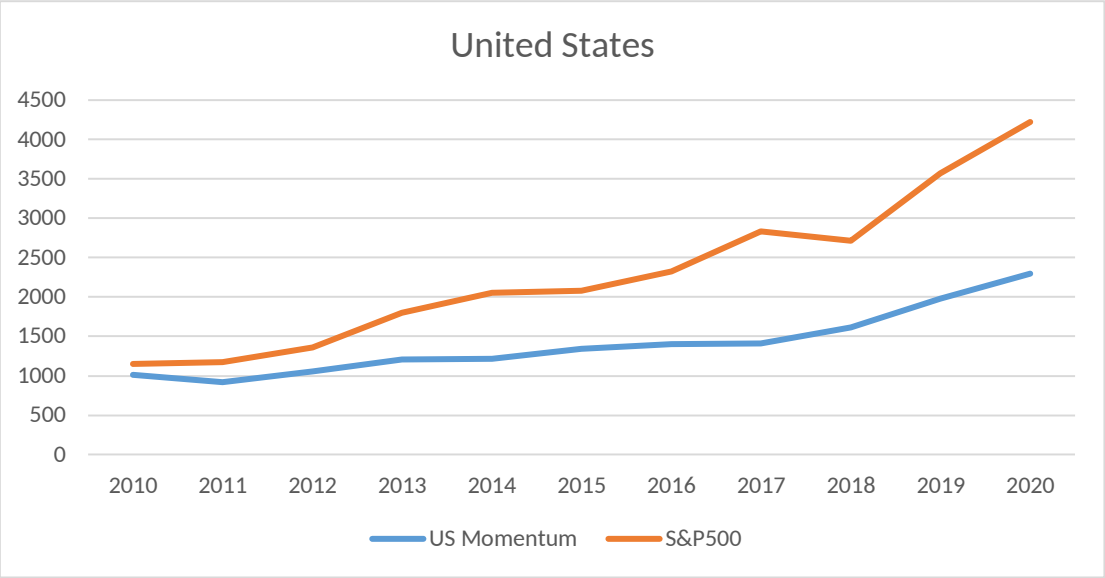

Figure 4. The annual performance of the ESG-momentum strategy and the S&P500 index visualized.

6.2.2 Empirical methodology

As mentioned earlier in the paper, a problem with ESG-studies is the non-uniform data used in the studies along with the multiple choices of regressions that can be used for

the empirical portion of the studies. Along the most used regression models are the capital asset pricing model and the multi-factor models presented in more detail in chapter 4 of this thesis. For this study the CAPM, Fama-French 3-factor model and the Fama-French 5-factor model will be used to first and foremost test for effects of ESG-ranking, but also to compare the two models against one another and account for possible misinterpretations regarding the disadvantages of using each model respectively. Many of the earlier studies (Nagy et al. 2013 & 2016; Giese et al., 2019) use a single regression for their studies. This study extends this with motivation drawn from Fama & French (2018) paper studying the differences of omitting variables and using different factors in testing portfolio performance.

The regression models used will be conducted using a linear least squares method of estimating variables called the ordinary least squares (OLS) method. This is done by minimizing the sum of the squares of the differences between a dependent and independent variable. When the regressors are exogenous and optimal in the class of linear unbiased estimators, the method of OLS provides a minimum-variance mean-unbiased estimation which is regarded as a maximum likelihood estimation under the assumption of normality.

7 Regression results

This paper focuses on the effects of socially responsible investing on financial performance, by inspecting the abnormal returns provided by forming momentum portfolios from ESG-rankings. In this chapter, the regression results for a CAPM -model, the Fama & French 3-factor model and the Fama & French 5-factor model are presented.

The results of the regressions will be presented in separate tables for each regression and each portfolio. Each table will have rows for coefficients representing different factors within each model, and the R-squared value to represent the fit of the model. Additionally, the top and bottom 10% portfolios are tested separately to get further insights into the dynamics of each portfolio's success. In addition to presenting the results for each regression model, some brief pointers are made about the values and results. More detailed discussion about the results and their implementations in chapter 8.

7.1 CAPM

First, the results for the capital asset pricing model are presented in table 6 and the MKT-RF, or the market factor, is the only explanatory variable in this regression. In this case this factor can also be interpreted as Beta, and the intercept of the regression as the Alpha. The US ESG portfolio also appears to provide a positive 3,9% alpha, although it is also statistically insignificant. The final row representing the R-squared variable, is below 0,2 for both portfolios which would indicate that these models do not explain the returns of these portfolios very accurately and may be missing some important factors needed for a better fit. The final row representing the R-squared variable, is below 0,2 for the portfolio, which would suggest that the model does not indeed explain the returns of the portfolio very accurately and is very likely omitting some important variables.

	US Portfolio
Alpha	3,891 (0,372)
MKT-RF	0,261 (0,261)
R	0,138

Table 6. The CAPM regressions results for the ESG-momentum portfolio

In table 7 are the results for the top and bottom 5% of the US long and short portfolios. The alpha for both is positive 1,6%, while remaining statistically insignificant. The Betas, however, are both statistically significant at confidence level of 2,5%. The top 5% has a beta of 1,013 and the bottom 5% has a beta of -0,751. The R squared for both exceed 0,7, the top 5% being almost 0,9 which would indicate great fit of model, and the results for the US top and bottom 5% would indicate that most of the returns generated by the portfolios have been due to the market performing well, but this can only be confirmed by looking at the 3-factor and 5-factor model result in the next subchapters.

	US Top 5%	**US Bottom 5%**
Alpha	1,698 (0,458)	1,671 (0,608)
MKT-RF	1,013 (0,000***)	-0,751 (0,001**)
R	0,896	0,7

Table 7. The CAPM regression results for the top and long portions of the portfolio

7.2 The 3-factor model

Next, the regression results for the Fama & French 3-factor model are presented. In addition to the alpha and beta, this regression also has variables for company size and book-to-market values. These factors are represented by SMB and HML.

The US ESG portfolio had a modest alpha, 3,14%, but just barely insignificant at all conventional levels. The beta for this portfolio was 0,281, the company size factor, -0,109, and the book-to-market factor -0,109, all being statistically insignificant. The R value for

the portfolio was 0,168. This is better than that of CAPM, but still quite low and could be interpreted as omitting variables or at this point a regression that's not able to explain the results overall. This will be discussed in more detail later

	US Portfolio
Alpha	3,135 (0,0546)
MKT-RF	0,281 (0,332)
SMB	-0,109 (0,821)
HML	-0,068 (0,729)
R	0,168

Table 8. The Fama & French 3-factor regression results for the portfolio

Next, the below 3-factor regression presented will be the US ESG portfolio top and bottom 20th decile. The Alpha for the top 5% was 2,164, though statistically insignificant. The beta, however, was 1,021 and significant at all conventional levels. The factors were 0,005 and 0,09 respectively. Both statistically insignificant. The bottom 20 th decile had an alpha of 0,632%, statistically insignificant. The beta was -0,748, again significant at all conventional levels. The factors were -0,074 and -0,153, both statistically insignificant by far. The R-values for both, the top and bottom deciles, were 0,909 and 0,756 which are very strong in relation to the earlier levels of model fit.

	US Top 5%	**US Bottom 5%**
Alpha	2,164 (0,413)	0,632 (0,859)
MKT-RF	1,021 (0,000***)	-0,748 (0,005***)
SMB	0,005 (0,984)	-0,074 (0,825)
HML	0,090 (0,376)	-0,153 (0,285)
R	0,909	0,756

Table 9. The Fama & French 3-factor regression results for the top and bottom portions

7.3 Fama & French 5-factor model

The final regression model for this study is the Fama & French 5-facctor model. As explained earlier, it's very similar to the 3-factor model, but it also accounts for operating

profitability of companies, and whether a company invests conservatively or aggressively as mentioned earlier in chapter 4.

The US ESG portfolio was a slight disappointment when compared to the earlier models. The alpha was a little bit higher at 5,81%. The beta was 0,206, the factors in the order as below were -0,488, -0,023, -1,165 and 0,125, all statistically insignificant. The R values for the portfolio is 0,574.

	US Portfolio
Alpha	5,806 (0,304)
MKT-RF	0,206 (0,450)
SMB	-0,488 (0,414)
HML	-0,023 (0,936)
RMW	-1,165 (0,089)
CMA	0,125 (0,871)
R	0,574

Table 10. The Fama & French 5-factor regression results for the portfolio

The US ESG portfolios top and bottom 5% performed quite well, and similarly to the results of the 3-factor regressions, had some statistical significance. The top 5% had an alpha of 4,72%, statistically insignificant. The beta was 0,932 and significant at all conventional levels. The other factors were 0,096, 0,252, -0,481 and -0,426, all statistically insignificant. The bottom 5% had an alpha of 0,91%, again statistically insignificant. The beta was -0,741 and statistically significant at all conventional levels. The factors were -0,519, -0,253, -0,689 and 0,499, again all insignificant. The R-values for these regressions were 0,943 and 0,88, which in comparison is a very good fit.

	US Top 5%	**US Bottom 5%**
Alpha	4,723 (0,153)	0,912 (0,802)
MKT-RF	0,932 (0,001***)	-0,741 (0,007***)
SMB	0,096 (0,765)	-0,519 (0,222)
HML	0,252 (0,165)	-0,253 (0,240)
RMW	-0,481 (0,177)	-0,689 (0,126)
CMA	-0,426 (0,342)	0,499 (0,362)
R	0,943	0,88

Table 11. The Fama & French 5-factor regression results for the top and bottom portions

In the next chapter the regression results will be discussed in more detail, in addition to some suggestions for improvements and further research.

8 Conclusions and discussion

In this paper, the alpha-producing capabilities of environmental and social factors have been investigated through an investment strategy that combines the popular momentum strategy with the rising importance of ecological values in the form of ESG-rankings. This is done by creating portfolios using ESG-momentum, and then testing these portfolios with some of the most common measures of portfolio performance, like the capital asset pricing model and multifactor -models. The main idea behind all of this is to figure out whether implementing ESG-ratings into strategies like momentum, actually provide investors with excess returns, and the findings of the empirical testing portion of the paper are discussed in more detail next.

8.1 Discussion and summary

8.1.1 The empirical results

The results of the empirical testing for this thesis resulted in the null hypothesis remaining intact as most of the variables in the regressions were statistically insignificant. First, the CAPM regression for the portfolio had an alpha and beta that were both statistically insignificant and therefore offer no real insights regarding the research question of this paper. And interesting find, however, is the beta factor for the top and bottom portions of the portfolio while the entire portfolio itself had a beta that was statistically insignificant. This can be interpreted as the top and bottom deciles having exposure to beta, being positive when going long and negative when going short. Whatever the CAPM findings for the entire portfolio would've been, they should've been taken with a grain of salt as the r-squared tells that the explanatory power of the model is very low.

The 3-factor regressions shower similar results in terms of alpha and beta, still being insignificant with the ESG-momentum portfolio. The additional factors also seem to be statistically insignificant and do not offer insights into the regression itself. The r-squared

for the portfolio itself was again relatively low and would indicate that some variables are missing.

The top and bottom portions of the portfolio gave similar results as they did with CAPM. The beta remaining significant and with similar direction as in earlier models, while also having a relatively high R-squared insinuating a good explanatory power of the model.

There are some reasons that may cause the low r-squared value of the portfolio, the first being the same as in the CAPM regressions, that is omitting variables from the regression. Another theory for the poor results of the regressions could be that the model itself does not indeed explain the profits of the portfolio very well, and that most of the returns cumulated by the portfolio were due to good performance in the underlying index.

Finally, the 5-factor regression results provide similar results, as the ESG-momentum portfolio's factors are still statistically insignificant and mostly negative even if they would be significant. The r-squared value for the portfolio was relatively good in comparison to earlier model's results, but even then, the model appears to be insignificant and therefore could be interpreted as the ESG-momentum not being a very good investment strategy. And interesting finding, however, is the fact that both the top and bottom portions of the portfolio appear to have a high r-squared value together with statistically significant exposures to Beta, which could be implemented into other investment strategies as a hedge strategy, perhaps.

8.1.2 Summary

In summary, the results of the empirical testing conducted in this paper suggest that excess returns cannot confidently be gained by forming portfolios going long companies that significantly improve their ESG-ratings and going short companies that decrease their ESG-rating, according to CAPM and multifactor models. The strategy does however appear to provide great exposure to Beta, which can in turn be used to hedge other strategies. Additionally, as per the above sub-chapter, it would appear that at least the

CBOE volatility index and the ESG-momentum strategy performance are not very correlated.

An alternative interpretation for the results of the performance testing would also be that the models are simply not effective enough in explaining the profits of this strategy, however, it is unlikely because when examining the and bottom portions of the portfolio, the explanatory power of the regressions was around 0,9 and the alpha factor was still deemed statistically insignificant.

8.2 Limitations

The results of this paper differ from earlier literature mentioned in this paper. (Nagy et al, 2013; Nagy et al, 2016) For example, the regression results can be interpreted as the ESG-momentum strategy not being a viable investment strategy, and not being able to provide statistically significant levels of positive excess returns. These results, however, are subject to some limitations that may cause the differing results.

The first limitation of this paper is that these results are not compared to other investment strategies for the same time period and therefore it may be that for the testing period this strategy would have performed better than other similar strategies. Additionally, during the testing period the underlying index performed relatively well, which may also skew the results.

The second limitation for this paper is the subjectively small portfolio size due to factors like real life implementation and transaction costs. These are factors that were considered in picking the correct portfolio size because the purpose of this paper is to examine an investment strategy that an investor can implement in real markets with high levels of transaction costs and limitations. This is discussed in more detail in data and methodology.

The third major limitation for this paper is that the testing is only conducted on one continent, and on a relatively small timescale. For a full-scale study the time-period could be longer, for example 50 years, and the testing could be conducted on multiple types of markets and continents. This is something that will be discussed more in the next chapter.

8.3 Ideas for further research

As mentioned in the earlier subchapter, the sample size for this type of study was relatively small because ESG-ratings are a somewhat new phenomenon and are largely unavailable for companies preceding the beginning of the test period in 2010. Additionally, some of the companies included in these indices that would've otherwise made the 10% deciles used to form the portfolios, may not have had ratings for each year beginning after 2009, and were thus omitted from the investment universe.

Further research on this matter could be conducted by increasing the testing period to cover more ground, but this simply requires time as this is still a relatively new field of study. This would help mitigate the problem of ESG-ratings being a new and interesting phenomenon to which investors have possibly not gotten completely used to, and thus maybe subject to biases that arise from greenwashing and other similar subjects.

Another great extension to this study would be to include a larger pool of companies from all around the world, instead of solely focusing on singular indices from developed markets. This would increase the sample size and investment universe greatly and mitigate the demographical differences in how people react to different factors affecting the market, like environmental and social values.

Upon reviewing the empirical results of this paper, it was also found that the strategy has a possible use in identifying stocks with large exposures to positive and negative betas. This could with further research prove to be a tool useful for hedging other investments. Additionally, this could be studied together with extensive testing of correlation with other uncertainty proxies.

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