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ESG as an Assessment of Risk

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Introduction

Socially responsible investing is an investment approach that integrates ethical principles into financials decisions; it is a field of finance that is growing in popularity, representing globally $30.7 trillion of assets at the start of 2018 (Global Sustainable Investment Alliance, 2018), and roughly one third of the assets professionally managed in the United States in 2020 (US SIF, 2020). With this thesis we focus our analysis on one of the most commonly discussed approaches to SRI, ESG integration, which consists of systematically associate factors linked to Environmental, Social, and Governance criteria to financial criteria. This thesis is an empirical study on the effectiveness of ESG scores as an assessment of risk, it is structured as a comparison between portfolio constructed using different approaches in order to see if integrating ESG principles with financials decisions can be beneficials for a value-only minded investor, and if those principles could be used to asses risk and future returns.

When we designed this project we had two main goals in mind: first we wanted to further the discussion around this topic by expanding on the work done by previous studies, second we wanted to create a thesis that could also work as an introductory piece for a beginner in this field, to bring more attention to it. In order to achieve both of this objectives we decided to utilize easily accessible data, so for the object of our analysis we observe stocks from the S&P 500 rated and the publicly accessible ESG scores from MSCI, also we focus our observation on a very recent, hence less discussed, time frame.

This thesis is divided into five chapters. In the first we want to provide the reader with the context necessary for the understanding of this subject, we do this firstly by describing the concepts that are at its cornerstones, Corporate Social Responsibility, Sustainable and Responsible Investing, ESG integration; then we present and discuss some of the more relevant and influential paper from the academic literature.

The second chapter is dedicated to the presentation of this thesis questions and the description of the data that we observe, so we will provide an explanation on the methodology that MSCI follows to derive its ratings and present the reasoning behind the choice for the stocks that we decided to observe.

In the third chapter, we discuss the approaches that we adopted to form the portfolios and we also present the financial metrics that use to compare them. In the fourth one we present the results we obtained and finally in the fifth and final chapter we discuss them, by proving some explanations and highlighting some possible avenues of expansions.

1.Background and Literature Review

With this first chapter we want to provide a context for all the subjects that we are going to discuss during the course of this thesis. We offer a background by introducing some key concepts such as Corporate Social Responsibility, Sustainable investing, and Environmental Social and Governance. Then we review some of the more relevant academic literature, both regarding sustainable investing in a broader sense, and ESG in its specificity; in that section some crucial observations by each paper are going to be pointed out and then discussed, in order to collocate this thesis into the existing literature.

1.1 Key concepts

In this first section we are going to review two of the most important concepts that are the foundation for the discussion of this thesis, Corporate Social Responsibility and Socially Responsible Investing. What we want to provide with this review is both to offer a definition of the concepts and to contextualize them by offering examples and highlighting the controversies that surrounds them.

1.1.1 Corporate Social Responsibility

Corporate Social Responsibility, or CSR, although a crucial aspect of sustainable finance, it is by itself, a controversial topic with harsh critiques that arise from all sides of the political spectrum. CSR can, in fact, be described as: “an imposition of public social preferences on private property rights” Sheehy (2014), so merely as a cost that companies must endure, and that diverts them from their only social responsibility, which is to generate profit (Friedman, 2007); on the opposite side it can be seen as mere virtue signalling and greenwashing (Mahoney et al, 2012), or mechanism to advance neo-liberalist ideals (Ireland and Pillay, 2009) by adopting practices that may improve the public perception of a company while it continues to generate social harms.

The divisiveness of this topic appears particularly evident when discussing one of the most famous examples, often used to describe CSR. It is a statement of purpose signed by 181 CEOs of some of the largest companies in the US (Business Roundtable, 2019) in which they affirm their willingness to shift the focus of corporations, from the maximization of shareholders wealth, in favour of a more stakeholders-driven approach. In their statement they commit to five principles, only the last one of which refers to shareholders, while the orders are commitments to preserve the interests of: consumers, employees, suppliers, and the communities affected by the business. The reception to this statement demonstrated how divisive the concept of CSR can be; in fact while it was welcomed with cautious optimism by some (Winston, 2019 and Gelles and Yaffe-Bellany, 2019), others harshly criticized it, with one of the most prominent critique of the statement being offered by Zingales (2019), who defined the statement as a "marketing ploy" at best or as a "dangerous power grab" at worst.

However, while it felt necessary to point out the controversies surrounding the concept, for the rest of the thesis those will be largely ignored, as an acceptance that CSR, not just as a burden or a façade but as a real and tangible effort by a company, is necessary when discussing ESG and sustainable finance.

The definition of CSR is something that has long been debated by scholars, but a very comprehensive description of the concept is offered by Sheehy (2014), who define it as: "a socio-political movement which generates private self-regulatory initiatives, incorporating public and private international law norms seeking to ameliorate and mitigate the social harms of and to promote public good by industrial organisations". In simpler terms, CSR can be described a set of internal practices that a company may adopt, with a positive impact on society, and that are not necessarily linked to economic goals. Starbucks, the American coffeehouse chain, can be used as a practical example of what those practices may look like. In fact, as reported in their Global Social Impact Report (2019) the company has set for itself goals such as: sourcing the totality of their coffee and tea ethically, reducing its carbon footprint by making their portable cups more easily recyclable, and helping women in impoverished area of Asia, Africa and Latin America by investing in their education.

CSR is crucially linked to sustainable finance because, as it will be later discussed, one way that an investor who wants to invest their money in a sustainable manner may operate is by prioritizing investing in companies that adopt good CSR practices or by excluding companies who don't.

1.1.2 Sustainable and Responsible Investing and ESG

Socially responsible investing, or SRI, is an investment approach that integrates ethical principles into financials decisions, people that chose this approach want to achieve a financial gain in conjunction with the notion that their investment has a positive social and environmental impact.

It is an increasingly popular field of finance, going with data coming from a Global Sustainable Investment Alliance report, SRI represented $30.7 trillion of assets at the beginning of 2018 which meant it had increased by 34% in the previous two years. In Figure 1 (Global Sustainable Investment Alliance, 2018) see a snapshot of the five major regions at the start of 2018, the values are expressed in billions.

Figure 1 Growth Of Sustainable Investing Assets By Region In Local Currency 2014–2018

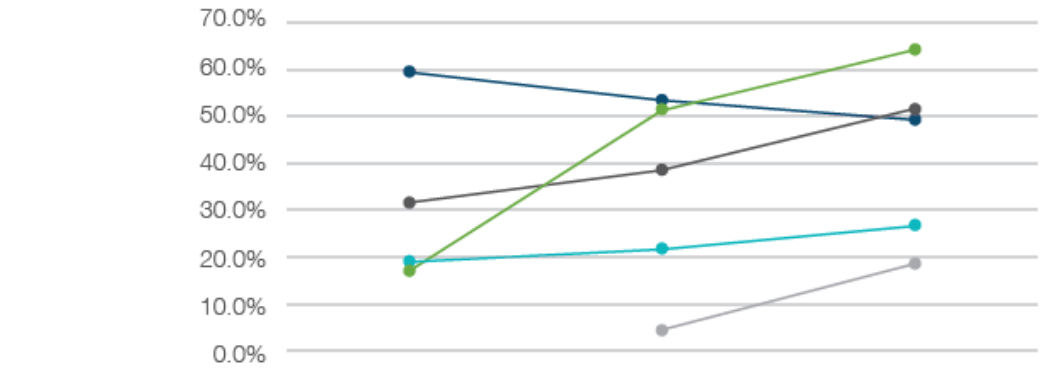
				Growth Per Period		Compound Annual Growth Rate (CAGR) 2014–2018
	2014	2016	2018	Growth 2014–2016	Growth 2016–2018	
Europe	€ 9,885	€ 11,045	€ 12,306	12%	11%	6%
United States	$ 6,572	$ 8,723	$ 11,995	33%	38%	16%
Canada (in CAD)	$ 1,011	$ 1,505	$ 2,132	49%	42%	21%
Australia/New Zealand (in AUD)	$ 203	$ 707	$ 1,033	248%	46%	50%
Japan	¥ 840	¥57,056	¥231,952	6692%	307%	308%

Note: Asset values are expressed in billions. All 2018 assets in this report are as of 12/31/17, except for Japan, whose assets are as of 3/31/18.

Another interesting element coming from the report is visible in Figure 2 (Global Sustainable Investment Alliance, 2018), which highlights the fact that non only sustainable investing grew compared to the previous two years but it also increased in proportion to the total amount of

managed assets in all regions but Europe, however both the Global Sustainable Investment Alliance (2018), and the Eurosif[1] (2018) partially attribute this relative decline in the region is to more rigorous standard and definitions regarding SRI that were introduced during this time frame; another worth mentioning element that is possible to observe is that, as of 2018, in regions such as Canada and Australia/New Zealand responsible investing assets now make up the majority of total assets under professional management.

Figure 2 Proportion of sustainable investing relative to total managed assets 2014-2018



	2014	2016	2018
Europe	58.8%	52.6%	48.8%
United States	17.9%	21.6%	25.7%
Canada	31.3%	37.8%	50.6%
Australia/New Zealand	16.6%	50.6%	63.2%
Japan		3.4%	18.3%

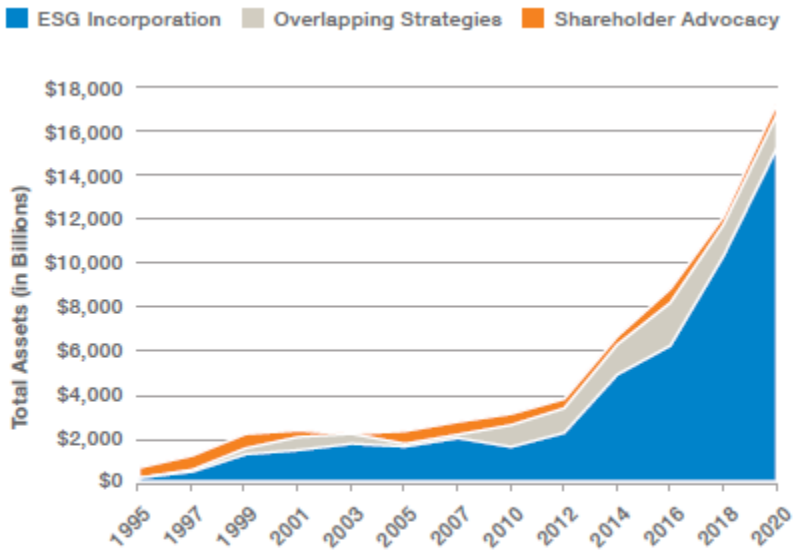
Note: In 2014, data for Japan was combined with the rest of Asia, so this information is not available.

If we want to discuss more recent data we need to focus our attention the US market as the latest reports from the US SIF Foundation[2] (2020) states that, between 2018 and 2020, assets under professional management that adopt some form of sustainable investing strategy grew from $12.0 trillion to $ 17.1 trillion, an increase of 42%, representing roughly one third of the $51.4 assets professionally managed in the United States. This continues the rapid growth that socially responsible investing is having, as shown in Figure 3 (US SIF, 2020), it has increased, in term

[1] European Sustainable Investment Forum
[2] US Forum for Sustainable and Responsible Investment

of billions of dollars invested, by 25 times from 1995 to 2020, with the biggest increase starting to happen after 2012.

Figure 3 Sustainable investing in the US



SOURCE: US SIF Foundation.

One of the leading factors this rise in popularity in the US, is the heighten interest that millennials[3] have shown for sustainable finance. According to a survey conducted in February 2019 among high net worth individual investors, by Morgan Stanley's Institute for Sustainable Investing: 95% of millennials are at least somewhat interested in sustainable investing, with 70% of them reporting a strong interest (MSCI ESG Research, 2020 a). This is in contrast with the general population of which, 85% reported a mild interest, a 10 percentage points increase compared to the previous survey in 2017, and 49% declared to have a strong interest. This is particularly relevant as millennials are the largest generation in US history, representing 80 million of people, and they are set to inherit $30 trillion of wealth (Seelan, 2019); as such, the strong interest by this part of population regarding Sustainable investing may signalize that this sector of finance will continue to grow in the foreseeable future.

[3] As the term millennials, although practical for quickly defining a generation, has an unclear meaning, it seems necessary to point out that throughout this paper it will be used under the same distinction adopted by the Pew Research Center, which classifies as "millennial" every person born between 1981 and 1996 (Dimock, 2019).

This higher focus towards SRI is not observable just in demographic studies, but it is also notable in call to actions coming from companies and institutional investors. One of the more high-profile ones, came last year in a form of an open letter written by Larry Fink, CEO of BlackRock, the largest asset manager company in the world (Ross Sorokin, 2020). In his letter, he addresses to chief executives of the world's largest companies, warning them that a "fundamental reshaping of finance" is coming, driven by a raised awareness by individual investors towards issues such as climate changes and social inequality. He argues that companies should adapt to this shift by increasing their focus when confronting climate change, considering the needs a broad range of stakeholders, and improving their accountability by being more transparent towards investors.

Although Fink's letter is definitely noteworthy, as it was defined by The New York Times as a "watershed" (Ross Sorokin, 2020), is not the sole example of these calls to action, another very relevant one is the Global Investor Statement to Governments on Climate Change (2019), a document, addressed to world governments, signed by 631 investors representing $37 trillion in assets. In the letter investors asks for governments to address climate related issues by focusing on achieving the Paris Agreement's goals, directing investments on low carbon transition for the private sector, and by committing to improve climate-related financial reporting.

The combination of these statements by investors and the increased reported interest by a young and increasingly rich portion of the population, highlight the importance that sustainable finance has and will continue to have on the world's economy, increasing the need for this phenomenon to be studied.

Generally speaking, when talking about sustainable finance and socially responsible investing, it is in reference to one particular method of this investment philosophy: Environmental Social and Governance, or ESG, integration. It is the most well-known approach, as it is the most adopted in the U.S. (US SIF, 2020), and as of 2018 the one that was growing more rapidly both globally (Global Sustainable Investment Alliance, 2018) and in Europe (Eurosif, 2018). However, although in this thesis we deal with the specific of ESG integration, in order to offer a more complete description of the concept and to not give the impression that all that ESG is all of what sustainable finance is, a couple of alternative approaches are also presented.

The first of this alternative practices is screening, namely the practice of deliberately investing or not investing in companies depending on certain criteria. There are three main form of screening: negative or exclusionary, which consists in the systematic exclusion of certain companies than an investors may consider unethical such as alcohol, tobacco, and gambling; positive, which consist in investing in company that an investor may consider particularly ethical according to their own personal ethics; norm-based, systematically investing in either firms or project that comply to specific international norms, issued by entities such as the UN or UNICEF.

Another approach is impact investing of which we report the definitions offered by the Global Sustainable Investment Alliance (2018): "targeted investments aimed at solving social or environmental problems, and including community investing, where capital is specifically directed to traditionally underserved individuals or communities, as well as financing that is provided to businesses with a clear social or environmental purpose". It is however a field of SRI it is mostly relegated as a micro-finance, and is lacking an established marketplace (Hebb, 2013).

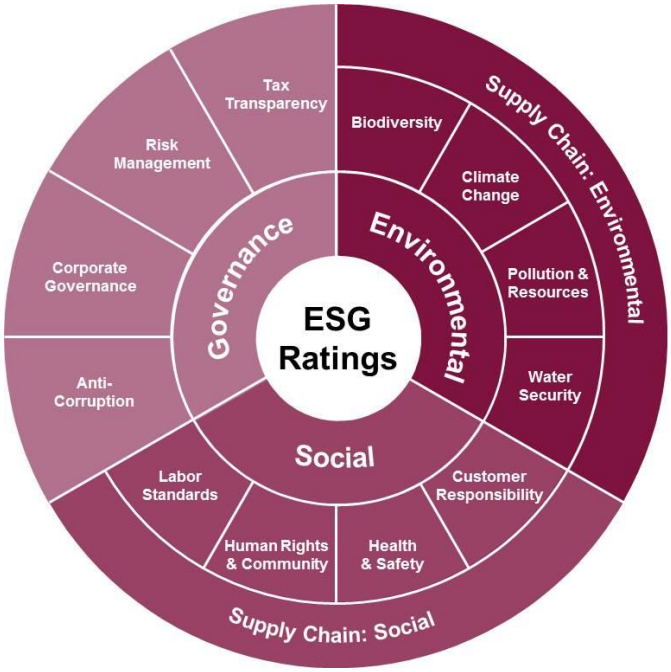
The final alterative that we are going to present is corporate engagement and shareholder action; this is the most direct approach to SRI and clearly not accessible to everybody, it consists in investing in company and shifting their business towards a more sustainable path through direct ad active engagement

As previously mentioned ESG integration is the most popular form of sustainable finance; it consists of systematically associate factors linked to environmental, social, and governance criteria to financial criteria. The reasoning behind this approach stands on the theory that those factors may help investors to identify risks and opportunities that would not emerge through conventional financial analysis. Whether this positive effect on returns is true or not will be discussed in the following chapters, for now let's focus on what those criteria are and how does the integration works.

Each of the three pillars of criteria, visualized in Figure 4 (FTSE Russell, 2021) refers to one particular category of factors that may impact or be impacted by a firm activity. The first are the environmental criteria, mostly related to the type of impact that a firm's business has on the environment, issue that relates to these criteria may be: how much energy does a company

consume, how much waste or pollution it generates, how much of its core business is tied to the consumption of natural resources. The second are social criteria, which measurer the type of impact a company has both towards its employee and the outside world, this includes how a company handles issues such as gender and racial diversity, ad respect for employee's and consumer's rights. Finally, governance criteria are in regard of how a company manages itself, so transparency in its financials statement, and the organization of the management structure are prime examples of factors relevant for this category.

Figure 4 ESG pillars visualized



Observing a company under these principles, not only can help individuals to invest their money in a manner more compatible with their personal ethics, but it may also offer insights regarding the company financial performance. ESG reports are provided by rating agencies, some of the more popular are MSCI, Bloomberg, Thomson Reuters and Sustainalytics. This thesis utilizes the ratings provided by MSCI in their ESG Ratings Corporate Search Tool (MSCI, 2021 a), we will explain how those are derived in the second Chapter.

1.2 Academic Perspective

When discussing sustainable and responsible investing one of the first factor that has to be considered is the Efficient Market Hypothesis, developed by Eugene Fama (1970). Is a theory that states that "asset prices fully reflect all available information", which directly implicate that is impossible for an investor to consistently "beat the market" on a risk adjusted basis, as prices should adjust to new information.

Consequently, if the financial markets are efficient, and any cost of benefits are already priced in, then SRI is just a form of constrained optimization, that would yield investors lower risk-adjusted returns because it would mean to reduce the opportunity set. At least one study seems to prove that this is what happens with impact investing; as previously mentioned, impact investing refers to a particular field of SRI where an investor actively seeks assets that have some form of a positive effect outside of the financial aspect. It is a form of investing that is considered very arduous if not outright impossible to study in the public market (Servaes, 2020) but that it was analysed in the venture capital field; a piece of research published by Barber, Morse, and Yasuda (2021) observed the returns earned by impact investing venture capitalist and compare those to regular investing venture capitalist. The period observed goes from 1995 to 2014, and they observe 4659 venture capital funds, 159 of which are impact investing funds; what they observe is that "that ex- post financial returns earned by impact funds are 4.7 ppts lower than those earned by traditional VC funds", thus proving that this type of SRI constitutes a form of constrained optimization. They also observe that, on average, impact investors are willing to accept internal rate of returns from 2.5 to 3.7 ppts lower than what they could have earned by investing in non-impact funds, meaning that those investors are willing to pay for "nonpecuniary characteristics of investments".

However, the efficient market hypothesis has been criticized for a long time both by professionals such as Warren Buffet, who in a famous, albeit ironic, quote linked his success to the inefficiency of the financial market (Rattner, 2013), and by academics, such as Burton Malkiel, and Robert Shiller. Writes Malkiel (2003): "by the start of the twenty-first century, the intellectual dominance of the efficient market hypothesis had become far less universal". As he points out in his paper "The Efficient Market Hypothesis and Its Critics", is possible to observe

numerous pricing irregularities, and patters such as days of the week, months, or size, caused by the fact that some of the people who partake in the stock market are, as Malkiel defines them, "less than rational". Robert Shiller also emphasize the presence of psychological and behavioural patterns in the stock market and links those to the formation of speculative bubbles. He states that "less than-perfectly-rational" behaviour, even among professional, are common in the financial market and the results of those can be observed during bubbles with a "feedback mechanism from price change to further price change" (Shiller, 2002).

1.2.1 Market Inefficiencies

In a similar way to how, despite how popular it is, the Efficient Market Hypothesis can be challenged; the idea that all investors that engage in sustainable finance are a monolithic group, that do so just because of their morals values, while, as previously discussed, is not without merit, is equally flawed. In fact, as pointed out by Derwall et al in "The Eco-Efficiency Premium Puzzle" (2005), certain investors approach SRI while still conforming with the traditional goal of maximizing wealth. Those investors, subscribing to the theory that markets are inefficient, adopt sustaianble measures in their investing strategies to exploit possible inefficiencies. In this paragraph some of those market inefficiencies will be presented, and it will be discussed how is possible to utilize SRI to take advantage of those.

The first possible inefficiency exploitable by this line of thinking is short-termism: the practice of putting an excessive focus on short-term results at the expense of the long-term interests of a company's stakeholder. The market may overvalue companies that consistently favours short-term profits while it undervalues the ones with an approach that is more long-term minded, and, since a lot of CSR practices and efforts in the ESG fields may yield results only in the long run, SRI can be an effective way to exploit this inefficiency. A study published in 2014 (Eccles, Ioannou, Serafeim , 2014), observed the performance of 180 US companies from 1993 to 2010; those were divided into 2 groups of 90 companies each: the ones that showed a "substantial number of environmental and social policies adopted for a significant number of years" were identified as "High Sustainability", while the ones that did not adopt any of those practices were categorized as "Low Sustainability" companies. Those two sets of companies were compared according to their performance in the stock market and the results showed that the High

Sustainability companies outperformed the abnormal annual returns by 4.8% on a value weighted base and by 2.3% on an equal weighted base. Additionally, this outperformance can also be observed when considering accounting rates of return, particularly for companies that either: sells directly to consumers, compete or a brand reputation basis, and those that depend on a substantial use of natural resources. Moreover the study found differences also in the people that invest in High sustainability company: they appear to be more interested in long-term gains than those who don't, creating thus, a positive loop where the company, in order to appease its investors is incentivized to: consider more stakeholders, to measure, and to disclose nonfinancial and ESG data and to not focus excessively on short term results.

Another possible inefficiency that may be exploitable by SRI is the fact that CSR practices may create an intangible asset that the market may not fully appreciate. In 2011, University of Pennsylvania's professors Alex Edmans published a study aimed to explore the impact that employee's satisfaction has on long-run stock returns; he argues that employee's satisfaction is an under-appreciated, therefore mispriced, characteristics of a firm, similar to what investment in R&D, advertisement, patent citations, and software development used to be, with the added difficulty that "satisfaction" is an intangible asset therefore harder to measure. As a main source for data he used the "100 Best Companies to Work for in America" list published by Forbes magazine; the list was released for the first time in March of 1984, updated once in February of 1993, and became an annual fixture of the magazine, being updated every January, from 1998 onwards. Edmans believed that the Forbes' list could be a good starting point for his research because: it is hard to manipulate compared to alternative rankings as it is based on a "grass-roots" analysis, it offered the longer time frame (26 years), and it is widely known and publicly available thus broaden the scope of interests of the paper. For the analysis he observed the performance of a portfolio composed by the companies present in the list, modifying the components over time accordingly; the results showed that, the portfolio, from 1984 to 2009, earned an annual four-factor alpha of 3.5%, and 2.1% above industry benchmarks, if the stocks were value-weighted, and 3.72% and 2.4%, if they were equally weighted. This results showed that employee satisfaction does, in fact, provides financial benefits to the firms, Edmans adds some hypothesis on where those benefits may come from: firstly satisfied employee may perform better in the workplace, rewarding the company for their treatment; secondly employee retention

and the recruitment of highly desirable worker are both higher since more people want to work for the firm; finally consumer may reward firms that treats workers fairly.

The last possible inefficiency that is possible to exploit to gain an advantage by SRI is observable in the case of surprises, or tail events, such as the global financial crisis of 2008. Analysed by Lins, Servaes and Tamayo in the paper "Social Capital, Trust, and Firm Performance: The Value of Corporate Social Responsibility during the Financial Crisis" (2017) this theory stands on the assumption that in situations where there is a breakdown of trust between consumers, companies, markets, and institutions, firms with established CSR practices enjoy a benefit thanks to the social capital that they build before the breakdown. The authors tracked the performance of 1673 nonfinancial firm from August 2008 to March 2009, taking the CSR data from the MSCI ESG database, and they found out that, during the crisis, companies with high social capital had stock returns that were 4 to 7 percentage points higher than those with low social capital, and that the overall performance of the stock improved with the ESG rating: meaning that even investing in a company in the second to worst quartile (so still below average), would still grants some benefits over investing in companies with the lowest social capital. Furthermore, they observe the firms in the top quartile outperformed the ones in the lower quartile also in operating return on assets, gross margin, sales growth and sales per employee. One point of particular interest observed by this paper, is the fact that: while the CSR outperformance does not persist during normal times, indicating that usually social capital benefits are already priced in, "the lack of a reversal in returns in the post-crisis period suggests that being trustworthy has remained important".

1.2.2 ESG specific literature review

So far, the papers presented dealt with SRI in the general sense and on what advantages can be gained by adopting this type of investing, but not with the specifics of ESG integration, which is the field that this thesis is focused on. Even the one from Lins, Servaes, and Tamayo, which adopted ESG metrics, did not explore themes related to portfolio construction. Therefore, the pieces of research that will be presented in this section all deal on the specificities of ESG investing, and a particular care will be put in illustrating the decisions made around the formation of the portfolios analysed. Also, before starting to discuss the individual papers, it seems

necessary to point out that, although it will not be directly cited, the literature review by Søren Hvidkjær (2017) was used as a source when researching for this section, especially for contextualize the articles in the academic literature.

The first piece of research presented comes from Kempf and Osthoff (2007) and it is titled: "The Effect of Socially Responsible Investing on Portfolio Performance". This study was made when the general opinion was still that SRI was mostly a moral decision, that would entail some financial trade-off on the side of the investors. Additionally, at time, most studies were conducted on mutual funds, comparing the performance of funds that adopted socially responsible strategies to those that did not. The authors criticize this approach in the paper as they states that, the performance of those funds is too critically linked to the ability of the people who manage them, so a study that focus on them does not accurately represent the validity of SRI. Kempf and Osthoff constructed their analysis utilizing the ESG database from KLD Research & Analytics[4], which was the first provider for such ratings starting from 1990. With this data they formed long-only and long-short portfolio (holding high ESG while selling the ones with low ESG), adopting different positive, and negative screening; the portfolios were constituted by taking the top and bottom 10% of all the available stocks, in addition, in order to avoid any bias towards any particular industry, a different set of positive screened portfolios were created utilizing the best in class approach , which is a form of screening where instead of excluding all companies from one particularly controversial field, such as tobacco, the investors selects the company that sustainability-wise perform better relatively to their competitors. The majority of the analysis was conducted utilizing value weighted portfolios, but in order to observe if the results were sensitive to that portfolio weighting scheme, the analysis was repeated on equally weighted portfolios as well. All portfolios were rebalanced every year in December, when KLD updated its ratings, and their performance was observed from 1992 to 2004. The Carhart's four factor model was adopted to compare the performance of all the portfolios, the results showed that: not only there was not a financial trade-off in SRI, but that investors could earn "remarkable high abnormal returns" implementing either the positive screen, or the best in class approach, with most of the portfolios having a significantly positive 4-factor alphas of around 5% per year. The

[4] Now MSCI

best results were reached by adopting the best in class approach in conjunction with several SRI screens, leading to abnormal returns up to 8.7% per year.

The results from Kempf and Osthoff's study were overall confirmed by Statman and Glushkov in their paper "The wages of social responsibility" (2009). They adopt a mostly similar approach to Kempf and Osthoff's research by utilizing the same dataset for ESG score, KLD, and adopting the best in class approach in the formation of the portfolios, and rebalancing each December, but instead of focusing the majority of the analysis on value weighted portfolios they weight the stocks equally. Other differences in the studies comes from the facts that that Statman and Glushkov in addition to Carhart four factor model they also use the CAPM and Fama French model to compare portfolios'' performances, also the observed period is longer going from 1992 to 2007. As previously said the results shows that high sustainability companies outperformed the low sustainability ones; this type of results aligned with the majority of literature at the time, with other papers, such as the ones from Derwall et al (2005), Galema et al (2008), and Edmans (2011), obtained results indicating that, between the 1990s and the first half of the 2000s, there was a financial benefit in integrating sustainable measures into financial decisions. However subsequent pieces of research argue that this outperformance, was a product of market underreaction, that disappeared after the initial sample period observed by those papers.

The first article that will be reviewed in this thesis that follows this line of reasoning is "Stakeholder relations and stock returns: On errors in investors' expectations and learning" from Borgers, Derwall, Koedijk and ter Horst (2013). The research handles the portfolio formation process in a manner that, although not unprecedented[5], can still be described as unconventional, especially if compared to the rest of the literature reviewed for this thesis: in fact, while the main source for sustainable data is still KLD, the authors rearrange it, in order to create an aggregate stakeholder relations index. They form this index by taking each year the individual scores for each relevant issue, then sum the ones that are considered strengths, subtract those that are considered weakness, while ignoring all indicators of human rights issues, as they do not believe they were covered with enough consistency. Starting from this index, they construct their portfolios, using different ESG screening, adopting both long only, and long-short strategies and

[5] The authors cite the works of Jiao (2010) and Hong and Kostovetsky (2012) as inspiration

balancing the stocks both on an equal and a value weight basis. The observed time frame goes from 1992 to 2009, and, to compare performance they use the Carhart four factor model; the results that they obtain show a that responsible stocks "generated risk-adjusted returns that were economically and statistically significant over the period 1992–2004, but that were largely non-significant over the period 2004–2009".

Similar conclusions are achievable even by adopting a more conventional approach to the research, such as the case with "The wages of social responsibility – where are they? A critical review of ESG investing" by Halbritter and Dorfleitner (2015). Portfolios are created in a similar fashion to Kempf and Osthoff, and Statman and Glushkov: the stocks are ranked according to their rating from the previous year, and then they are divided into equally weighted and marked cap weighted portfolios according to their score. A crucial differentiating factor between this research and the ones previously presented is the fact that multiple ESG data provider are adopted, which are KLD, Bloomberg and ASSET4[6], consequently the time frames observed varies as Blomberg and ASSET4 cover shorter time periods. The authors conclude that "ESG portfolios do not show significant return differences", this happens regardless of weighting or screening approach adopted, and both if the overall score or a particular ESG aspect is used when constructing the portfolio. When the analysis is conducted under the Carhart four factor model the dataset adopted also does not affect the results: the portfolios and their respective performance are different from one another, as each data provider rates companies in a slightly different manner, and the companies rated may not be the same, nonetheless ESG ratings do not affect future performance. However, if the Fama and MacBeth regression is used some ESG variables from the Bloomberg and ASSET4 databases, show an "ambiguous significant influence", that said, their analysis is an unable to explain where and how this difference of results is originated. Moreover, the authors do not identify any systematic pattern concerning this variable, and their significance appears to be decreasing over time.

The results of this two papers indicates that, while ethical indicators such as ESG could be used as a good predictor for future performance up until the mid to late 2000s, the market appears to have adapted around that time, integrating the intangibles that were measured by those indicators

[6] Now Thompson Reuters

in the price of the stock. However as pointed out by Friede, Bush, and Bassen (2015) the overwhelming majority of empirical studies on the subject find some sort of positive relation between ESG and financial performance, and this is observed even by more recent pieces of research such as the works of: Verheyden et al (2016), Limkriangkrai et al (2017), Velte (2017), and Maiti (2020).

In this thesis we will focus our research on the effectiveness of ESG ratings in more recent years, with a particular care put on the 2020 stock market crash; several pieces of research that observe this particular time frame have already and are still being published during the time of our writing, the majority of them, so far, reports some type of positive effect offered by ESG rating. Starting from the practitioners' point of view, Blackrock reported better risk-adjusted performance across all of its sustainable investment products during 2020 (Blackrock, 2021), Morningstar stated that last year 24 out of its 26 sustainable index funds outperformed their conventional version (Hale, 2020). This thesis ESG rating's provider, MSCI reported that all four of its ESG focused indexes outperformed their traditional counterparts (Giese and Nagy, 2020). From the academic perspective, examples of pieces of research that reports positive relations between sustainability and financial performance during the crisis are: the work from Ferriani and Natali (2020), who reported the outperformance during the first half of 2020 for companies that are highly rated under the Morningstar's ESG risk indicators, and the paper from Broadstock et al (2021), who focused their research on the Chinese market and report that that ESG performance was positively associated with the short-term cumulative returns around the COVID-19 crisis. However, we do not want to give the impression that a consensus around this topic has already being reached as the majority of research is yet to be published, moreover papers that dispute the outperformance of sustainable companies during the COVID-19 crisis already exist, a such as the work from Folger-Laronde et al (2020), who centred their research on the performance of ETFs during the first quarter of the 2020 and reported that "higher levels of the sustainability performance of ETFs do not safeguard investments from financial losses during a severe market downturn"; a second example, which more closely resembles our thesis, as it analyses stocks and uses, among others, the MSCI ESG database, is the work from Demers

et al (2021)[7], in which the authors report that it may be erroneous to state that the better performance that certain companies had during the crisis was due to better ESG practices but that could be better explained by investments in internally generated intangible assets, not necessarily ESG related.

With this discussion on the latest pieces of research published, we conclude our literature review, and this chapter dedicated to contextualize our work; in the next one we will reiterate on some of concepts that we presented during the hypothesis development, and how the particular set of ratings that we use as our basis are constructed will be the main topics of the following chapter.

[7] As the time of this writing, this paper has not yet been published nor peer reviewed, however it was accepted for publication by the Journal of Business Finance & Accounting in March 2021

2. Research Questions and Data Presentation

This chapter begins by discussing the hypothesis formulation of the thesis; in that section, we will reiterate one some of themes and ideas discussed in the previous chapter's literature review in order to point out how those have influenced the structure of this thesis; the aim of that paragraph will be to explain what we want to analyse this thesis analyses and what kind of results we expect. Afterward we will present the different ESG rating agencies, discussing how those derive their scores; a particular care will be put into describe MSCI's methodology, as it is the data provider adopted for this thesis. That section will also deal with the reasons behind the choices of both the database and the stocks analysed. Finally, the chapter concludes by highlighting some of the limitations of the work by pointing out some factors that will be just acknowledged, but not discussed, as they go beyond the scope of this research.

2.1 Research Questions

The previous chapter worked as an introduction on what is sustainable finance is; it did so by highlighting its popularity, by discussing on what concept it is based on, and by presenting an excursus of the academic discourse around the subject. Although it was neither exhaustive nor comprehensive of all the facets that from this field of finance (as a work of that magnitude would require a thesis by itself) it still offered a glimpse of the scope of this subject. Throughout this introduction some two key elements emerged as crucial, on which will be constructed the analysis of this thesis:

1. Rising popularity of sustainable investing is mostly driven by the integration of ESG metrics into financial decisions, consequently, that is the field that merit the most scrutiny.

2. Not all of those who adopt ESG strategies do so just because of their moral values; ESG investing can be a valuable strategy even for profit only minded investors as it may be an effective avenue to exploit market's inefficiencies. In order to entertain this line of reasoning without preconceptions, some traditional investing principles such as the efficient market hypothesis must be ignored.

With these concepts in mind, we can start formulating the first hypothesis. The main question surrounding ESG ratings is still whether they offer any financial benefits to investors or not; as we discussed in the literature review, a trend that emerged by observing past studies is that sustainable metrics proved to be beneficial during the 1990s and the first half of the 2000s, and that this benefit seemingly disappeared around 2004 (Borgers et al, 2013) presumably because the market adapted, this appeared to be true up until around 2012. In this thesis we focus our analysis on more recent years (from 2016 to 2020), while studies closer to this time frame exists, it is still too early to observe major communalities between those, however some factors are present that make it possible to expect certain results. The majority of literature about ESG investing finds some sort of positive relation between sustainable metrics and returns (Friede et al, 2015), and even in the cases where such positive relation was not found (Borgers et al, 2013 and Halbritter and Dorfleitner, 2015), ESG scores have not lead to underperformance. That said recent literature has not yet reached a consensus on the last year which coincides with the start of the COVID 19 global pandemic and the financial crash associated with the event; in fact, while the majority of the papers that we consulted pointed towards a positive relation (e.g. Hale, 2020; Giese and Nagy, 2020; Ferriani and Natali, 2020), some divergent opinions exists such as Demers et al (2021) that attributes the better performance of sustainable stocks to intangible assets not necessarily linked to ESG. However, considering the results of the majority of the empirical literature that we reviewed and in particular, the work from Lins Sevares and Tamanyo (2017) that point to overperformance during tail events as a possible way where SRI may create value we expect to find some benefit in ESG integration during our observed time frame. All this considered, we can formulate the first hypothesis as follows:

ESG metrics offered investors some measurable performance benefit during this period.

The second hypothesis is derivative of the first one but deals more with the specifics of the database observed. In all of the papers that we read during the research for this thesis the authors divided the stock present in the ESG databases observed according to arbitrary cut off points (usually around 20% or 25%), and in the majority of the papers only the top and the bottom performers were observed[8]. However an interesting aspect that may be worth exploring is if there

[8] This was mostly because the databases were massive with thousands of companies rated. This point will be further examined when discussing the selection of the stocks

are any notable changes in performance at every rating, formulating an hypothesis on this aspect may appear complex but the work from Lins Servaes and Tamayo (2017) may serve as an indicator to type of results that we can expect. In fact, in their analysis, there were noticeable improvement in financial performance for every quartile of ESG rating; considering that their work is based on a very similar database[9], and that they also observed the performance during a financial crisis, it is not unreasonable to assume that the results will be similar. Consequently, the second hypothesis can be written as:

Noticeable performance improvements are visible for every ESG rating

Presenting the methodology adopted to verify these hypothesis will be the main topic of the following chapter, additionally we will explore two more questions in this thesis, namely if the possible benefits offered by ESG metrics are enhanced when some principles of portfolio optimization from Markowitz Modern Portfolio Theory (1952) are introduced, and whether or not is possible to compare ESG metrics to more traditional financial measures. However, expecting a certain type of results for those would be pure guesswork because, out of the ones that we analysed when researching for this thesis, not enough papers dealt about the subject, thus we will not formulate any hypothesis.

2.2 Data Presentation

In this section we will present the ESG database and stocks that we will analyse in this thesis. The section is structured as follows: first the major ESG rating agencies will be presented together with the findings of some papers that compare the different agencies methodologies; then the processes that MSCI, this thesis provider, adopts in order to derive its ratings will be described in detail. We will conclude this section with a paragraph explaining the reasons behind the stock selection. The data will be presented in this order because some factor that will be discussed when presenting the ESG ratings were influential when selecting which stocks to analyse.

[9] MSCI, this thesis' database provider, acquired RiskMetrics, owner of KLD Research & Analytics in 2010 (Corderio and Kotoky, 2010)

2.2.1 ESG Rating agencies

ESG providers are companies that offer investors reports that evaluate the performance of firms under ethical lenses; some of the most prominent providers of are: MSCI, Thompson Reuters, Bloomberg, Standard and Poor, and Sustainalitics. While, at their core, all of these companies offer a similar service, and the broader principles under which they derive their data more often than not align, several studies have reported that scores between different provider not always correlate with each other. For example, Dorfleitner, Halbritter and Nguyen (2015) confront three of the major providers, namely KLD, ASSET4[10], and Bloomberg, the results shows an "evident lack in the convergence of ESG measurement"; similar conclusions are reached by Semenova and Hassel (2015) in a paper focused on the environmental measures, while they notes some points of commonalities when comparing KLD with ASSET4, "on aggregate they do not converge"

This divergence in ratings is mostly due to the fact that while the goal of all agencies is the same, the methodology that each adopts varies greatly. A particularly relevant perspective on the matter can be gained by reading the work of Berg, Kölbel and Rigobon (2020): they compare six different providers and they highlights that "the correlations between the ratings are on average 0.54, and range from 0.38 to 0.71". They go deeper on the matter trying to find a source for this divergence, and they identify three possible ones: first scope divergence, referring to when two agencies may base their rating on different sets of attributes, the example that they offer is the fact that not always evaluating lobbying activities tend to be part of the rating process; second measurement divergence, these can refer both when two agency rate the same attribute under different indicators and when they use different sources for a particular set of attributes; finally weights divergence which refers to when agencies assign different importance to the same attributes when evaluating a company. Taking into consideration these three points of divergence they report that "measurement divergence explains more than 50 percent of the overall divergence while Scope and weight divergence together are slightly less important".

[10] The KLD database is now integrated into the MSCI one, while ASSET4 is integrated into the Thompson Reuters

Overall the general sentiment that can be gauged by reading the conclusion of these papers is that while a "level of subjectivity is inevitable" (Rogers, 2013), there is a need for more uniformity in ESG ratings as the lack of it may lead to the creation of "different investment universes" and benchmarks (Billio et al, 2021). However, while it felt important to highlight the difference between the rating agencies, these themes will not be explored further during this thesis, as the bulk of the analysis will be structured on a single provider, MSCI.

2.2.2 MSCI ratings

Morgan Stanley Capital International, more often referred with the acronym MSCI, is an investment research firm mostly known for its benchmark indexes, and for being a provider of portfolio risk and performance analytics such as ESG ratings. It is considered one of the pioneers in the field calming to possess, in conjunction with its legacy companies KLD, Innovest, IRRC, and GMI Ratings, more than 40 years of experience and to be the first provider to measure exposure of companies to ESG risks and embedding it in their score (MSCI, 2020). In this paragraph we will offer an overview on the process that MSCI uses to derive its rating, all the sources utilized in this paragraph come from MSCI itself. The quantity and quality of the resources regarding ESG that MSCI offers publicly, without the need to buy any subscription or to be an institutional investors, was actually one of the deciding factors when selecting a database on which to base the research, as, following a line of thinking similar to that of Edmans (2011), working on publicly available data can potentially broaden the scope of interest of the paper, considering that despite its rising popularity ESG investing can still be considered a niche.

As is reported in the Rating Methodology executive summary published last December, MSCI ESG ratings are model to answer four key questions (MSCI ESG Research, 2020 b):

1. What are the most significant ESG risks and opportunities facing a company and its industry?
2. How exposed is the company to those key risks and/or opportunities?
3. How well is the company managing key risks and opportunities?

4. What is the overall picture for the company and how does it compare to its global industry peers?

The whole process focuses around the identification of ESG risks and opportunities that a company may face, those can be posed both by large scale trends such as Climate Change, or by industry specific factors. Only the issues that are considered "material" are taken into account when constructing the rating, meaning risks that can lead to substantial losses, or opportunities that a company could capitalize on. MSCI identifies those material issues, for each industry through a "quantitative model that looks at ranges and average values for each industry for externalized impacts such as carbon intensity, water intensity, and injury rates" (MSCI ESG Research, 2020 b). Exception for this rule exists, in fact some companies may have particularly peculiar business model in relation to the rest of their industries that they may be rated on either fewer or more issues. As of November 2020 MSCI, identifies 35 of these issues, which are referred to as "Key", in Figure 5 (MSCI ESG Research, 2020 b) is possible to see what they are and how the relate to the ESG principles.

Figure 5 Key Issue Hierarchy

3 Pillars	10 Themes	35 ESG Key Issues	
Environment	Climate Change	Carbon Emissions Product Carbon Footprint	Financing Environmental Impact Climate Change Vulnerability
	Natural Capital	Water Stress Biodiversity & Land Use	Raw Material Sourcing
	Pollution & Waste	Toxic Emissions & Waste Packaging Material & Waste	Electronic Waste
	Environmental Opportunities	Opportunities in Clean Tech Opportunities in Green Building	Opportunities in Renewable Energy
Social	Human Capital	Labor Management Health & Safety	Human Capital Development Supply Chain Labor Standards
	Product Liability	Product Safety & Quality Chemical Safety Financial Product Safety	Privacy & Data Security Responsible Investment Health & Demographic Risk
	Stakeholder Opposition	Controversial Sourcing Community Relations	
	Social Opportunities	Access to Communications Access to Finance	Access to Health Care Opportunities in Nutrition & Health
Governance*	Corporate Governance	Ownership & Control Board	Pay Accounting
	Corporate Behavior	Business Ethics Tax Transparency	

** The Governance Pillar carries weight in the ESG Rating model for all companies.*

MSCI ESG Ratings are not an absolute evaluation, but they should be seen as an industry level comparison[11]: the final score, which ranges on a seven step scale that goes from CCC to AAA, it is derived by doing the weighted average of the grades for each individual Key Issue normalized relative to industry peers. As previously said, the issues on which the score is constructed varies depending on industry and sub industry, classified under the GICS[12], on Table 1 we offer a breakdown on how much the Environmental Social and Governance pillar are weighted for each individual sector (MSCI 2021b)[13]. However, while the key issues observe, and how much are they weighted varies, the principles underneath the weighting decisions stay the same across all industries; typically non company specific issues make up between 5% and 30% of the final score, they are weighted more or less heavily depending on the expected time frame that the risk/opportunity has to materialize, and depending on the level of contribution to environmental or social impact: the higher the impact and the shorter the frame, the heavier the issue is going to be weighted. The Governance pillar is the only one that is considered for every rating and, starting from November 2020, the minimum value that can be assigned to the pillar as a whole is of 33% .

Table 1 Pillars weighting for each sector

	Enviromental	Social	Governance
Communication Services	5,10%	50,50%	44,40%
Consumer Discretionary	19,00%	43,30%	37,70%
Consumer Staples	31,50%	34,90%	33,60%
Energy	42,90%	23,10%	34,00%
Financials	10,70%	52,60%	36,70%
Health Care	7,50%	53,90%	38,60%
Industrials	28,20%	26,10%	45,70%
Information Technology	16,20%	44,30%	39,50%
Materials	45,30%	21,60%	33,10%
Real Estate	30,20%	26,80%	43,00%
Utilities	48,95%	15,75%	35,30%

[11] This approach while not universal is not exclusive to MSCI as even Thompson Reuters scores are constructed in this manner (Thompson Reuters, 2018)
[12] Global Industry Classification Standard, an industry classification method developed by MSCI and Standard and Poor's
[13] Data subject to change, the one shown in this paper were retrieved in February 2021.

As for how MSCI derives the information on which to base the ratings, three avenues of sources are listed:

1. Company reported information: self-disclosure that aligns with one of the four major corporate sustainability disclosure frameworks[14]; corporate governance disclosure, a range of government data collected from "annual filings, proxy filings, and annual meeting vote results" (MSCI, 2021c); non ESG related self-disclosure, is a set of information that varies greatly from company to company, it includes any form of data that is not included in the first two categories.
2. Information from other sources: any type of reporting regarding a company that does not come from within so: NGO, academia, government database, and intragovernmental institutions
3. Company characteristics: the least standardized set of data, mostly focused on contextualize the company business among its competition and the geographic area that affects.

Each company rating is reviewed at least once a year however companies are systematically monitored in the case of particularly significant events.

2.2.3 Selection of the stocks

For this thesis we use as bases for our analysis stocks from the S&P 500, there are three main reasons on why we landed on that particular group of stocks that we hereby present.

First the popularity of index and of its constituents was surely a factor, as one of the objective of this thesis is attempt to demystify the world that is ESG finance, adopting a set of stocks that is often used as a barometer for the US financial market seemed an apt choice. Also we wanted to operate with a defined, yet well diversified, group of stocks so that our observed sample would not have been too massive, forcing us to focus our analysis just on a portion of it, such as was

[14] Standardized guidelines that a company can adopt to do disclose ESG information, the four that MSCI lists as major are: Sustainability Accounting Standards Board (SASB), the Global Reporting Initiative (GRI), Task Force on Climate-Related Financial Disclosures (TCFD), and the CDP (MSCI ESG Research, 2020 b).

the case for Kempf and Osthoff (2007), while still been meaningful enough to allow us to make relevant observations.

Finally, this selection helped to circumvent one complication that may arise when comparing performance of stocks with different ESG ratings, namely the positive correlation between ESG scores and company's size (Drempetic, Klein and Zwergel, 2019). The theory behind this concept stands on the assumption that bigger firms tend to adopt better Corporate Social Responsibility practices and are able to allocate higher budgets to ESG reporting, all factors that tend to positively influence their ESG ratings. Although the study by Drempetic, Klein and Zwergel is based on the ASSET4 database, and the authors themselves state that they can't, nor want, generalize their results, it is still fair to assume that a similar firm size bias may exists even in different ESG scoring systems; therefore by using as sample only stocks that are constituents of the S&P 500, issues that may skew the results, such as a period when bigger firms outperforms smaller one in the financial market, are largely avoided.

To retrieve historical financial data for our research we use the function "getSymbols" from the package quantmod (Ryan et al, 2020) of R, which draws them directly from the Yahoo Finance database

2.3 Limitations of the work

In the following chapter we will present the methodology that we adopted during the portfolio formation process and the metrics on which we based our comparison; however, before we delve into that we want to conclude this chapter, and the introductory portion of this thesis, by making some clarifications that we deem to be necessary as we highlight some of the limitations of this work.

As previously mentioned, one of the most common critique to ESG rating is that there is a positive correlation between the size of a company and its rating, putting into question the validity of the system as a whole. Issues such as this, although considered, are not analysed in this thesis: the ratings are taken as provided and their accuracy is not put into question

When dealing with themes such as environment or sustainability, it may be reasonable to assume that some sort of bias, guided by a sense of morality or by personal values, may be involved, and for some it could be even consider wrong not to do so. That said, is important to reiterate that this thesis studies ESG rating only from a purely financial perspective, and every comment that we will make pro or against this type of rating system is just in relation to their validity as financial indicator.

This thesis is an observation on this particular set of stocks in this particular timeframe, rated according MSCI rating system. Although it may be possible that the results of this thesis may hold up even in different circumstances, it is impossible to make such a claim in good conscience without before testing its validity.

Since we wanted to operate with publicly accessible data, we used as a source for the ESG ratings, MSCI's ESG Ratings Corporate Search Tool (MSCI, 2021 a), as the earliest available rating through the tool is from 2016 that is also how far back as this analysis is able to go; it would have been interesting to analyse a larger time frame, but it was impossible with the data at hand.

3. Portfolio Formation and performance benchmarks

The main focus of this chapter is to describe how we conducted the analysis, it is divided in two parts. First we discuss the methodology and the reasoning we adopted to construct the portfolios observed, in this section we also highlight a couple of questions that are explored in the thesis, that came up when constructing the portfolios, on which it was impossible to formulate hypothesis. The section that follows is a presentation of the performance benchmarks that we selected to confront the portfolios' performances, the theory behind those will be briefly reviewed and the motivations that lead us to the choice of those particular models will be illustrated.

3.1 Portfolio Formation

As we explained in the hypothesis formulation paragraph in the previous chapter there are two major themes that this thesis is trying to explore: whether ESG metrics offer investors financial insight, and whether these are noticeable changes at every rating. In order to explore those the analysis will be divided into two parts, with the major differentiating factor between those being the portfolios' formation process; in fact, while in both sections the portfolios will be formed based on ESG scores, following an approach similar to the empirical literature reviewed in the first chapter, elements such as holding periods, rebalance, division of the stock and even stock observed will change. For this reason, the two approach will be presented in two separate paragraphs. One point of communality between both approach is the timeframe observed which goes from 01-11-2016 to 01-11-2020, the reason why those particular date were selected will be better explained when discussing the second approach, however it has to do with the fact that November is when MSCI re-evaluates the key issues on which the scores are assigned.

3.1.1 Portfolio Formation: Ex Post

For the first part of the analysis the approach that we selected shared some similarities and some differences with the ones that were used in the literature reviewed in this thesis; the first, and probably major point of differentiation is the choice to not divide stock not according to their

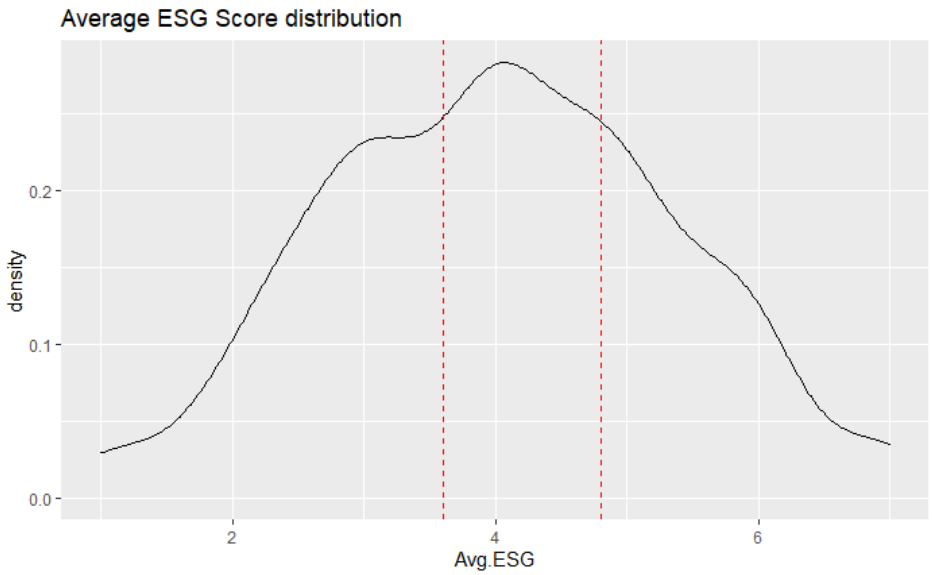
rating each year but according to their average score throughout the all period observed. This decision was made primarily for two reasons, eliminating the need for rebalancing and assessing the continued effectiveness of the MSCI ESG rating as an indicator for financial performance, allowing some fluctuation. Consequence of the fact that there is no rebalancing and that averages are being used it was imperative that all the stocks were already existing in 2016 and that their ESG score was available thru MSCI's ESG Ratings Corporate Search Tool for each year; out of the 505tickers that compose the S&P 500, 463 met both of this conditions, those will constitute the observed sample for this portion of the analysis. One advantage to operate with a number of stock that, while large enough to constitute a good sample, is not too massive, is that not just the top and bottom ESG performers will observed, as it was the case with a lot of the empirical literature reviewed, but every single stock will be part of the analysis.

Since MSCI assigns its final scores in the form of letters, ranging from CCC to AAA, we assigned a numerical value, from 1 to 7, to each rating in order to calculate the average. Considering that the main focus of this part of the analysis is to gauge if there are any positive relations between sustainability and financial performance it was decided to divide the stocks in three portfolios, so that each of them would still be fairly large and well diversified while still representing a distinguished level of sustainability. One complication that came up, as a consequence of working with averages, is the fact that several companies shared the same average value, and that it was impossible to divide the sample into thirds without separating stocks with the same score. We considered several options such as ranking higher companies that improved their sustainability during this time frame, or taking into account the size bias brought up by Drempetic et al (2020) however both of this solutions would have introduced additional variables to the analysis and would have required to make assumptions without a very strong theoretical base[15]. In the end we decided to accept the inevitability that the portfolios would have slightly different dimensions, and to divide them by adopting some firm cut-off points. The ones selected had to allow the creation of three portfolios of similar dimensions and with a defined range of sustainability. In the end it was decided that the stocks the companies

[15]The concept of size bias was already brought up in the previous chapter. Regarding the positive effect of "sustainable momentum" not enough information was found during the research process to form an idea about the subject; to the best of our knowledge it appears to be a field of sustainable finance yet to be explored.

that had an average ESG score up to 3.4 would constitute the "Worst ESG" portfolio, the ones from 3.6 to 4.6 the "Medium ESG" portfolio, and those from 4.8 upwards "Best ESG" portfolio; in Figure 6 is possible to observe the distribution of the averages scores, and the cut off points. Since we wanted to add the least possible amount of bias to the analysis all portfolios adopt a long only strategy and the stocks are equally weighted; both of these choices were made in an attempt to follow the approach the majority of the empirical literature reviewed.

Figure 6 distribution of the Average ESG

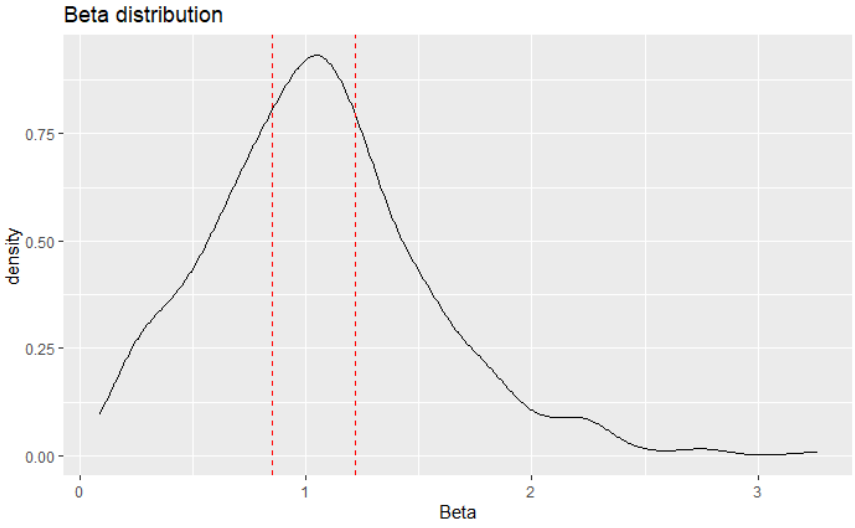


Since the main focus of the thesis is to test the effectiveness of ESG ratings as an assessment of risk and potential return, we decided to create two additional sets of three portfolios each, constructed according to the performance of each stocks under two more traditional financial parameters: Beta and standard deviation. Both the observed sample of stocks and the strategy are the same to the ones adopted when constructing the ESG portfolios: 463 stocks, one continuous holding period, the portfolios are equally weighted, and all follow a long-only strategy.

The beta for each stock was retrieved directly from Yahoo Finance, it is monthly Beta calculated over a five-year period. Since the value was rounded at the second decimal too many stocks ended up having the same value and it was impossible to divide them into three portfolios of identical sizes, without having to make some compromise; so as was the case for the ESG

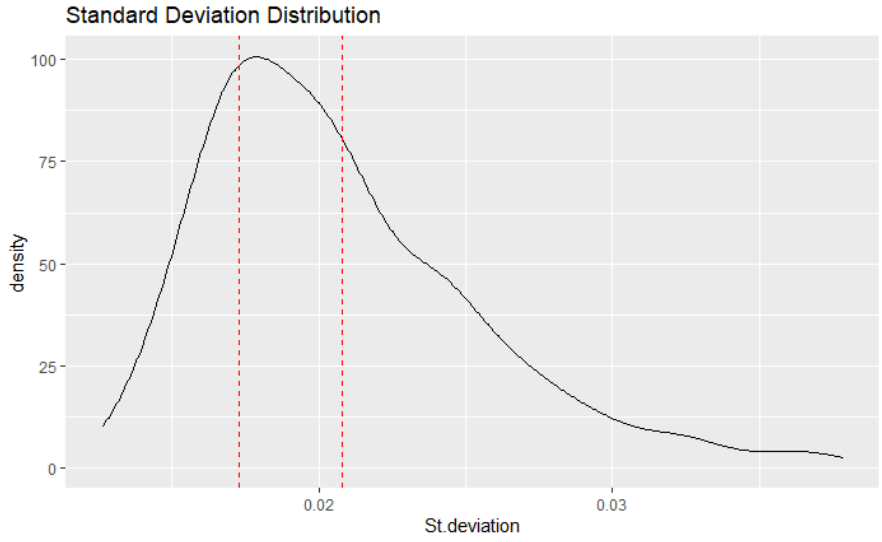
portfolios, we selected firm cut-off points to separate the stocks: the ones with Beta up to 0.85 were put into the “Low Beta” portfolio, the ones with Beta included between 0.87 to 1.21 were put in the “Medium Beta” portfolio, and the ones with Beta from 1.22 upwards were put into the “High Beta” portfolio. Figure 7 shows the distribution of the Betas and the divide.

Figure 7 distribution of the Betas



For the last set in this section, the standard deviation of the daily returns from November 2016 to November 2020 was calculated for each stock, which were then divided into three portfolios. In this case it was not necessary to define firm cut-off points, as the problem of having too many stocks with the same value did not present itself.

Figure 8 distribution of the standard Deviation



3.1.2 Portfolio formation: annual rebalance

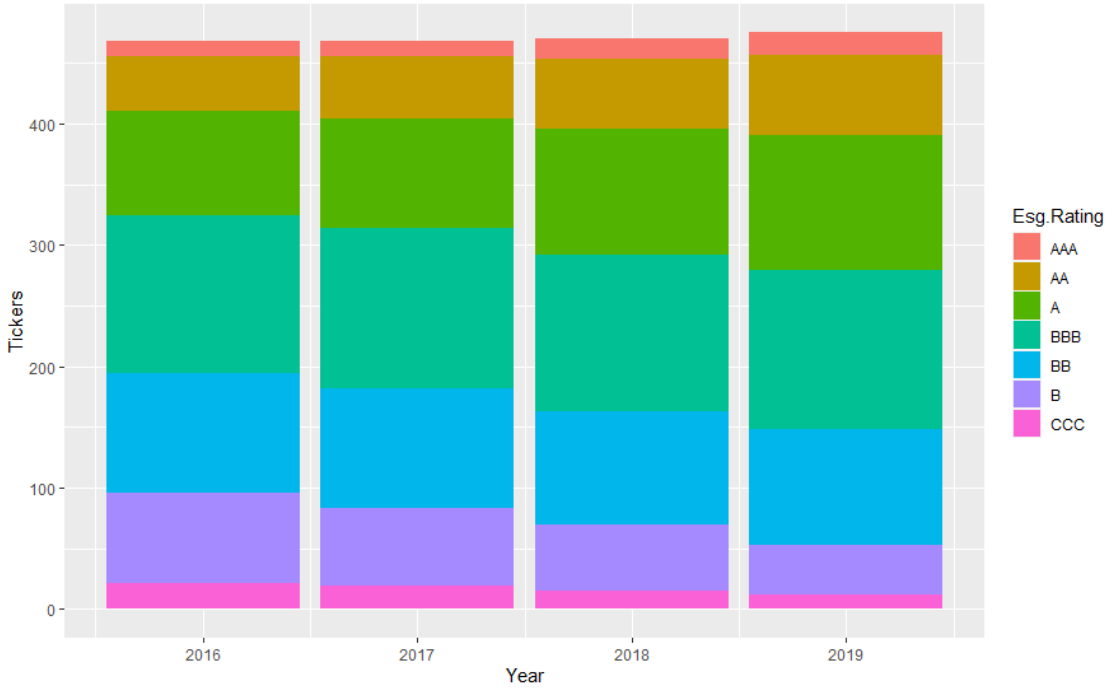
The main focus of this section is to observe if MSCI's individual ESG ratings proved to be a useful financial indicator at every level. The idea for this came to mind when reading past literature on the subject, in fact, all of the papers reviewed when researching for this thesis operated in a manner not too dissimilar to the one illustrated in the previous section, which is to observe the performance of the companies rated, by dividing them at some cut-off point decided by the authors and not according to the particular rating assigned by the provider; just to give a few examples Kempf and Osthoff (2007) observed only the top and bottom 10% portion of their database, Lins, Servaes, and Tamayo (2017) dived their observed sample in quarters and Halbritter and Dorfleitner (2015) adopted several cut off points.

In order to observe the performance at every rating, we had to apport several changes to the portfolio formation methodology. First, since ratings are updated every year (Figure 9 shows a breakdown) it is impossible to have just a single holding period throughout all of the observed time frame but the portfolios need to be rebalanced every year taking into account changes in ratings. This introduced the issue of when to rebalance, as there is not a single date when MSCI updates all its ratings. As discussed in the previous chapter, in fact, MSCI re-evaluates individually all of the companies in its databases at least once a year making it impossible for all of them to be updated at same time, also the nature itself of the ratings prevents it from happening, as events significant enough to force change for a particular company could happen at any time. In the end we decided to select November 1st of every year as rebalancing date, since the month of November is when MSCI re-evaluates the key issues on which the scores are assigned; while this date did not guarantee that all ratings would not change for the reminder of the year[16], what it did was assured that they were all constructed under the same principles. Since the portfolios are rebalanced yearly it is no longer necessary to have a rating every single year, consequently the observed sample of stocks slightly increases each year, in fact there are: 463 tickers observed in 2016, 468 in 2017, 470 in 2018 and 475 in 2019. Since the holding period is

[16] Just to give an example, although it is outside of the timeframe observed by this thesis, Apple was downgraded from A to BBB in December 2020.

one year, 2020 ratings are no being used for this section, as this thesis is being written during the theoretical holding period for that particular set.

Figure 9 ESG Ratings breakdown through the years



One additional element that could be taken into account when rebalancing annually are transaction costs, that considering the size of the portfolios observed, and the fact that they are all are completely rebalanced each year, could amount to a substantial sum. However, due to the fact that the approach adopted in this thesis is more theorical than practical, we elected to ignore transaction costs, or any additional expenses related to investing. This decision falls in line with the majority of the academic literature, in fact, out of all the past papers reviewed, only one accounted for transaction costs (Kempf and Osthoff, 2007).

We divided the stocks according to their given ESG rating for the year with the exception of the very best, AAA, and the very worst, CCC, which contained too few companies to be meaningfully compared with the others, so, we decided to incorporate them with next best, AA, and next worst, B. While this may appear to go against our initial goal for this approach, that is to not create additional separations to ones made by the provider, MSCI itself already identifies

these two groups as companies “Leaders” and “Laggard” respectively, while three middle ratings are considered “Average”.

One observation that we made during this process is how the distribution of the stocks changes during the years as we could clearly see an apparent trend towards improving the rating during our observed time frame. As Table 2 shows, the number of stocks that improved their rating each year excited those who worsen it, while this did not affect our analysis too much as overall the dimensions of the portfolios did not shift too greatly, it is still an interesting observation. While we cannot offer a clear explanation for this trend nor we can say if it represent a shift towards actual sustainability or simply an indication of widespread greenwashing, we believe that, in either cases it may be related to the increasing popularity of ESG investing that we highlighted in Chapter 1.

Table 2 Changes in Rating

	Improved	Unchanged	Got.worse	New.entry
2017	76	357	35	0
2018	102	337	29	2
2019	97	343	30	5
2020	162	266	42	7

Going back to the portfolios’ formation process, another substantial change that we made in this section, is the way the portfolios are balanced. One commonality among most of the literature reviewed was the fact that close to no portfolio’s strategy or optimization was used, portfolios were either equally weighted or value weighted. So, we decided to optimize the portfolios in different manners in order to have different points of comparison, and to see if the differences in performance that may come with different level of sustainability are enhanced or neutered by optimization. So we decided to create three different sets: we still have one that is equally weighted, to observe the performance at different ratings adding the least amount of bias, and to stay in line with the majority of literature on the subject; the other two sets were formed following Markowitz’ Modern Portfolio Theory (1952), and are a set of minimum variance portfolios, to observe if there are any benefits in ESG investing for particularly risk adverse

investors, and a set of tangency portfolios, to observe the best risk adjusted return achievable in each group or stocks. In order to preserve a more comfortable reading experience and not to cram this chapter with graphs we present all the efficient frontiers for all portfolios in Appendix A.

3.2 Performance Measures

In this section we will present the performance measure that we adopted to compare the portfolios, and some of the motivations on why these particular ones. The measures presented will be the Capital Asset Pricing Model, Jensen's Alpha and the Sharpe Ratio. Additionally, since it is being used in the formation of two sets of the portfolios observed, we will also review Markowitz' Modern Portfolio Theory and some we will present some examples that tried to integrate this framework to ESG metrics.

3.2.1 Capital Asset Pricing Model

The Capital Asset Pricing Model, or CAPM, is a framework that describes the relationship between systematic risk and expected return of an asset. Developed in the early 60 by Sharpe (1964), and Linter (1965), although not without detractors, it is still extremely popular thanks to the fact that is able to offer "powerful and intuitively pleasing predictions" (Fama and French, 2004). It was preferred this model over multifactor ones such as the Fama and French Three Factor Model or the Carhart four-factor model to favour the simplicity that CAPM offers, as it helped with one of the goals of this paper which is to work as an introduction to the field of sustainable finance.

The CAPM it is most commonly formulated as follows:

$$E(Ri) = Rf + \beta[E(RM) - Rf]$$

Where:

- $E(Ri)$ is the expected return for the asset
- Rf is the risk free rate
- β is the sensitivity of the expected excess return of the assets

- $[E(RM) - Rf]$ is usually referred to as the market premium, if the difference between the expected return of the market portfolio minus the risk-free rate

Since this thesis is an empirical analysis, and it is not necessary to calculate the expected returns, the element of the model that was used to confront the portfolios is β, which measures the systematic risk of the asset. As for the other components, it was decided to use the returns of the SPY ETF, an index fund that mimics the performance of the S&P 500, as market risk, while, for the risk free rete, we elected to follow the same approach of Statman and Glushkov (2009), which is to equating Rf to zero and to not consider it. Since this is a theoretical approach mostly interested in testing the effectiveness of ESG rating by comparing different ESG portfolios to each other, it we decided that including Rf would not have added any relevant information to the analysis.

3.2.2 Jensen's Alpha

Jensen's Alpha is a risk-adjusted performance measure, theorized by Michael Jensen in 1967. It is a value that measures the difference between the average return of an asset with its theoretical performance calculated with the CAPM and it is formulated as:

$\alpha = Ri - [\, Rf + \beta(RM - Rf)]$

A common way to describe this measure is to say that it explains the portion of excess return of an asset that is not explained by systematic risk; considering that among the explanations on where is possible to find value by integrating ESG principles into financial decisions, is that it may be possible to exploit intangible assets undervalued by the market, alpha should prove to be an effective point of comparison. For this thesis, it was derived following the same approach used to calculate the CAPM Beta, that is to set the Rf equal to zero, as is not particularly relevant for this analysis, and the SPY ETF, as market risk.

3.2.3 Sharpe Ratio

The Sharpe Ratio, developed by William Sharpe in 1966, is a measure of the risk to return ratio of a financial asset, and it is expressed as:

Sharpe Ratio=$(Ri - R\text{f})/\sigma\text{i}$

Where σi stands for the standard deviation, or volatility, of the assets excess return.

This measure works as a good indicator for evaluating risk adjusted returns, as it evaluates how well an investor was compensated for the risk taken. Again similarly to Jensen's Alpha the Sharpe Ratio should prove to be an effective point of comparison for the portfolios, especially if one the possible of avenue of ESG value creation, protection during tail events, proves true in this case study: if in a period of high volatility good ESG performing stocks were able to keep a low standard deviation in relation to their returns, this should be particularly evident thru the Sharpe Ratio.

As it was for CAPM Beta and Jensen's Alpha, the risk-free rate is equated to zero.

3.2.4 Markowitz Modern Portfolio Theory

Modern Portfolio Theory is not a model of a financial measure as the ones that we introduced in the first three paragraph of this section but is a mathematical framework for forming portfolio of assets, theorized by Harry Markowitz in 1952. The framework has two dimensions, Expected Returns and Risk, which is represented by the variance of the asset prices; the goal of the model is to maximize the returns while minimizing risk.

The two dimension of the model can be expressed as follows:

$$E(R_p) = \sum_i w_i \, E(R_i)$$

$$\sigma_p^2 = \sum_i \sum_j w_i \, w_j \sigma_i \sigma_j \rho_{i,j}$$

Where:

- $E(R_p)$ is the expected return of the portfolio
- $E(R_i)$ is the expected return of the asset
- w_i is the weight of the asset
- σ_p is the standard deviation of the periodic return of the portfolio
- $\sigma_{(i,j)}$is the standard deviation of the periodic return of the assets
- $\rho_{i,j}$ the correlation coefficient between the returns on assets i and j.

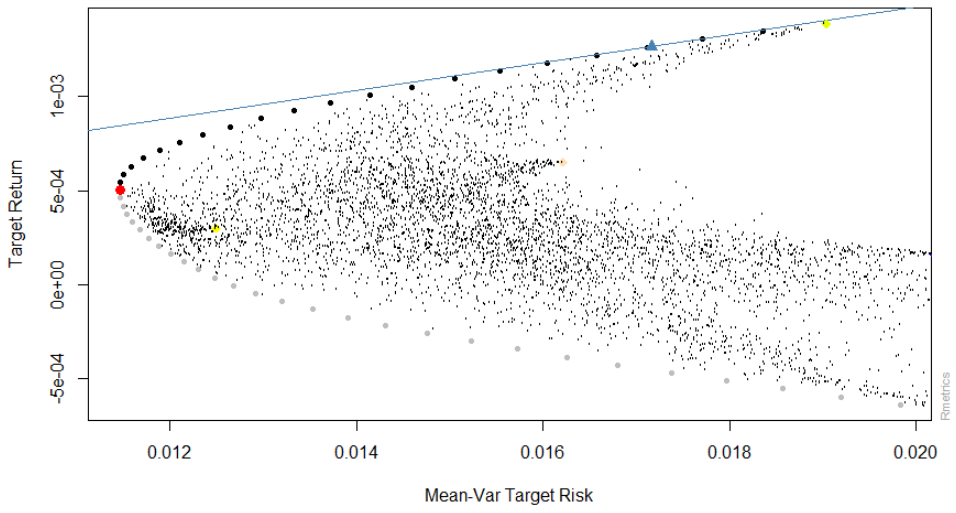
The most important assumption, required for the model to work is the fact that investors are rational and risk adverse, which means that when presented with the options of two different portfolios, with the same expected returns, they will always pick the safer one, and, consequently, in order for an investor to prefer a riskier asset it must offer higher expected returns. The portfolios that offer the highest possible returns for their given level of risk are called efficient. Plotting all possible portfolios constructed with a given number of securities will create a region defined by an hyperbolic line, the upward sloped portion of this line is called efficient frontier, which is a line formed by all of the most efficient portfolios, Figure 10 shows an example of this line constructed with five randomly selected stocks among the ones of the observed sample. One crucial element of this theory is that while all portfolios on the efficient frontier are equally efficient, the desired return and the level of risk acceptance for each individual investor can both vary greatly, the model in fact can be also expressed as:

$$max\ \alpha E(R_p) - \beta\sigma_p^2$$

Where:

- α represents an investor's return preference
- β represents an investor's risk preference or risk aversion

Figure 10 Example of an efficient frontier



As we already mentioned, in our research we are applying modern portfolio theory in the portion of the analysis where we explore whether there are any noticeable changes at every single ESG score, and, since we did not want to insert an hypothetical investor's bias by selecting certain levels of desired return and risk tolerance, so we decided to focus our observations on two very specific portfolios: the minimum variance portfolio, represented in Figure 10 with the red dot, and the tangency portfolio, represented with the blue triangle. The first is the efficient portfolio with lowest possible level of risk, selected to give an indication for an extremely risk adverse investor, the second is the portfolio with highest Sharpe ratio, is the one that coincides with the point of tangency between the efficient frontier and the capital market line, which is the graphic representation of all the portfolios that optimally combine risk and return.

However, although we decided to apply modern portfolio theory only after we had already divided their stock into their different ratings, meaning that utilized more as point of comparison, we want to present two different approaches that tried to integrate ESG measures into this framework and the reasoning why, in the end, we elected to not include neither of them in our portfolio construction process.

The first of the two approaches that we are going to present comes from Gasser, Rammerstorfer and Weinmayer (2017), who propose a revision of Markowitz's framework by adding to it the third dimension of sustainability which is proxied by ESG ratings; for their paper they use the Thompson Reuters ESG database as a source for the scores, however any type of unbiased and independent measure which gives comparable scores and allows reproducible analysis of assets should be apt to be fitted in the framework. Gasser, Rammerstorfer and Weinmayer three-dimensional model can be expressed[17] as follows:

$$max\ \alpha E(R_p) + \gamma\theta - \beta\sigma_p^2$$

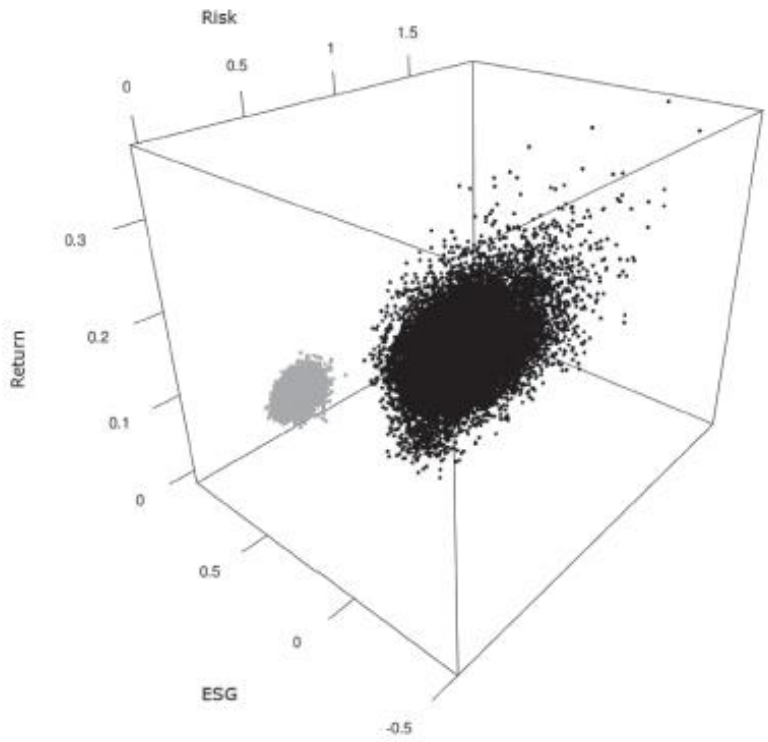
Where:

- θ represents the social responsibility rating
- γ represents the social responsibility parameter for the individual investor

[17] The authors express the model with different mathematical symbology in their paper, in order to maintain graphical consistency with the previous equations showed we decided to change it

As the model is three dimensional so is the capital allocation plane that lo longer resembles the one from Figure 10 but it is represented by Figure 11 (Gasser Rammerstorfer and Weinmayer, 2017) the dark cloud in the Figure is composed by the Sharpe ratios of all the assets.

Figure 11 Three Dimensional Capital Allocation Plane



The reason why we decided not to include this model into our research is due to an assumption that is needed for it to work. In fact, in addition to the ones from the standard modern portfolio theory, an investor must be rational and risk adverse, under Gasser, Rammerstorfer and Weinmayer model the investor must also be willing to forego a portion of revenue in order to reach a desired level of sustainability. The authors base their assumption on past empirical literature, in particular they cite the overview of Basso and Funari (2014), stating that while they do not expect neither higher nor lower returns for sustainable stocks they assume that if an investors willingly choses to integrate ethical principles into their financial decisions, they must be willing to pay a price for it. While we do not completely disregard this assumption, as even in our literature review we presented the work of Barber, Morse, and Yasuda (2021) who found

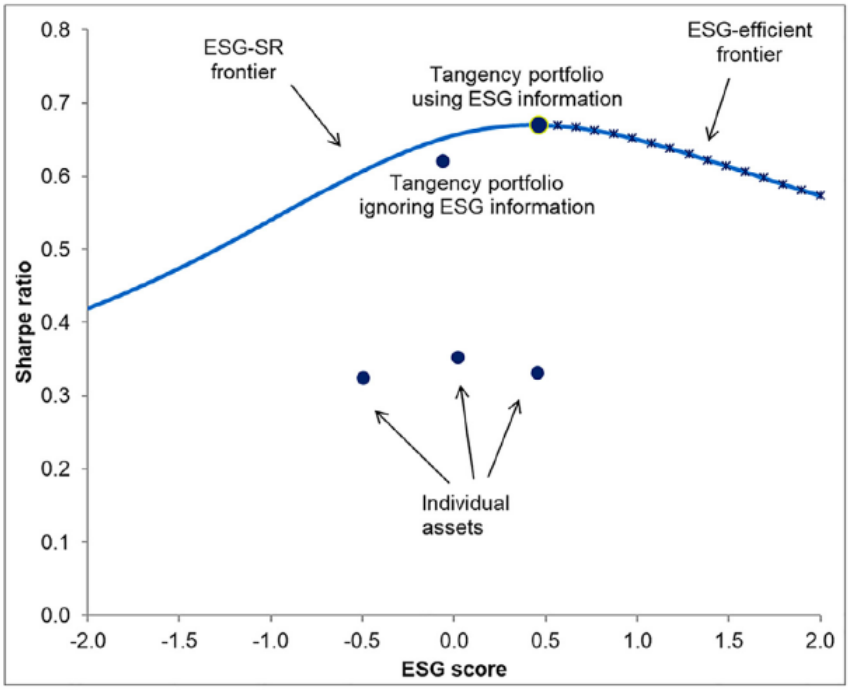
that impact investors were willing to sacrifice revenue for their morals, it is still a dealbreaker for us as we are more interested in studying whether is possible to exploit ESG measures as a tool for exploiting market inefficiencies, and we did not want to include ethical considerations into our analysis.

The second approach that we considered is the one from Pedersen, Fitzgibbons, and Pomorski (2020), who instead of constructing a three dimensional model, as the one that we introduced earlier, solve the issue of integrating ESG measures into the portfolio formation process by creating a different, two dimensional capital allocation plane, no longer defined by the Markowitz's dimensions of Expected Returns and Risk, but by ESG and Sharpe Ratio. They call this model the ESG-efficient frontier and, to under different conditions test it, they used four different proxies for ESG, three dedicated to one singular pillar, and one all-encompassing score: as a measure for the environmental pillar they compute each company's emission intensity; for measuring the social pillar they adopt the sin stock indicator first defined by Hong and Kacperzyk (2009); as a measure of the governance pillar they computed how aggressive or unaggressive each firm is in accounting choices based on the accruals in the financial statements, citing Sloan (1996) as inspiration; finally for an all-encompassing ESG metrics they used the aggregate rating provided by MSCI.

They test their model considering the point of view of three hypothetical investors with different predispositions towards SRI and ESG. The first, referred to a Type U, is unaware of ESG rating and simply uses the traditional model from Markowitz to maximize their profits. The second investor, Type A, is aware of ESG ratings and seeks "a portfolio with an optimal trade-off between a high expected return" but also has some ethical preference and desires to achieve a certain ESG score with its investment. The third and final investor, Type M, is motivated by ESG, for this investor to be satisfied there must be an "optimal trade-off between a high expected return, low risk, and high average ESG score", in order to achieve that they operate exclusively on the ESG-Sharpe ratio frontier.

Figure 12 shows the ESG-Sharpe ratio frontier proposed by this mode; Sharpe ratio, on the y-axis, that can be achieved for all portfolios with a given ESG score on the x-axis. The ESG-Sharpe ratio frontier peaks at the Sharpe ratio of the tangency portfolio. Investors interested both in returns and in should choose a frontier portfolio to the right of that point, which is the portion of the frontier called the ESG-efficient frontier.

Figure 12 ESG-Sharpe ratio frontier



While we do believe that this approach is promising we still elected to not integrate it into our portfolio formation process as it would have clashed with our goals with this paper. In fact, we wanted to include some form of optimization into our analysis mostly because we wanted to add an additional point of comparison between the individual scores, as we intended to observe if there were some appreciable differences were still present even after optimization, and this model would not help us in that direction because: it is still unproved so not apt to be used as comparison as it requires more testing, and it does not guarantee us that it would work even if we isolated the stocks into their individual scores. We also considered adding another section to this thesis where we constructed the portfolios under this model, however we decided that it

would have gone behind the intended scope of the work as this model needs further examination and including in a paper where the main objective is not to verify its effectiveness, would have not been ideal.

With this review of Modern Portfolio Theory, and of two possible evolution to the model, we conclude this chapter and the presentation on how we conducted our analysis, in the next one we will present and discuss the results that we obtained.

4. Results from the empirical analysis

This chapter will present and discuss the empirical results of this thesis, it is divided into three main sections: in the first we present the results for the Ex Post portfolios, formed taking the data at the end of the period observed, while in the second we will present the results for annually rebalanced portfolios. Finally in the third section a sector breakdown for all of the portfolios formed is performed, in order to observe how diversified were they.

4.1 Empirical Results: Ex Post

In this section we will present the results for the first portion of the analysis where portfolios are all equally weighted, and never rebalanced throughout one continuous holding period that goes from the start of November 2016 to end of October 2020. We will present separately the three sets of three portfolios dedicating one paragraph to each of them; considering that the portfolios formed according to the Beta and the standard deviation are not the element of the analysis but will be used as a comparison in the discussion section, the comment to their results will be slightly briefer compared to the one of the ESG portfolios. All the data that will be presented was calculated on a daily frequency.

4.1.1 ESG Portfolios

The performances of the ESG portfolios are summarized in Table 3 and visualized in Figure 13; the most important metrics that will be discussed are the ones presented in the previous chapter so Beta, Jensen's Alpha and Sharpe Ratio.

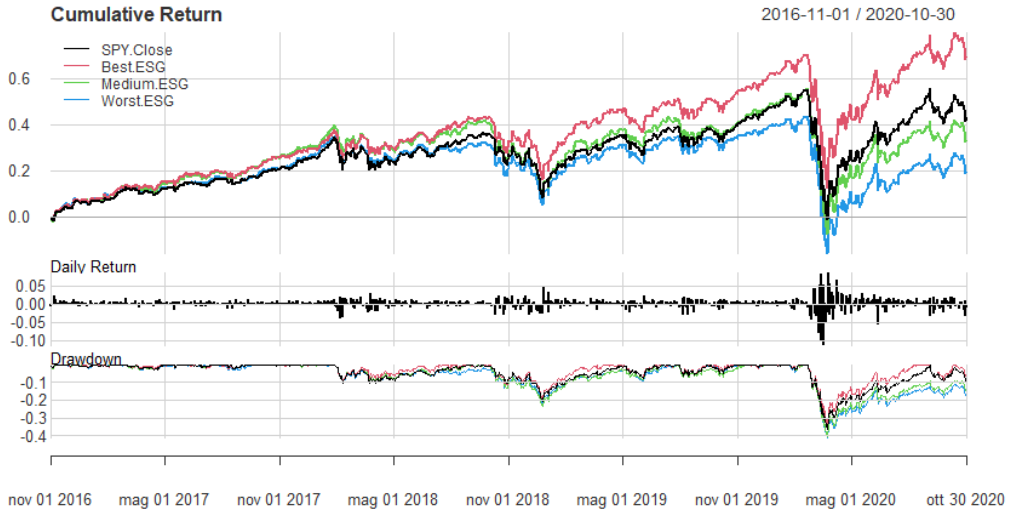
Table 3 ESG portfolios

	Mean	ST.Deviation	Beta	Jensen.Aplha	Sharpe.Ratio
Worst	0,03%	1,33%	1.02	-0.0492	0.0195
Medium	0,04%	1,33%	1.03	-0.0203	0.0277
Best	0,06%	1,29%	1.00	0.0487	0.0466

Looking at the performance benchmarks, we observe that the Best ESG portfolio was the one that performed better out of the three, having higher mean returns, Jensen's alpha and Sharpe Ratio, while the Medium ESG was the second best and the Worst ESG was also the worst in term of performance, indicating that there was some type of benefit in ESG investing in this time frame. The Best ESG is also the only one out of the three to outperform the SPY ETF benchmark.

An element that has emerged through this metrics that holds particular interest is that despite the fact that the Best ESG portfolio generates the highest returns, it does so without bearing the highest risks as both the volatility and the Beta are almost identical for all portfolios.

Figure 13 ESG portfolios vs SPY



4.1.2 Beta Portfolios

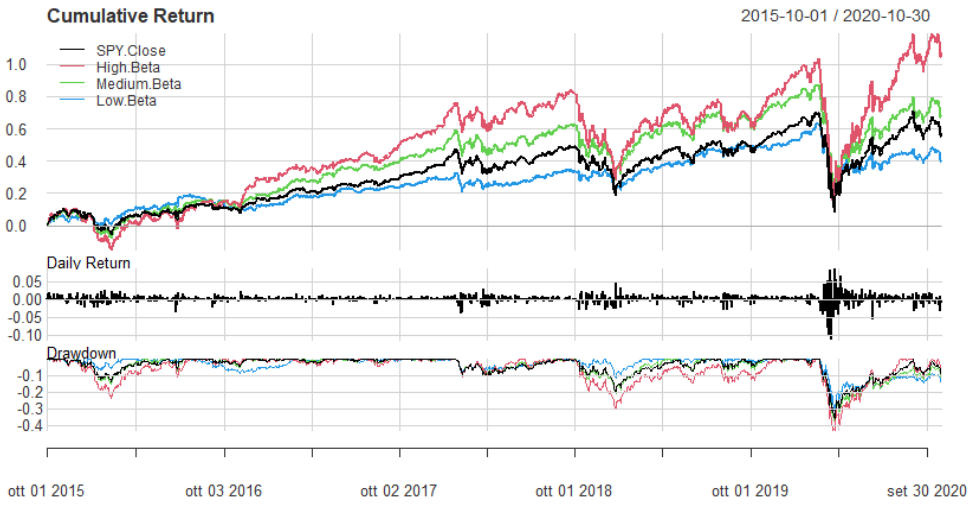
The performance of the Beta portfolios is summarized in Table 4 and visualized in figure 14.

Table 4 Beta portfolios

	Mean	ST.Deviation	Beta	Jensen.Aplha	Sharpe.Ratio
Low	0,03%	1,04%	0.80	-0.0001	0.0321
Medium	0,05%	1,59%	1.04	0.0089	0.0371
High	0,07%	1,59%	1.26	0.0372	0.0431

Unsurprisingly, the one formed with higher beta stocks is the one that generated the highest returns, while the one formed with the lower betas generates the lowest returns while bearing the lowest risks expressed both in standard deviation and beta. An interesting detail that deserve to be mentioned is that the Medium and High Beta portfolios have the same standard deviation, meaning that higher betas stocks better rewarded better investors for the risk taken.

Figure 14 Beta portfolios vs SPY



4.1.3 Standard deviation portfolios

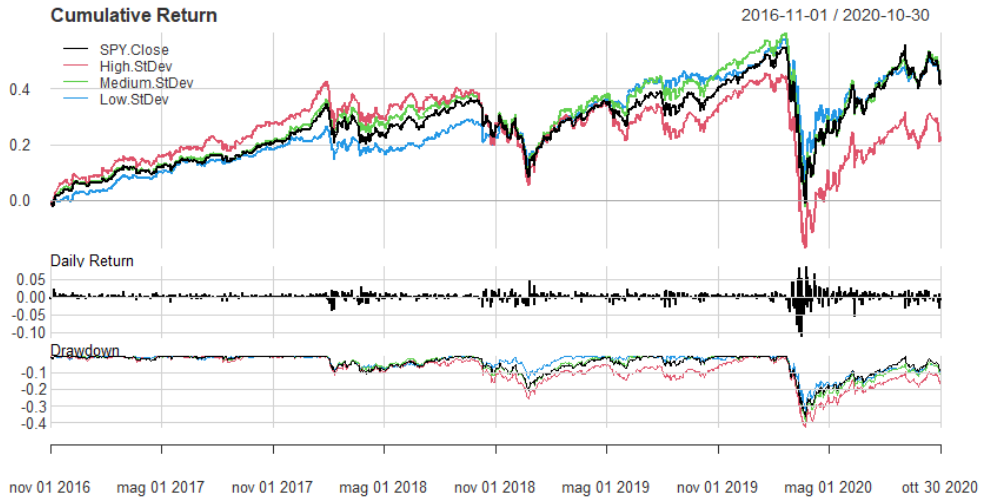
The performance of the Standard deviation portfolios is summarized in Table 5 and visualized in figure 14.

Table 5 Standard Deviation portfolios

	Mean	ST.Deviation	Beta	Jensen.Aplha	Sharpe.Ratio
Low	0,04%	1,12%	0.83	0.0168	0.0368
Medium	0,04%	1,63%	1.02	-0.0083	0.0310
High	0,02%	1,63%	1.23	-0.0935	0.0127

In contrast to what was observable with the Beta ones, where higher risk lead to higher returns, for this set of portfolios, the opposite happened; in fact, the better performing portfolio in term of mean returns, Sharpe ratio, and alpha, also being the only one with a positive value for that category, is the one formed with the least volatile stocks, while the worst performer is the High Standard Deviation portfolio.

Figure 14 Standard Deviation Portfolios vs SPY



4.2 Empirical Results: Annual Rebalance

In this section the results for the second portion of the analysis will be presented; the portfolios in this section were all rebalanced yearly at the start of November from 2016 to 2020, and different types of weighting systems are adopted. As it was for the previous section, the results of the portfolios will be presented separately dedicating one paragraph for each type of optimization adopted. Each section will first discuss the full run of all the portfolio and then the year to year results. As it was the case for the previous section all the data that will be presented was calculated on a daily frequency.

4.2.1 Equally Weighted

The performance for the equally weighted portfolios is summarized in Table 6 for the full run, in Table 7 for the individual years, the full run is visualized in Figure 15. Overall, all five

portfolios have quite similar performances, with almost identical mean returns, standard deviation and Beta, however some differences can be noted.

Table 6 Equally Weighted portfolios: full run metrics

	Mean	ST.Deviation	Beta	Jensen.Aplha	Sharpe.Ratio
2016-2020					
CCC-B	0,02%	1,36%	1.03	-0.0717	0.0126
BB	0,03%	1,37%	1.04	-0.0486	0.0194
BBB	0,02%	1,31%	1.00	-0.0479	0.0189
A	0,04%	1,32%	1.01	-0.0130	0.0290
AA-AAA	0,04%	1,24%	0.95	-0.0042	0.0310

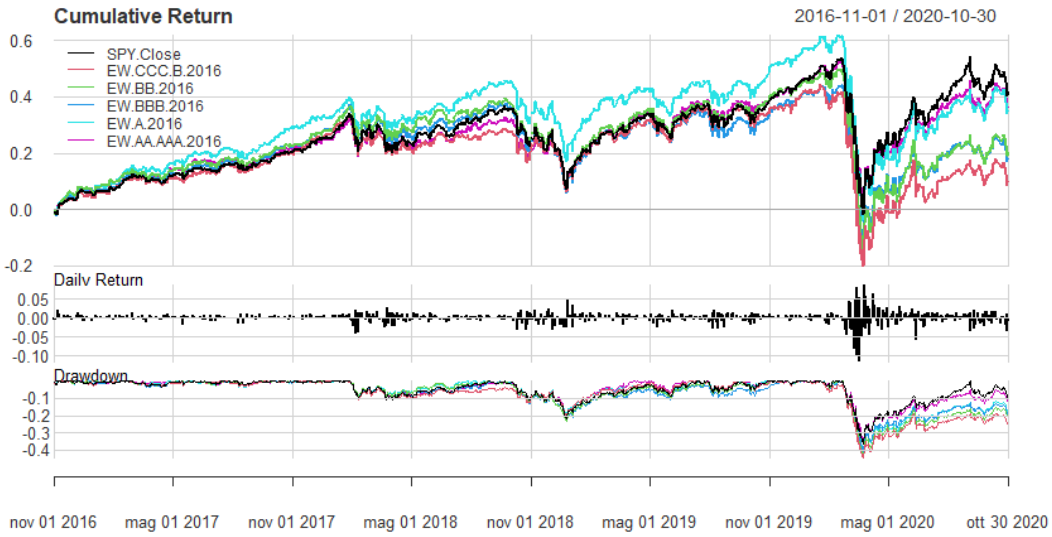
The first the both the Jensen Alpha and Sharpe ratio shows the highest value for the AA-AAA portfolio and the lowest for the CCC-B, and with the exception of the jump from BB to BBB both metrics improve the more sustainable a portfolio is, while not decisive this is definitely an indication of a benefit in ESG investing. That said considering that the observed period is one of high market volatility.

Table 7 Equally Weighted portfolios: single year metrics

	Mean	ST.Deviation	Beta	Jensen.Aplha	Sharpe.Ratio
2016-2017					
CCC-B	0,07%	0,50%	0.98	-0.0053	0.1447
BB	0,08%	0,53%	1.05	0.0098	0.1549
BBB	0,08%	0,51%	1.03	0.0096	0.1569
A	0,10%	0,53%	1.06	0.0729	0.1934
AA-AAA	0,08%	0,50%	0.96	0.0158	0.1568
2017-2018					
CCC-B	0,00%	0,82%	0.88	-0.0355	0.0008
BB	0,01%	0,87%	0.94	-0.0050	0.0160
BBB	0,01%	0,86%	0.94	-0.0222	0.0081
A	0,02%	0,82%	0.89	0.0010	0.0185
AA-AAA	0,00%	0,84%	0.90	-0.0409	-0.0014
2018-2019					
CCC-B	0,05%	0,94%	0.90	0.0178	0.0518
BB	0,04%	0,99%	0.96	-0.0016	0.0451
BBB	0,04%	0,96%	0.93	-0.0195	0.0380
A	0,05%	0,97%	0.94	0.0152	0.0511
AA-AAA	0,06%	0,92%	0.88	0.0603	0.0679
2019-2020					
CCC-B	-0,05%	2,36%	1.08	-0.2039	-0.0224
BB	-0,03%	2,33%	1.08	-0.1628	-0.0146
BBB	-0,02%	2,22%	1.03	-0.1354	-0.0111
A	-0,01%	2,26%	1.05	-0.1132	-0.0061
AA-AAA	0,01%	2,09%	0.98	-0.0351	0.0070

Observing the year to year performance it appears clear that the benefits shown by the Jensen's alpha and the Sharpe ratio for the AA-AAA in the full run were generated in the last two years when that portfolio is the best performer in both categories. The other years all portfolios behave quite similarly, it is interesting however that besides from the year 2019-20 the level of risk measured by Beta and standard deviation of all the portfolios, is almost identical, while in 2019-20 the AA-AAA is clearly the safer of the five.

Figure 15 Equally Weighted portfolios vs SPY



4.2.2 Minimum Variance Portfolios

The performance for the minimum variance portfolios is summarized in Table 8 for the full run, in Table 9 for the individual years, the full run is visualized in figure 16.

Table 8 Minimum Variance portfolios: full run metrics

	Mean	ST.Deviation	Beta	Jensen.Aplha	Sharpe.Ratio
2016-2020					
CCC-B	0,05%	0,91%	0.58	0.0618	0.0517
BB	0,05%	0,92%	0.62	0.0773	0.0585
BBB	0,04%	0,79%	0.49	0.0430	0.0456
A	0,04%	0,79%	0.48	0.0648	0.0533
AA-AAA	0,04%	0,72%	0.39	0.0672	0.0571

When optimizing portfolios for minimum variance it does not appear to be many benefits in preferring better ESG performing stocks with all portfolios achieving remarkably similar performances; that said the AA-AAA is the one with the lower standard deviation, albeit with by a very low margin, thus the one that better achieves the goal of minimizing risk, and overall, risk, expressed booth in beta and standard deviation appear to decrease with the increase of sustainability.

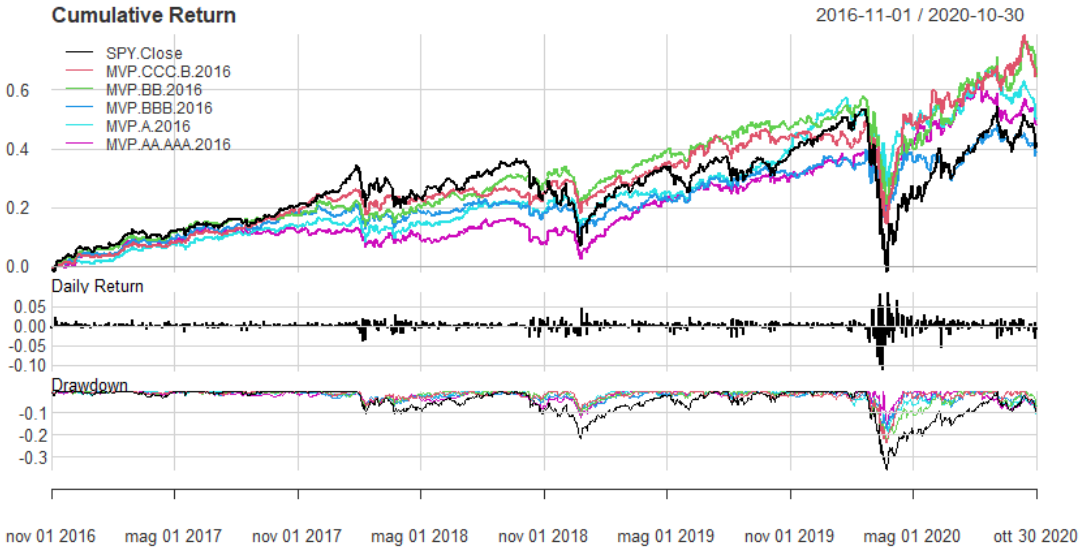
Table 9 Minimum Variance portfolios: portfolios: single year metrics

	Mean	ST.Deviation	Beta	Jensen.Aplha	Sharpe.Ratio
2016-2017					
CCC-B	0,07%	0,34%	0.56	0.0635	0.1926
BB	0,06%	0,35%	0.58	0.0530	0.1800
BBB	0,07%	0,35%	0.56	0.0666	0.1928
A	0,05%	0,35%	0.47	0.0393	0.1648
AA-AAA	0,06%	0,39%	0.65	0.0191	0.1464
2017-2018					
CCC-B	0,07%	0,34%	0.56	0.0635	0.1926
BB	0,06%	0,35%	0.58	0.0530	0.1800
BBB	0,07%	0,35%	0.56	0.0666	0.1928
A	0,05%	0,35%	0.47	0.0393	0.1648
AA-AAA	0,06%	0,39%	0.65	0.0191	0.1464
2018-2019					
CCC-B	0,06%	0,60%	0.41	0.1027	0.0946
BB	0,06%	0,64%	0.48	0.0914	0.0869
BBB	0,04%	0,57%	0.38	0.0711	0.0775
A	0,07%	0,57%	0.46	0.1266	0.1035
AA-AAA	0,07%	0,64%	0.43	0.1521	0.1159
2019-2020					
CCC-B	0,04%	1,58%	0.64	0.0736	0.0284
BB	0,06%	1,56%	0.67	0.1074	0.0363
BBB	0,03%	1,32%	0.51	0.0508	0.0240
A	0,04%	1,32%	0.48	0.0675	0.0281
AA-AAA	0,04%	1,09%	0.36	0.0856	0.0374

Looking at the year to year performance the parity between all portfolios is once again reiterated as all metrics are very similar each year. The biggest difference can be noted by looking at the standard deviation, which is almost identical for all portfolios every year with the exception of

the AA-AAA in 2019-2020, confirming again that that particular group of stocks was less impacted by the stock market crash of march 2020.

Figure 16 Minimum Variance portfolios vs SPY



4.2.3 Tangency portfolios

The performance for the tangency portfolios is summarized in Table 10 for the full run, in Table 11 for the individual years, the full run is visualized in Figure 17.

Table 10 Tangency portfolios: full run metrics

	Mean	ST.Deviation	Beta	Jensen.Aplha	Sharpe.Ratio
2016-2020					
CCC-B	0,16%	1,24%	0.71	0.3891	0.1258
BB	0,19%	1,20%	0.73	0.5090	0.1560
BBB	0,16%	1,18%	0.69	0.4139	0.1372
A	0,19%	1,25%	0.75	0.5007	0.1489
AA-AAA	0,16%	1,21%	0.73	0.3992	0.1314

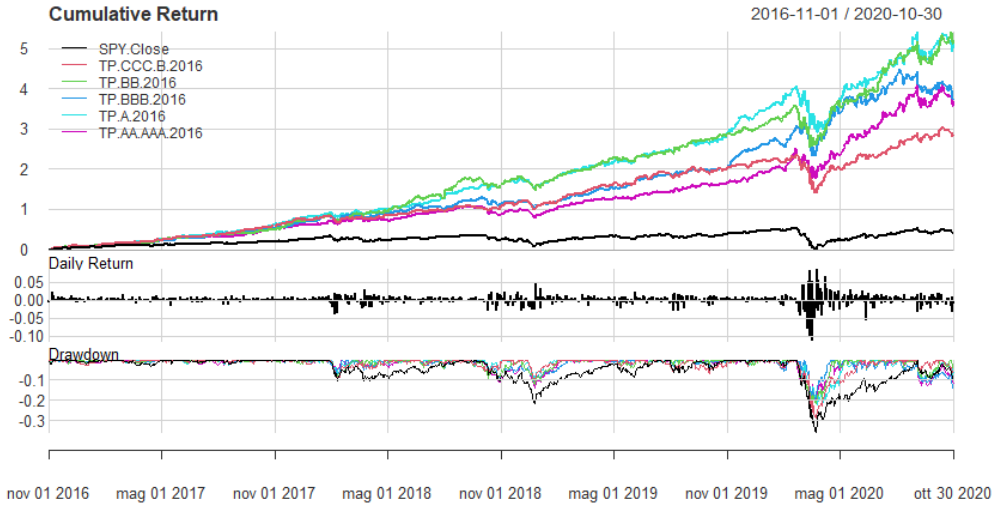
As the tangency portfolio is the most efficient portfolio achievable under Markowitz's modern portfolio theory, all of the portfolio achieve excellent returns. There doesn't seem to be any appreciable difference in performance between the portfolios, and the one that generates the highest Sharpe ratio is the BB one.

Table 11 Tangency portfolios: portfolios: single year metrics

	Mean	ST.Deviation	Beta	Jensen.Aplha	Sharpe.Ratio
2016-2017					
CCC-B	0,12%	0,81%	0.71	0.3308	0.1528
BB	0,22%	1,14%	0.72	0.7073	0.1967
BBB	0,14%	0,94%	0.85	0.3688	0.1455
A	0,19%	0,90%	0.74	0.5793	0.2136
AA-AAA	0,10%	0,84%	0.74	0.2580	0.1222
2017-2018					
CCC-B	0,20%	0,52%	0.75	0.5057	0.3875
BB	0,16%	0,50%	0.83	0.3378	0.3265
BBB	0,17%	0,49%	0.80	0.3705	0.3465
A	0,19%	0,57%	0.90	0.4382	0.3376
AA-AAA	0,16%	0,57%	0.96	0.2849	0.2744
2018-2019					
CCC-B	0,15%	0,81%	0.57	0.3737	0.1813
BB	0,16%	0,86%	0.65	0.4092	0.1852
BBB	0,14%	0,73%	0.53	0.3560	0.1916
A	0,16%	0,79%	0.55	0.4328	0.2062
AA-AAA	0,14%	0,77%	0.54	0.3518	0.1808
2019-2020					
CCC-B	0,15%	2,14%	0.75	0.3666	0.0705
BB	0,20%	1,86%	0.75	0.5725	0.1076
BBB	0,20%	1,97%	0.69	0.5500	0.0999
A	0,20%	2,12%	0.79	0.5383	0.0928
AA-AAA	0,23%	2,05%	0.76	0.7007	0.1146

Even observing the year to year performances there does not seem to be any particular trend, the highest mean return is reached by the BB portfolio between 2016-2017, when it also achieves the highest alpha. One interesting element can be observed in 2019-2020, when the AA-AAA portfolio achieves both the highest alpha and Sharpe ratio out of the five between 2019-2020.

Figure 17 Tangency portfolios vs SPY



4.3 Sector breakdown

This section provides the sectorial breakdown for all the portfolios formed during this thesis, it is divided in two parts: in the first we present the performance of the individual sectors during the observed time frame, this is done in order to see if a particular industry either severely outperformed or underperformed the others; then in the following section we present the actual breakdown, first by observing how the index benchmark, the S&P500, is divided to then compare it to all of the portfolios formed.

The sectors are classified under the Global Industry Classification Standard, or GICS, developed by MSCI and Standard and Poor's, an industry classification system that intensifies eleven sectors, here listed in alphabetical order: Communication Services, Consumer Discretionary, Consumer Staples, Energy, Financials, Health Care, Industrials, Information Technology, Materials, Real Estate and Utilities. A description of all the sector is available in the references under MSCI, 2018.

4.3.1 Sector Performance

To observe the performance of all of the individual sectors, we divided the observed sample of stocks according to their industry of origins and formed one portfolio for each ones; in order to not inject any bias to the observation the portfolios are all equally weighted and never rebalanced, their performance is summarized in Table 12 according to the same metrics adopted for the rest of the thesis.

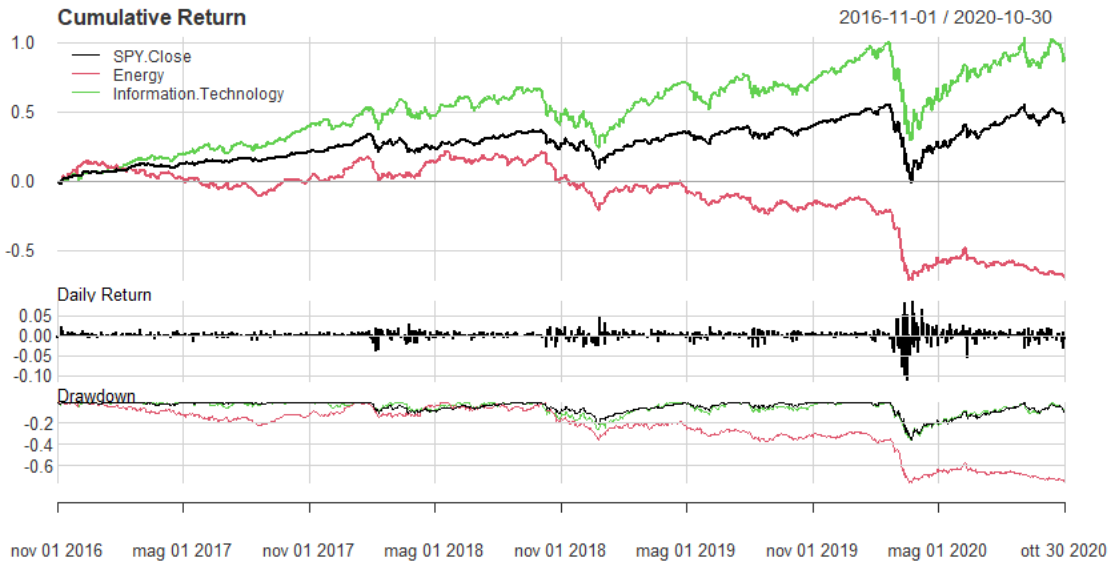
Table 122 Sector performance

	Mean	ST.Deviation	Beta	Jensen.Aplha	Sharpe.Ratio
Communication Services	0,03%	1,35%	0.95	-0.0249	0.0243
Consumer Discretionary	0,03%	1,41%	1.00	-0.0341	0.0228
Consumer Staples	0,02%	1,06%	0.68	-0.0304	0.0168
Energy	-0,09%	2,24%	1.33	-0.3728	-0.0398
Financials	0,02%	1,62%	1.15	-0.0941	0.0107
Health Care	0,05%	1,34%	0.95	0.0259	0.0382
Industrials	0,05%	1,43%	1.05	-0.0039	0.0314
Information Technology	0,07%	0,07%	1.18	0.0608	0.0465
Materials	0,02%	1,49%	1.04	-0.0644	0.0155
Real Estate	0,01%	1,48%	0.90	-0.0968	0.0035
Utilities	0,03%	1,40%	0.75	-0.0273	0.0185

While there is variance between the performance of all sectors, two in particular emerge as outliers, Energy and Information Technology, the first for how much it has underperformed compared to the others, being the only one with negative expected returns, and the second for the opposite reason as it is clearly the best performer, with the highest expected returns, alpha and Sharpe ratio. This is why, although we will check all portfolios for all sectors, a particular care must be put when controlling for one of this two, as a significant difference in representation for either of them in one could have heavily influenced the performance of a particular portfolio. Figure 18 offers a visual representation of the two outliers compared to the benchmark, to

preserve clarity we decided to show only the performance of these two in this chapter, however graphs with the performance of every sector are available in Appendix B.

Figure 185 Energy vs Information Technology vs SPY

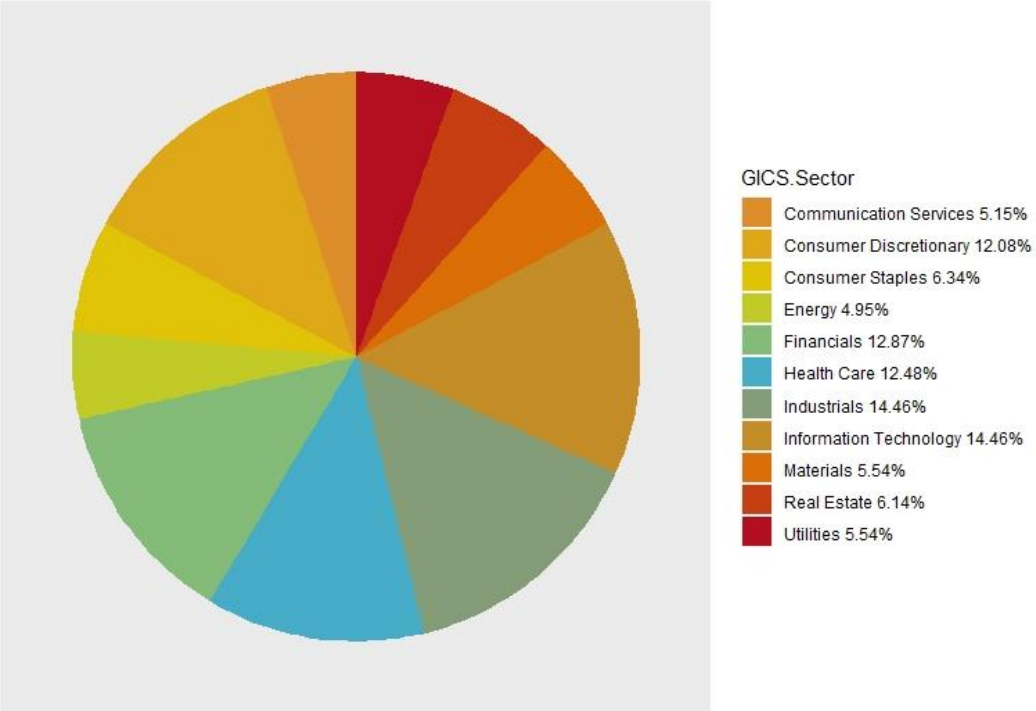


4.3.2 Sector representation

Before we begin to observe the how the sectors are distributed in the individual portfolios, it is necessary to perform the sectorial breakdown on the S&P500 in order to have a point of comparison. The breakdown is visualized in the following page in Figure 19, that will be the only occasion in which we will present a breakdown graphically, for all the other portfolios we will present it in the form of a tables. We made this decision because while we did not want to cram this section with too many graphs, we thought that having the benchmark index's breakdown clearly presented and separated from all the others would have been useful, as it would offer the reader a clear point of reference were to go back when comparison are made. Following that, we discuss all of the other portfolios, starting from the ones from the first approach, which are presented in separate tables, one for each set, and then the yearly rebalanced ones for the which we observe the breakdown for each year.

One final note before we start to discuss the breakdown itself, as the S&P 500 is a market capitalization weighted index most of the sectorial breakdown made on it are made under the same weighting system, however, since we are observing the sectorial breakdown of the index purely to use it as a point of comparison for all the other portfolios, and none of them are market capitalization weighted, we decided that operating in a traditional manner would have not been particularly useful, so we concluded that it was preferable to observe the distribution of the sectors as if the index were equally weighted.

Figure 19 S&P 500 Sector Breakdown as of November 2020



Looking at the S&P 500 breakdown we can note some interesting points, first despite the fact that we are observing the sector distribution on an equal weight basis, there is still a noticeable difference in representation between sectors as the most represented ones, Industrials and Information Technology, have almost three times as many stocks as the least represented, Energy. Even more worth nothing is the fact that one of the most represented, Information Technology, and the least represented are also the best and worst performer respectively.

We start the observation of the sector breakdown of the individual portfolios with the ESG set of the first approach, and for this set, while every sector is represented in every portfolio, some clear and worth nothing differences emerge, however overall we can say that the Medium ESG portfolio is the one that most closely resembles the index benchmark, with most sectors having at most a two percentage points difference. Focusing on the two performance outliers, we can clearly see some divergence: in particular we can observe that the top performer, Information Technology constitutes a 18.67% of the High ESG portfolio compared to a 14.46% of the S&P 500 and a 10.43% of the Worst ESG, while the worst performer, Energy constitutes just a 2.67% of the High ESG, a 4.95% of the S&P 500, and 6.75% of the Worst ESG. Other two sectors that have great divergence between the portfolios are Utilities, and Communication Services, with the first being particularly overrepresented, and the second particularly underrepresented. in the High ESG portfolio.

Table 13 ESG portfolios: sector breakdown

	Worst.ESG	Medium.ESG	High.ESG
Communication Services	7,98%	4,55%	1,33%
Consumer Discretionary	15,34%	10,39%	6,00%
Consumer Staples	5,52%	5,84%	9,33%
Energy	6,75%	3,90%	2,67%
Financials	17,18%	13,64%	8,67%
Health Care	13,50%	13,64%	13,33%
Industrials	8,59%	12,99%	20,00%
Information Technology	10,43%	16,88%	18,67%
Materials	7,36%	5,84%	3,33%
Real Estate	4,91%	6,49%	6,67%
Utilities	2,45%	5,84%	10,00%

We continue the observation with the Beta portfolios, for this set not every sector is represented in all portfolio, and overall, all three have fairly different composition compared to the S&P 500. The starkest differences are observable in the High Beta portfolio as the Utility sector is completely absent from it and Consumer Staples, which constitutes a 6.34% of the S&P 500, is barely present with only a 0.66%. An interesting to note to make is that the worst performing sector, Energy, is mostly represented in High Beta, which, worth reminding, is the best performer

of these three, while it is barely present in the Low Beta portfolio, the one that performed the worst in this set, representing only a 0.63% of the portfolio's stock.

Table 14 Beta portfolios: Sector breakdown

	Low.Beta	Medium.Beta	High.Beta
Communication Services	4,40%	5,88%	3,97%
Consumer Discretionary	5,66%	8,50%	18,54%
Consumer Staples	15,72%	3,27%	0,66%
Energy	0,63%	1,31%	11,92%
Financials	12,58%	9,15%	18,54%
Health Care	16,98%	17,65%	5,96%
Industrials	6,29%	20,26%	13,91%
Information Technology	7,55%	20,26%	17,88%
Materials	3,77%	7,19%	5,96%
Real Estate	10,69%	4,58%	2,65%
Utilities	15,72%	1,96%	0,00%

To conclude the breakdown of the first approach we observe the last set of portfolios, the one formed using to the standard deviation of the stocks; as it was for the Beta ones not all sectors are represented in all portfolios, as Energy is completely absent from the Low Standard Deviation, and Consumer Staples is barely present in High Standard Deviation with just a 0.68%. Predictably the overall sector distribution of all the portfolios is fairly similar to the ones of the Beta.

Table 15 Standard Deviation: Sector breakdown

	Low.StDev	Medium.Standard.Dev	High.st.Dev
Communication Services	4,58%	4,55%	5,48%
Consumer Discretionary	3,27%	10,39%	19,86%
Consumer Staples	13,73%	5,84%	0,68%
Energy	0,00%	1,30%	13,01%
Financials	9,80%	14,94%	16,44%
Health Care	14,38%	16,23%	10,96%
Industrials	15,03%	18,83%	6,85%
Information Technology	11,11%	14,94%	13,70%
Materials	3,92%	6,49%	6,85%
Real Estate	9,15%	4,55%	4,79%
Utilities	15,03%	1,95%	1,37%

As the portfolios in the second approach are rebalanced yearly in order to meaningfully observe the distribution of the sectors we had to do it each year, Table 16 in the next page shows the breakdown; we are writing the comment separated to the table mostly for pagination reasons and because we did not wanted to not divide the yeas of the tables, as it would have defeated the purpose of highlighting the changes in distribution through the years.

Observing the breakdown, we can say that, overall, all sectors are represented in all portfolios every year with the exception of Communication Services that has zero company in the AA-AAA portfolios from 2016 to 2018. Generally, we can see that that three portfolios formed with average ESG rating, BB, BBB, and A, have sector breakdowns that more closely resembles the S&P 500. While greater variance at the extremes must be expected it is still a phenomenon that is worth noting as this raises some questions on the nature itself of the ratings. In fact, while measures such as Beta or Standard Deviation are absolute, meaning that if two companies that operates in different industries have the same Beta that means that they have the same market sensitivity, the ESG ratings that MSCI provides do not work in that sense, because, as we explained in chapter 2, they are industry adjusted and "are explicitly intended to be relative to the standards and performance of a company's industry peers" (MSCI, 2020).

So considering how the ratings are constructed there should not be this high of a difference between the sectors distribution yet, if we focus our observation just on the CCC-B and AA-AAA ratings, which following MSCI naming convention can also be referred as Laggard and Leaders respectively, some stark differences can be found. Taking as example the Utility sector, it constitutes 5.54% of the S&P 500 and is tied with Materials as the third least represented sector in the index, however it is consistently on the top half of the most represented for the ESG leaders never going under 10.34% and representing as much as 12.16% in 2018. For the opposite side we already mentioned Communication Services, completely absent from the AA-AAA portfolios up to 2019, and while it constitutes only 5.15% of the S&P 500, making it the second least represented sector on the index, it is one of the three most prominent for the CCC-B portfolio in 2018. We will discuss the implications that these disparities hint at in the following chapter.

Table 36 Second Approach: year to year sector breakdown

	CCC.B	BB	BBB	A	AA.AAA
2016					
Communication Services	7,37%	8,16%	3,08%	3,57%	0,00%
Consumer Discretionary	14,74%	14,29%	9,23%	8,33%	5,17%
Consumer Staples	7,37%	3,06%	6,92%	5,95%	12,07%
Energy	6,32%	3,06%	6,15%	2,38%	3,45%
Financials	16,84%	15,31%	15,38%	9,52%	5,17%
Health Care	17,89%	10,20%	12,31%	13,10%	15,52%
Industrials	9,47%	12,24%	11,54%	17,86%	20,69%
Information Technology	8,42%	14,29%	15,38%	21,43%	18,97%
Materials	3,16%	11,22%	4,62%	4,76%	3,45%
Real Estate	4,21%	5,10%	6,92%	8,33%	5,17%
Utilities	4,21%	3,06%	8,46%	4,76%	10,34%
2017					
Communication Services	9,64%	7,07%	4,55%	2,22%	0,00%
Consumer Discretionary	18,07%	14,14%	7,58%	7,78%	6,25%
Consumer Staples	4,82%	7,07%	4,55%	8,89%	10,94%
Energy	7,23%	4,04%	5,30%	2,22%	3,13%
Financials	12,05%	20,20%	15,15%	10,00%	4,69%
Health Care	20,48%	7,07%	13,64%	14,44%	12,50%
Industrials	10,84%	9,09%	14,39%	16,67%	18,75%
Information Technology	6,02%	14,14%	16,67%	16,67%	23,44%
Materials	2,41%	9,09%	8,33%	1,11%	4,69%
Real Estate	4,82%	6,06%	5,30%	8,89%	4,69%
Utilities	3,61%	2,02%	4,55%	11,11%	10,94%
2018					
Communication Services	11,59%	5,38%	5,43%	1,92%	0,00%
Consumer Discretionary	15,94%	15,05%	10,85%	4,81%	8,11%
Consumer Staples	2,90%	7,53%	6,20%	5,77%	12,16%
Energy	5,80%	7,53%	3,88%	2,88%	2,70%
Financials	15,94%	16,13%	13,95%	14,42%	5,41%
Health Care	21,74%	7,53%	13,95%	13,46%	12,16%
Industrials	7,25%	11,83%	12,40%	21,15%	14,86%
Information Technology	7,25%	12,90%	14,73%	18,27%	21,62%
Materials	4,35%	8,60%	6,98%	2,88%	4,05%
Real Estate	2,90%	6,45%	6,98%	5,77%	6,76%
Utilities	4,35%	1,08%	4,65%	8,65%	12,16%
2019					
Communication Services	17,31%	4,21%	6,11%	0,89%	2,38%
Consumer Discretionary	17,31%	14,74%	10,69%	8,04%	5,95%
Consumer Staples	1,92%	5,26%	7,63%	6,25%	10,71%
Energy	7,69%	6,32%	4,58%	1,79%	3,57%
Financials	11,54%	20,00%	12,98%	12,50%	8,33%
Health Care	17,31%	11,58%	11,45%	14,29%	14,29%
Industrials	3,85%	11,58%	12,21%	19,64%	16,67%
Information Technology	13,46%	9,47%	13,74%	19,64%	17,86%
Materials	5,77%	6,32%	9,16%	3,57%	3,57%
Real Estate	1,92%	7,37%	6,11%	6,25%	5,95%
Utilities	1,92%	3,16%	5,34%	7,14%	10,71%

5. Discussion

In this final chapter we will discuss and comment all the results obtained by this thesis contextualizing them with the theory and the previous empirical findings from the academic literature reviewed; we will also attempt to find possible explanations for the results obtained and propose some avenues that could further expand the work. One final note before we start the discussion: throughout this thesis when presenting a topic we always preferred to separate all of its facets into different paragraphs in order to keep the discussion more organized and to provide an easier reading experience; however we decided to present all the final remarks in one continuous section, as we thought that separating them would have made them feel disjointed from one another and it would have not given this work a sense of cohesion. We can begin the discussion section by highlighting the key findings of this paper, that can be summarized into these 3 main points:

1. ESG metrics proved to be beneficial to value minded investors during the observed time frame, as we obtained higher performances for the highest rated portfolios, both when we operated, ex-post, forming our portfolios on the average ratings, and we adopted a more realistic approach based on yearly rebalancing.

2. However whatever types of benefit ESG metrics offer does appear to be outweighed by some strong from of portfolio optimization.

3. We found severe differences in the sectors distribution between the ratings, this raises some question as MSCI ESG ratings are industry based.

Starting this analysis by reviewing the theoretical background of the topic, in chapter 1 we discussed how the general sense that could be gained by reading pats empirical literature, was that ESG measures were positively related to future returns in the 1990s and early 2000s (Kempf and Osthoff, 2007, and Statman and Glushkov, 2009), that this positive relation appeared to have disappeared by the mid-2000s (Borgers et al, 2013, and Halbritter and Dorfleitner, 2015), and that more recent pieces of research hinted at return of ESG benefits in recent years (Hvidkjær, 2017, and Limkriangkrai et al 2017, and Maiti, 2020). Our research was focused on a very recent time frame, starting the analysis in 2016, and considering both past the past pieces of research

reviewed, and the historical context of a global pandemic, that brought high volatility to the stock market, we hypothesized that ESG metrics would be beneficials to value minded investors. Our empirical results showed that was indeed the case as obtained higher performances for the highest rated portfolios when those were equally weighted on both portfolio formation approaches.

While our process does not allow us to identify the origin of this sustainable outperformance, we can still formulate some educated guesses. In chapter one we presented the three most likely avenues where is possible to find value with socially responsible and ESG investing, those are: ESG related long-term benefits, the exploitation of intangibles not fully appreciated by the market, and protection during tail events. Considering that time frame observed is fairly short we are not in the conditions to make any meaningful comments regarding possible long term benefits, and in order to confidently say that ESG metrics are able to identify intangibles undervalued by the market differ types of analysis should be performed, either a sectorial one where the operations of different companies competing in the same sector are compared, or one more focused on a single ESG issue such as the work of Edmans (2011) that we mentioned in the first chapter. However, what our results strongly suggest is that the more sustainable companies handled better the financial crash caused by the pandemic. In fact, observing the results of the equally weighted, yearly rebalanced portfolios (Table 5) we can see that overall the performance where generally similar every year at every rating except in 2019-2020 when the two best performer where the two portfolios formed with highest rated companies, while the worst one is the one formed with the lowest rated. The better performance of the highest rated companies during this particular period of time is also noticeable in the two optimized sets of portfolios (Table 7 and Table 9), although the difference is less prominent the AA-AAA portfolios always generates the highest risk adjusted returns. This results appear to fall in line with the works of Lins et al (2017) that we presented in the first chapter; they observed the performance of companies during the 2008-2009 financial crisis, and, while during normal times they were unable to find any noticeable difference related to sustainability, they reported that during the crisis companies with higher ESG ratings suffered less than the lower rated ones. Also, worth nothing is the fact that the rating provider adopted for their research is the same that we use for ours, MSCI.

One objection that could be made against this theory is that highly rated companies performed better during the crisis because they bear less risk, in normal market conditions they should underperform; however in their work Lins et al did not found a reversal in returns post crisis, and while is too soon to make such a statement in our case, observing the Beta and standard deviations of the stocks (Tables 17 and 18), we can see that in the years pre-crisis there was not any particular difference in risk between highly and lowly rated companies, again indicating that this apparent risk protection offered by ESG metrics kicks in only in times of crisis. Scatter plots that further confirms this relations, not just for Beta and Standard Deviation, but for mean returns, alpha and Sharpe ratio are available in Appendix C.

Table 5 Single Stock Beta

	Mean.Beta	Max.Beta	Min.Beta	Median.Beta
2016-2017				
All	0.99	2.54	-0.24	0.99
CCCB	0.95	1.89	0.06	0.94
BB	1.03	2.00	0.07	1.02
BBB	1.00	2.54	-0.07	0.98
A	1.02	2.42	-0.24	1.04
AA-AAA	0.94	2.05	0.10	0.92
2017-2018				
All	0.90	2.01	0.04	0.92
CCCB	0.89	1.64	0.17	0.92
BB	0.93	1.81	0.22	0.91
BBB	0.92	1.72	0.06	0.93
A	0.88	1.71	0.04	0.92
AA-AAA	0.88	2.01	0.05	0.95
2018-2019				
All	0.94	2.43	-0.01	0.96
CCCB	0.92	1.90	0.12	0.88
BB	0.98	1.58	0.24	0.98
BBB	0.94	2.43	-0.01	0.95
A	0.95	1.65	0.18	1.00
AA-AAA	0.90	2.02	0.21	0.95
2019-2020				
All	1.09	2.30	0.25	1.07
CCCB	1.13	2.07	0.51	1.15
BB	1.13	2.03	0.60	1.11
BBB	1.10	2.30	0.41	1.05
A	1.08	1.78	0.25	1.09
AA-AAA	1.00	1.52	0.26	1.00

Table 4 Single Stock Standard Deviation

	Mean.STDv	Max.ST.Dv	Min.StDv	Median.StDv
2016-2017				
All	1,30%	3,97%	0,64%	1,23%
CCCB	1,34%	2,72%	0,72%	1,23%
BB	1,35%	3,83%	0,75%	1,28%
BBB	1,28%	3,97%	0,75%	1,19%
A	1,28%	3,11%	0,64%	1,17%
AA-AAA	1,22%	3,15%	0,67%	1,11%
2017-2018				
All	1,58%	3,56%	0,89%	1,50%
CCCB	1,65%	3,51%	0,96%	1,63%
BB	1,65%	3,51%	0,96%	1,63%
BBB	1,56%	3,56%	1,00%	1,49%
A	1,55%	3,42%	0,89%	1,46%
AA-AAA	1,54%	2,97%	0,97%	1,48%
2018-2019				
All	1,69%	3,79%	0,87%	1,61%
CCCB	1,74%	3,24%	0,89%	1,59%
BB	1,70%	3,04%	0,99%	1,67%
BBB	1,72%	3,79%	0,87%	1,61%
A	1,67%	3,14%	0,94%	1,63%
AA-AAA	1,59%	3,23%	0,91%	1,52%
2019-2020				
All	3,16%	7,29%	1,54%	2,97%
CCCB	3,33%	7,28%	1,91%	3,06%
BB	3,32%	7,29%	1,77%	3,23%
BBB	3,21%	6,99%	1,54%	2,97%
A	3,13%	6,09%	1,79%	2,94%
AA-AAA	2,82%	4,88%	1,64%	2,77%

Our research is not the first one to report an ESG outperformance in 2020, as we discussed in the first chapter: from the practitioners' side, Blackrock reported better risk-adjusted performance across sustainable investment products (Blackrock, 2021), Morningstar stated that

24 out of its 26 sustainable index funds outperformed their conventional version (Hale, 2020); from the providers point of view, MSCI reported that all four of its ESG focused indexes outperformed their traditional counterparts (Giese and Nagy, 2020); and finally from academia, pieces of research that reports results comparable to ours such as the works of Ferriani and Natali (2020), who reported the outperformance of highly rated ESG companies according to the Morningstar's ESG risk indicators, and Broadstock et al (2021), who focused their research on the Chinese market. However, since we are still too close to the to the event, it is too soon to draw definitive conclusions on the matter, as some repercussion may still occur, moreover papers that dispute the outperformance of sustainable companies during the COVID-19 crisis are being published (Folger-Laronde, et al 2020), and are still been worked on (Demers et al, 2021). That said, what ours, and the other positive results that we mentioned, attests is that this a theme that merits further exploration, both in the general sense, testing the Lins et al theory that ESG offers protection during tail events, and more in the specific observing how ESG affected financial performance during and post pandemic.

However, when we integrated portfolio optimization into our process the benefits that we were able to observe with the equally weighted portfolios were mostly neutered as we could not find major differentiation based on sustainability. What we could note is that for the minimum variance portfolios, the ones formed with more sustainable stocks were also the less risky both in term of beta and volatility in the full run (Table 6) meaning that they were the ones that better satisfied the goal of the optimization strategy. On the other hand for the tangency portfolios in the full run (Table 8) we were not able to report any observable difference, but the most sustainable portfolio was clearly the best performer during 2020, which is an indication for two factors: first, this is further confirmation that the more sustainable companies performed better during the crisis, and second, this also indicated that the benefits offered by ESG metrics in this period could have been outweighed by good portfolio management, as in the full run other groups of stocks that are not the most sustainable obtained better results. Nonetheless we feel necessary to once again reiterate on the fact that the approach that we adopted was strictly theorical and that the forms of optimization that we used were, intentionally, very extreme and unrealistic, aimed to represent extreme cases; as such, while our results can be used as indication on where to start additional research they cannot absolutely be interpreted as definitive. Our

recommendation to further explore the interaction between ESG metrics and portfolio optimization would be to operate in a similar manner to how Barber, Morse, and Yasuda (2021) analysed the impact investing space, which is to observe and compare the work of practitioners in the field. While this it would add the variable of the ability of the portfolio manager into the analysis, we still strongly believe that the benefits of that approach outweigh its drawbacks as operating in a more theoretical manner would require many assumption that may skew the analysis even more than a real world observation.

Continuing our review by discussing our second hypothesis, we theorized that noticeable performance improvement would have been visible at every ESG rating. While, again, the short time frame of our analysis does not allow us to claim that our results are definitive, we still believe that we have enough data to say that this hypothesis was false, as, regardless of how we optimized the portfolios, we could never observe clear benefits at each rating increase; the closer we could get to observe something similar to what we hypothesized was with the full run of the yearly rebalanced equally weighted portfolios, as the performance improved at every rating with the exception of the jump from BB to BBB. Overall, what we can observe throughout most of the portfolios that we created is that ESG offered some general benefits to investors, those are not so specific that clear differences are observable at every rating changes. This leads us to another question that we tried to explore during our analysis, which is whether ESG ratings could be compared to more traditional financial measures such as Beta and standard deviation. As for everything we are discussing we still want to reiterate on the fact that our research was focused on very specific time frame and on a very specific group of stocks, we are able to make comments only in the confines of our time frame and our observed sample; with this precaution made clear, we can say ESG rating cannot be compared neither to Beta nor to Standard Deviation: a stock with an high Beta is more sensible to the changes of the market, the price a stock with high standard deviation has more fluctuation, while a company with lower ESG ratings is exposed to more risk, but not necessarily those risk would translate into inferior financial performance. However, we do believe that we approached this issue incorrectly as an analysis not centred on the final rating, but on the evaluation of specific key issues may be more beneficial when comparing ESG metrics to traditional financial measures. It is, in fact, possible that the reason why we cannot observe clear benefits at every rating is that the final score encompass such a

broad spectrum of themes and issues that the differences between the non-tail ratings may be neutered in certain periods, as a company may score generally worse than its competitor in most issues but is better equipped in one particular category that may be the most influential in a particular time. To conclude the discussion regarding these two points we would like to propose some recommendations in the case someone would want to expand this portion of the analysis both in the observation of the performance at different ESG ratings: first, if the intention is to observe the final score as offered by the provider both the time frame and the observed sample must be expanded. In our case we came the closest to observe a clear distinction between each rating only when we observed the full run; it is possible that with a longer time frame and a bigger observed sample, the differentiation between the highly rated and lowly rated stocks may become more clear so that it would be appreciable even for non-tail ratings. Second if the intention is to compare ESG to more traditional metrics we would recommend to start not with the final score but with an individual valuation of each key issue; the main complication with this approach would come with the fact that it would require the direct approval from the provider, as, for example MSCI prohibits any form modifications of its ratings made without prior consent, however we do believe that this approach would help to identify where exactly the outperformance signalled by ESG is originated.

The last element that we want to discuss is the disparity in representation between sectors in the different ratings; these findings gave us pause as MSCI ratings are industry based, and, while a certain level of disparity, especially at the tails, is to be expected, we were surprised to find this high of a difference as, for example, Communication Services was completely absent from the leaders in three out of four year examined. Disparities such as this would not have been surprising were the rating absolute, but since, again, they are industry based, meaning that they represent the sustainability of a company relative to its industry peers are harder to explain because, although the S&P 500 is not exactly representative of the whole market, it is formed by 500 of the largest companies in the US market, thus differences in representation such as the ones we found are indicative of some type of bias in the rating. To exactly point at explanation, without some additional research, would be disingenuous on our part however we would like to propose some possible hypothesis that could be used as starting points for future examinations. One possible explanation is that it may be more beneficial for large companies to comply to ESG

principles, in certain sectors compared to others, thus the S&P 500 would be more populated by sustainable companies in sectors where ESG principles are beneficial factors and by less sustainable in sectors where those principle are not impactful to the core business. Another explanation would be that is simply easier for large companies in certain field to achieve higher score compared to others, this would hint either to some type of bias intrinsic in the scoring system that would favour certain sectors over others, or to the fact that in certain field there are more ESG related challenges that come with scale so that the larger companies tend to be overall less sustainable. However, regardless of where these differences may be originated, what this line of questioning suggests is the need to not only study the effectiveness of ESG ratings as financial indicators but the actual nature of the ratings themselves. Example of this type of research are the work from Drempetic, Klein and Zwergel, (2019), that points out the positive correlation between final ratings and company size, or the work from Berg, Fabisik and Sautner (2021) that reports "widespread changes to the historical ratings" that poses serious complications for researchers and professionals. One point of commonality between these two pieces of research is the fact that they both adopt the ASSET4 database as object of their analysis, in fact, to the best of our knowledge, no research of this type has ever been conducted on MSCI's database, thus creating a conspicuous gap in literature that needs to be filled. Out of the possible avenue of expansion of our research that we proposed during this chapter, we strongly believe that this should be considered as the most important, because any type of results coming from other lines of research, could be put into question if serious doubts are put on the nature itself of ESG data.

Conclusions

Sustainable and Responsible Investing is a field of finance that, in recent years, is experiencing a surge in popularity; in the US market alone, the assets under professional management that adopt some form of sustainable investing strategy grew from $12.0 trillion to $ 17.1 trillion between 2018 and 2020, and they now represents roughly one third of the whole market (US SIF 2020). What we wanted to offer through this thesis was a comprehensive insight into this field of finance and in particular, into ESG integration the most popular form of this investment approach; in order to accomplish that, we decided to structure our work in a manner that could be useful for both a reader that was already versed in the field and for someone who was not.

The approach that we used for satisfy both of these audiences was to construct an empirical study based on publicly accessible data focused on a time frame where a consensus on the effectiveness of ESG measures was not reached yet (e.g. Ferriani and Natali, 2020 and Demers et al, 2021). Our empirical analysis consisted in constructing portfolios formed by stock from the S&P 500 and rated according the MSCI ESG database, and compare their performance between 2016 and 2020 under traditional financial metrics such as Beta, Jensen's alpha and Sharpe Ratio. The main elements that we wanted to observe were whether there were any benefits in integrating ESG into our portfolio making process, if it was possible to observe some differences in financial performance at every different score, if ESG metrics could be compared to existing and more established financial indicators such as Beta and Standard Deviation, and finally whether the eventual benefits offered by sustainable metrics could be enhanced or neutered by portfolio optimization.

What we found was that when we did not introduced any form of optimization the portfolios formed with the more sustainable stocks outperformed the others, indicating some sort of benefits in ESG investing during this time frame; the benefit was particularly apparent when the observation was focused solely on last's year performance signalling that more sustainable company handled better the financial crisis caused by the pandemic; however when we introduced optimization the difference in performance between different sustainability level were mostly neutered. Regarding the final two questions, we did not observe clear differences between the individual scores, and we did not find the comparison between ESG and standard

deviation or Beta to be fitting. One interesting element that we observed was a great disparity in representation between GICS sectors at different rating, which we did not expect as MSCI ratings are industry based.

Although all of the results that we obtained do not allow us to make any definitive statement, we do believe that they could be used as an indication to where to expand future research; in the final chapter we proposed some recommendations that in our opinion could be a valuable addition and could improve the existing literature. Out of all the possibilities that we proposed, the one that we believe to be the most crucial, is the need for pieces of research that investigate the nature itself of MSCI ESG ratings, akin to the works made on the ASSET4 database such as the ones by Drempetic, Klein and Zwergel, (2019), that observed the size bias of the ratings and by Berg, Fabisik and Sautner (2021) that noted several changes in historical ratings.

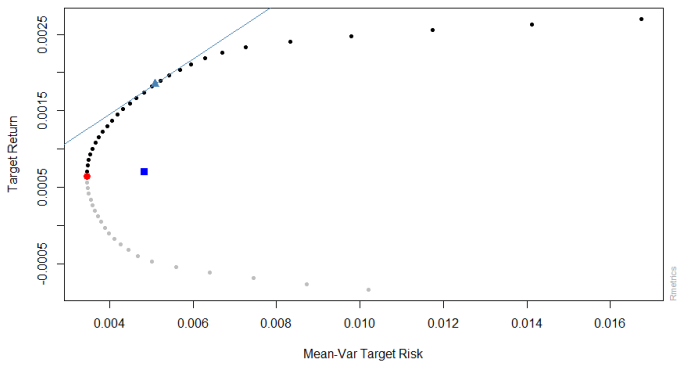
As a final note we would like to offer recommendation regarding some of the choices that we decided to adopt when we designed our research. First, the decision to operate with publicly accessible data, while instrumental in our goal of broadening the appeal of the research was a limitation especially in regard of the time frame that we were able to observe as the earliest available data was from 2016. Second, the decision to adopt an approach strictly theoretical and without assumptions, following examples of past empirical literature such as Kempf and Osthoff (2007), Statman and Glushkov (2009), Halbritter and Dorfleitner, (2015), was helpful as it allowed us to focus on testing the effectiveness of the scoring system, but it also limited us in certain areas, especially when we had to decide how to optimize our portfolios. While we do not regret our decisions as they helped us to shape our thesis, we still wanted to highlight the complications and limitations that we encountered as a result.

Appendix A: Markowitz efficient frontier

In this appendix we show the efficient frontier for all the portfolio formed following the yearly rebalanced approach, the reasoning that went behind the formation of these portfolios is explained in Chapter 3, while their results are shown in Chapter 4. The graph were created in R using the command portfolioFrontier from the R package "fPortfolio" (Wuertz et al, 2020) adding the constraint "longonly"; in each graph the red dot represent the Minimum variance portfolio, the light blue triangle the tangency portfolio, and the blue square the equally weighted portfolio.

CCC-B

Figure A-1 2016



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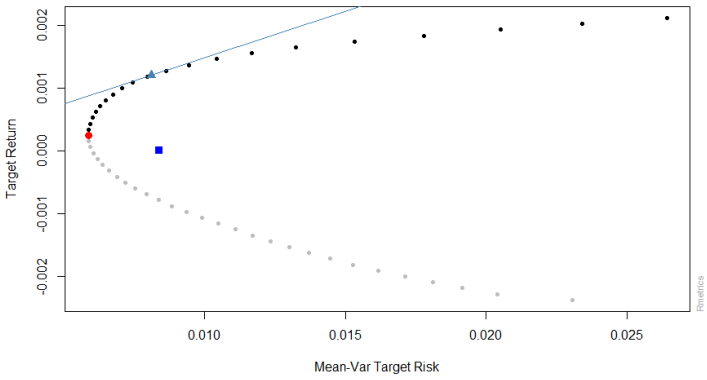

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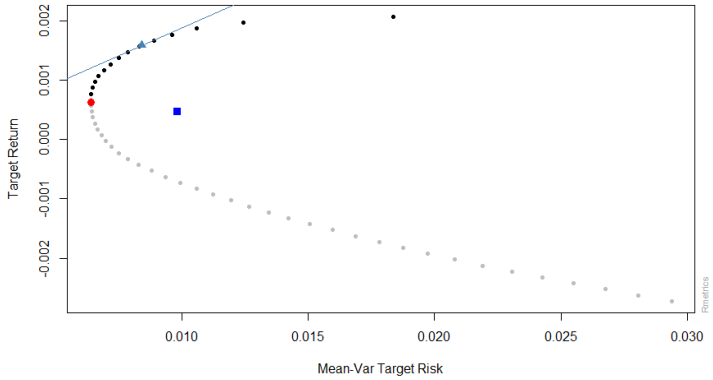

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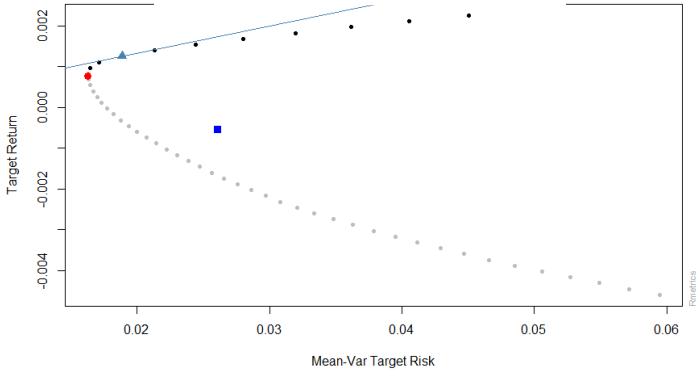

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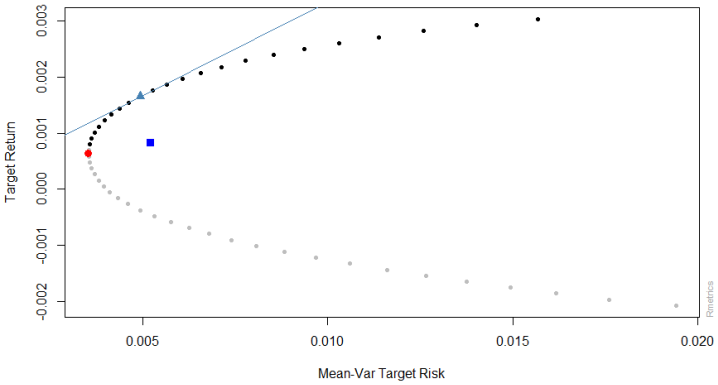

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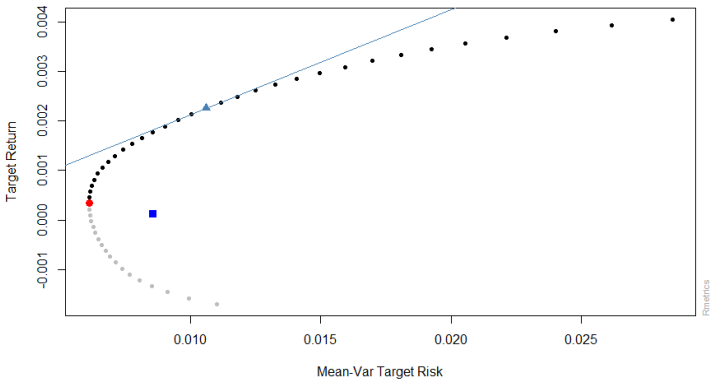

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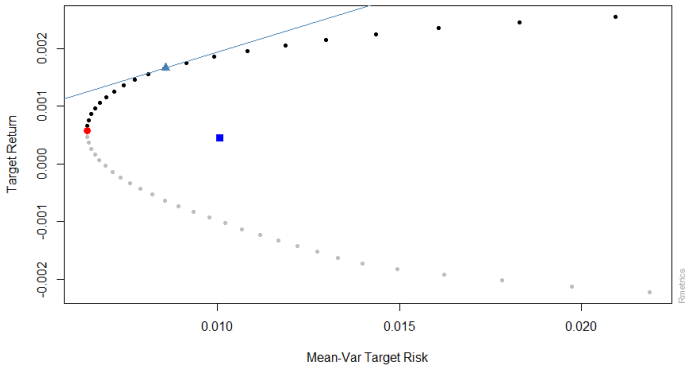

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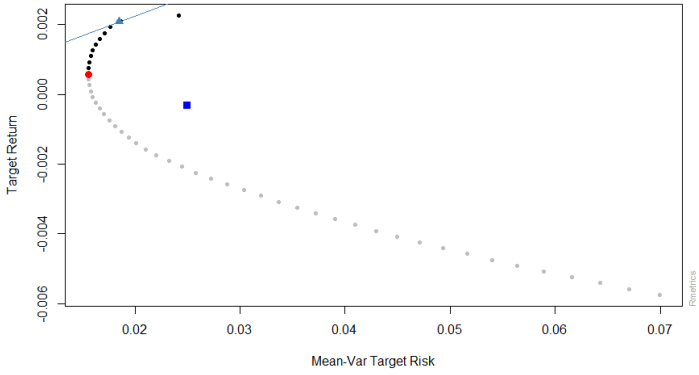

BBB

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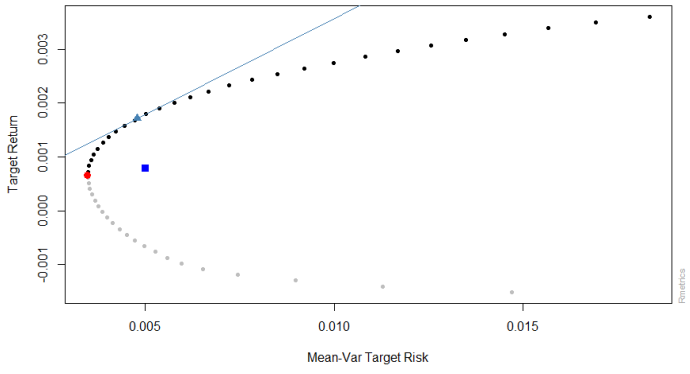

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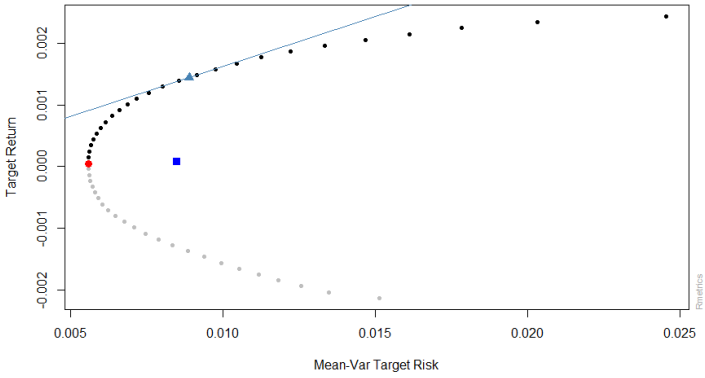

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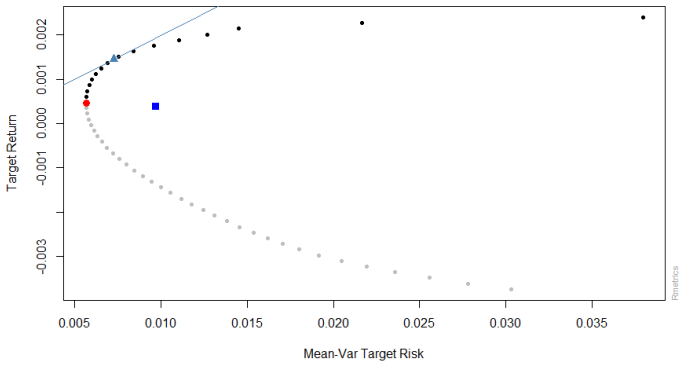

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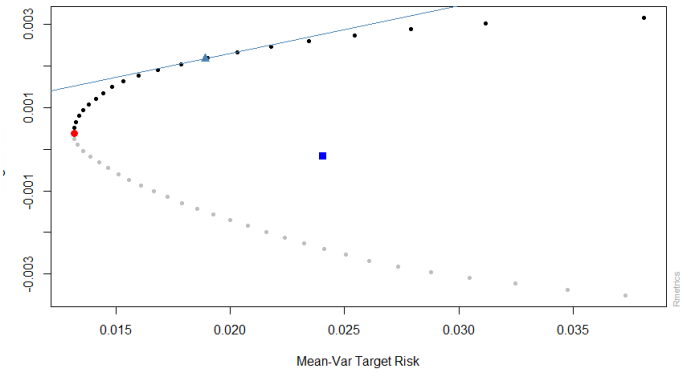

A

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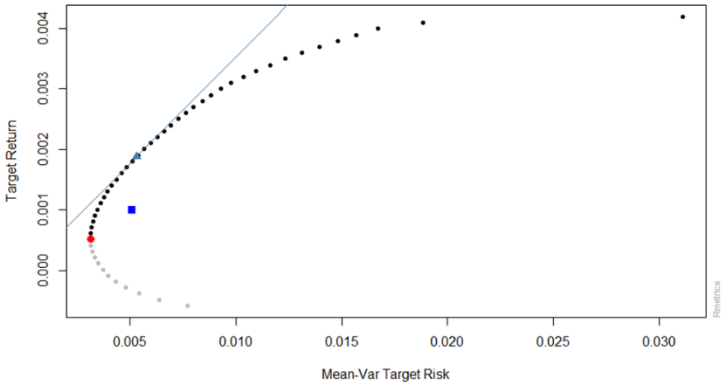

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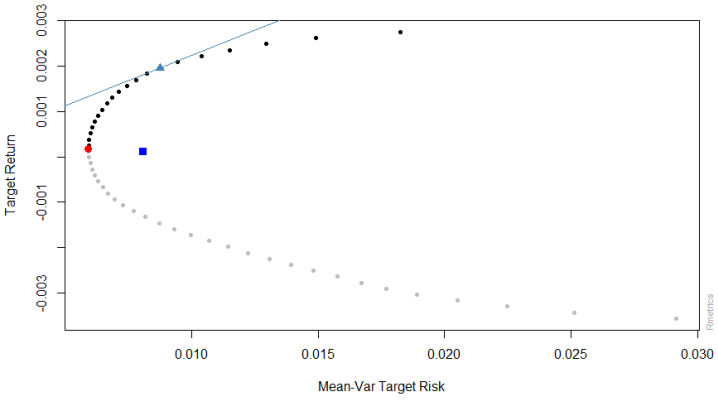

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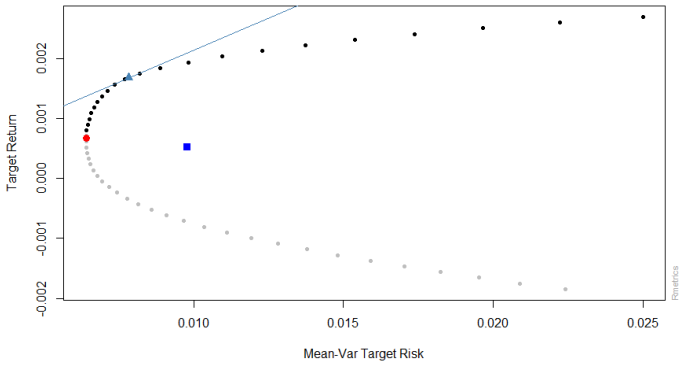

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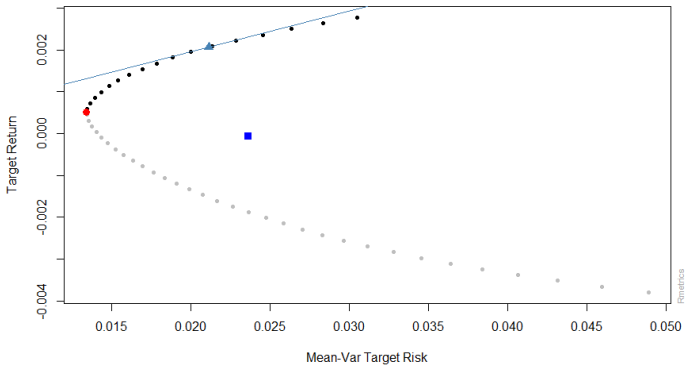

AA-AAA

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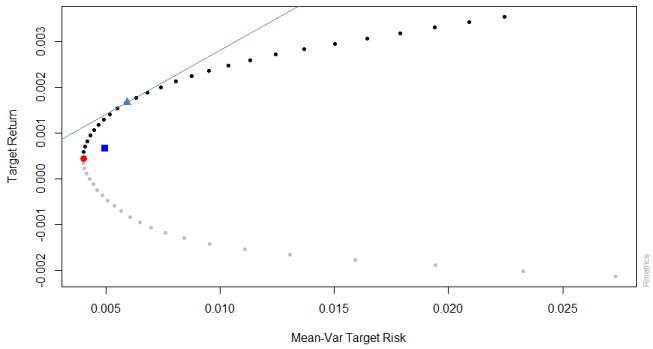

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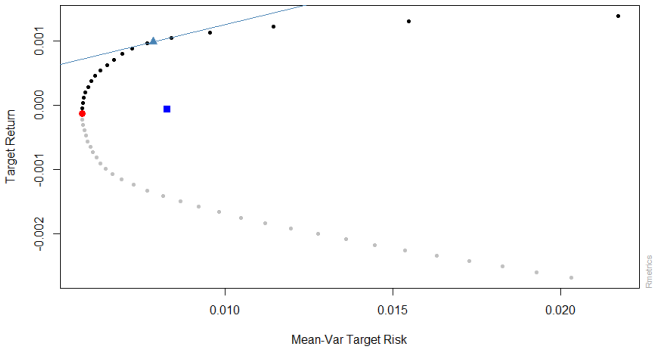

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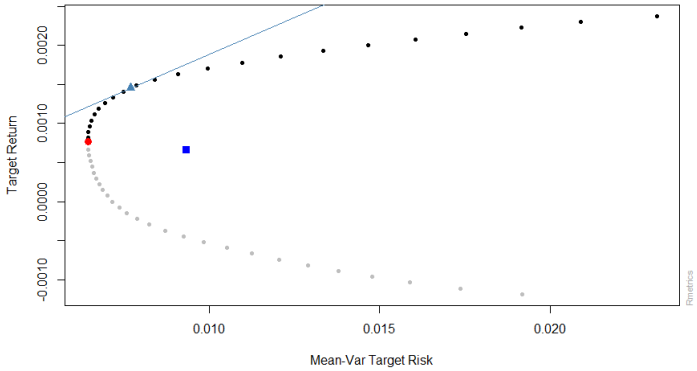

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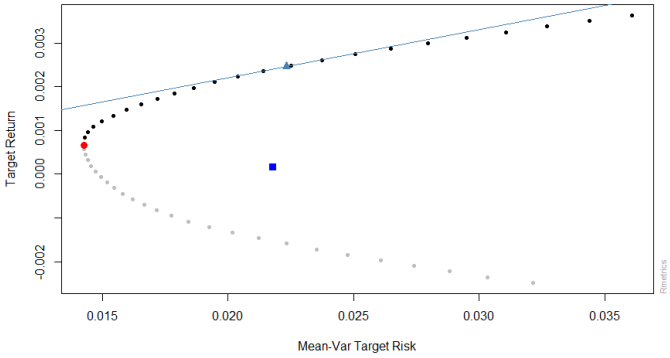


Appendix B: Performance graphs for GICS sectors

In this appendix we present the performance graph for every GICS sector compared to the SPY ETF.

Figure B-1 Consumer Services VS SPY ETF

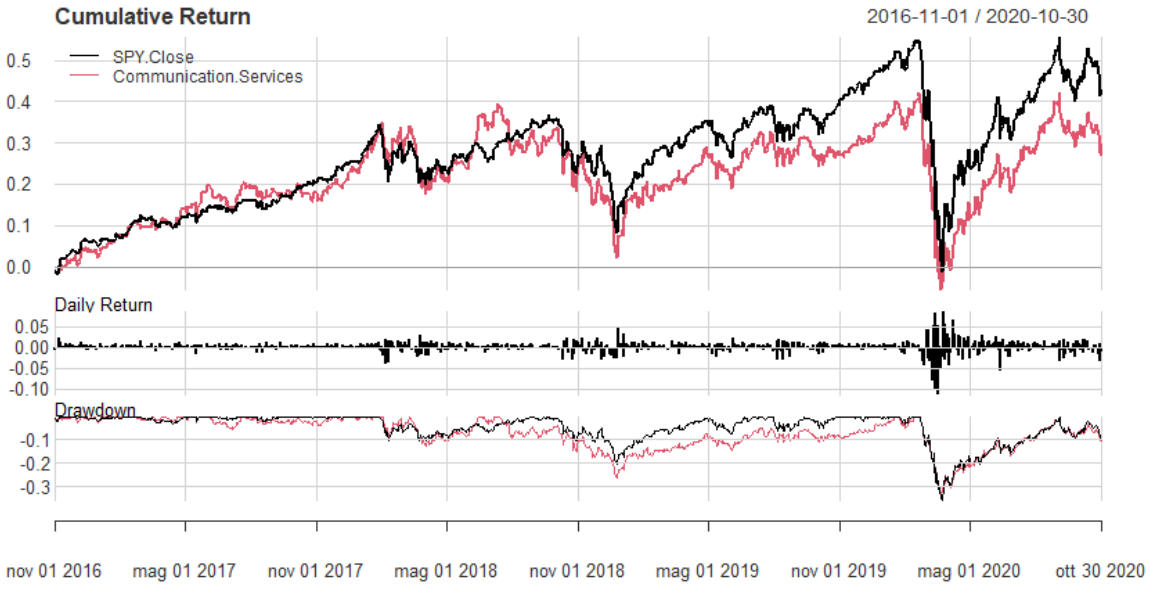


Figure B-2 Consumer Discretionary VS SPY ETF

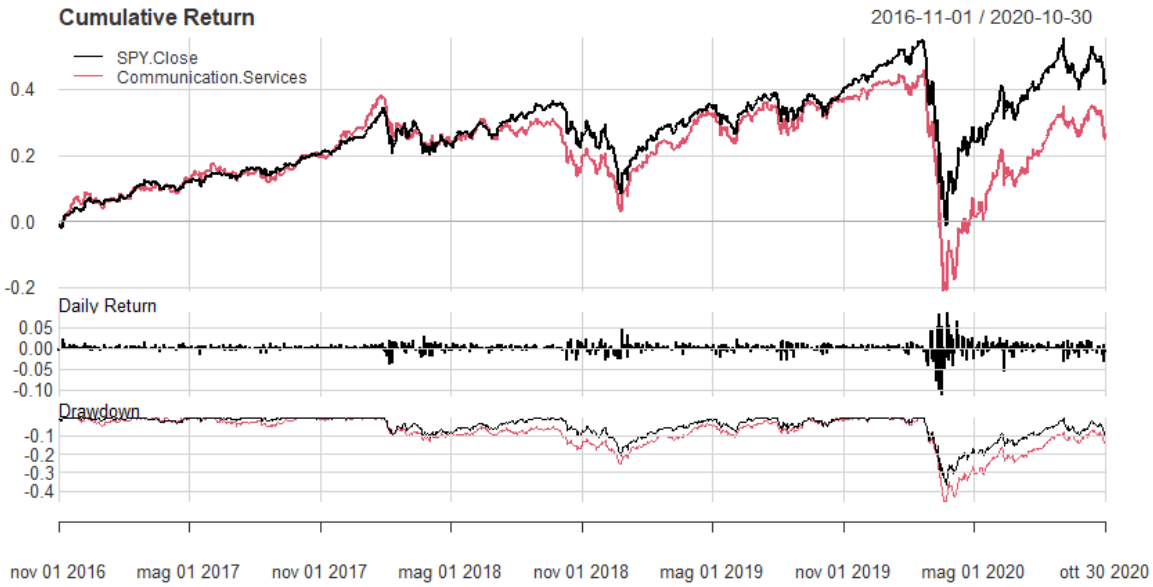


Figure B-3 Consumer Staples VS SPY ETF

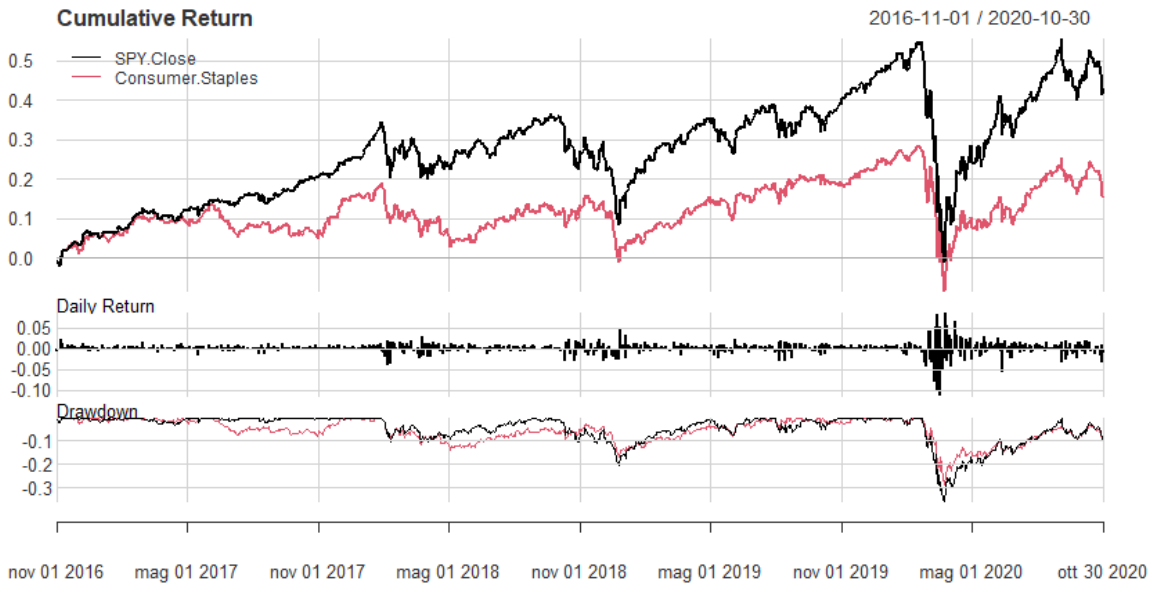


Figure B-4 Energy VS SPY ETF

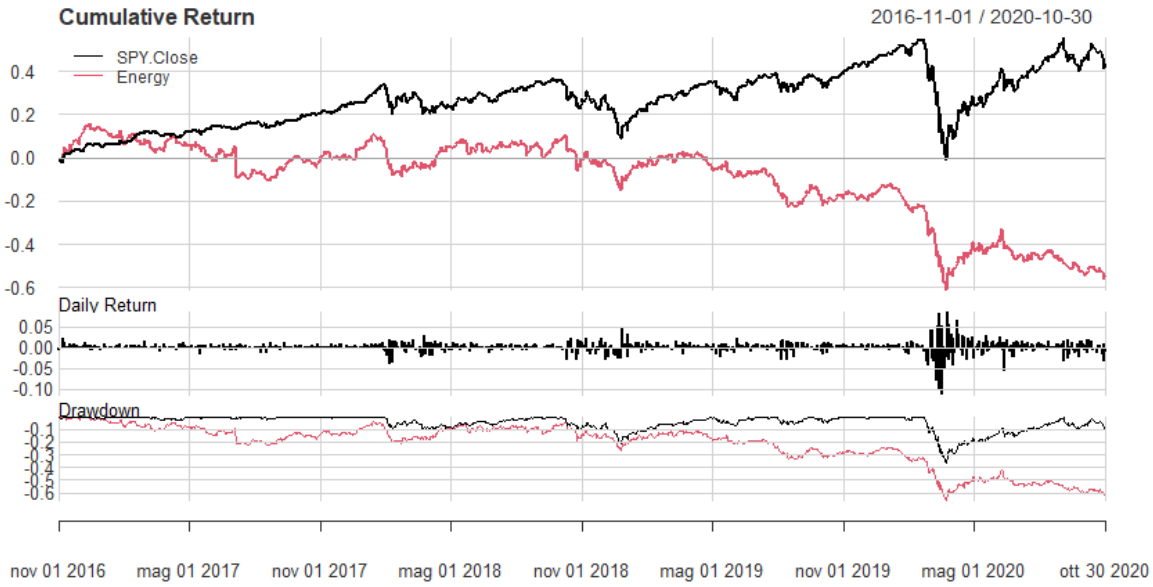


Figure B-5 Financials VS SPY ETF

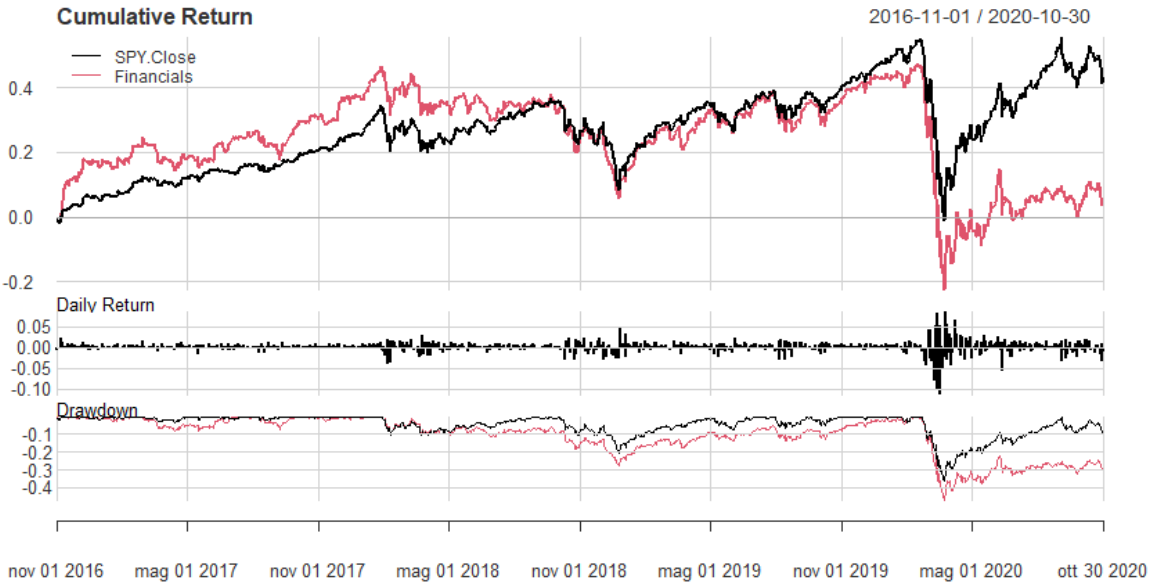


Figure B-68 Industrials VS SPY ETF

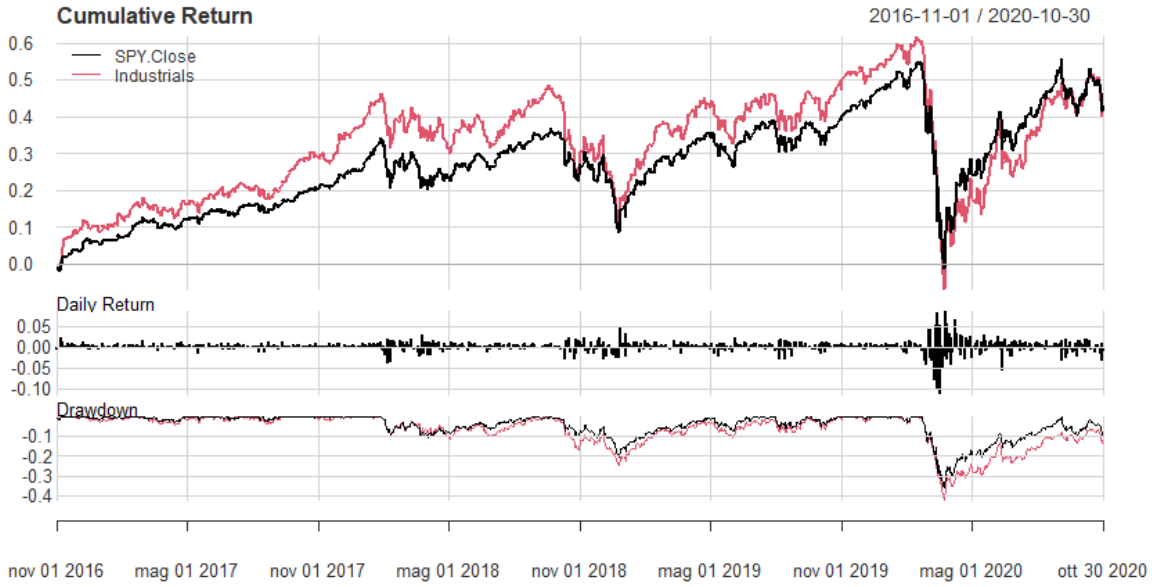


Figure B-7 Information Technology VS SPY ETF

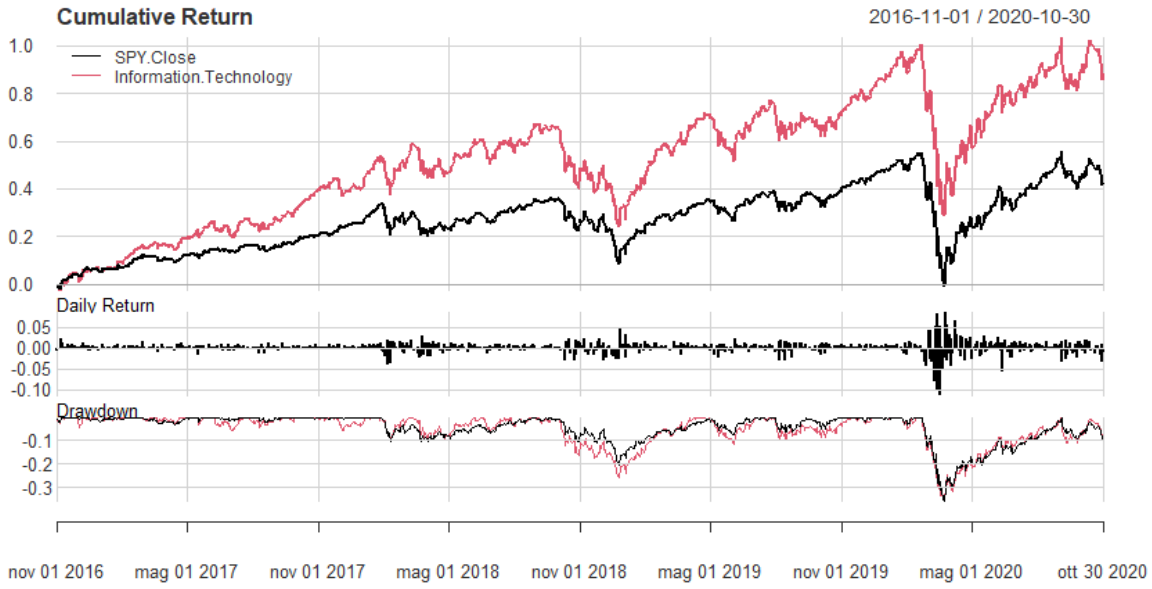


Figure B-8 Materials VS SPY ETF

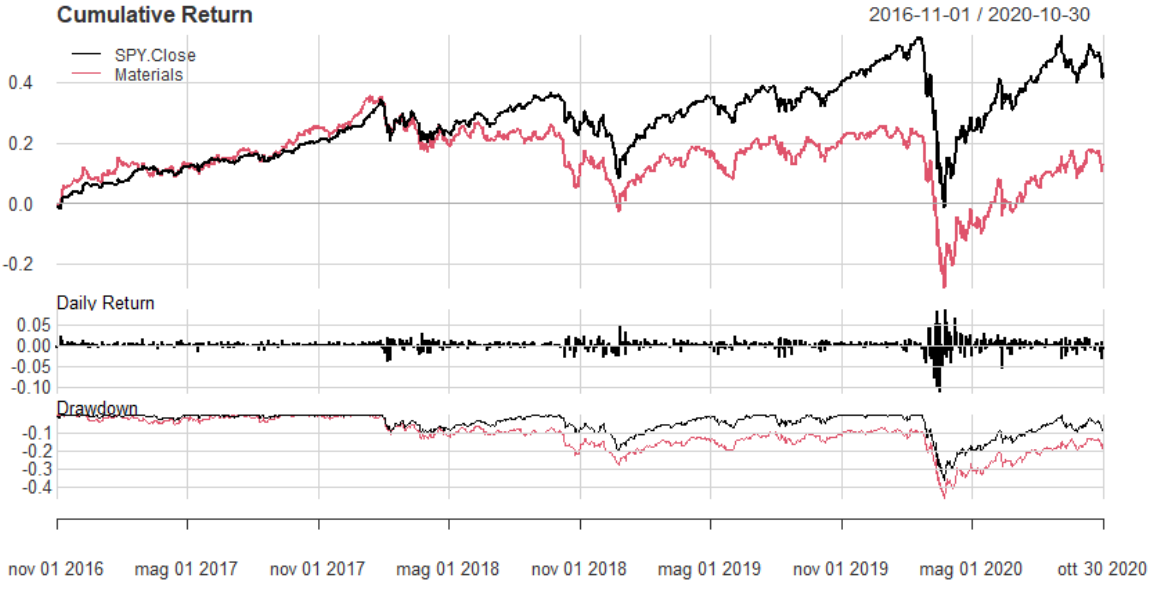


Figure B-9 Health Care VS SPY ETF

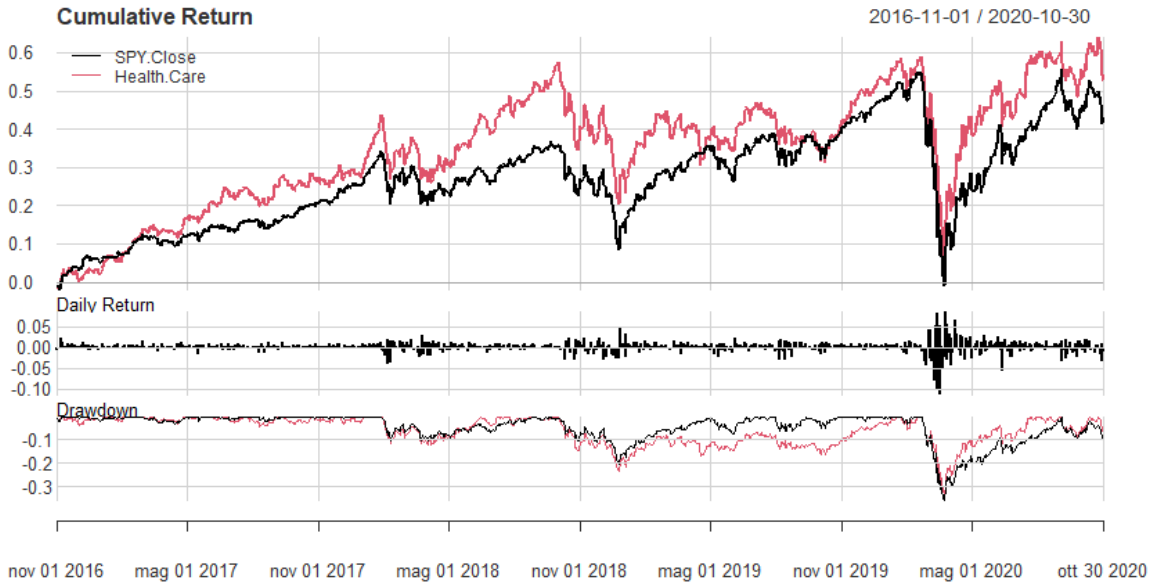


Figure B-10 Real Estate VS SPY ETF

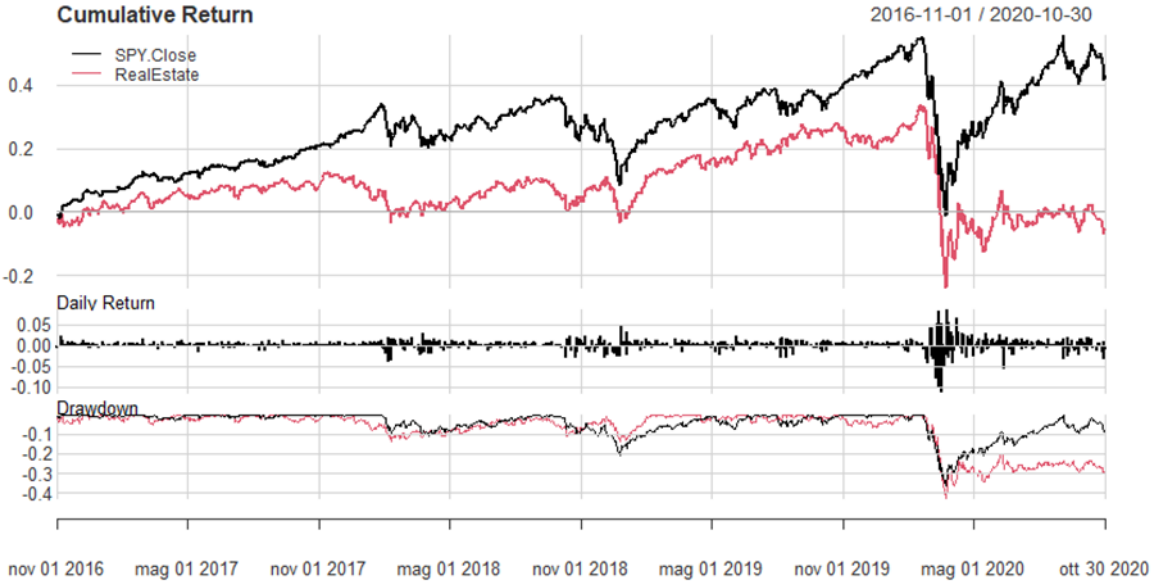
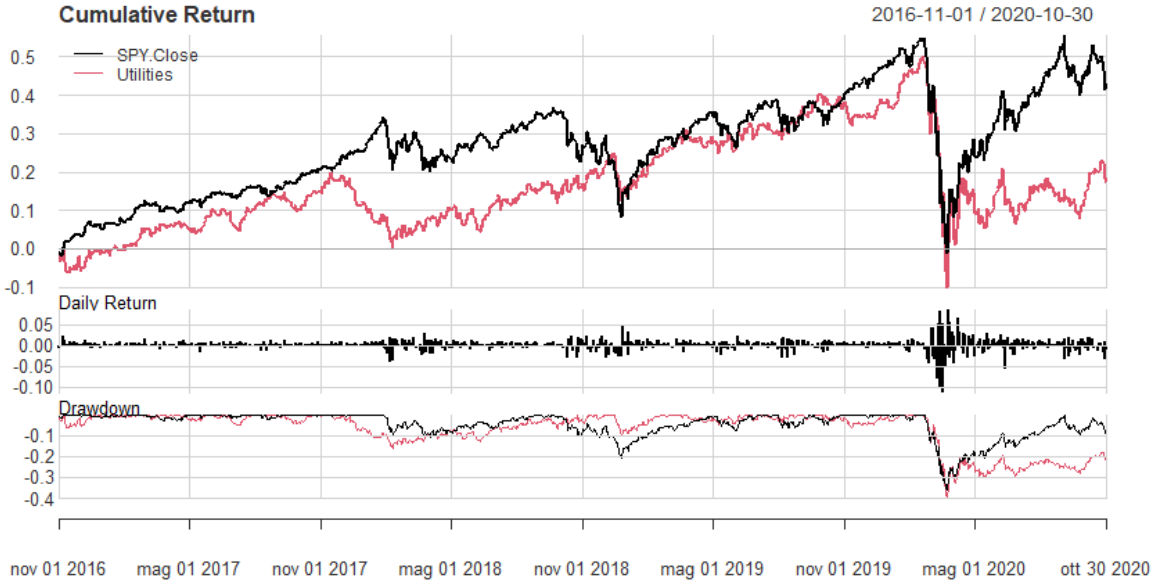


Figure B-11 Utilities VS SPY ETF



Appendix C: Scatter Plots

The following graphs are scatter plots that shows the level of Mean returns, standard deviation, Beta, Alpha, and Sharpe ratio for every single stock, every single year; what is particularly interesting about these is fact that for the three year prior to last all metrics are quite similar, but in 2019-2020 the more sustainable stocks appear to be overall the best performers. All the graphs have the ESG score converted to number in on the x axis an the metric is on the y axis, one important note is the fact during the portfolio formation we unified the two best and two worst scores respectively, here however they are all divided, hence the reason for the fact that we have 7 columns in the graphs and 5 portfolios

Mean Returns

Figure C-1 Mean returns 2016-2017

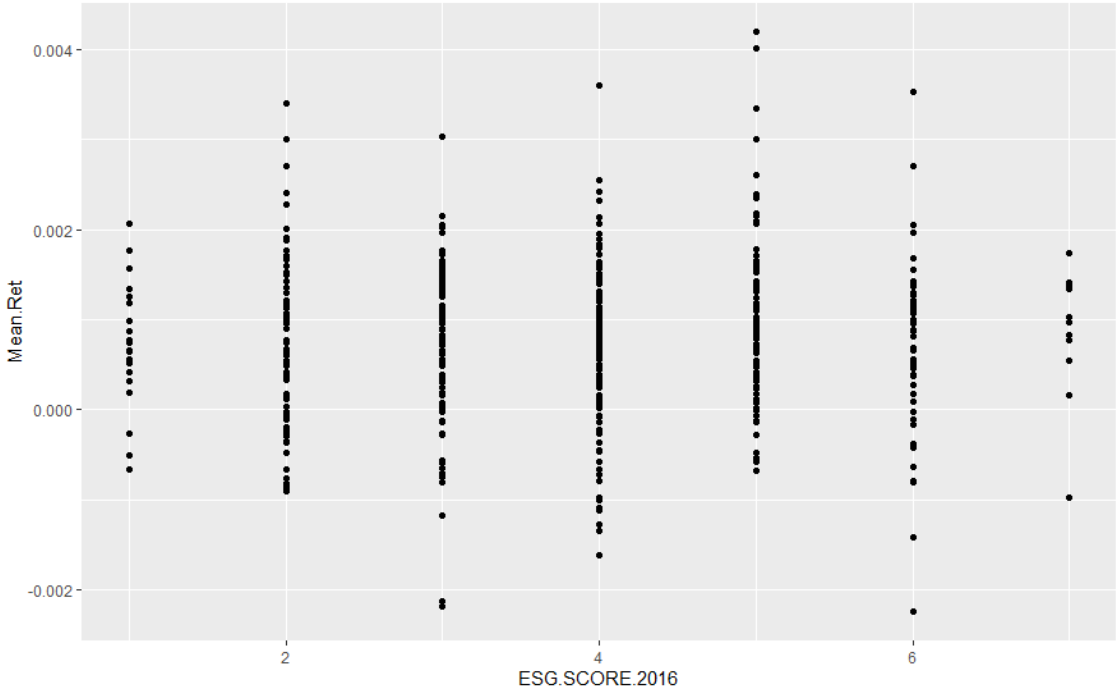


Figure C-2 Mean returns 2017-2018

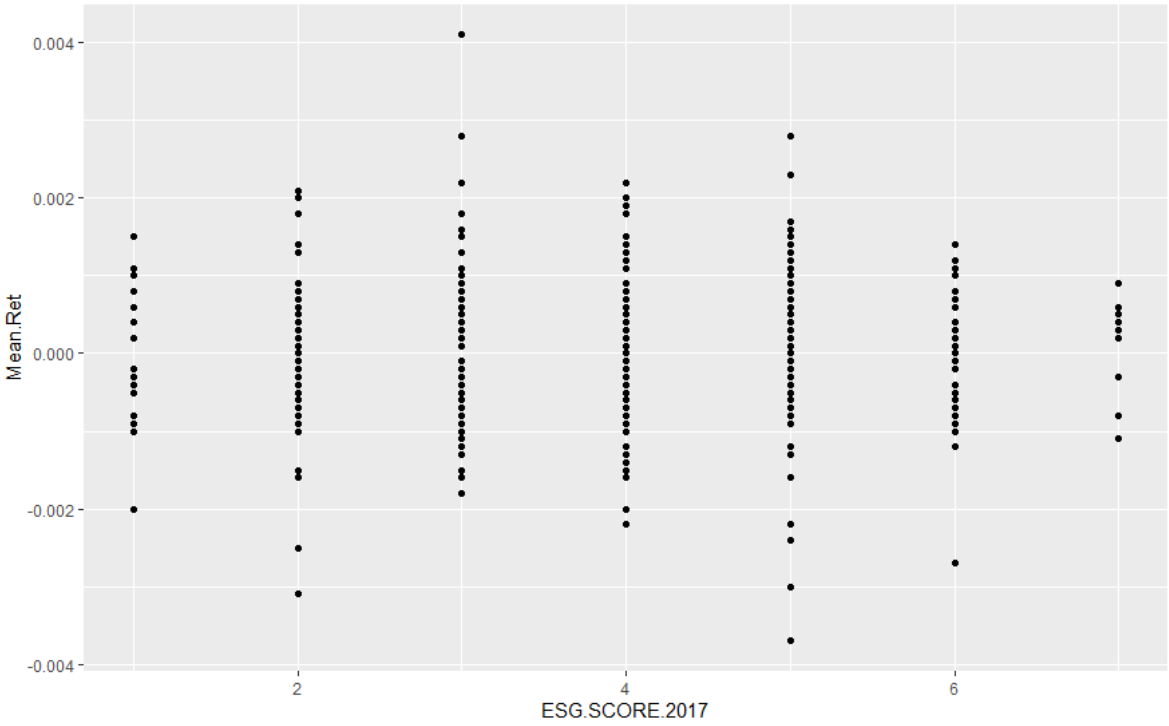


Figure C-39 Mean returns 2018-2019

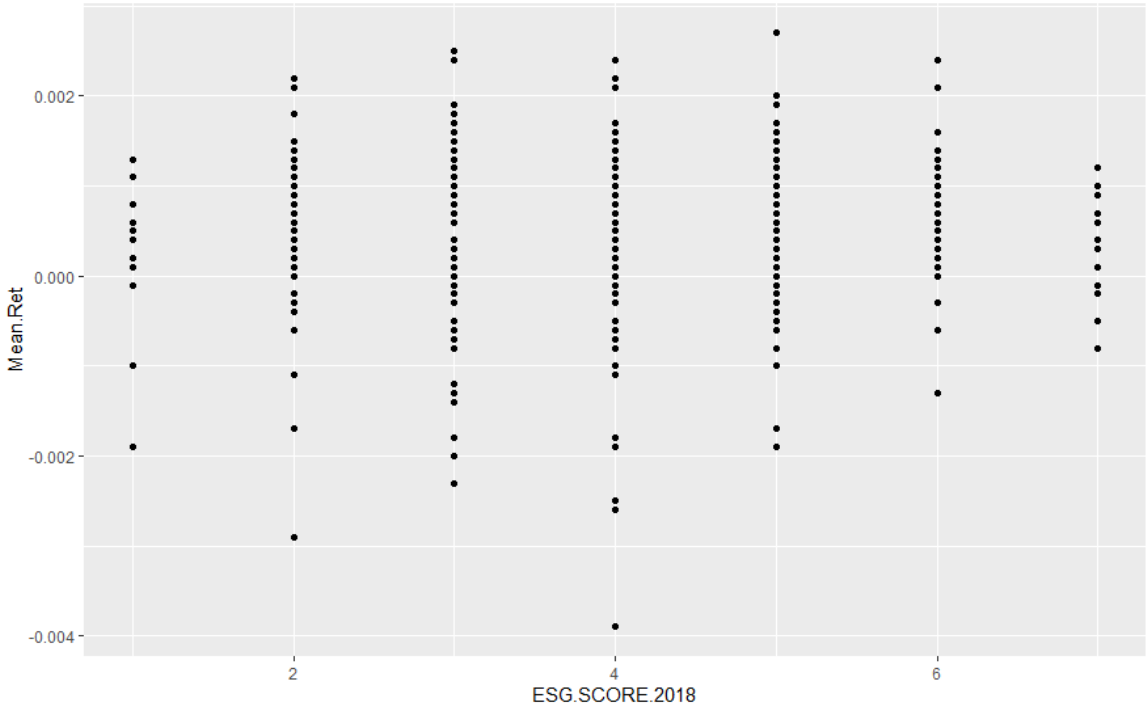
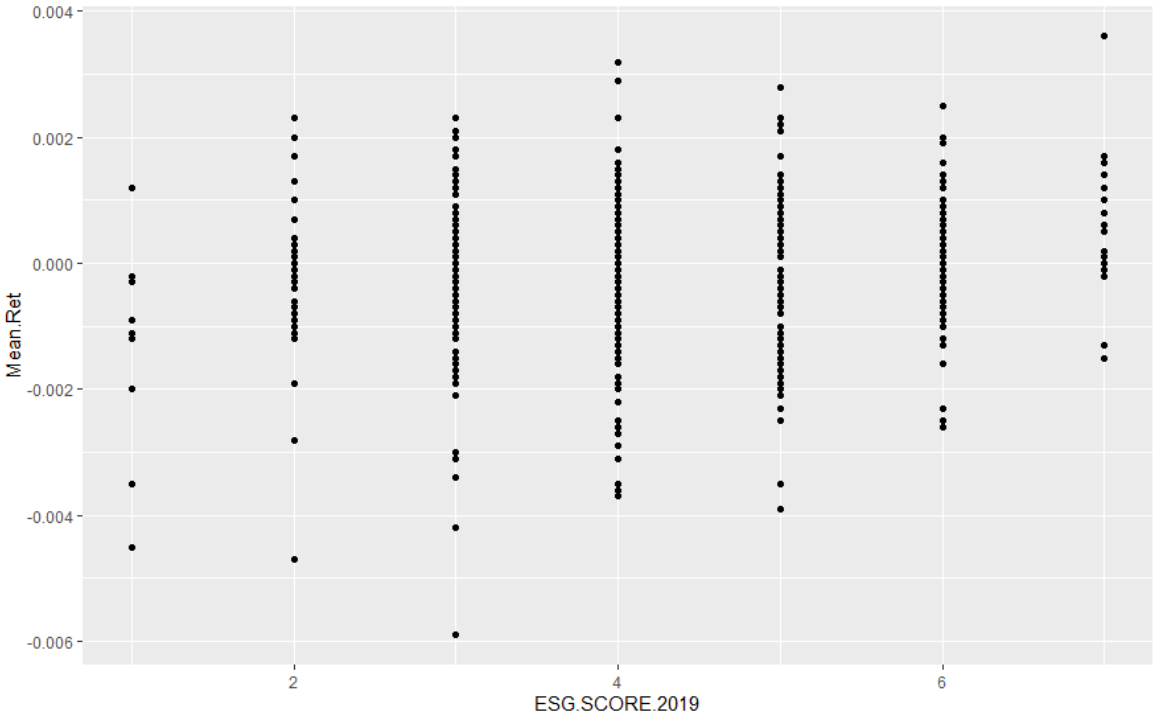


Figure 10-4 Mean returns 2019-2020



Standard Deviation

Figure C-5 Standard Deviation 2016-2017

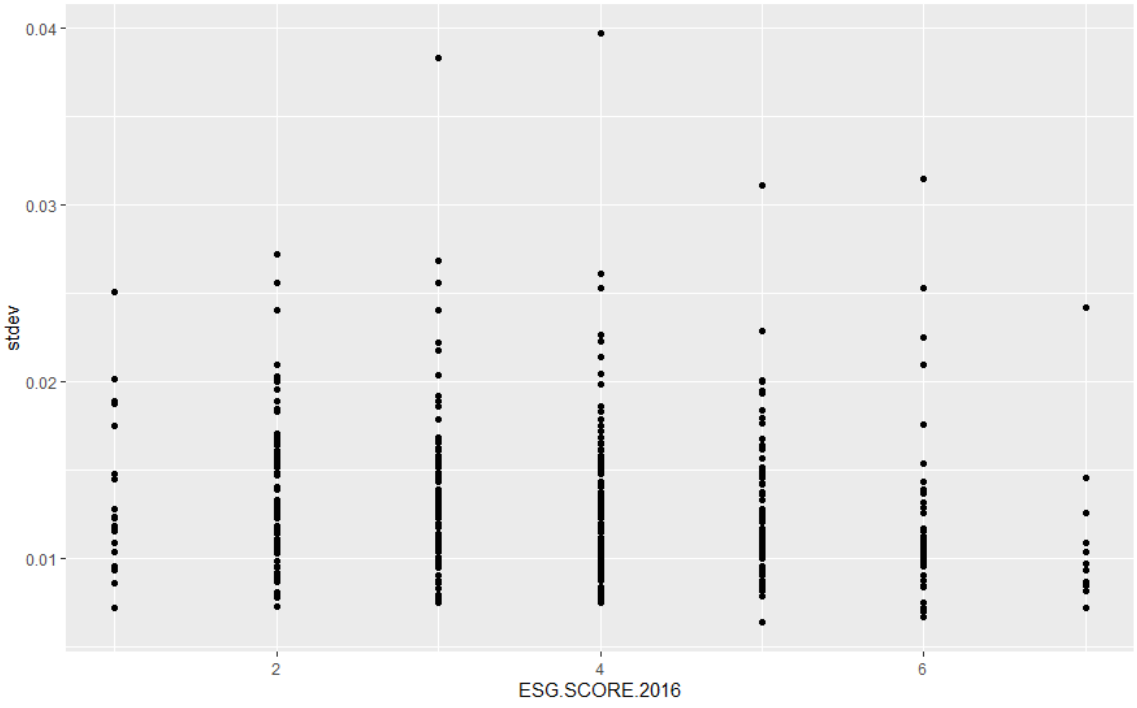


Figure C-6 Standard Deviation 2017-2018

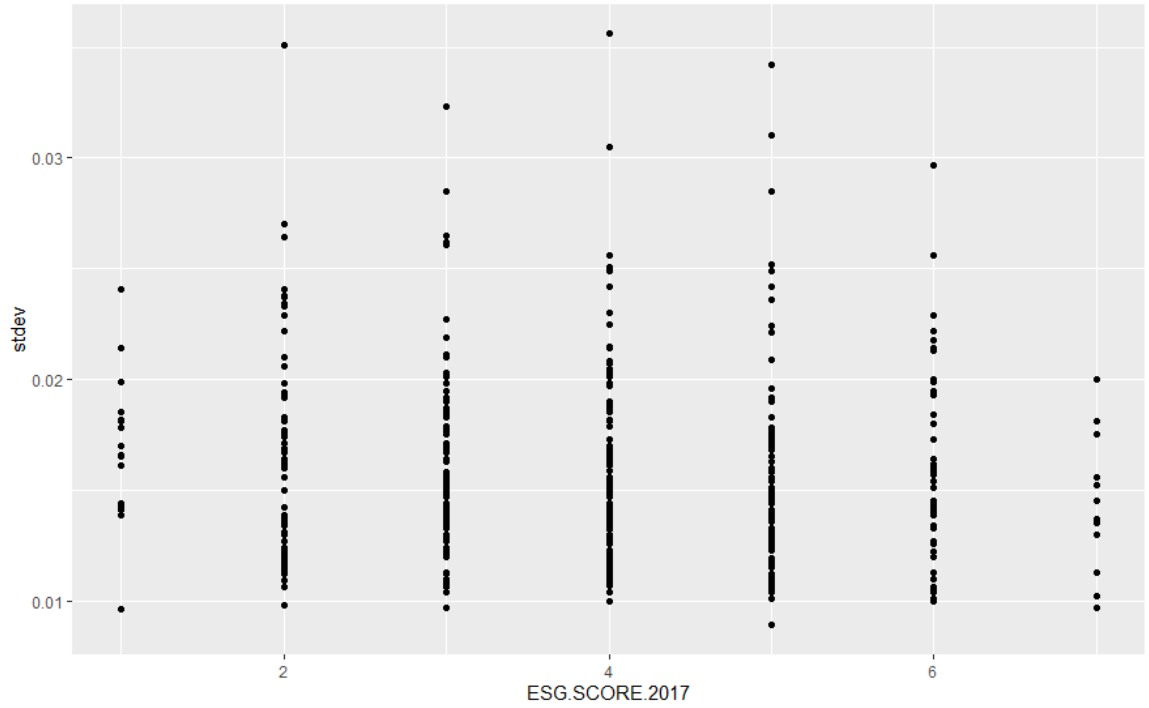


Figure C-7 Standard Deviation 2018-2019

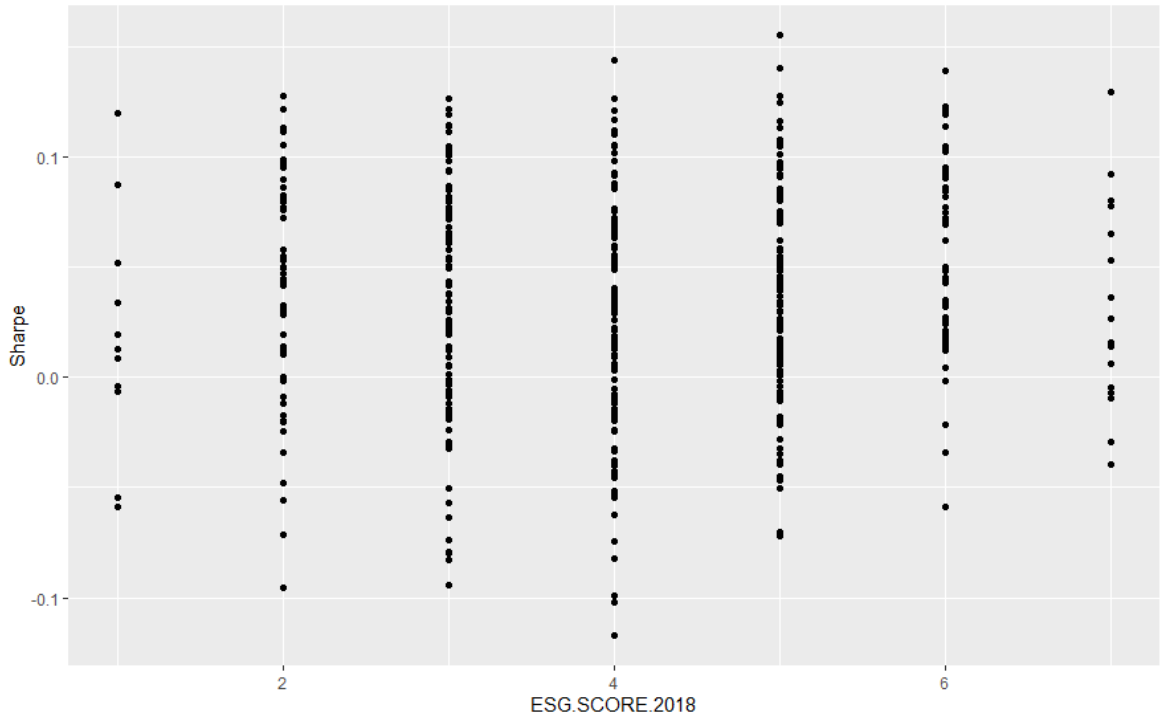
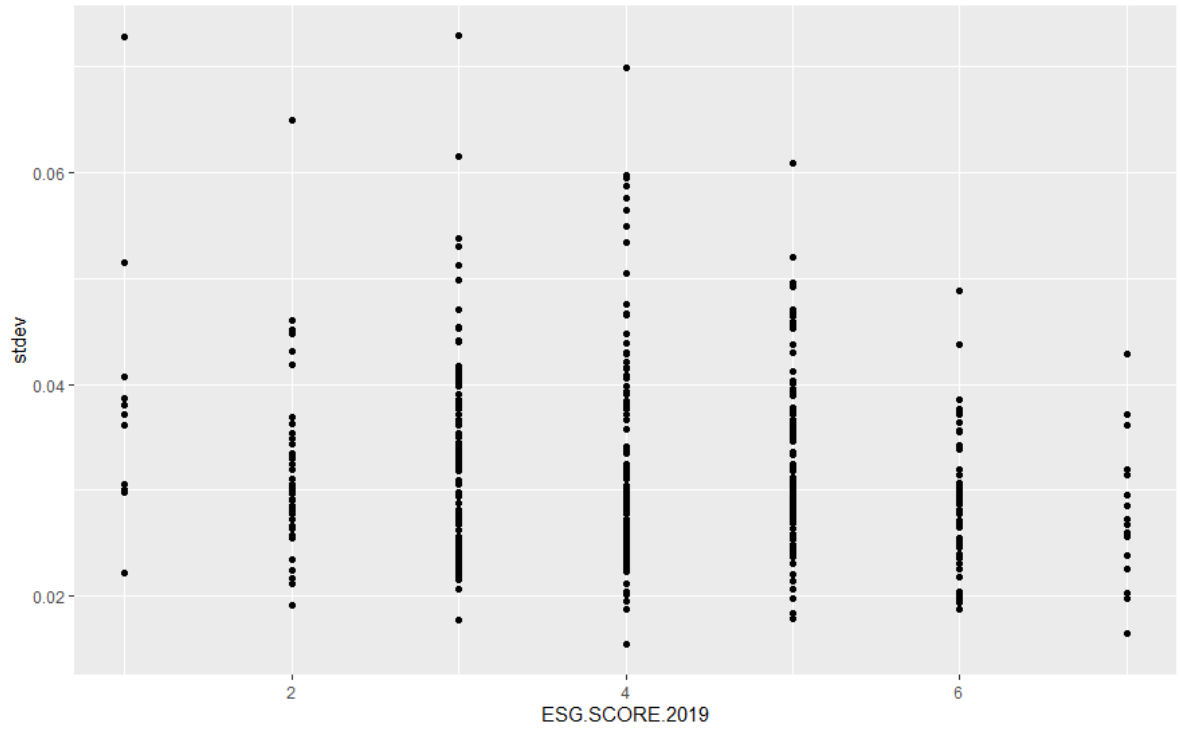


Figure C-8 Standard Deviation 2019-2020



Beta

Figure C-9 Beta 2016-2017

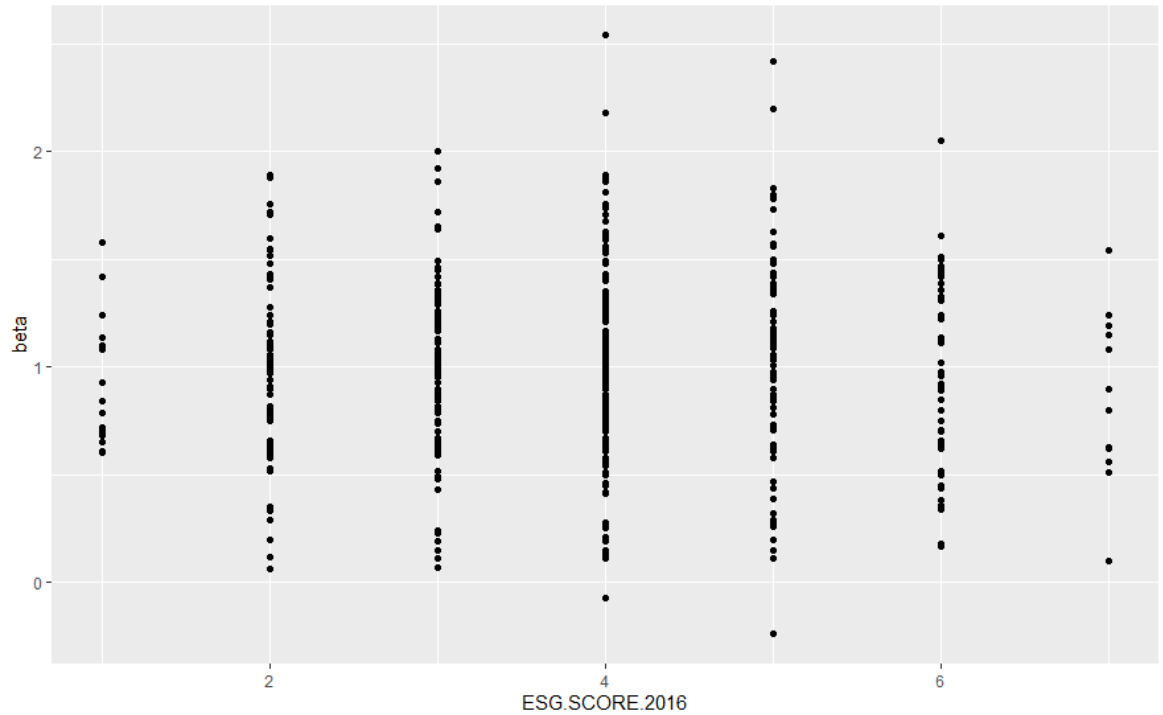


Figure C-10 Beta 2017-2018

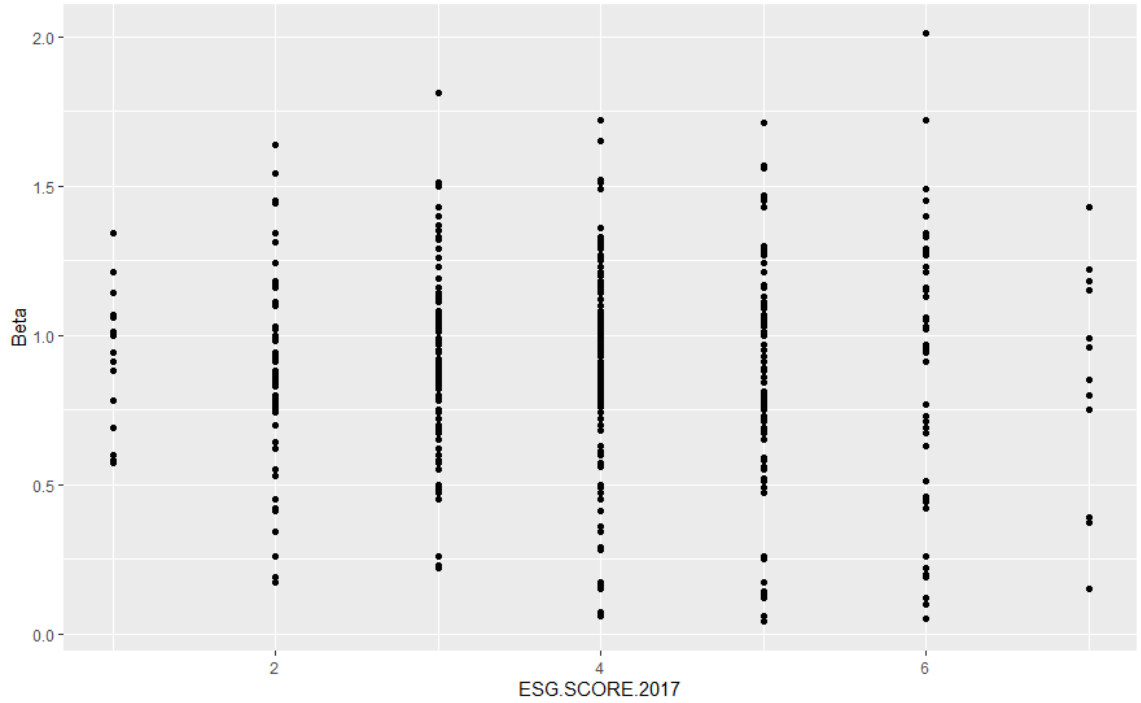


Figure C-11 Beta 2018-2019

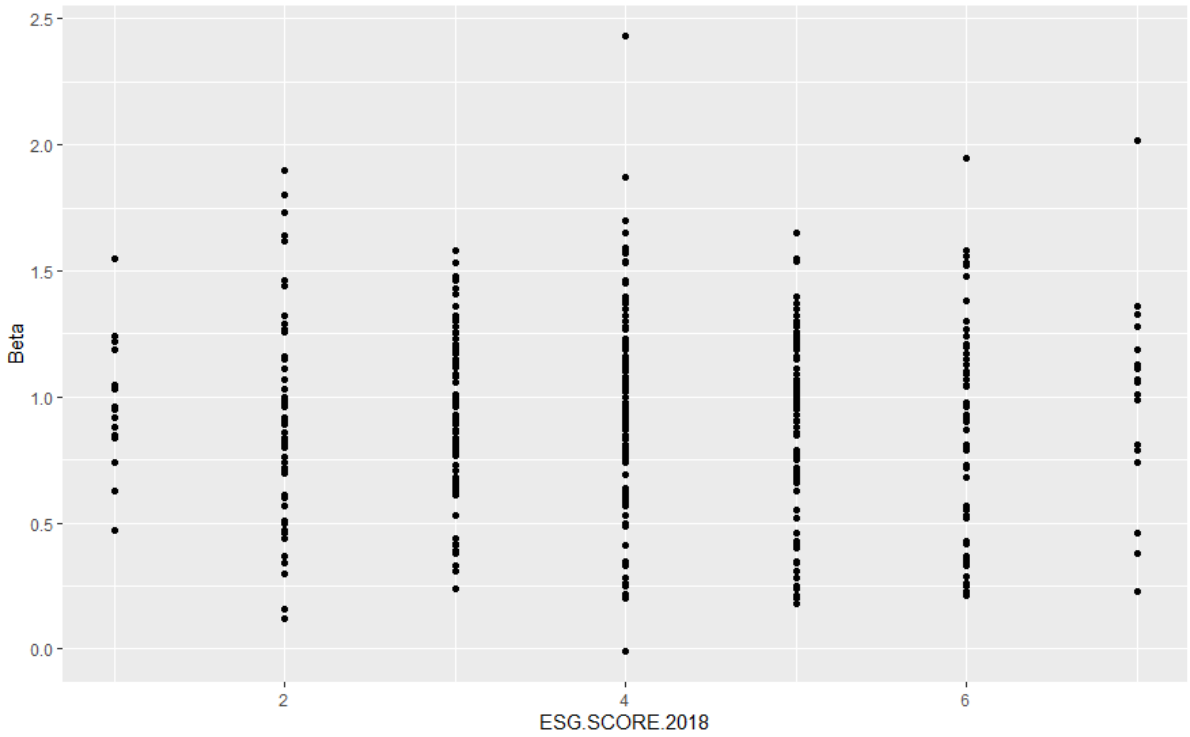
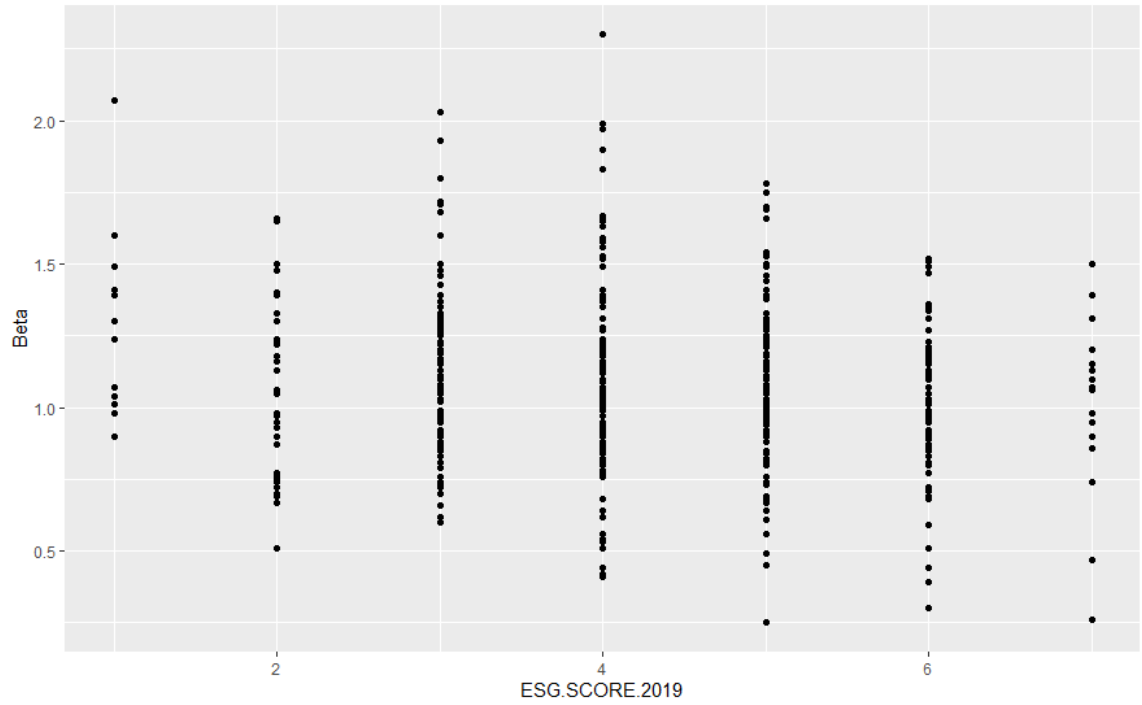


Figure C-12 Beta 2018-2019



Alpha

Figure C-13 Alpha 2016-2017

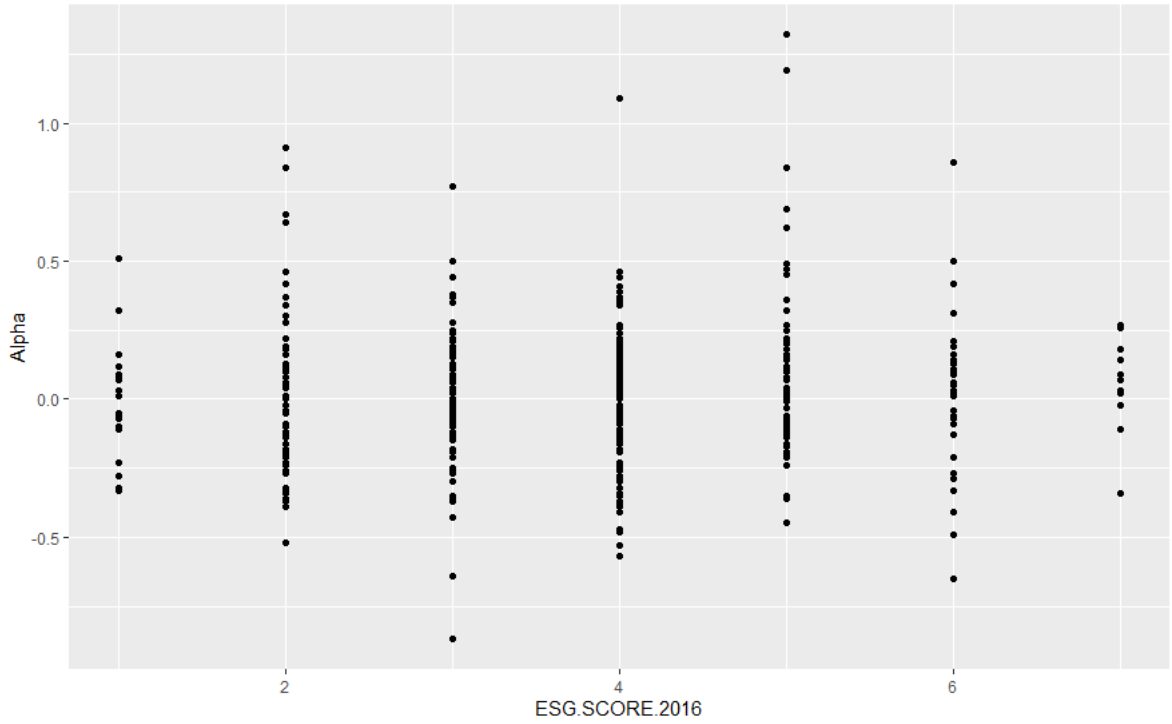


Figure C-14 Alpha 2017-2018

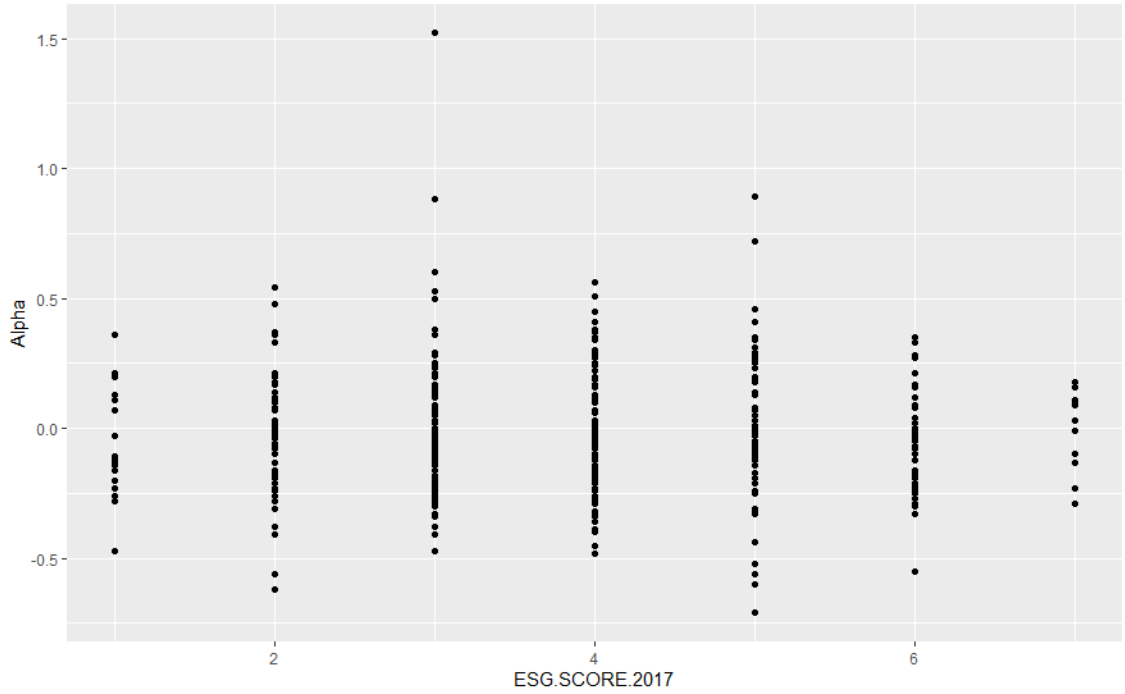


Figure C-15 Alpha 2018-2019

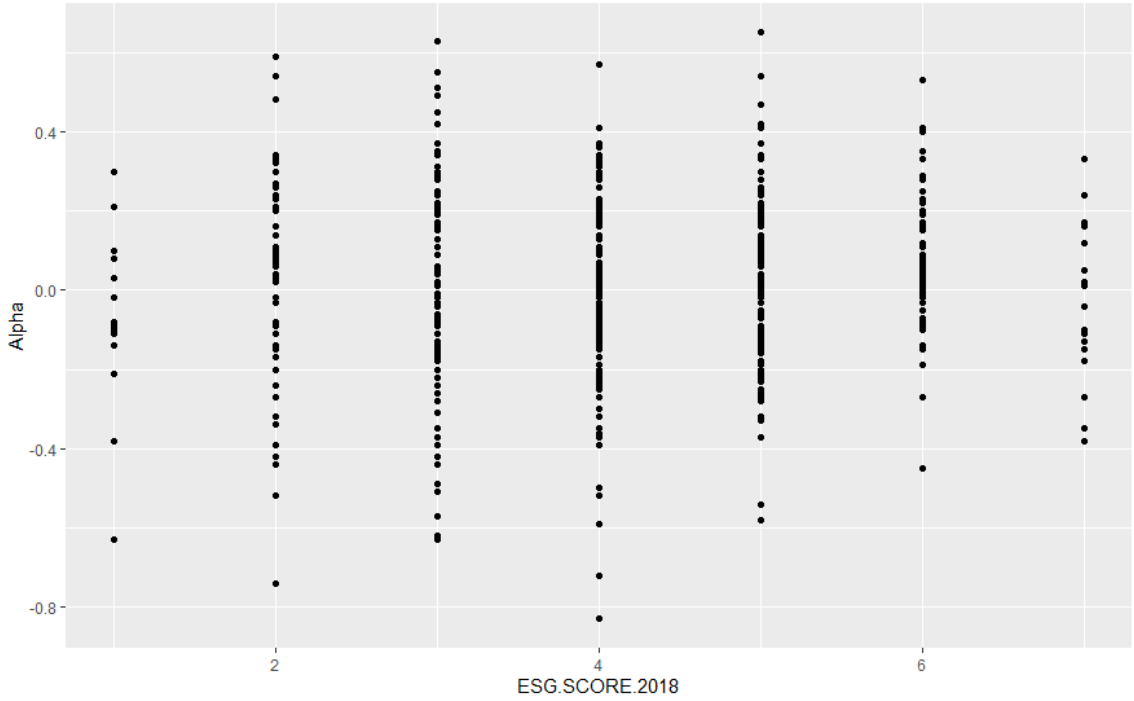
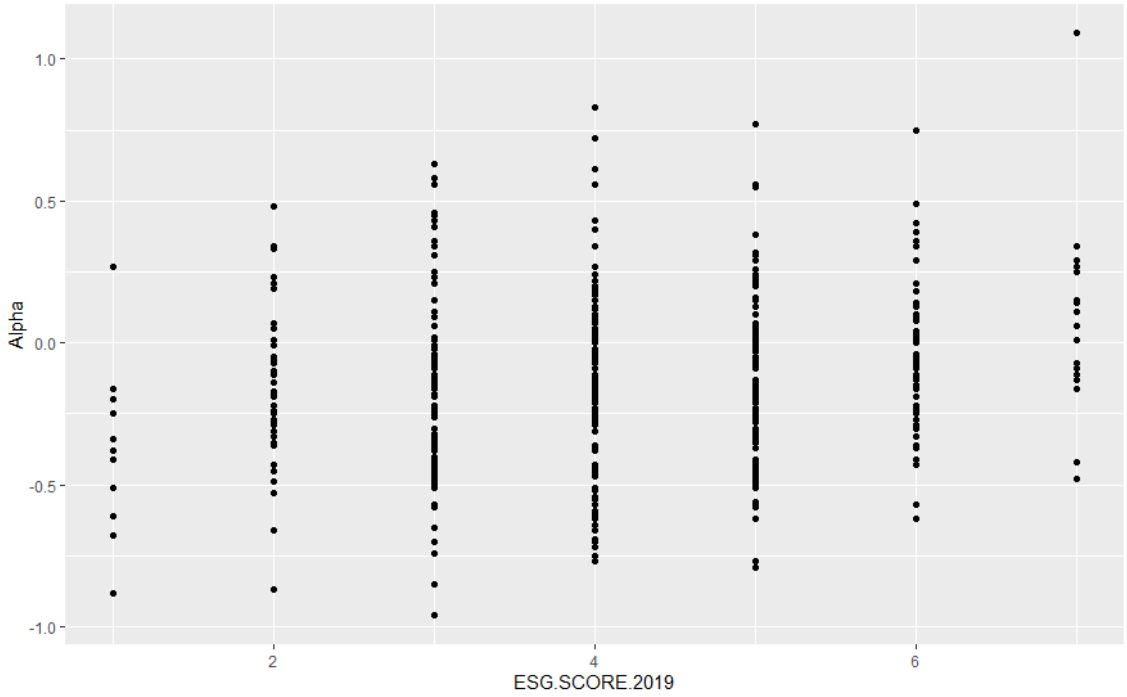


Figure C-16 Alpha 2019-2020



Shape Ratio

Figure C-17 Sharpe Ratio 2016-2017

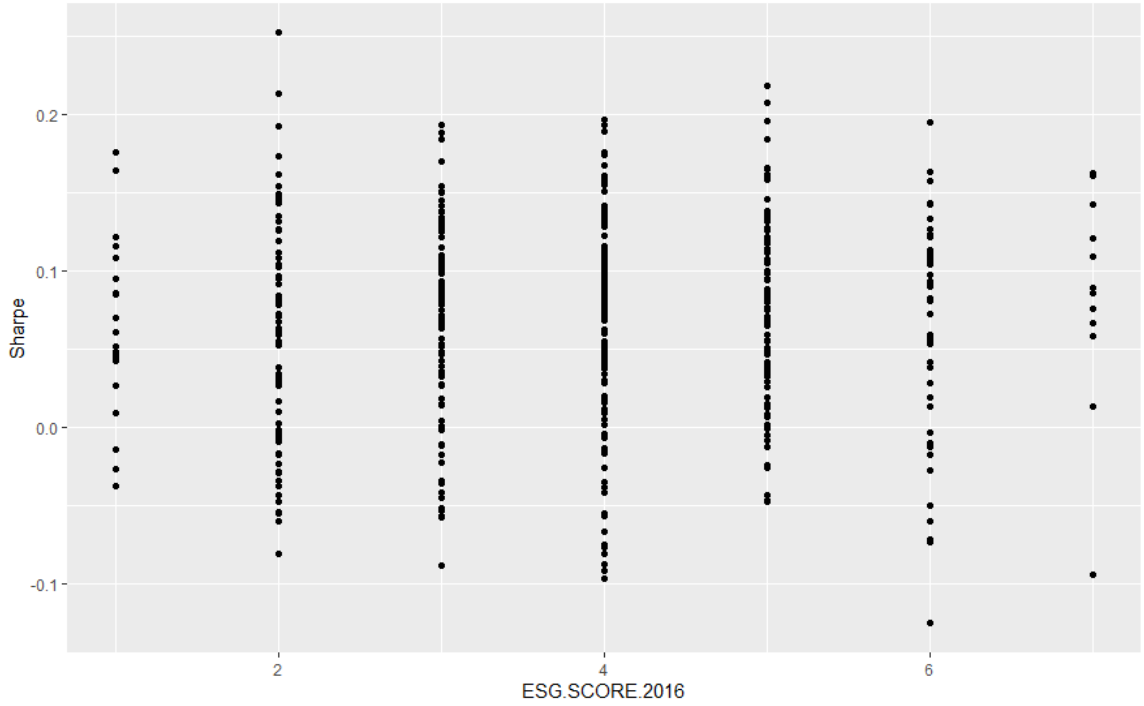


Figure C-18 Sharpe Ratio 2017-2018

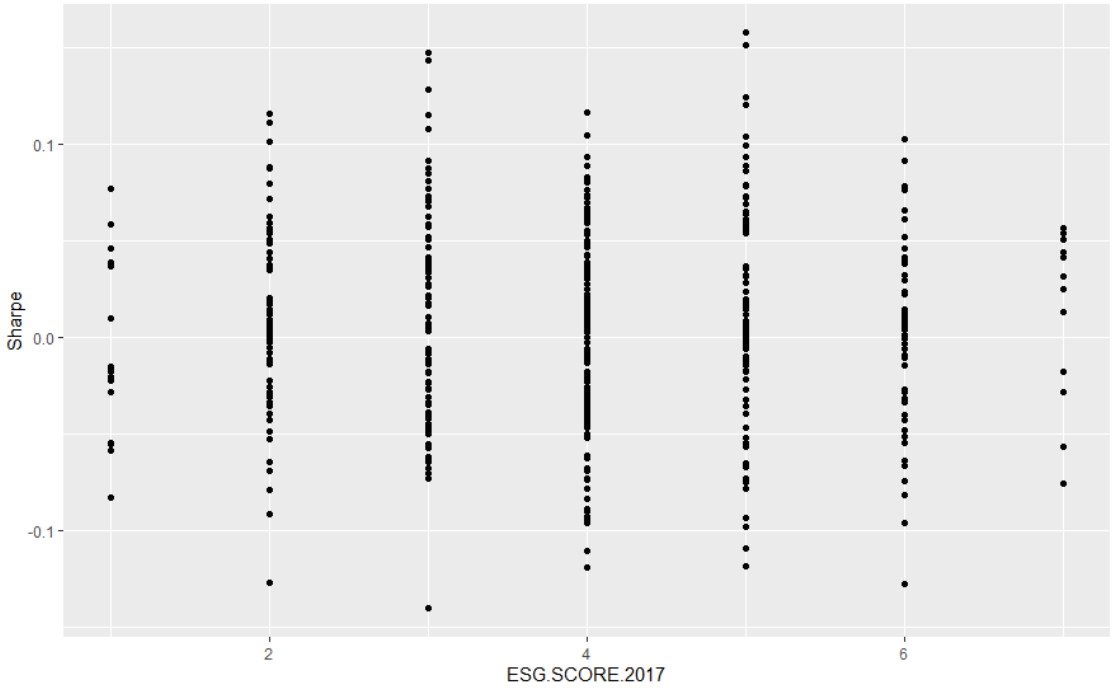


Figure C-19 Sharpe Ratio 2018-2019

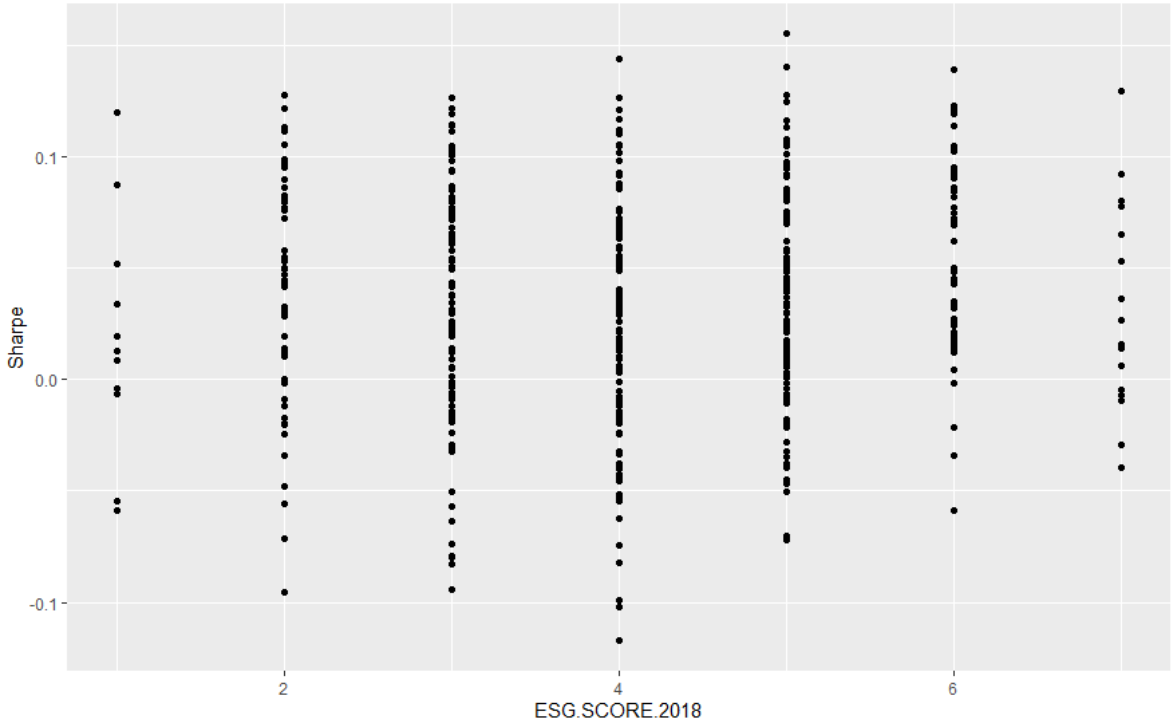
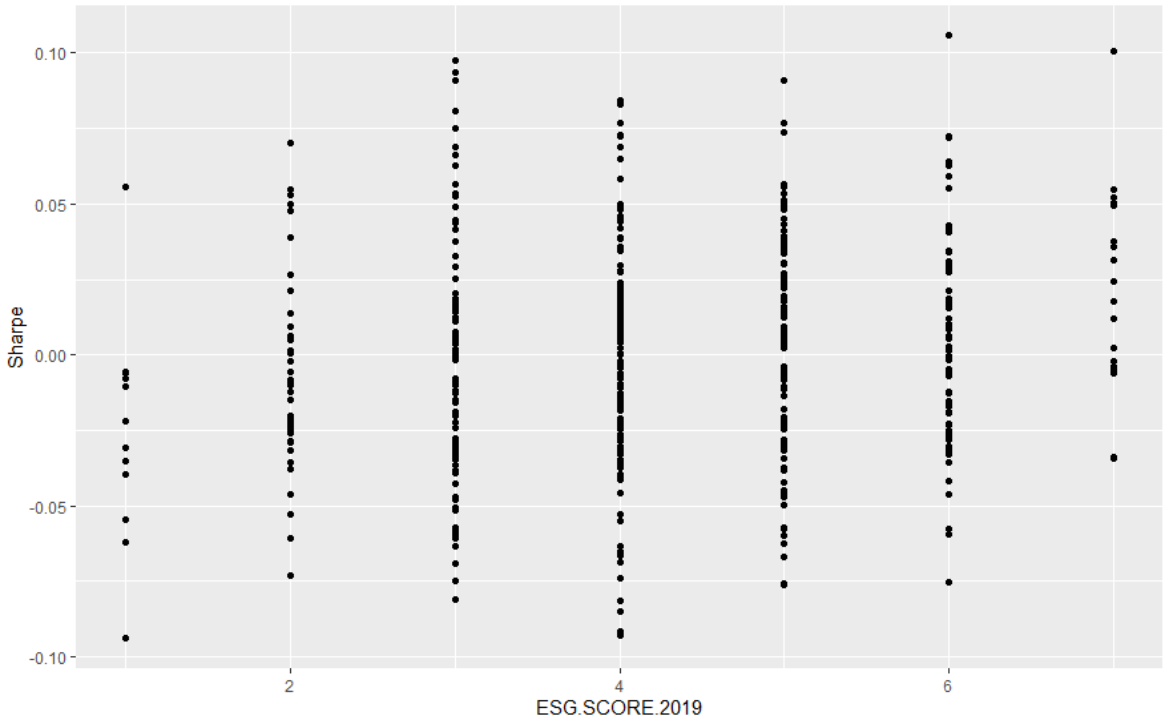


Figure C-20 Sharpe Ratio 2019-2020



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