Are high ESG-rating companies performing better?

AALBORG UNIVERSITY
DENMARK

Education:

4th semester Economics and Business Administration / Finance

Master Thesis

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Due Date:

1st of June – 2022

Number of strokes:

116.770 strokes (48.5pages)

Abstract.

The purpose of this thesis is to investigate and observe ESG-investing and if ESG-rating on companies has an impact on financial performance and if ESG-rating companies are exposed to value and growth investing. Previous studies suggest different results of the relation between ESG-rating and financial performance, with both supportive and denying findings and the divergence of ESG-rating agencies.

The thesis tested the impact of ESG-ratings between a time-period of 1st January 2017 to 1st January 2022 by constructing portfolios representing either High or Low ESG-ratings the portfolios in the thesis is High- and Low ESG-rating portfolio, High- and Low Sector-based portfolios of, Consumer Non-Cyclicals, Finance, Technology, Healthcare, and Industrial and Value- and Growth-portfolio based on the median P/E-ratio of the sectors. Further, each portfolio is estimated and compared based on the performance of annual average excess return, Sharpe-ratio, Sortino-ratio, and Alpha-value.

Furthermore, the thesis used Fama & French 5-factor model to determine if the High- and Low ESG-rating portfolio are exposed to the five-factors, and to determine the alpha-value of each portfolio constructed. The last analysis examined in the thesis is testing if the High- and Low ESG-rating portfolio is exposed to value- and growth-portfolio.

The thesis finds that Low ESG-rating portfolios tend to outperform High ESG-rating portfolios when comparing the measurement of excess return, Sharpe-ratio, and Sortino-ratio. The thesis found no evidence that suggests a statistically significant difference in returns on ESG-rating since both the High- and Low ESG-rating portfolio showed insignificant alpha-values. Further, the thesis found the growth-portfolio outperformed the value-portfolio and found significant evidence of growth having an impact on the High- and Low ESG-rating portfolio. The evidence found in the thesis show similar and opposite findings to previous research.

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1. Introduction.

Sustainable and sustainability aspects in financial decisions have become more into the foreground and investors request more sustainable investments, why this topic has had a deep interest to the researcher of the thesis. Academical and professional investment managers have watched and followed the stock market, especially the development of ESG (Environmental, Social & Governmental) monitoring the ESG-ratings of stocks from different agencies, to construct their definition of best performing ESG-portfolios. ESG is perhaps one of the most significant recent global trends and the attention has increased, the main objective of the strategy is long-term financial returns and most importantly, a sustainable impact (2022 Adler Haysler u.d.). The matters of ESG vary widely but are considered to include topics related to climate change, diversity and inclusion, human rights, the rights of company shareholders, and companies 'compensation structure (2022 ICI Report u.d.). ESG investing is a broad field with many different investment approaches, that are addressing various investment solutions, MSCI research paper (Foundation of ESG investing) has broken down ESG investing into three main areas. First ESG Integration, improving the risk-return characteristics of a portfolio, secondly Values-Based Investing, investors seek to align the portfolio with norms and beliefs and thirdly Impact Investing, investors use their capital to trigger changes for social or environmental purposes e.g., accelerate the decarbonization of the economy (2022 MSCI u.d.).

In the recent years, researchers from both academia and the asset-and wealth management industry have analyzed the relationship between ESG companies and their financial risk and performance, the research has been plentiful that serval meta-studies such as (2012 Fulton u.d.) found that the correlation between ESG characteristics and financial performance was inconclusive, other literature found a positive, negative and non-existent correlation, and the majority of researchers before 2015 found a positive correlation e.g., (2015 Christophe u.d.) and (2009 Andreas u.d.). It seems fair to assume that there are different results when analyzing the performance of ESG portfolios. This research will therefore aim to evaluate the high- and low ESG-Rating performances.

1.1 – The problem description.

Environmental, Social, and Governance are the characteristics factors of ESG investing and strategy. ESG investing, as it is known, is an approach that seeks to meet a certain level of the three main characteristics factors and incorporated them into the decision-making of asset allocation.

The evolution of the popularity of ESG investing can be tracked in the MSCI ESG Indexes dating back to the 1990s. The index was designed to help socially conscious investors support the weight of social and environmental factors in their investment choices and in 2020, 30 years later there are 268 ESG ETFs and 1.500 indexes (2022 MSCI u.d.).

According to the report from GSIA (Global Sustainable Investment Alliance), the total sustainable investment was $35.301 trillion globally in 2020 and 35.9% of total AuM (Assets under Management) was sustainable investments, and the report stated that the US and EU market compounded annual growth of 17% and 1% (2020 GSIA u.d.).

The increasing awareness of sustainable investment choices of investors has created a market where financial returns and ESG coexist, and due to the increasing popularity of this type of investment strategy, has led this thesis to focus on the determination of whether high ESG-rating companies tend to offer a better return than low ESG-rating companies.

The introduction above forms the foundation of the motivation behind the thesis research and leads to the problem statement and research questions of the thesis.

1.2 – Problem statement

"Are high ESG-rating companies performing better?"

To answer the problem statement the following questions, have to be examined and answered:

1. Does a high ESG-rating result in higher returns?
2. Do systematic risk size, value, profitability, and investment explain different ESG-ratings across companies?
3. Do Value & Growth have an impact on the performance?

The following hypothesis for this research is based on the questions above, indicating what the expected results of this research will be:

H1: High ESG-rating companies perform better than low ESG-rating companies.
H2: High- and low ESG-rating companies are exposed to Fama & French's five factors.
H3: Do Value- and Growth have an impact on the performance of High- and Low ESG-rating.

1.3 – Delimitation

The research of the thesis is delimited to the US market, why the remaining markets in the world are irrelevant to this research thesis. The US market is chosen on behalf of its size and transparency, containing some of the largest exchanges based on market capitalization (2022 Statista u.d.). The research thesis is delimited to 5 sectors within the US market and contains 20 companies from each sector, to construct different portfolios based on ESG-ratings. Using the US market, the market portfolio for US stocks is usually measured by a stock index e.g., the Standard & Poor's 500 indexes (S&P500), NASDAQ, or Dow's Jones. In this research, the benchmark is the S&P500 index.

As the objective of this research is to examine if high ESG-rating companies perform better, the delamination of asset types will be limited to stocks while other types of assets are excluded. During this research, the risk-free rate is applied in serval contexts and the risk-free rate is usually measured by using the Treasury Bills. However, in this research, the risk-free rate provided on Kenneth R. French's webpage is applied (2022 Kenneth u.d.)[1]. This is for practical reasons and the same risk-free rate is therefore used throughout the different calculations.

The thesis is based on a five-year period from 01.01.2017 to 01.01.2022. During this period the COVID-19 pandemic may have affected the volatile movements in the market, which can cause outliers in the data, and disrupt the results. The thesis research considers the pandemic when calculating the Gauss Makorv's 6-assumptions and analyzing the result (2012 Wooldridge u.d.).

Since the thesis is based on ESG-ratings and historical performance the data collections for ESG-ratings are restricted to using only Refinitiv (2022 Refinitive u.d.) and FactSet (2022 FactSet u.d.). FactSet is used to construct the five-year average FTSE ESG-rating for the S&P500 companies and the historical stock prices are downloaded from FactSet and delaminated to five years as mentioned above.

[1] Excel data-collection spreadsheet (Kenneth R. French data)

Furthermore, this research strives to construct different portfolios based on ESG-ratings for the companies and their respective sector to evaluate the performance using the Sharpe-ratio, Sortino-ratio, and Jensen's-Alpha comparing it to the benchmark S&P500 index.

1.4 – Structure of the thesis research.

The following chapter encompasses a brief presentation of the structure of this thesis research. The research consists of five main chapters; Introduction, Theory & Literature-, Data Sample & Methodology-, Empirical Findings & Results and Conclusion, and each chapter is described to provide an overview of the thesis approach.

The first chapter is the introduction of the thesis topic and gives an insight into the problem definition and research question for the thesis, furthermore the delimitation of the thesis as well.

The second chapter is Theory & Literature, to present an overview of relevant theories that have been applied in the thesis and Empirical literature is presented to give an overview of studies and findings from previous research regarding High-and Low ESG-rating performance.

The third chapter is Data Sample & Methodology, which presents the methodology consideration and the empirical data used to answer the research's question and problem definition of the thesis.

The fourth chapter presents the empirical findings and results and consists of the following analysis, construction and evaluation of High- and Low ESG-rating portfolios, and construction and evaluation of Sector-based High- and Low ESG-rating portfolios, Fama & French 5-factor regression, and lastly the construction and evaluation of Value- and Growth portfolio and if they have an impact on the performance.

The fifth chapter presents the conclusion on the problem statement and analysis results in the thesis.

2. Theory & Literature.

In this chapter, the chosen theoretical framework for this research thesis is presented and an introduction of the ESG theory is presented and the last part of the chapter is relevant empirical studies and findings.

2.1 – ESG investing.

The ESG-investing approach pursues to incorporate E, environmental, S, Social, and G, governance (ESG) factors into asset allocation and risk decisions, to generate sustainable and long-term financial performance. Over the recent years, it has evolved to meet the demands of retail investors, certain public authorities, and institutional investors, to incorporate long-term financial risk and opportunities to generate long-term value. The figure below presents examples of what each ESG characteristic means and what "ESG companies" should focus on to earn a high ESG-rating (2020 Boffo u.d.).

Table 2.1.1 – ESG Characteristic.
(Description of what E-S-G factors weight on)

Environmental	Social	Governance
Climate Change	Human Rights	Corporate Governance
Natural Resources	Product Liability	Corporate Ethics
Pollution & Waste	Stakeholder Opposition	Regulations and Laws
Environmental Opportunities	Social Opportunities	Shareholders Rights

Source: Authors Creation

As mentioned above ESG investing seeks to incorporate these factors into the long-term financial returns. The factors can include downside risks that have the potential to erode equity value and increase credit risk over time. Therefore, it aims to combine better risk management with improved portfolio returns and reflect investors' values in an investment strategy. The investment community considers ESG as an investment approach seeking to incorporate greater and more consistent information regarding material environmental, social, and governance developments, risks, and opportunities, into asset allocation and risk management decisions to generate sustainable long-term financial returns (2020 Boffo u.d.).

2.1.1 - Environmental Factor.

The Environmental criterion focuses on the impact a given company has on the environment. This can include the company's carbon footprint, toxic chemicals involved in the manufacturing, and sustainability efforts on their supply chain. If companies can incorporate environmental effort, it can create possible advantages, such as efficient use of renewable energy, and can lower potentially lower the costs. If companies do not incorporate an environmental focus, can create a disadvantage on behalf of environmental emissions and a bad reputation (2022 E. Napoletano u.d.).

2.1.2 - Social Factor.

The social criterion focuses on the social impact a given company leaves within and in the broader community. This can include the company's, human rights, the working conditions, diversity, and racial diversity, programs within the company, and hiring practices. Social issues of a given company might be underpaying employees, lack of benefits for employees, lacking relationships with the customers, and human rights issues. Lacking these criteria can cause the given company's social responsibility and investors to exclude the company (2022 CFI u.d.)

2.1.3 - Governance Factor.

The governance criterion focuses on how companies are managed by the executive board, executive officers, and leadership positions within the company and how well the executive management and board of directors attend to the interest of the given company's stakeholders, employees, and suppliers, shareholders and customers. At the same time, the given company needs to give back to the local community it operates. For investors, financial and accounting transparency and honesty are often key elements of good corporate governance, and the board members "act in a genuine fiduciary relationship with stockholders", avoiding conflicts of interest. The lack of the abovementioned is often seen when the executive board or directors is operating for their purpose and interest and not the given company, and if that happens, investors might look for other investments (2022 CFI u.d.).

As mentioned in the introduction and problem description, ESG investing is a growing industry and investment strategy amongst institutional investors, and retail investors who pursue to allocate their capital. The proportion of global sustainable investing assets, that incorporate elements of ESG in the U.S market in 2020 was 48% and the proportion of global sustainable

investing assets relative to total managed assets in the U.S was 41.6% in 2020, meaning the global sustainable investing asset in the U.S was $17.081 billion in 2020 (2020 GSIA u.d.).

Firstly, as mentioned both asset- and wealth managers and academic studies suggest that ESG investing can, under certain conditions, improve risk management and lead to returns that are not inferior to returns from traditional financial investment strategies.

Secondly, due to the risk climate challenges, and the increasing influence of governance, investors and consumer choices concerning to the environmental and social factors can cause an impact the performance of the companies.

Thirdly, there is a momentum for corporations and financial institutions to shift from short-term perspectives of risk and return to long-term sustainable investment performance which is growing. The growing evidence from research studies and investors on the sustainability of finance has caused a must to incorporate broader external factors in the pursuit of maximizing returns and profits over the long-term investment while reducing controversies that could impact the stakeholder's trust. (2020 Boffo u.d.).

2.2 Empirical Literature.

Empirical studies related to ESG-investing today are Socially Responsible Investing (SRI) and Corporate Social Responsibility (CSR). Despite the differences, a long list of studies examined the relationship between ESG and financial performance, and most studies before 2015 found a positive correlation between ESG-performance and operational efficiencies, stock performance, and lower cost of capital (T. W. 2021 u.d.). Indicating there are suitable quantity of empirical findings and comparability for this research and is leading to the research from Global sustainable investment review (2020) the report is mapping the state of sustainable investment in the major financial markets globally. The report shows that sustainable investment shapes global capital markets and influences companies and other investors seeking to raise capital in global markets. The report shows that sustainable investment reached $35.3 trillion in Asset under Management (AuM) and a growth of 15% in two years (2018-2020). The findings indicate the Asset under Management (AuM) reached 35.9% in 2020 from 33.4% in 2018 and the United States proportion of sustainable investment assets is 33% and the United States and Europe represent more than 80% of global sustainable investing assets during 2018-

2020 (2020 GSIA u.d.). This indicates that the ESG-investing strategy is becoming more and more relevant for investors and more empirical studies and findings are included beneath for the thesis research.

Firstly, Kempf & Osthoff (A. K. 2007 u.d.) researched the relationship between investors applying socially responsible screens to portfolios and their performance. The research approach was based on long-short investment of high- and low SRI-rated companies, from KLD Research & Analytics, the research found the strategy generated abnormal high returns of 8.7% per year, applying the Best-in-Class screening approach, Statman & Glushkov (2009 u.d.) did similar study analyzing returns of stocks with high SRI-rating from KLD from 1992-2007, and concluded return advantage towards socially responsibility compared conventional stocks, while more recent research from Nordea analyst (2018 Hugo u.d.), researched the performance of ESG-companies from 2012-2018, based on MSCI ESG, FactSet and Nordea ESG-ratings and concluded high ESG-rating companies have outperformed the lowest ESG-rating companies with 5% per year, Pastór (L. P. 2021 u.d.) found that high ESG-rating should outperform low ESG-rating stocks, Mendiratta (R. M. 2021 u.d.) researched the relationship between financial performance and risk of ESG percentiles high to low ESG-ratings from 2014-2020, the findings showed the upper percentile showed improved risk and showed better risk-adjusted returns than the lower percentile, Jeff, Fitzgibbons & Pomorski did similar study of ESG focusing on the risk side and found evidence that stock with low ESG-rating are riskier and the worst ESG-rating quintile have higher volatility than high ESG-rating stocks quintile in the U.S market (2017 u.d.).

In contrary to above mentioned research papers, opposite studies and result was found in Fama & French (F. &. 2007 u.d.) who developed a more detailed framework to determine how investors preferences for “Green Companies” or High ESG-rating companies affect expected returns and concluded the expected return investing in “Green Companies” would be lower depending on the amount of money invested, and research from Pastor (P. 2020 u.d.), concluded the same as Fama & French (F. &. 2007 u.d.), investors preferring “Green Companies” the risk-adjusted expected return is less equilibrium and Galema (R. G. 2008 u.d.), Manescu (2011 u.d.), and Gerhard Halbritter & Gregor Dorfleinter (2015 u.d.), did not found evidence that suggest a statistically significant difference in risk-adjusted returns and relationship between corporate social and financial performance, between high- and low ESG-rating companies on the U.S market using the Carhart (1997 u.d.) four-factor model, cross-

sectional data from Fama & MacBeth (1973 u.d.) and Fama & French 5-factor model (B. K. 2019 u.d.). More recently studies from Landi & Sciarelli (G. L. 2019 u.d.), also found no evidence of positive and statistically significant impact in terms of market premium when undertaking ESG-rating stocks, a similar study from Nora Judit (N. J. 2020 u.d.), also found no evidence that suggests a statistically significant difference in risk-adjusted return between High and Low ESG-rating companies. Hoepner (2018 u.d.) investigated the relationship between ESG performance and financial risk from 2005 to 2018 and concluded ESG showed reduced downside risk.

Sustainable funds have continued to grow during the past few years (2020 GSIA u.d.). During the COVID-19 pandemic crisis and other market crises, Nofsinger & Varmawhich (J. N. 2013 u.d.), found that socially responsible funds outperform during market crises. This research period is from 2017-2022, and during this period the world experienced the biggest health crisis that caused a slowdown in the economy worldwide, the U.S market experienced records highs, rapid collapse or "market crash", the pandemic would expected to have long-term, political, environmental, economic and social (ESG) consequences on the financial performance during the COVID-19 pandemic, but researches from Pavlovva & Boyrieb (2022 u.d.), Singh (S. &. 2020 u.d.), Albuquerque, (R. A. 2020 u.d.), Ding (W. D. 2020 u.d.), Pastor and Vorsatz (P. &. 2020 u.d.) and Broadstock (D. C. 2021 u.d.) found that high ESG-rating and Corporate Social Responsibility (CSR) funds, companies and ETF's performed well during the crisis, where Demers (E. D. 2020 u.d.), Dötlling and Kim (R. D. 2020 u.d.) and Glossner (S. G. 2020 u.d.) found that ESG-ratings does not explain a company's, fund or ETF returns during the pandemic and during the 2020 market crash high ESG-rating funds, companies underwent a higher decline.

Since the results of the empirical studies show different results based on more or less the same ESG-rating agencies analysing the performance and financial risk of ESG-investing strategy, it might imply investors might sacrifice returns using ESG-investing and ESG-rating divergence, Fish, Dong & Venkatraman (A. F. 2019 u.d.) investigated if investors sacrificed returns using ESG-investing strategy using Bloomberg ESG-rating and the historical performance of the stocks in U.S and EU, and found in contrary to Halbritter and Dorfleinter (2015 u.d.) there was a minimal difference between non-weighted and ESG-weighted portfolios, and the ESG-portfolio performed slightly better, similar to the studies from Kempf & Osthoff (A. K. 2007 u.d.) and Statman & Glushkov (2009 u.d.) with a difference the returns

was not abnormal but only slightly better. In the perspective of ESG-rating divergence, Berg, Koelble, and Rigbon (B. K. 2019 u.d.) investigated the ESG-rating divergence using different ESG-rating agencies and found that using single ratings must be carefully justified and most use the average ESG-ratings to represent the markets consensus view and the difference between agencies ESG-ratings are not merely conceptual difference but also measurement difference, where Feifei and Ari (2020 CFA u.d.) researched the ESG-ratings discrepancy impact on investors and using the approach based on two ESG-rating agencies and constructed two separate portfolios based on U.S market and EU market in the period from 2010-2017 and concluded a noticeable difference between the two strategies with identical portfolios using different ESG-rating agencies.

The increasing awareness of sustainable investment choices of investors has created a market where financial returns and ESG coexist, and due to the increasing popularity of this type of investment strategy, which could be combined with the historical strategies as Value- and Growth-investment strategy. This research investigated whether or not Value or Growth stocks have an impact on ESG-rating performance, where most of the early studies from Baumann & Miller (1997 & 1998 u.d.), Broussard (2005 u.d.), Capaul (1993 u.d.), and Mikutowski (M. 2019 u.d.) found value stocks perform better than growth stocks, while studies from Cordeiro & Machado (C. &. 2013 u.d.), Cheh et al (J. J.-w. 2008 u.d.), Beneda (2003 u.d.) and Emm & Trevino (E. &. 2014 u.d.), showing value-stocks no longer outperforms growth-stocks and research from Vanguard (V. R. 2021 u.d.) on value and growth stocks from 1936-2021 on the U.S market based on the annual returns, showed the past ten-years on average growth stocks has outperformed value-stocks. Recently study based on the performance of value and growth with different ESG-rating, uses the same approach as this research. The study from (2021 Repka u.d.), found evidence of statistically significant best performing portfolio was the growth portfolio of High ESG risk and the worst performing was the value portfolio of low ESG risk.

3. Data sample & Methodology

The following chapter includes an overall presentation of the research thesis methodological framework, data sample, and applied for the thesis research. The framework is based on portfolio construction, evaluation and Multi-factor models.

3.1 Data sample and Selection.

The thesis has constructed 15 portfolios in total, where the first portfolio is the Benchmark (S&P500), two portfolios of ESG-rating from the High- to Low portfolio, ten portfolios of Sector-portfolios of High- and Low ESG-rating companies, and the last two portfolios are based on the median P/E-ration of the sector-based portfolios to construct a Value- and Growth-portfolio. The construction of each portfolios is described in this chapter.

The research period starts from 01.01.2017 to 01.01.2022 and takes into account that some of the companies might not fulfill the period and in such case, the stock is replaced by the next in rank. Before portfolios are constructed, ESG-ratings of all 500 companies in the S&P500 are collected, secondly, the stock price of all the S&P500 companies is downloaded from FactSet. The research uses two agencies to collect the ESG-ratings, the first is the Refinitiv Eikon (2022 Refinitive u.d.) and the second is from FactSet, using the five-year average FTSE-ESG-rating (2022 FactSet u.d.). All the ESG-ratings of the S&P500 companies are ranked from the highest rated to the lowest rated companies. How the ESG-ratings are determined is described in the appendix[2].

The selection of the stocks used in this thesis research is based on two ESG-investment styles: Following Table 3.1.1 illustrates the objectives, key considerations, and examples. Where the focus of the thesis is based on the ESG-ratings from Refinitiv and FactSet's FTSE, to construct 13 different portfolios and 2 portfolios based on the sector's P/E-ratio median, to construct a Value and Growth portfolio, all the portfolios are equally weighted in the thesis, secondly, the key consideration is to analyze if the portfolios are exposed to serval factors, lastly the thesis focus on the top and bottom ESG-ratings and P/E-ratios. The portfolios are compared to the benchmark (S&P500) in the thesis.

[2] Appendix 1 - ESG – Data collection

Table 3.1.1 – Portfolio Construction.

(The thesis focus areas of the research)

	ESG Rebalancing	**Thematic Focus**
Objective	Investment based on ESG-ratings and agencies	Focus on ESG-investing based on ESG-ratings of High- and Low and sectors with companies represented and P/E-ratio of Value and Growth
Key Consideration	ESG-rating from agencies, desired risk taken and ESG-rating divergence	Broad vs. Specific exposure
Examples	Optimize ESG-benchmark, active strategies	Focus on ESG-ratings overall top and bottom of the sectors and Value and Growth

Source: Authors Creation

The construction of the High- and Low ESG-rating portfolio in the research is constructed by using the 10% of the highest-rated and the 10% of the lowest-rated in the S&P500. Applying this approach, the High- and Low ESG-rating portfolios in the research are taken the top 10% of companies placed at the top is equivalent to 50 companies, and the same is done lowest 10% of companies placed at the bottom is equivalent to 50 companies. This leads to two portfolios with 50 companies in each equivalent to 100 companies in total.

Secondly, the selection of the sectors used in the research is based on the descriptive statistics of the sectors, where the selected sectors are based on the number of companies representing the sectors and the ESG-ratings which are illustrated below in table 3.1.2

Table 3.1.2 – ESG-ranking of the sectors

(Excel Data Analysis tool - Descriptive statistic of sectors used in the thesis research)[3]

Different Sectors	FTSE ESG-rating (five-year average rating of the sectors)	Number of companies represented in each sector	Minimum	Maximum	Standard deviation
Consumer Non-Cyclicals	2.5	29	0.0	4.0	0.866
Consumer Cyclicals	2.4	44	0.0	4.0	0.890
Finance	2.3	100	0.0	4.1	0.978
Non-Energy Materials	2.3	32	0.0	4.2	1.097
Telecommunications	2.3	7	0.0	4.1	1.039
Utilities	2.3	28	0.0	3.7	0.907
Energy	2.2	20	0.0	3.3	0.866
Healthcare	2.2	64	0.0	4.3	1.376
Industrials	2.2	58	0.0	4.3	1.263
Technology	2.2	70	0.0	4.6	1.445
Business Services	2.0	16	0.0	3.4	1.071

Source: Authors Creation

The table above illustrates each sector presented in the S&P500-index. The selection of the five different sector-portfolios is based on the two following factors: first the average ESG-rating of the sector, and secondly the number of companies represented in each sector. This is applied in the thesis research and the following sectors are selected: Consumer Non-Cyclicals, Finance, Healthcare, Industrials, and Technology. After the selection of sectors, the 10 highest- and 10 lowest ESG-rating companies within the selected sectors are used to construct a High ESG-rating- and Low ESG-rating sector portfolio for each sector.

Lastly, the selection of the companies used in the research is to construct the value and growth portfolio, which is based on the median P/E-ratios, gathered from FactSet, and based on the

[3] Excel data-collection spreadsheet (Sector ESG-ratings)

P/E-ratio trailing twelve months (ttm) (2022 FactSet u.d.). The selected sectors mentioned above and are illustrated below in table 3.1.3

Table 3.1.3 – Value & Growth portfolio selection.

(Excel Data Analysis tool - Descriptive statistic of sectors P/E-ratio used in the thesis research)[4]

	Consumer Non-Cyclicals	**Finance**	**Technology**	**Healthcare**	**Industrial**
Mean	22.94	25.00	36.55	29.94	24.20
Median	22.72	13.97	26.59	29.01	20.04
Standard deviation	10.24	27.85	47.09	19.20	19.03
Minimum	0.00	0.00	0.00	0.00	0.00
Maximum	51.39	150.97	377.86	82.20	135.56

Source: Authors Creation

The table presented above shows the median P/E-ratio of the sectors used in the sector-portfolios (French 1992,1996). The median P/E-ration of the sectors is used to select the companies to construct the Value- and Growth portfolio. As shown in the table above some P/E-ratios is relatively high and low, as the minimum and maximum indicate, these outliers could cause a higher median P/E-ratio of the sectors in the research. Since the difference of companies represented in each sector is different and the thesis research will be using the top 50 value companies and top 50 growth companies to construct the portfolios.

After the 15 portfolios in the thesis research are constructed, the weights of the selected companies have to be determined. For this thesis research, the weights of all companies selected for all the portfolios are equally weighted. To be able to compare the performance of the High- and Low ESG-rating portfolio, Sector-portfolios, and the Value- and Growth portfolio, each portfolio constructed is measured on behalf of the performance with the most common measuring being the Sharpe-ratio, Sortino-ratio, and Jensen's Alpha and all applied and compared on annual basis in the research (2022 Bodie page 164 u.d.).

[4] Excel data-collection spreadsheet (Consumer Non-Cyclicals, Finance, Technology, Healthcare, and Industrial)

3.2 Methodology.

As mentioned in the Data Sample & Selection, the research has constructed 15 different portfolios namely, Market portfolio (benchmark S&P500), High- and Low ESG-rating portfolios, Sector-portfolios, and Value- and Growth portfolios. The research has downloaded the monthly stock prices of S&P500 companies from FactSet (2022 FactSet u.d.)[5]. The ESG-ratings are collected from Refinitiv Eikon (2022 Refinitive u.d.) and FactSet – FTSE five-year average ESG-rating, how the scoring is determined is described more in detail in the appendix[6].

After the selection and construction of all the portfolios used in the research in the period from 01.01.2017 to 01.01.2022, the calculations to compare and evaluate the performance of the portfolios are made and compared on annual basis. The mentioned period is equivalent to 61 observations as it includes all of 2017.

3.2.1 Portfolio return.

The monthly returns in the research are calculated by the following equation:

$$\text{Monthly return} = \frac{\text{ending price} - \text{starting price}}{\text{starting price}} \quad (1)$$

As the monthly returns of each stock and the benchmark are calculated, the average monthly return of each stock in the period 01.01.2017 to 01.01.2022 is calculated by the following equation:

$$\text{average monthly return} = \frac{\text{Sum of returns}}{\text{Number of returns}} \quad (2)$$

After the monthly and average returns of the stocks and benchmark is calculated, the excess return of each stock and the benchmark with the use of the risk-free rate from Kenneth R. French webpage, and is calculated by the following equation (2022 Kenneth u.d.):

$$\text{Excess return} = \text{Monthly return} - \text{risk free rate} \quad (3)$$

[5] Excel data-collection spreadsheet (data overview)
[6] appendix 1 - ESG – Data collection

As all the portfolios are equally weighted, the average excess return of the portfolio is simply the average of all the expected returns.

3.2.2 Portfolio Covariance and Correlation.

The key determinant of portfolio risk is the extent to which the return on the assets tends to vary either in tandem or in opposition. The risk of the portfolio depends on the correlation between the return of the stocks. The variance of the portfolio is the probability-weighted average across all scenarios of the square-deviation between the return of the portfolio and the expected return, mentioned above; the standard deviation is the square-root of the variance of the stock/portfolio (2019 Bodie page 150 u.d.)

The systematic risk is measured by the beta-value and is calculated separately for each stock on monthly basis equivalent to 61 observations in the portfolios by the following equation:

$$\beta_i = \frac{\mathrm{Cov}(R_i, R_m)}{\mathrm{Var}(R_m)} \tag{4}$$

Where, $\mathrm{Cov}(R_i, R_m)$, measures the stock R_i returns relative to the market R_m, and $\mathrm{Var}(R_m)$, measures the variance of the market (2019 Bodie page 150 u.d.). The correlation coefficients lie in the interval of $-1 \leq p \leq 1$, where the correlation of -1 means a negative correlation between the stocks or the benchmark and stock, while a correlation of 1 means a positive correlation. If the correlation is 1 the stocks move in the same direction as each other or the market used, while -1 negative correlation, the stocks move in the opposite direction of each other or the market used (2019 Bodie page 150 u.d.).

After the monthly beta-value is calculated the portfolio beta-value is calculated by the following equation:

$$\beta_{\mathrm{portfolio}} = \frac{\text{Sum of each } \beta_{\mathrm{stocks}}}{\text{Numbers of observation}} \tag{5}$$

In this research for a realistic comparison between the market portfolio and all the portfolios constructed, the market portfolios are risk-adjusted to the same beta-value as the portfolio, meaning if a leverage position in the market portfolio (S&P500) and if then the risk-free rate

is used to lower the beta-value of the market portfolio, this is done to build on the assumption of that the beta-value of the is 1 and the risk-free rate is 0.

3.2.3 Portfolio variance.

The standard deviation is calculated as a part of the Sharpe-ratio calculations.
If a given portfolio consist of two stocks, the following equation is used to calculate and determine the portfolio variance:

$$\sigma_p^2 = w_1^2\sigma_1^2 + w_2^2\sigma_2^2 + 2w_a w_b * \sigma_{12} \quad (6)$$

Where σ_{12}, is the covariance between the two returns: $\mathrm{Cov}(R_1, R_2)$. As the portfolio in this research consists of more than two stocks, the calculations of the portfolio variance are calculated by the following equation:

$$\sigma_p^2 = \left(\frac{1}{N}\right)(\overline{\sigma_j^2} - \overline{\sigma_{jk}})\overline{\sigma_{jk}} \quad (7)$$

Where $\frac{1}{N}$, is the difference between the average variance and the average covariance, $\overline{\sigma_j^2}$, is the average variance, and $\overline{\sigma_{jk}}$, is the average covariance.

The expression shows for small N, the difference between variance and average covariance is important, as N grows larger, the average covariance is more important.
To simplify the calculations, the vectors and matrices are applied in this research, to calculate the portfolio variance-covariance matrix using the following equation:

$$\sigma_p^2 = w'\Omega w$$
$$w = [w_1 w_2]'$$
$$\Omega = \begin{bmatrix} \sigma_1^2 & \sigma_{12} \\ \sigma_{21} & \sigma_2^2 \end{bmatrix}, where\ \sigma_{12} = \sigma_{21} \quad (8)$$

3.2.4 Sharpe Ratio.

Sharpe-ratio divides the expected return of the portfolio minus the risk-free rate over the sample period by the standard deviation of the returns. The numerator is the incremental return of the

portfolio less the risk-free asset, and the denominator is the volatility of the portfolio. The Sharpe-ratio measures the Reward-to-Volatility trade-off, which means the higher the Sharpe-ratio is, the greater the investment is to the level of risk. The Sharpe-ratio is also applied by analysts, portfolio managers, and asset- and wealth managers, and can be applied to evaluate a single stock, investment, or entire portfolio (2020 Bodie page 869 u.d.). The Sharpe-ratio in the research is calculated by the following equation:

$$SR_p = \frac{R_p - R_f}{\sigma_p} \tag{9}$$

R_p, is the return of the stocks, R_f, is the risk-free rate, and σ_p, and is the standard deviation of the market's excess return. The results of the equation above (Sharpe-ratio) can be divided into four gradings (2022 CFA u.d.):

1. $SR_p < 1: \text{Bad}$
2. $1 \leq SR_p \leq 1.99: \text{Adequate, Good}$
3. $2 \leq SR_p \leq 2.99: \text{Very Good}$
4. $SR_p > 3: \text{Excellent}$

The main objective of using the Sharpe-ratio is to maximize returns and reduce volatility (the risk). An unrealistic example and the most wished scenario for investors would be a high expected return with zero volatility, which would result in an infinite Sharpe-ratio which is not possible.

3.2.5 Sortino Ratio.

The Sortino-ratio divides the excess return by the lower partial standard deviation (LPSD). In the research thesis, the lower partial standard deviation of excess return is calculated by using only "bad" returns and using only negative deviations from the risk-free rate (rather than a negative deviation from the sample average). These deviations are squared to obtain an analog to variance then taking the square-root to obtain a "left-tail standard deviation".
The lower partial standard deviation is, therefore, the square-root of the averaged squared deviation, conditional on the negative excess return (2022 Bodie page 169 u.d.)

The Sortino-ratio is calculated by the following equation:

$$\widehat{\text{Sortıno Ratıo}_k} = \frac{\widehat{r_{p,K}}}{\widehat{\sigma_{dp,K}}} \quad (10)$$

$\widehat{\text{Sortıno Ratıo}_k}$, is the Sortino-ratio for strategy K, the $\widehat{r_{p,K}}$, is the mean of the returns for strategy K and $\widehat{\sigma_{dp,K}}$, is the mean of the standard deviation for the downside risk for strategy K. The market with the highest Sortino-ratio is the best performing market.

The Sortino-ratio is applied to evaluate to measure the downside risk of the portfolios since the standard deviation of the returns greater than the average is expected to be beneficial (1994 Sortino & Price u.d.).

The last analysis of the research uses the medium P/E-ratio (ttm) from FactSet to calculate the median P/E-ratio of the following sectors: Consumer Non-Cyclicals, Finance, Healthcare, Industrial and Technology, to separate Value & Growth stock in the sectors. The median P/E-ratio is calculated by the following equation:

$$\text{Median} = \left(\frac{n+1}{2}\right)^{\text{th}} \text{observations} \quad (11)$$

3.3 Fama & French 5-factor regression.

In 1993, Fama & French proposed a three-factor model that has become a standard tool in many empirical studies of asset returns. The model is built on the theory of the CAPM-model but includes two additional factors. The two factors added as observations suggest the average return on stocks of small firms and stocks of firms with a high ratio of the book value of equity to the market value of equity have historically been higher than the predicted by the security market line of CAPM. The three-factor model also observed that size or book-to-market ratio may proxies for exposures to the source of systematic risk, which is not captured by the CAPM factor (beta), causing return premiums. Fama & French pointed out that firms with high ratios of the book to market value are likely to suffer from financial distress and small stocks may be more sensitive to changes in the business condition (2019 Bodie page 213 u.d.).

The research paper from Norvy-Marx (2012 u.d.) identified that profitability and average return are strongly related, and Aharoni, Grundy, and Zeng (2013 Gil Aharoni u.d.) documented a reliable relationship between investment and average return, indicating that Fama & French 3-factor model miss the relation between the average expected return and expected profitability and investment. Fama & French then created a new model adding two additional factors the profitability and investment factor and became the Fama & French 5-factor model, which is commonly used in empirical studies of asset return today. This research thesis uses the Fama & French 5-factor model for asset pricing.

The thesis strives to determine and predict the prices of assets using the Fama & French 5-factor model, which contains SMB (Small minus Big), HML (High minus Low), RMW (Robust minus Weak profitability), and CMA (Conservative minus Aggressive investment stocks). The first step of the Fama & French regression is by estimating the variable "y" which in this research is the monthly average excess return of each portfolio and sector-based portfolios, the data consist of 61 observations based on five years from 01.01.2017 – 01.01.2022.

The purpose of the test in the research is to examine the alpha of the portfolios and to determine if the five-factors are significant in explaining each of the portfolios' excess returns. The data collection of the five factors, MKT(Rm-Rf), SMB, HML, RMW, and CMA is downloaded from Kenneth R. French's webpage under the data library section (2022 Kenneth u.d.). The data is represented in Excel[7]. The data of the returns are on monthly basis and are equivalent to 61 observations in each portfolio.

By using the Fama & French 5-factor model in multiple linear regression, the alpha and significance of each factor are determined by the following equation (F. &.-f. 2014 2014):

$$R_{it} - R_{ft} = a_i + \beta_i(R_{Mt} - R_{Ft}) + SMB_t + HML_t + RMW_t + CMA_t + \varepsilon_{it}] \quad (12)$$

$$R_{it} - R_{ft} = a_i + \beta_i(R_{Mt} - R_{Ft}) + SMB_t + HML_t + RMW_t + CMA_t + Value_t + Growth_t + \varepsilon_{it}] \quad (13)$$

[7] Excel data-collection spreadsheet (Kenneth R. French Data)

Where, a_i; Alpha, if the model captures all variation in the predicted returns, the intercept is zero, R_{it} is the return on the stock or portfolio, $R_{ft}$is the risk-free rate return, R_{Mt} is the return on the value-weighted market portfolio.

As shown in the two-equation above, and mentioned in the problem statement the three hypotheses in the thesis, are calculated as:

$$H_1: \text{High ESG} - \text{Rating companies performs better than Low ESG} - \text{Rating companies}$$
$$H_2: \text{High and Low ESG} - \text{Rating companies are exposed to Fama \& Frech 5} - \text{factor}$$
$$H_3: \text{Do Value or Growth have an impact on High and Low ESG} - \text{rating companies}$$

$Mk_f - R_{ft}$ $(\beta_i(R_{Mt} - R_{Ft}) =$ is the market factor.
$SMB_t =$ Return on a diversified of small stocks minus the return on a diversified portfolio of big stocks
$HML_t =$ The difference between returns on diversified portfolios of high- and low B/M stocks.
$RMW_t =$ The difference between the returns on diversified portfolios of stock with robust and weak profitability.
$CMA_t =$ Is the difference between the return on diversified portfolios of low and high investment stocks, which are called conservative and aggressive stocks
$Value_t =$ the monthly excess return of the constructed value-portfolio
$Growth_t =$ the monthly excess return of the constructed growth-portfolio
$\varepsilon_{it} =$ Is the zero-mean residual

The coefficients in this research multiple linear regression are: β_i, SMB_t, HML_t, RMW_t, CMA_t, $Value_t$, and $Growth_t$. The error term for the multiple linear regression ε_{it}, is the difference between the observed excess return and the estimated excess return by the OLS-method.

3.4 OLS-assumptions.

Before the regression is conducted in the thesis, the OLS-assumption *T1-T6* has to be tested, the testing is provided in the appendix[8]. In the use of the Fama & French 5-factor model for predictions, the OLS-assumptions have to be met. The validity of the OLS-estimators depends on various assumptions. These are the Gauss Markov assumptions that determine if the OLS-

[8] Appendix 4 - OLS-Assumptions from 4.1.1 to 4.1.6

estimates for the regression coefficients above are the best linear unbiased estimates. It is specifically assumptions for time series applied which are the following (J. M. 2012 Wooldridge u.d.). The remaining sector-based-and Value- and Growth-portfolios in the research thesis is assumed to follow the same results.

The first assumption TS.1: Linear in parameters, examines how the linear relationship between the dependent variable in this research the excess return, and the explanatory variables (Fama & French 5-factors) is. The linear relationship is tested by using the Best Fitted Line, which determines if the data-points of the dataset are on the line. In the research thesis, Excel is used for this test where the excess return of the portfolios is on the Y-axis and the 5-factors is on the X-axis. For an example of a perfectly linear relationship, all the data-points will be on the line. The result of the test is presented in the appendix[9].

The second assumption is TS.2: No perfect Collinearity: "No independent variable is constant or nor a perfect linear combination of the others", examines the correlation between the independent variable in the thesis research on the 5-factors from Fama & French. The correlation is tested in Excel constructing a correlation-matrix, using the following function and the result of the test is presented in the appendix[10].

The third assumption is TS.3: Zero Conditional Mean is tested using scatterplot from R-studio, where the residual is placed and if the trendline is around zero. If the mean of the residual is zero, then assumption four is satisfied. The closer to zero the better. The result of the scatterplot is presented in the appendix[11].

The fourth assumption is TS.4: Homoskedasticity is tested using the Breusch-Pagan-test in R-studio. As described in assumption 3, the error u is constant and does not increase with time. The Breusch-Pagan-test consist of the following null-hypothesis:

$$H_0 = \text{Homoskedassticity is present (the residuals are distributed with equal variance)}$$
$$H_a = \text{Heteroskedasticity is present (the residuals are not distributed with equal variance)}$$

[9] Appendix 4 - OLS Assumptions 4.1.1
[10] Appendix 4 - OLS Assumptions 4.1.2
[11] Appendix 4 - OLS Assumptions 4.1.3

In the thesis research test, the Breusch-Pagan-Test follows a significance level of 0.05 (5%). If the p-value of the test is less than 0.05, the null-hypothesis can be rejected and conclude that the heteroskedasticity is present in the regression, and if the test is above 0.05 the alternative-hypothesis is used and homoskedasticity is present in the regression. If the regression has heteroskedasticity present the regressions standard errors are corrected by using the Robust Standard Error test in R-studio, the result of the test is presented in the appendix[12].

The fifth assumption is TS.5: No Serial Correlation is tested by using the Ljung-Box test (LB-test) statistics. The test consists of the following null hypothesis:

$$H_0 = \text{The model does not show a lack of fit (the model does not show sign of autocorrelation)}$$
$$H_a = \text{The model show lack of fit (the model shows sign of autocorrelation)}$$

In this research test, the Ljung-Box test follows a significance level of 0.05 (5%). If the p-value of the test is less than 0.05, then the null-hypothesis can be rejected and conclude that the time series does not show a sign of autocorrelation, if the p-value is above 0.05 the alternative-hypothesis is used, and the time series show sign of autocorrelation. The result of the test is presented in the appendix[13].

The last assumption TS.6: Normality is tested for multicollinearity (J. M. 2012 Wooldridge u.d.). "If two or more independent variables in this research the five-factors have an exact linear relationship between them, then the regression has perfect multicollinearity". As two independent variables have the same effect on the dependent variable in this research the excess return, the marginal effect of each cannot be estimated. The best case is low collinearity between the independent and dependent variables and is tested by the Q-Q-plot and Shapiro-Wilk test in R-studio and the result is presented in the appendix[14].

As the Fama & French 5-factor regression model is corrected for any problems and meets the Gauss Markov's 6-assumptions, the regression will be conducted. The purpose of this research as mentioned is to test whether the coefficients of the 5-factors and the value-and growth-factor have some explanatory power over the dependent variable the excess return. The research uses

[12] Appendix 4 - OLS Assumptions 4.1.4
[13] Appendix 4 - OLS Assumptions 4.1.5
[14] Appendix 4 - OLS Assumptions 4.1.6

a significance level of 0.05 (5%), and the p-value is the main indicator to determine the significance of each coefficient.

After the OLS-assumption is tested in the thesis, the five-factors are regressed on each portfolio based on the excess returns. Depending on the significance level and p-values of each regression the level of exposure to the five-factors is determined. Furthermore, the alpha-value, adjusted R-square, and standard error are examined on the models in the thesis, to indicate the prediction of the excess returns of the portfolios. The next step is the general-to-specific approach, which is done by excluding the insignificant factors from regressed regression in the thesis and constructing a new regression again. The best-fitting model is chosen by using the Criteria approach of the Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC), to estimate the prediction error and the relative quality of the models regressed in the thesis, and the lowest value indicates the best fitting model (2019 Paolella u.d.)

4. Empirical Findings & Results.

This chapter consists of four analyses Portfolio performance evaluation, the Fama & French 5-factor model regression, the sector-based portfolio, and the value and growth portfolio. Each analysis helps clarify whether or not the ESG-ratings of the chosen companies and sectors influence on the performance of the stocks and whether or not value-or growth-stocks have an impact. Furthermore, it determines if any of the portfolios are affected by the Fama & French 5-factors, creating the best model for price prediction.

4.1 Benchmark and market portfolio performance.

This chapter examines the benchmark (S&P500) performance, helping to determine whether or not each portfolio has over-or underperformed the benchmark. The risk-free market portfolio is based on previous empirical evidence from (2017 Ronald Q Doeswijk u.d.). Furthermore, the chapter provides the results of portfolios with both High and Low ESG-rating stocks, indicating whether or not ESG-ratings contribute to the performance of the stocks.

When comparing the High- and Low ESG-rating portfolios, the sector-portfolios, and the value- and growth-portfolio the market portfolio beta-value is risk-adjusted with the corresponding difference in the excess returns. In the thesis research, this is done by combining the benchmark (S&P500) outcome shown in table 4.1.1 with a beta-value of 1 and the risk-free rate with an alpha-value of 0. This indicates if one of the given portfolios in the research has a

beta-value above 1 then the portfolio is more volatile than the market, and if the beta-value is below 1 then the portfolio is less volatile than the market.

Table 4.1.1 – Market portfolio performance

(Performance result from S&P500 – calculated in excel)[15]

S&P500	Annually performance
Benchmark excess return	14.68%
Sharpe-ratio	0.938
Sortino-ratio	1.076
Downside deviation	13.6%
Standard deviation	15.6%
Variance	0.024
Beta	1.000
Alpha	0.000
Skewness	-1.659
Kurtosis	2.953

Source: Author's creation.

The research period is from 01.01.2017 to 01.01.2022, equivalent to 61 observations. As illustrated in table 4.1.1, the benchmark generated an excess return of 14.68% on annual basis, indicating investors would generate an average of 14.68% annually over five years by investing in the S&P500-index. Generally, the standard deviation is closely related to the return of a stock/portfolio. The larger volatility, the larger the gains or losses in returns are expected. The relation between risk and reward is determined by the Sharpe-ratio and the Sortino-ratio determines the downside risk of the stock/portfolio. Illustrated in Table 4.1.1, the benchmark performed a Sharpe-ratio of 0.938 and a Sortino-ratio of 1.076 on annual basis during the research period. The ratios are used to compare the portfolios and market-portfolio as indicators of Reward-to-Volatility and Downside-risk, the highest value generated indicates the best result.

To compare the distribution of the portfolios based on the annual excess return. The result of the S&P500-index in table 4.1.1, shows it is not perfectly distributed, which partially can be described by the skewness and kurtosis. The skewness measures the symmetry of the research dataset and generated a skewness of -1.659 indicating the excess return is negatively skewed, resulting in larger left-handed tails, and implies the S&P500-index generates few large losses

[15] Excel data-collection spreadsheet (High-Low ESG portfolio)

and frequent small gains (2022 Bodie Kane u.d.). The kurtosis indicates the thickness of the tails of the calculated dataset of the benchmark S&P500, the annual excess return has a kurtosis of 2.953 which is categorized as "platykurtic" also called "broad", indicating the distribution is predictable in the sense that rarely will be extreme returns by investing in the S&P500-index.

4.2 High- and Low ESG-rating portfolio performance.

This chapter examines the High-and Low ESG-rating portfolio performance. The thesis research is proceeding to the performance evaluation of the High- and Low ESG-rating portfolios. The construction of the High- and Low ESG-rating portfolio in the research is constructed by using the top 10% of the highest-rated and the 10% of the lowest-rated. Applying this approach, the High- and Low ESG-rating portfolios in the research are taken the top 10% of companies placed in the S&P500 is equivalent to 50 companies, and the same is done lowest 10% of companies placed in the S&P500 equivalent to 50 companies. This leads to two portfolios with 50 companies in each based on the ESG-ratings ranking from Refinitiv and FTSE and illustrated in the table 4.2.2.

Table 4.2.1– High- and Low ESG-rating companies

(The thesis focus area of High-and Low ESG-rating companies and construction method))

	ESG Rebalancing	**Thematic Focus**
Objective	Investment based on ESG-ratings and agencies	Focus on ESG-investing based on ESG-ratings of High- and Low companies from S&P500.
Key Consideration	ESG-rating from agencies, desired risk taken and ESG-rating divergence	Broad vs. Specific exposure
Examples	Optimize ESG-benchmark, active strategies	Focus on the highest- and lowest ESG-rating companies, sectors and Value vs. Growth

Source: Authors creation

Table 4.2.2– Screenshot of ESG-rating ranking

(The S&P500 companies ranking from highest to lowest based on Refinitiv and FTSE ESG-ratings)[16]

Companies	**Refinitiv ESG-rating**	**FTSE 5-year avg. ESG-rating**
High ESG-rated companies		
1. Microsoft Corp	93.0	4.6
2. Cisco Systems	89.0	4.3
3. Johnson & Johnson	89.0	4.0
4. Humana Inc.	87.0	4.2
5. Newmont Corp	87.0	4.2
……	…….	……..
Low ESG-rated companies		
1. News Corporation Class A	26.0	0.0
2. Abiomed Inc.	25.0	0.0
3. Caesars Entertainment Inc.	18.0	0.0
4. Rollins Inc.	7.0	0.0
5. Lumen Technologies Inc.	0.0	0.0

Source: Authors creation

From table 4.2.2, and the construction of the High- and Low ESG-rating portfolio, the highest ESG-rated company was Microsoft Corp (MSFT) with a rating of 93 from Refinitiv and 4.6 from FTSE five-year average ESG-rating, and the lowest ESG-rated company was Lumen Technologies (LUMN) with a rating of 0.0 from Refinitiv and 0.0 from FTSE five-year average ESG-rating.

The thesis research period is from 01.01.2017 – to 01.01.2022, equivalent to 61 months, eight stock from the S&P500-index has been excluded from the observations. The three of them are Corteva Inc, Dow Inc, and Fox Corporation Class A since their historical data begins in 2019. The lack of information will influence the research and why the researcher has historical going back five-years, to get a more precise result. To compare the performance of the High- and Low ESG-rating portfolio, Sector-based portfolios and the value- and growth-portfolio the thesis research compares the Sharpe-ratio, Sortino-ratio, and Alpha-value on an annual basis.

[16] Excel data-collection spreadsheet (High-Low ESG portfolio)

Table 4.2.3– Performance of High- and Low ESG-portfolio

(The performance result calculated in excel (High-Low ESG portfolio spreadsheet) – to compare the performance) [17]

	Market portfolio Annual performance	High ESG-rating portfolio Annual performance	Low ESG-rating portfolio Annual performance
Excess Return	14.68%	13.16%	18.32%
Sharpe-ratio	0.938	0.800	1.438
Sortino-ratio	1.076	1.450	1.921
Downside Deviation	15.6%	9.1%	8.8%
Standard Deviation	13.6%	16.5%	11.8%
Variance	0.024	0.027	0.014
Beta	1.000	1.013	1.066
Alpha-value	0.000	-0.001	0.003
Skewness	-1.659	-0.029	-0.457
Kurtosis	2.953	0.360	0.527

Source: Authors Creation

From table 4.2.3 above both the High- and Low ESG-rating portfolio generated beta-values above 1 indicating the portfolios is more volatile than the market. Only the Low ESG-rating portfolio outperformed the benchmark with 3.64% on annual basis, while the High ESG-rating portfolio underperformed with -1.52% on annual basis. The Low ESG-rating portfolio generated Sharpe- and Sortino-ratios of 1.438 and 1.921 and outperformed both the benchmark and High ESG-rating portfolio indicating greater returns relative to the amount of risk taken, and greater returns of each unit of downside risk, while the High ESG-portfolio underperformed the benchmark based on the Sharpe-ratio and outperformed the benchmark based on the Sortino-ratio. Referring to chapter 3.2.4 of the Sharpe-ratio the Low ESG-rating portfolio generated an adequate/good ratio compared to the High ESG-rating portfolio.

Referring to the methodology chapter 3.3 Fama & French 5-factor, the following regression is generated in Excel and R-studio, shown in the appendix[18]:

$$R_{it} - R_{ft} = a_i + \beta_i(R_{Mt} - R_{Ft}) + SMB_t + HML_t + RMW_t + CMA_t + \varepsilon_{it}] \quad (14)$$

[17] Excel data-collection spreadsheet (High-Low ESG portfolio)
[18] Appendix 2 – Fama & French 5-factor regression R-studio and Excel result

The results from equation 14 are presented in Table 4.2.4 below and despite the performance measured by the excess return, both the High- and Low ESG-rating portfolio generated insignificant alpha-values of -0.1% and 0.3% on a significance level of 0.05 (5%) but generated positive and significant beta-values on a significance level of 0.05 (5%). From the regression both the High- and Low ESG-rating generated positive and significant values on the high minus low (HML)-factor, indicating the portfolios are sensitive and correspond to the HML-factor or "portfolio" of stocks with high book-to-market value, only the Low ESG-rating portfolio is exposed to the Robust minus Weak (RMW)-factor, indicating the returns corresponds to the profitability of the companies or "portfolio".

Table 4.2.4 – Fama & French 5-factor regression

(applying Data analysis tool regression in excel, y-variable = High- and Low ESG-rating excess return, x-variables = FF5-factors)[19]

	Alpha	**Mkt-RF**	**SMB**	**HML**	**RMW**	**CMA**	**Adjusted R-square**	**Std. Error**
High ESG-portfolio	-0.001	0.949	-0.064	0.263	0.053	-0.010	0.945	0.011
P-value[20]	0.468	0.000 (***)	0.339	0.000 (***)	0.528	0.913		
Low ESG-portfolio	0.003	0.921	0.120	0.200	0.077	-0.397	0.919	0.014
P-value	0.181	0.000 (***)	0.168	0.004 (**)	0.478	0.001 (**)		

Source: Authors Creation

As the alphas are different from zero, the Fama & French 5-factor model does not capture all of the ESG-risks. This is even though the portfolios are created with zero exposure to the risk factors, meaning that either the market is inefficient, or the risk factors do not fully capture all the risks.

From the risk point of view in Table 4.2.3, only the Low ESG-rating portfolio outperformed the benchmark with a Sharpe-ratio of 1.438, indicating an adequate/good ratio and the portfolio tends to generate greater returns relative to the amount of risk taken, with a beta-value above 1 and a Sortino-ratio of 1.921 indicating the portfolio tends to generate greater returns of each unit of downside risk compared to the benchmark and High ESG-rating portfolio. The High

[19] Appendix 2 Fama & French 5-factor regression R-studio result.
[20] The stars in the P-value indicates the significance level where
*** = significance level of 0.00
** = significance level of 0.05
* = significance level of 0.1

ESG-rating portfolio underperformed compared to the benchmark based on the Sharpe-ratio, indicating less great return relative to the amount of risk taken, while the portfolio outperformed the benchmark based on Sortino-ratio indicating greater returns for each unit of downside risk.

The distribution of annual excess return of the High- and Low ESG-rating portfolio generated negative skewness for both portfolios, indicating frequent small gains and few large losses, and with a relatively low kurtosis of 0.360 and 0.527, indicating "platykurtic" distribution, and the portfolios have a small probability of extreme returns.

4.3 Sector based portfolio.

This chapter examines the sector-based portfolios performance. The thesis is proceeding to the sector-based portfolio the construction of sector-portfolios is based on the average ESG-rating based on the five-year average FTSE ESG-rating, the ESG-rating are rated from 0-5 where 0 is the lowest and 5 is the highest rating. As presented in table 4.3.1 each sector is presented with the average ESG-rating of the sector. The thesis research five sectors are selected by the following factors: The average ESG-rating of the sector and the number of companies represented in the sector, applying these factors, the five factors used in the thesis research: Consumer Non-Cyclicals, Finance, Healthcare, Industrials, and Technology. After the selection of the sectors, the portfolios are constructed by taking the 10 highest ESG-rated companies and lowest ESG-rated companies in each sector, giving 5 sector portfolios with 20 companies and the portfolios are equally weighted.

Table 4.3.1 – Average ESG-rating of the sectors.

(Calculated in Excel using "average" formula in spreadsheet Sector ESG-ratings)[21]

Different Sectors	FTSE ESG-rating (five-year average rating of the sectors)	Number of companies represented in each sector	Minimum	Maximum	Standard deviation
Consumer Non-Cyclicals	2.4	44	0.0	4.0	0.890
Finance	2.3	100	0.0	4.1	0.978
Healthcare	2.2	64	0.0	4.3	1.376
Industrials	2.2	58	0.0	4.3	1.263
Technology	2.2	70	0.0	4.6	1.445

Source: Author's Creation

The table above illustrates the sectors used for the sector-based portfolios in the thesis. The highest ESG-rating sector is the Consumer Cyclicals with an overall average of 2.5, and the lowest ESG-rating sector is the Technology sector with an average rating of 2.2. As mentioned above, due to the lack of companies represented in the sectors of Consumer Cyclicals, Non-Energy Materials, Telecommunications, Utilities, Energy, and Business services are excluded in this research construction of sector portfolios. The following sectors are used in the research: Consumer Non-Cyclicals (44 companies), Finance (100 companies), Technology (70 companies), Healthcare (64 companies), and Industrials (58 companies)

4.3.1 Sector-based portfolio performance & evaluation.

Proceeding to the performance evaluation of the sector-based portfolios of the thesis research. As mentioned above the selection of the sectors is based on the average ESG-rating of the sectors and companies represented, and the construction of each portfolio within the sectors, is based on the 10 highest- and 10 lowest ESG-rated companies within the selected sectors. The thesis has created an overall table to compare the different sector-portfolios with each other and the benchmark. Table 4.3.2 below illustrates a screenshot of the ESG-ranking of the sector-based portfolios used in the thesis.

[21] Excel data-collection spreadsheet (Sector ESG-ratings)

Table 4.3.2– Screenshot of ESG-rating ranking

Consumer Non-Cyclicals	FTSE ESG-rating	Finance	FTSE ESG-rating	Technology	FTSE ESG-rating	Healthcare	FTSE ESG-rating	Industrial	FTSE ESG-rating
Walmart Inc	4.0	Capital on Financial	4.1	Microsoft	4.6	Biogen Inc	4.3	Delta Airlines	4.3
TJX Companies	3.9	JPMorgan Chase	4.1	HP Inc.	4.3	CVS Health	4.3	Xylem Inc	4.3
Campbell Soup	3.8	Bank of American	4.0	Intuit Inc	4.3	Humana Inc	4.2	Cummins Inc	4.2
Coca-Cola	3.7	PNC Financial	3.9	Cisco system	4.2	Boston Scientific	4.0	FedEx Corp	4.0
PepsiCo.	3.7	State Street Corp	3.8	Intel Corp	4.2	Johnson & Johnson	4.0	Lockheed Corp	4.0
……..	……..	……..	……..	……..	……..	……..	……..	……..	……..
Ulta Beauty	2.4	Extra Space	1.0	Monolithic Power	0.0	Catalent Inc	0.0	General Electric	1.1
Constellation Brands	2.3	Loews Corp	1.0	MSCI Inc.	0.0	Dexcom Inc	0.0	Generac Holdings	1.0
Church & Dwight	2.2	Berkshire	0.6	Match Group Inc	0.0	Molina Healthcare	0.0	Ingalls Industries	0.0
Kraft Heinz	2.2	Alexandria Real Estate	0.0	Paycom Software Inc	0.0	Charles River Lab.	0.0	IDEX Corp	0.0
Walgreens	2.2	CBOE Global	0.0	PTC Inc	0.0	PerkinElmer Inc	0.0	IPG Photonics	0.0

(High- and Low ESG-rating companies of selected sectors ranked from highest to lowest based on FTSE ESG-rating)[22]

Source: Authors creation

[22] Excel data-collection spreadsheet (Consumer Non-Cyclicals, Finance, Technology, Healthcare, and Industrial sector)

Table 4.3.3 – Performance of the Sector-portfolios.

(Calculated performance of each High- and Low ESG-rating portfolio using excel) [24]

Annual performance	Benchmark	High ESG Consumer Non-Cyclicals	Low ESG Consumer Non-Cyclicals	High ESG Finance	Low ESG Finance	High ESG Technology	Low ESG Technology	High ESG Healthcare	Low ESG Healthcare	High ESG Industrial	Low ESG Industrial
Excess return	14.68%	7.18%	11.62%	10.14%	14.36%	18.77%	39.66%	11.75%	25.25%	10.58%	17.54%
Sharpe-ratio	0.938	0.589	0.501	0.366	0.816	1.091	1.739	0.700	1.188	0.462	0.913
Sortino-ratio	1.076	0.417	0.407	0.389	0.667	1.050	1.529	0.723	1.057	0.426	0.788
Standard Deviation	0.156	0.122	0.232	0.277	0.176	0.172	0.228	0.168	0.213	0.229	0.192
Downside Deviation	0.136	0.172	0.285	0.260	0.215	0.179	0.259	0.163	0.239	0.248	0.223
Alpha-value[23]	0.00	0.021 (**)	0.039 (**)	0.043 (**)	0.025 (**)	0.025 (**)	0.025(**)	0.022 (**)	0.020 (**)	0.036 (**)	0.020 (**)
Beta	1.00	0.587	1.261	1.498	0.987	1.014	1.116	0.732	1.070	1.234	1.050
Skewness	-1.659	-0.050	1.759	-0.162	-0.075	0.194	1.224	-0.560	-1.896	-0.503	-0.563
Kurtosis	2.953	-0.608	4.758	-0.632	-0.210	-1.229	2.673	3.654	4.539	-0.592	0.096

Source: Authors creation

[23] *** = significance level of 0.00 ** = significance level of 0.05 * = significance level of 0.1
[24] Excel data-collection spreadsheet (Consumer Non-Cyclicals, Finance, Technology, Healthcare, and Industrial sector)

Table 4.3.4 – Fama & French 5-factor regression.

Fame & French 5-factor regression[25]	High ESG Consumer Non-Cyclicals	Low ESG Consumer Non-Cyclicals	High ESG Finance	Low ESG Finance	High ESG Technology	Low ESG Technology	High ESG Healthcare	Low ESG Healthcare	High ESG Industrial	Low ESG Industrial
Alpha	0.021	0.039	0.043	0.025	0.025	0.025	0.022	0.019	0.036	0.020
P-value	0.000 (***)	0.000 (***)	0.000 (***)	0.001 (**)	0.000 (***)	0.000 (***)	0.018 (**)	0.036 (**)	0.000 (***)	0.013 (**)
Mkt-RF	0.906	1.621	1.584	1.212	1.389	1.377	1.081	1.665	1.626	1.331
P-value	0.000 (***)	0.000(***)	0.000(***)	0.000(***)	0.000(***)	0.000(***)	0.000(***)	0.000(***)	0.000(***)	0.000(***)
SMB	-0.327	0.624	0.157	-0.120	-0.073	0.350	-0.087	0.067	0.313	0.230
P-value	0.197	0.144	0.702	0.689	0.798	0.423	0.831	0.869	0.423	0.503
HML	-0.124	0.071	1.545	0.607	0.078	0.228	-0.233	-0.710	0.343	0.058
P-value	0.487	0.812	0.000(***)	0.006(**)	0.699	0.423	0.422	0.017(**)	0.216	0.812
RMW	1.068	0.566	-0.465	-0.371	0.120	-0.379	-0.177	-0.360	0.812	-0.135
P-value	0.013(**)	0.423	0.496	0.459	0.658	0.222	0.795	0.600	0.214	0.814
CMA	0.770	0.156	-0.797	-0.743	-0.670	-2.072	0.875	-0.514	-0.390	-1.347
P-value	0.037(**)	0.799	0.181	0.090	0.107	0.002(**)	0.142	0.388	0.489	0.008(**)
Adjusted R-square	0.475	0.588	0.730	0.640	0.661	0.528	0.265	0.522	0.644	0.603
Std. Error	0.026	0.043	0.042	0.030	0.029	0.044	0.041	0.041	0.040	0.035

Source: Authors creation ***(FF5-factor regression result using data analysis regression in Excel – x-variables = excess return of the portfolios, y-variable = FF5-factors)***[26]

[25] *** = significance level of 0.00 ** = significance level of 0.05 * = significance level of 0.1
[26] Appendix 2.1 – Fama & French 5-factor regression result of all sectors from Excel-Anova

The results of the sector-based portfolios in Table 4.3.3 are based on the annual excess return of the portfolios compared to the benchmark only the High ESG Technology-, Low ESG Technology-, Low ESG Healthcare- and Low ESG Industrial-portfolios outperformed the benchmark.

The Sharpe-ratio of the portfolios also indicates the benchmark outperformed 7 out of 10 portfolios and the Low ESG Industrial-portfolio underperformed despite generating higher annual excess return, whereas the High ESG Technology-, Low ESG Technology- and Low ESG Healthcare-portfolios generated higher Sharpe-ratios and referring to the methodology chapter 3.2.4 each of the portfolios generated an adequate/good Sharpe-ratio, indicating greater returns relative to the amount of risk taken in the portfolios, while the benchmark outperformed 7 portfolios indicating the benchmark generates greater returns relative to the amount of risk taken. The systematic risk in the thesis research is based on beta-value where only the High Consumer Non-Cyclicals have a beta-value below 1 and indicating the portfolio tends to be less volatile than the benchmark, and the rest has a beta-value above 1, indicating the portfolios tend to be more volatile than the benchmark. The Sortino-ratio of the portfolios indicates that 9 out of 10 portfolios tend to underperform the benchmark, indicating the benchmark tends to generate greater returns for each unit of downside risk, whereas only the Low Technology ESG-portfolio outperformed the benchmark and the rest of the portfolios.

Overall, the Low ESG Technology-portfolio outperformed all of the portfolios and the benchmark when comparing the performance based on annually excess return, Sharpe-ratio, Sortino-ratio, and Alpha-value.

The result from the Fama & French 5-factor regression in table 4.3.4 is based on the significance level of 0.05 (5%). All of the portfolios generated significant alpha-values indicating they outperform the market, despite lower annual excess returns on 7 out of 10, and all the portfolios generated significant beta-values, where 9 out of 10 portfolios have a beta-value above 1 indicating the portfolios tend to be more volatile than the market. Only the High ESG Finance-, Low ESG Finance- and Low ESG Healthcare-portfolios generated significant coefficients on the High minus Low (HML)-factor, The High- and Low ESG Finance portfolios generated positive values indicating both portfolios are sensitive and responsive to the factor and perform well when stock/portfolios with high book-to-market perform well, while the Low ESG Healthcare generated a negative value indicating the portfolio is sensitive and responsive

to the factor and perform well when stock/portfolios with low book-to-market perform well. The Robust minus Weak (RMW)-factor only the High ESG Consumer Non-Cyclicals portfolio generated a positive and significant value, indicating the portfolio excess return responds to the profitability of the stock/portfolios. The Conservative minus Aggressive (CMA)-factor, the High ESG Consumer Non-Cyclicals-, Low ESG Finance- and Low ESG Technology-portfolios generated significant values, only the High ESG Consumer Non-Cyclicals has a positive value indicating the excess return are exposed to firms with high investment policies and moves in the same direction as conservative stocks, while the Low ESG Finance- and Technology-portfolios generated negative values, indicating the portfolios excess return are exposed to firms with low investment policies and moves in the opposite direction of conservative stocks.

4.4 Summary of portfolio performance evaluation.

Based on the calculations and results from chapters 4.2 and 4.3 from the High- and Low ESG, Consumer Non-Cyclicals, Finance, Technology, Healthcare, and Industrials portfolios, especially the Low Technology-sector ESG portfolio generated the highest return of 39.66%.

Empirical evidence from Nordea analysts concluded that ESG-companies delivered solid operational performance since 2012 and High ESG-rated companies outperformed the Low ESG-rated companies by 5% per year (2018 Hugo u.d.). Contrary to (2018 Hugo u.d.) the thesis research with the top 10% and lowest 10%, based on FactSet FTSE 5-year average ESG-rated companies from S&P500 found the opposite result from Nordea analysts. From the result of the High- and Low ESG-rating portfolio in the period from 01.01.2017 to 01.01.2022, the Low ESG-rating portfolio outperformed both the market portfolio and High ESG-rating portfolio and performed on average per year 5.16% better than the High ESG-portfolio. Furthermore, the result of the overall excess return for the sector-based portfolios indicates Low ESG-rating sector portfolios tend to outperform the High ESG-rating Sector portfolios and indicates the opposite of the above-mentioned evidence.

Empirical studies like Halbritter & Dorfleitner (2015 u.d.) found no significant return difference between companies with High- and Low ESG-ratings and Fama & MacBeth (1973 u.d.) did find statistical significance of serval ESG-variables, but the magnitude and direction of the impact were substantially dependent on the rating provider and subperiod and concluded

that investors should not expect abnormal returns focusing on High- or Low ESG-rated companies (2015 u.d.). The thesis research from the results of the performance for all portfolios, the High- and Low ESG-rating portfolios both generated insignificant alpha-values, while all the sector-based portfolios generated significant alpha-value at a significance level of 0.05 (5%). The research also found the High- and Low ESG-rating portfolios showed statistical significance at a significance of 0.05 (5%) on the High minus Low factor and only the Low ESG-rating portfolio showed statistical significance on the Conservative minus Aggressive factor. The research on the sector-based portfolios found that the High Consumer Non-Cyclicals ESG portfolio, High-and Low Finance ESG portfolio, High- and Low Technology ESG portfolio, Low Healthcare ESG portfolio, and Low Industrial ESG portfolio showed statistical significance at a significance level of 0.05 (5%) on the High minus Low-, Robust minus Weak- and Conservative minus Aggressive factors, indicating the same result as Fama & MacBeth (1973 u.d.) with some significance of serval ESG-variables.

The Low Technology-sector ESG portfolio is followed by the Low Healthcare ESG portfolio with an annual return of 25.25%. Interesting are the High Finance ESG, High Industrial ESG- and Low Consumer Non-Cyclicals ESG portfolios which all is representing high risk based on the beta-values, the high risk and low excess return are also reflected by low annual Sharpe- and Sortino-ratios indicating the portfolios has high risk and low excess return. Presented in figure 4.4.1 below.

Table 4.4.1 – High risk portfolios with low excess return.

(Screenshot of the highest calculated beta-value of sector-based portfolios using Excel formula "slope") [27]

Portfolios	Annual Avg. excess return	Beta-value	Sharpe-ratio	Sortino-ratio
High ESG-rating Industrial portfolio	10.14%	1.234	0.462	0.426
High ESG-rating Finance portfolio	10.58%	1.498	0.366	0.389
Low ESG-rating Consumer Non-Cyclicals portfolio	11.62%	1.261	0.501	0.407

Source: Authors Creation.

From the Risk-to-Reward point of view, measured by the standard deviation, the High-and Low ESG-rating portfolio, the High ESG-rating portfolio exceed the Low ESG-rating portfolio

[27] Excel data-collection spreadsheet (Consumer Non-Cyclicals, Finance, and Industrial sector)

and can partly be explained by political and transition risk and two out of five Low ESG-rating sector portfolios exceed the high portfolios (2021 Bolton u.d.). Furthermore, there is a growing trend of private and institutional investors allocating capital from Low ESG-rated companies to High ESG-rated companies, the trend, and benefits of investing in ESG are a matter of time before reaching an equilibrium.

Finally, referring to chapter 1.2 (Problem Statement) the first of the three null-hypothesis, that High ESG-rating results in higher returns than Low ESG-rating, the research thesis rejects *"H1"* hypothesis, since both portfolios generated statistical insignificant alpha-values, indicating there is no evidence of statistical difference between the excess returns, but the Low ESG-rating portfolio outperformed the High ESG-rating portfolio based on the annual excess return, Sharpe-ratio, and Sortino-ratio.

4.5 Regression Analysis.

The analysis in the research thesis investigated and observed which factors of the risk size, value, profitability, and investment, that High- and Low ESG-portfolios are exposed to. Furthermore, the alpha-value from the regression is used as an indicator of over-or underperformance to the predicted value, representing Jensen's alpha.

Table 4.5.1 –Fama & French 5-factor regression.

(Excel Data analysis tool regression – x-variable = excess return of high-and low ESG-rating portfolio, y-variable = FF5-factors) [28]

	Alpha	Mkt-RF	SMB	HML	RMW	CMA	Adjusted R-square	St. Error
High ESG-portfolio	-0.001	0.949	-0.064	0.263	0.053	-0.010	0.945	0.011
P-value[29]	0.468	0.000(***)	0.339	0.000(***)	0.528	0.913		
Low ESG-portfolio	0.003(**)	0.921	0.120	0.200	0.077(*)	-0.397	0.919	0.014
P-value	0.181	0.000(***)	0.168	0.004(**)	0.478	0.001(**)		

Source: Authors Creation.

[28] Appendix 2 Fama & French 5-factor regression High- and Low ESG-rating portfolio result
[29] *** = significance level of 0.00 ** = significance level of 0.05 * = significance level of 0.1

Presented in Table 4.5.1 is the summary result using the excess return in the period 01.01.2017 to 01.01.2022 equivalent to 61 observations. Each portfolio consists of stocks with the 10% highest and lowest ESG-rated companies from S&P500. The result from the regression examined and presented in this chapter of the research analysis is the alpha-value (intercept), the 5-factor, the adjusted R-square, and the standard error.

Referring to the theory-chapter 2.3.1 Fama & French 5-factor model, the factors in the regression are Mkf-Rf (Market factor), SMB (Small minus Big), HML (High minus Low), RMW (Robust minus Weak,) and CMA (Conservative minus Aggressive).

The adjusted R-square, explains the degree of variation in the excess return of each portfolio, the results are somewhat different. Both High- and Low ESG-rating portfolio are considered strong, as the values are above 0.9 which indicates a strong explanatory power within Finance (2012 Wooldridge u.d.).

The High ESG-rating portfolio has the highest explanatory power with an R-squared value of 94.5% while the Low ESG-rating portfolio has an R-squared value of 91.9%. This is also reflected by the standard error of each model, where the High ESG-rating portfolio has a standard error value of 1.1% and the Low ESG-rating has a standard error value of 1.4%.
Further, the alpha-value of each portfolio is also showing two different results. The High ESG-rating portfolio has generated an insignificant negative alpha-value of -0.11% at a significance level of 0.05 (5%), while the Low ESG-rating portfolio also generated an insignificant positive alpha-value of 0.03% at a significance level of 0.05 (5%). The alpha-values of both portfolios indicate statistically insignificant values, and the model cannot predict the returns.

The exposure of the excess return of each portfolio on the 5-factors is explained by the five coefficients in Table 4.5.1. With the market factor (Mkf-RF), both portfolios are significant at a confidence level of 0.01 (1%). The High ESG-rating portfolio has an Mkf-RF value of 0.949 while the Low ESG-portfolio has a value of 0.921. As the Mkf-RF for both portfolios is below one (1), the portfolios are less volatile than the market and therefore less exposed to the systematic risk.

The size factor or Small minus Big (SMB) indicates the exposure to the performance of stock with small capitalization vs. large capitalization. In thesis research, both portfolios have

insignificant values, but the High ESG-rating portfolio has a negative coefficient, while the Low ESG-rating portfolio has a positive coefficient. Since both portfolios generated insignificant values at a significance level of 0.05 (5%) it cannot be concluded that a significant difference exists in the SMB-factor.

The interpretation of the High minus Low (HML) or "portfolio" of stock from high book-to-market value companies minus low book-to-market value companies, is the opposite of the SMB-factor, meaning both High- and Low ESG-rating portfolio generated significant positive values at a significance level at 0.05 (5%). In the High ESG-rating portfolio the positive coefficient value is 0.263 and the Low ESG-rating portfolio positive coefficient is 0.200, indicating both portfolios are sensitive and responsive to the HML-factor and perform well when stocks with high book-to-market perform well compared to low book-to-market companies.

Both the High- and Low ESG-rating portfolio are insignificant to the exposure of the Robust to Weak (RMW) factor. This indicates that the excess return of the portfolio does not correspond to the profitability and no further explanation has to be done.
The Last factor, Conservative minus Aggressive (CMA), indicates whether or not the excess return of the two portfolios is exposed to firms with low investment policies to companies with high investment policies. The High ESG-rating portfolio generated an insignificant value on the CMA-factor, while the Low ESG-rating portfolio generated a negative significant coefficient, indicating the portfolio moves in the opposite direction of conservative stocks.

Based on the results of the Fama & French's 5-factor regression in Table 4.5.1. it is not all the five factors that are significant in the High-and Low ESG-rating portfolio. By excluding the insignificant factors. It is expected in the research that the model will gain larger explanatory power. The corrected Fama & French model for the High- and Low ESG-rating portfolio are presented below.

Fama & French 5-factor model referred to equation 12 in chapter 3.3:

$$R_{it} - R_{ft} = a_i + \beta_i(R_{Mt} - R_{Ft}) + SMB_t + HML_t + RMW_t + CMA_t + \varepsilon_{it}] \quad (15)$$

High ESG-rating portfolio:

$$R_{it} - R_{ft} = -0.001 + 0.949_{mfkp} + 0.263_{hmlp} + \varepsilon_{pt}] \quad (16)$$

Low ESG-rating portfolio:

$$R_{it} - R_{ft} = 0.003 + 0.921_{mfkp} + 0.200_{hmlp} - 0.397_{cmap} + \varepsilon_{pt}] \quad (17)$$

Table 4.5.2 –Fama & French 5-factor regression.

(Excel Data analysis tool regression – x-variable = excess return of high-and low ESG-rating portfolio, y-variable = significant FF5-factors) [30]

	Alpha	Mkt-RF	SMB	HML	RMW	CMA	Adjusted R-square	St. Error
High ESG-portfolio	-0.001	0.940	-	0.252	-		0.946	0.011
P-value[31]	0.648	0.000(***)	-	0.000(***)	-		-	-
Low ESG-portfolio	0.003	0.952	-	0.236	-	-0.409	0.919	0.014
P-value	0.197	0.000(***)	-	0.004(**)	-	0.001(**)	-	-

Source: Authors Creation.

Table 4.5.4 above presents the regression model summary after excluding the insignificant factors. Compared to the summary of the five-factor regression presented in table 4.5.1, the changes by excluding the insignificant factors have resulted in changes in all factors.
Beginning with an adjusted R-squared, increased by 0.01% for the High ESG-rating portfolio, while remaining the same for the Low ESG-rating portfolio. The standard error on both the High- and Low ESG-rating portfolio remained the same at 1.1% and 1.4%.

The High- and Low ESG-rating portfolio Mfk-RF factors both changed to respectively higher values from 0.940 to 0.949 and 0.921 to 0.952 indicating higher volatility than the previous result. The HML-factor for the High ESG-rating portfolio shows changes in coefficient-value changing from 0.263 to 0.252, resulting in the portfolio is still sensitive and responsive to the

[30] Appendix 2 Fama & French 5-factor regression High- and Low ESG-rating portfolio result
[31] *** = significance level of 0.00 ** = significance level of 0.05 * = significance level of 0.1

factor and performing well when high book-to-market companies perform well, the Low ESG-rating portfolio showed changes in the significance level of 0.05 to 0.01 and the coefficient-value changing from 0.200 to 0.236, resulting in the portfolio is a bit more sensitive and responsive to the factor and perform well when high book-to-market companies perform well. Lastly the CMA-factor in the Low ESG-rating portfolio the coefficient-value changed from -0.397 to -0.409, resulting in the portfolio moving more in the opposite direction of conservative stocks. To finally determine whether the general- or specific regression model is the best for the research, the info criteria Akaike's Information Criteria (AIC) and Bayesian Information Criteria (BIC) are used for both the High- and Low ESG-rating portfolio to determine the best fitting model. In tables 4.5.3 and 4.5.4 below the AIC and BIC result is presented and the lowest AIC- and BIC-value of each respective model represents the best fitting model.

Table 4.5.3 – AIC and BIC criterion High ESG-rating portfolio.

(R-studio result of AIC and BIC) [32]

High ESG-rating portfolio	5-factor regression	Corrected regression with significant factors
AIC	-368.2156	-371.1913
BIC	-353.4395	-362.7478

Source: Authors Creation.

The High ESG-rating portfolio, the specific model with the five-factors, as expected represents the best fitting model. By excluding the insignificant factors and only using the Mfk-Rf and HML factor, the AIC went from -368,1256 to -371,1913 and the BIC from -353,4395 to -362,7478.

Table 4.5.4 – AIC and BIC criterion Low ESG-rating portfolio.

(R-studio result of AIC and BIC) [33]

Low ESG-rating portfolio	5-factor regression	Corrected regression with significant factors
AIC	-336.6560	-338.5224
BIC	-321.8779	-327.9681

Source: Authors Creation.

The Low ESG-rating portfolio, the specific model with the five-factors outcome was also the best fitting model, as expected. By excluding the insignificant factors and only using the Mfk-Rf, HML, and CMA factors the AIC went from -336,6560 to -338,5224, and the BIC from -321,8779 to -327,9681.

[32] Appendix 3 - AIC & BIC result from R-studio
[33] Appendix 3 - AIC & BIC result from R-studio

From the above results, each regression model fits the time series better, by not excluding the insignificant factor, since the value of AIC and BIC value is higher than the 5-factor regression compounded.

4.6 Summary of the Fama & French 5-factor model.

As the best-fitted model of the thesis research is the specific-model, and not corrected for insignificant factors, the following summary is based on the specific-model. The best-fitted model in this research was determined by Akaike's Information Criteria (AIC) and Bayesian Information Criteria (BIC). Furthermore, the specific regression model and corrected regression model results had the same explanatory power on both the High- and Low ESG-rating portfolio.

From the regression summary, both the High- and Low ESG-rating portfolio generated insignificant alpha-values, where the High ESG-rating generated a negative value and the Low ESG-rating portfolio a positive value. Implying both the High- and Low ESG-rating portfolio has a p-value above 0.05 (5%) significance level, and therefore it cannot be concluded that a significant difference exists, and the return cannot be predicted. However, both values are different from zero, indicating the models do not explain all of the excess returns.

Referring to the literature chapter 2.2, The Fama & MacBeth (1973 u.d.) did show some significance of serval ESG-variables but the magnitude and direction of the impact are substantially dependent on the rating provider, the company sample, and particular subperiod. Halbritter & Dorfleinter (2015 u.d.) concluded that investors should no longer expect abnormal returns by focusing on high or low ESG-rated companies and Kempf & Osthoff (A. K. 2007 u.d.) and Statman & Glushkov (2009 u.d.), both found evidence that stock with High ESG-ratings generated significant positive alpha-values and achieve an excess return, while empirical studies conducted by Galema (R. G. 2008 u.d.), Manescu (2011 u.d.), Halbritter & Dorfleitner (2015 u.d.) did not found evidence that suggests a statistically significant difference in risk-adjusted returns between High- and Low ESG-rating companies. More recently research papers from Giovanni Landi & Sciarelli (G. L. 2019 u.d.) found no evidence of positive and statistically significant impact in terms of market premium, when undertaking socially responsible investment (SRI) also called "ESG-rating Stocks" and research by Nora (N. J. 2020

u.d.) found no evidence of portfolios performing well from an ESG-rating aspect, and did not generate significant positive alpha-values for any asset-pricing-model, while Filbeck & Zhao (A. F. 2019 u.d.) found evidence based on ESG-criteria on the long-term stock, that firms with High ESG-ratings statistically outperformed the S&P500-index, not on a risk-adjusted basis. The empirical studies regression models used is the Cahart (1997 u.d.) four-factor model and Fama & French 5-factor model, but with different selection method and periods compared to this research.

From the thesis research, using the Fama & French 5-factor model, the result of the regression is opposite of the empirical studies from Kempf & Osthoff (A. K. 2007 u.d.) and Statman & Glushkov (2009 u.d.) on High ESG-rating companies generating negative insignificant alpha-values and Flibeck, & Zhao (A. F. 2019 u.d.) found High ESG-rating companies statistically outperformed the S&P500-index, not on a risk-adjusted basis.
This thesis research supports the findings of Fama & MacBeth (1973 u.d.), Galema (R. G. 2008 u.d.), Manescu (2011 u.d.) and Halbritter & Dorfleitner (2015 u.d.) and more recent studies from Landi & Sciarelli (G. L. 2019 u.d.) and Nora Judit (N. J. 2020 u.d.), finding no evidence that suggests a statistically significant difference in the returns between High and Low ESG-rating companies.

Last and finally, the regression results show the High- and Low ESG-rating portfolio are exposed to serval Fama & French 5-factors, as Fama & MacBeth (1973 u.d.) findings, the results suggest this research hypothesis should be rejected, since both portfolios generated insignificant alpha-values and both portfolios are not exposed to all five-factor, therefore the null-hypothesis *"H2"* is rejected in the thesis research.

4.7 Value- & Growth-portfolio

This chapter examines the Value-and Growth-portfolio performance. Proceeding to the last analysis of the thesis research, the Value & Growth portfolio. The two portfolios are based on the medium P/E-ratio of the respective sectors: Consumer Non-Cyclicals, Finance, Healthcare, Industrial, and Technology. The medium P/E-ratio is used in this research chapter to rank the highest 10 companies and lowest 10 companies in each sector from the medium P/E-ratio and used to construct two portfolios. The construction of the portfolio follows the same approach mentioned in chapter 4.1, and each of the five sectors used represents 10 companies each

equivalent to 50 companies in total. The Value-portfolio is represented by the 10 highest P/E-ratios of each sector and the Growth-portfolio represents the 10 lowest P/E-ratios of each sector. The table below illustrates the descriptive statistics of each sector.

Table 4.7.1 – Sector P/E-ratio.

(Excel Data analysis tool – Descriptive statistics of all the company's P/E-ratio representing the selected sectors of the thesis research)[34]

	Consumer Non-Cyclicals	Finance	Technology	Healthcare	Industrial
Mean	22.94	25.00	36.55	29.94	24.20
Median	22.72	13.97	26.59	29.01	20.04
Standard deviation	10.24	27.85	47.09	19.20	19.03
Minimum	0.00	0.00	0.00	0.00	0.00
Maximum	51.39	150.97	377.86	82.20	135.56

Source: Authors Creation

The table above is used in the thesis research to construct two portfolios representing Value and Growth stocks with respectively 50 companies in each portfolio. The table below illustrates a picture of the selected companies for the two portfolios.

Table 4.7.2 – Value- & Growth-portfolio stocks.

(Screenshot of the highest and lowest P/E-ratio of selected sectors)[35]

Growth portfolio	P/E-ration ranking	Value portfolio	P/E-ration ranking
Amazon Inc (Consumer Non-Cyclicals)	51.39	Campbell Soup (Consumer Non-Cyclicals)	15.30
Ventas Inc (Finance)	150.97	Invesco Ltd. (Finance)	6.33
ServiceNow Inc (Technology)	377.86	Seagate Technology (Technology)	12.38
Bio-Techne Corp (Healthcare)	82.80	Hologic Inc (Healthcare)	10.76
Enphase Energy Inc (Industrial)	135.56	Alaska Air Group (Industrial)	12.75

Source: Authors Creation

Table 4.7.1 shows the descriptive statistics of each sector selected in the thesis research. The median is used in this research to consider whether or not the respective companies in each

[34] Excel data-collection spreadsheet (Consumer Non-Cyclicals, Finance, Technology, Healthcare, and Industrial sector)
[35] Excel data-collection spreadsheet (Value and Growth portfolio)

sector are considered a Value or Growth stock. In the thesis research stock with high P/E-ratio are considered Growth stocks and stocks with low P/E-ratios are considered Value stocks based on (French 1992,1996) (1994 Vishny u.d.). The Value- and Growth-portfolio each consist of 10 of the highest P/E-ratios above the median P/E-ratio of each sector and 10 of the lowest P/E-ratio below the median P/E-ratio of each sector. Table 4.7.2 above illustrates the highest and lowest P/E-ratios of companies from the respective sectors: Consumer Non-Cyclicals, Finance, Technology, Healthcare, and Industrial.

4.7.1 Value- & Growth portfolio performance.

Proceeding to the performance evaluation of the Value- and Growth-portfolio. As mentioned above the selection of the portfolios is based on the P/E-ratio of the stocks, and the construction of the portfolios is based on the 10 highest P/E-ratio companies representing the Growth-portfolio and the 10 lowest P/E-ratio companies representing the Value-portfolio of each sector and equivalent 50 highest P/E-ratios of the Growth-portfolio and 50 lowest P/E-ratios of the Value portfolio.

Table 4.7.1.1 – Value- and Growth-portfolio performance.

(Excel calculations of the performance of the Value- and Growth-portfolio) [36]

	Benchmark	**Growth-portfolio**	**Value-portfolio**
Annually Excess Return	14.63%	21.35%	6.83%
Sharpe-ratio	0.938	1.265	0.328
Sortino-Ratio	1.076	1.404	0.334
Standard Deviation	15.6%	16.8%	20.7%
Downside Deviation	13.6%	15.2%	20.4%
Beta	1.00	1.006	1.214
Alpha-value **P-value**[37]	0.000	0.004 0.064(*)	-0.006 0.023(**)
Skewness	-1.659	-1.128	-1.500
Kurtosis	2.953	3.270	5.880

Source: Authors creation

[36] Excel data-collection spreadsheet (Value and Growth portfolio)
[37] *** = significance level of 0.00 ** = significance level of 0.05 * = significance level of 0.1

The results of the Value- and Growth-portfolio from table 4.7.1.1. based on the annual excess return of the portfolios compared to the benchmark only the Growth-portfolio outperformed the benchmark with 6.72% per year and outperformed the Value-portfolio with 14.7% per year, while the Value-portfolio underperformed the benchmark with -7.8%.

The Sharpe-ratio of the Value- and Growth-portfolio only the Growth-portfolio outperformed the benchmark (S&P500) indicating the Growth-portfolio tends to generate greater returns relative to the amount of risk taken with a beta above 1, indicating the Growth-portfolio is more volatile than the benchmark, while the Value-portfolio underperformed the benchmark (S&P500) indicating less great returns relative to the amount of risk taken with a beta-value above 1 and above the Growth-portfolio indicating the Value-portfolio is more volatile than the benchmark and Growth-portfolio. Referring to the methodology chapter 3.2.4, the Growth-portfolio generated an adequate/good Sharpe-ratio. In perspective to the Sharpe-ratio, the Sortino-ratio, only the Growth-portfolio outperformed the benchmark (S&P500) and the Value-portfolio with the highest Sortino-ratio, indicating the portfolios tend to generate greater returns for each unit of downside risk taken, while the Value-portfolio underperformed compared to the benchmark.

Overall, the benchmark and Value- and Growth-portfolio generated negative skewness, implying the benchmark and two-portfolios generate few large losses and frequent small gains, while the kurtosis of the benchmark and Growth-portfolio of 2.953 and 3.207 which is relatively close to 3, implying a moderate level of risk and probability of extreme returns are low, which the beta-value of 1.006 also indicates, while the Value-portfolio kurtosis of 5.880 implies high risk and high probabilities of extremely large or small returns, which also can be seen at the beta-value of 1.214. As mentioned above the Growth-portfolio outperformed the benchmark and Value-portfolio on all the performance parameters, which Jensen's-Alpha from the Fama & French 5-factor regression also indicates in table 4.7.1.2, both portfolios generated significant alpha-values. The Growth-portfolio generated a positive alpha-value of 0.4% on a significance level of 0.10 (10%), while the Value-portfolio generated a negative alpha-value of -0.6% on a significance level of 0.05 (5%), indicating the Growth-portfolio outperforms the market and the Value-portfolio underperforms the market.

Table 4.7.1.2 – Fama & French 5-factor regression.

(Excel Data Analysis tool Regression – x-variable = Excess return of value and growth portfolio, y-variable = FF5-factors)[38]

	Alpha	Mkf-RF	SMB	HML	RMW	CMA	Adjusted R-square	Std. Error
Growth-portfolio	0.004	0.891	0.052	0.041	0.066	-0.423	0.884	0.017
P-value[39]	0.064 (*)	0.000(***)	0.598	0.593	0.595	0.003(**)		
Value-portfolio	-0.006	1.055	0.168	0.471	0.024	-0.207	0.910	0.018
P-value	0.023 (**)	0.000(***)	0.121	0.000(***)	0.860	0.163		

Source: Authors creation

The result from the Fama & French 5-factor regression in table 4.7.1.2. is based on a significance level of 0.05 (5%) and 0.10 (10%). Both portfolios showed significant alpha-values, where the growth-portfolio outperforms the market with a positive alpha-value of 0.004, while the value-portfolio underperform the market with a negative alpha-value of -0.006. The Value- and Growth-portfolio both generated significant beta-values, where the Growth-portfolio beta-value is below 1, indicating it is less volatile than the market, while the Value-portfolio beta-values is above 1, indicating is more volatile than the market. Only the Value-portfolio generated a positive significant coefficient on the High minus Low (HML)-factor, indicating the portfolio is sensitive and responsive to the factor and performs well when stock with high book-to-market value companies performs well compared to companies' low book-to-market value. The Growth-portfolio generated a negative significant coefficient on the Conservative minus Aggressive (CMA)-factor, indicating the portfolio moves in the opposite direction of conservative stocks and moves in the same direction of aggressive stocks.

Compared to the High- and Low ESG-rating regression model in table 4.5.1 the Growth-portfolio shows a lower adjusted R-square value of 0.884, which is below 0.9 and indicates a poorly explanatory power of the excess return compared to 0.919 and 0.945 respectively, and resulting in a slightly significant decline in the explanatory power of the regression model, while the Value-portfolio adjusted R-square value of 0.910 is relatively close to 0.919 and 0.945 and are above 0.9 indicating strong explanatory power (2012 Wooldridge u.d.). Despite

[38] Appendix 2.2 Fama & French 5-factor regression result on Value-and Growth portfolio
[39] *** = significance level of 0.00 ** = significance level of 0.05 * = significance level of 0.1

the lower explanatory power, two out of five factors are significant and do to some degree explain the risk of the Growth-portfolio, and two out of five factors are significant in the Value-portfolio. Following the same approach as in the High- and Low ESG-rating portfolios the specific model in table 4.7.1.2 is corrected and excluding the insignificant factors from regression in equation (18).

Fama & French 5-factor model:

$$R_{it} - R_{ft} = a_i + \beta_i(R_{Mt} - R_{Ft}) + SMB_t + HML_t + RMW_t + CMA_t + \varepsilon_{it}] \quad (18)$$

Growth portfolio:

$$R_{it} - R_{ft} = 0.004 + 0.891_{mfk} - 0.423_{cma} + \varepsilon_{pt}] \quad (19)$$

Value portfolio:

$$R_{it} - R_{ft} = -0.006 + 1.055_{mfk} + 0.471_{hml} + \varepsilon_{pt}] \quad (20)$$

The corrected regression model, with the significant factors illustrated in table 4.7.1.3 below.

Table 4.7.1.3 – Fama & French 5-factor regression (with significant factors).
(Excel Data Analysis tool Regression – x-variable = Excess return of Value- and Growth-portfolio, y-variable = significant FF5-factors) [40]

	Alpha	**Mkf-RF**	**SMB**	**HML**	**RMW**	**CMA**	**Adjusted R-square**	**Std. Error**
Growth-portfolio	0.004	0.920	-	-	-	-0.335	0.888	0.016
P-value[41]	0.072(*)	0.000(***)	-	-	-	0.001(**)		
Value-portfolio	-0.007	1.125	-	0.440	-	-	0.906	0.018
P-value	0.006 (**)	0.000(***)	-	0.000(***)	-	-		

Source: Authors creation

Based on the results of the corrected regression, both portfolios showed significant alpha-values and the growth-portfolio outperform the market, while the value-portfolio underperform the market. The adjusted R-square changed from 0.884 to 0.886 for the Growth-portfolio

[40] Appendix 2.2 Fama & French 5-factor regression result on Value-and Growth portfolio
[41] *** = significance level of 0.00 ** = significance level of 0.05 * = significance level of 0.1

indicating better explanatory power, but is still below 0.9, indicating a poorly explanatory power, while the adjusted R-square of the Value-portfolio declined from 0.910 to 0.906, indicating the corrected regression shows less explanatory power on the returns and risk. The alpha-values still indicate the Growth-portfolio to outperform the market on a significance level of 0.10 (10%), while the Value-portfolio underperforms compared to the market.

To determine whether the general or the specific corrected regression model is the best, the Akaike's Information Criteria (AIC) and Bayesian Information Criteria (BIC) are used for both the Value- and Growth-portfolio in the thesis research. Table 4.7.1.4 and 4.7.1.5 below shows the outcome of the AIC- and BIC-value of each model and represents the best fitting models based on the lowest value.

Table 4.7.1.4. – AIC and BIC criterion Growth portfolio

(R-studio result of AIC and BIC) [42]

Growth portfolio	5-factor regression	Corrected regression with significant factors
AIC	-319.3155	-324.1198
BIC	-304.5394	-315.6763

Source: Authors Creation.

The Growth-portfolio, the specific model with the five-factors, as expected represents the best fitting model. By excluding the insignificant factors and only using the Mfk-Rf and CMA factor, the AIC went from -319.3155 to -324.1198 and the BIC from -304.5394 to -315.6763

Table 4.7.1.5. – AIC and BIC criterion Value portfolio

(R-studio result of AIC and BIC) [43]

Value portfolio	5-factor regression	Corrected regression with significant factors
AIC	-309.4457	-309.5318
BIC	-294.6696	-301.0883

Source: Authors Creation.

The Value-portfolio, the specific model with the five-factors outcome was also the best fitting model, with a very low difference in the AIC. By excluding the insignificant factors and only

[42] Appendix 3.1 – Result from R-studio on AIC & BIC.
[43] Appendix 3.1 – Result from R-studio on AIC & BIC.

using the Mfk-Rf, and HML factors the AIC went from -309.4457 to -309.5318, and the BIC from -294.6696 to -301.0883.

From the above results, the AIC and BIC indicate the specific 5-factor model is the best fitting as the results have the lowest values, as the same result from the High- and Low ESG-rating portfolio. Furthermore, it is tested in the research if Value and Growth have explanatory power on High- and Low ESG-rating portfolio using the excess return of the Value and Growth-portfolios using equation 21 below, and the result is shown below in table 4.7.1.6

$$R_{it} - R_{ft} = a_i + \beta_i(R_{Mt} - R_{Ft}) + SMB_t + HML_t + RMW_t + CMA_t + Value_t + Growth_t + \varepsilon_{it}] \quad (21)$$

Table 4.7.1.6. – Fama & French 5-factor + value and growth factor

(Excel Data Analysis tool Regression – x-variable = excess return high-and low ESG-rating portfolio, y-variable = FF5-factors + value and growth)[45]

	Alpha	Mkf-RF	SMB	HML	RMW	CMA	Value	Growth	Adjusted R-Square	Std. Error
High ESG-portfolio	-0.001	0.595	-0.098	0.191	0.034	0.120	0.132	0.242	0.957	0.010
P-value[44]	0.368	0.000(***)	0.106	0.002(**)	0.651	0.176	0.111	0.008(**)		
Low ESG-portfolio	0.001	0.448	0.082	0.138	0.047	-0.200	0.096	0.418	0.941	0.012
P-value	0.456	0.000(***)	0.280	0.065(*)	0.614	0.071(*)	0.350	0.000(***)		

Source: Authors creation

The results of the Fama & French 5-factor plus value and growth factor, both portfolios generated insignificant alpha-values. Only the growth-factor generated positive significant coefficients on both the High- and Low ESG-rating portfolios, indicating the growth-portfolio of the thesis research has some degree of explanatory power on the High- and Low ESG-rating portfolios, and the portfolios are responsive and sensitive to growth stocks. The Low ESG-rating portfolio generated significant values on Mkf-Rf-, HML-, CMA- and Growth-factors on a significance level of 0.10 (10%), indicating the Low ESG-rating portfolio is responsive and sensitive to these factors. Both regressions show a high adjusted R-square of 95.7% and 94.1%.

[44] *** = significance level of 0.00 ** = significance level of 0.05 * = significance level of 0.1
[45] Appendix 2.3 Fama & French 5-factor + value and growth factor, regression result

Following the same approach above to construct a corrected regression model excluding the insignificant factors and testing which of the models has the best fitting. The result of the regression is presented in table 4.7.1.7 excluding the insignificant factors from regression in equation (22) below.

Fama & French 5-factor model + growth and value-factor:

$$R_{it} - R_{ft} = a_i + \beta_i(R_{Mt} - R_{Ft}) + SMB_t + HML_t + RMW_t + CMA_t + Value_t + Growth_t + \varepsilon_{it}] \quad (22)$$

High ESG-rating portfolio:

$$R_{it} - R_{ft} = 0.595_{mfk} - 0.191_{hml} + 0.242_{Growth} + \varepsilon_{pt}] \quad (23)$$

Low ESG-rating portfolio:

$$R_{it} - R_{ft} = 0.448_{mfk} + 0.242_{hml} - 0.200_{CMA} + 0.418_{Growth} + \varepsilon_{pt}] \quad (24)$$

Table 4.7.1.7. – Corrected Fama & French 5-factor with significant factors

(Excel Data Analysis tool Regression – x-variable = Excess return of Value- and Growth-portfolio, y-variable = significant FF5-factors + value and growth [47]

	Alpha	Mkf-RF	SMB	HML	RMW	CMA	Value	Growth	Adjusted R-Square	Std. Error
High ESG-portfolio	-0.001	0.696	-	0.272	-	-	-	0.251	0.953	0.010
P-value[46]	0.293	0.000(***)	-	0.000(***)	-	-	-	0.002(**)		
Low ESG-portfolio	0.0005	0.526	-	0.208	-	-0.209	-	0.470	0.941	0.012
P-value	0.777	0.000(***)	-	0.000(***)	-	0.058	-	0.000(***)		

Source: Authors creation

[46] *** = significance level of 0.00 ** = significance level of 0.05 * = significance level of 0.1
[47] Appendix 2.3 Fama & French 5-factor + value and growth factor, regression result

Based on the result of the corrected regression, both portfolios still generated insignificant alpha-values. The adjusted R-square changed from 0.957 to 0.953, while the adjusted R-square of the Low ESG-rating portfolio remained the same. The alpha-values are still insignificant for both High- and Low ESG-rating portfolios. The High ESG-rating portfolio generated positive values on the HML- and Growth-factor indicating the portfolio is responsive and sensitive to these factors and the portfolio performs well when high book-to-market companies perform well. This is also the case of the Low ESG-rating portfolio and generated a negative value on the CMA-factor at the same time indicating the portfolio moves in the opposite direction of Conservative stocks indicating the portfolio performs well when "growth stocks, aggressive stocks perform well.

4.7.2 Summary of Value- and Growth performance.

The last analysis of the thesis research examined the Value- and Growth-portfolio representing the so-called "value-stocks" and "growth-stocks", each portfolio representing 50 stocks of the top 10 and lowest 10 value- and growth-stocks from each sector based on the P/E-ratio represented in table 4.5.1.

In the first part, the Value- and Growth-portfolio was tested with the same approach as the High- and Low ESG-rating portfolio and Sector-based portfolios on an annual basis. Compared to High- and Low ESG-rating portfolio and Sector-based portfolios, which indicated Low ESG-rating- and Low ESG Sector-portfolios tends to outperform the benchmark and High ESG-rating- and High ESG Sector-portfolios based on measurements of Sharpe-ratio, Sortino-ratio, and Jensen's-Alpha, the same outcome is for the Value- and Growth-portfolio indicating the Growth-portfolio outperform the Value-portfolio. On basis of the Growth-portfolio outperforming the Value-portfolio, comparable results are seen in empirical studies from Cordeiro & Machado (C. &. 2013 u.d.), Cheh et al (J. J.-w. 2008 u.d.), Beneda (2003 u.d.) and Emm & Trevino (E. &. 2014 u.d.) showing value-stocks no longer outperforms growth-stocks and research from Vanguard (V. R. 2021 u.d.) on value and growth stocks from 1936-2021 on the U.S market based on the annual return, showed the past ten-years on average growth stocks have outperformed value-stocks.

Most importantly, the Value- and Growth-portfolio regression indicates that both portfolios are responsive and sensitive to the Growth-portfolio excess return and are not responsive and

sensitive to the Value-portfolio excess return, which is used as two more factors in thesis research. Both portfolios constructed generated positive significant values on the Growth-factor, where the High ESG-rating portfolio only generated a positive significant value on the HML-factor while the Low ESG-rating portfolio generated a positive significant value on the HML-factor and negative significant value on the CMA-factor, which indicates the Low ESG-rating portfolios is responsive to the CMA-factor and moves in the opposite direction of conservative stocks and the same direction as aggressive stocks, indicating the Low ESG-rating portfolio is responsive and sensitive to "growth stocks".

Based on the results generated from the regression constructed in the research the null-hypothesis from the research question *H3 "do Value- and Growth have an impact on the performance"* is accepted since both portfolios generated positive significant values on the growth-factor.

5. Conclusion

Previous research papers have used serval methods and datasets to identify the relationship between ESG-ratings and financial performance and it is necessary to take into account the differences between the ESG-rating agencies and methods to make a related comparison. The research investigated the divergence using different ESG-rating agencies and found using single ratings must be carefully justified and most use the average ESG-ratings to represent the market consensus view and also showed measurement difference (B. K. 2019 u.d.).
The thesis also found different measurements of ESG-ratings from Refinitiv Eikon and FactSet, both using different methodology and rating-systems, why the thesis uses the five-year average FTSE ESG-rating from FactSet applying the average ESG-rating to represent the market. This also might be an indication of previous findings of different results. Furthermore, the thesis applied different approaches to investigate the relationship between ESG-rating and financial performance, to construct pure ESG-rating portfolios of the highest- and lowest-rated companies and to investigate if value- and growth stocks have an impact on high- and low ESG-rated companies and portfolios.

Previous empirical studies have suggested different results by using similar as the approach for research thesis, and found that high ESG-rating companies should outperform low ESG-rating companies (L. P. 2021 u.d.), and highly rated companies outperform low rated companies (2022 Tarelli u.d.), and high abnormal excess return based on SRI-ratings (A. K. 2007 u.d.),

and that High ESG-rating companies outperformed low ESG-rating companies with 5% per year (2018 Hugo u.d.), and stocks with low ESG-ratings are riskier and have higher volatility than high ESG-rating companies (2017 u.d.), while some found no significant excess return difference regarding high- and low ESG-rating companies (2015 u.d.), and the risk-adjusted expected return is less equilibrium (R. G. 2008 u.d.), (2011 u.d.) and more recently studies also found non-statistically significance difference in the return of high- and low ESG-rating companies (G. L. 2019 u.d.) and (N. J. 2020 u.d.), and might be related to the findings of ESG-rating measurement from (B. K. 2019 u.d.).
The result from the thesis suggested, only a positive link between ESG-ratings and financial performance on the Low ESG-rating portfolio, as it outperformed the benchmark based on annually excess return, while the High ESG-rating portfolio suggest a negative link, as it underperformed the benchmark. This is reflected by the higher level of risk of the Low ESG-rating portfolio expressed, compared to the High ESG-rating portfolio, and can to some degree be explained by the high returns of the portfolio. From the risk-reward and risk-adjusted perspective, the Low ESG-rating portfolio outperformed both the High ESG-rating portfolio and market portfolio, and the portfolio generated relatively high ratios suggesting the portfolio generates greater returns to the amount of risk taken and for each unit of downside risk.

Secondly, the results of the research thesis, based on Sector-based portfolios suggest, a positive link between the High-and Low Technology sector ESG-rating-, Low Healthcare sector ESG-rating- and Low Industrial sector ESG-rating portfolios as the sector-portfolios outperformed the benchmark portfolio based on the annually excess returns, while the High- and Low Consumer Non-Cyclicals sector ESG-rating-, High- and Low Finance sector ESG-rating-, High Healthcare sector ESG-rating- and High Industrial sector ESG-rating portfolios suggest a negative link, as it underperformed the benchmark. From the risk-reward and adjusted-risk perspective the High-and Low Technology sector ESG-rating-, Low Healthcare sector ESG-rating- and Low Industrial sector ESG-rating portfolios outperformed the other sector-portfolios and the benchmark and generated relative high ratios suggesting the portfolios generates greater returns to the amount of risk taken and of each unit of downside risk.
The null-hypothesis *"H1"* is rejected in the research thesis, as High ESG-rating companies did not perform better than Low ESG-rating companies.

Thirdly, the Fama & French 5-factor regression of the High- and Low ESG-rating portfolio results of the thesis suggest a better performance by the Low ESG-rating portfolio, as it

generated a positive alpha-value, while the High ESG-rating portfolio generated a negative alpha-value. Both portfolios did generate insignificant alpha-values and suggest there is not statistically sufficient evidence that High- and Low ESG-rating portfolio outperform the market and results also suggest none of the portfolios was exposed to all the five-factors, why the null-hypothesis *"H2"* is rejected in the research thesis.

Fourth and lastly, the thesis tested if the Value- and Growth-portfolio had an impact on the High- and Low ESG-rating portfolio. The Value- and Growth portfolio was based on the median P/E-ratios of the sector-based portfolios, and the excess return of the portfolios was used as two new factors in the Fama & French 5-factor regression test. The result suggested and partly supported the assumption that Growth and Value have an impact on ESG-rating, both High- and Low ESG-rating portfolio generated positive significant p-values and suggest the High- and Low ESG-rating portfolio is exposed to the growth-factor to some degree and the null-hypothesis *"H3"* is not rejected and concludes growth-stocks/portfolio has some explanatory power of the High- and Low ESG-rating portfolio. The researcher of the thesis did previous research *"Does Value-investing outperform Growth-investing"* the research indicated growth-stocks have outperformed the value-stocks in the period 2000-2019 using data from MSCI on Developed- and Emerging markets and value-stocks have underperformed in the last five years using the same approach and analysis as this thesis (Kristensen 2021).

Lastly, the thesis concludes that investors in the period from 1st January 2017 to 1st January 2022 would benefit most from investing in the Low ESG-rating-, High and Low Technology sector ESG-rating-, Low Healthcare sector ESG-rating- and Low Industrial sector ESG-rating portfolios, especially the Low Technology sector ESG-rating portfolio. During the thesis research, the limitations were the ESG-rating agencies, time-period, and construction of the portfolios and which can be considered to be narrow. The performance from the 15 constructed portfolios could potentially differ using different ESG-rating agencies or different time-period and different construction of the portfolios could affect the outcome of the thesis, with changes in the weights and a more versatile portfolio. In the future, it could be interesting to do the research in a longer time-period since the data would be more comprehensive, and in future research and studies, it could be beneficial to cover more ESG-rating agencies, asset classes, and investor preferences, and different determinations method on value- and growth-stocks.

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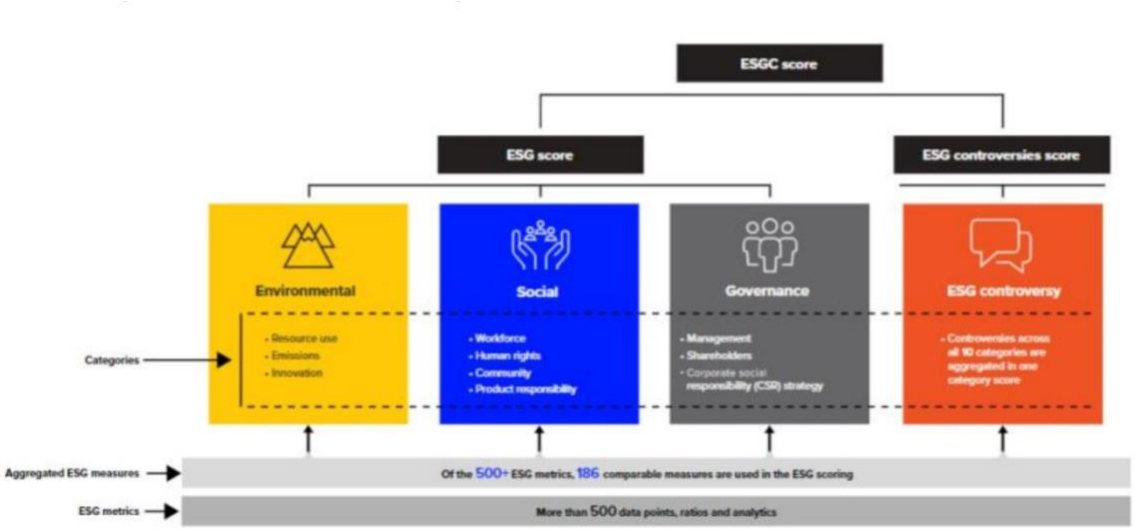
Appendix.

1. ESG Data collection.

There exist serval rating agencies that provides ESG-ratings of companies, Funds and EFT's some of the major agencies are Bloomberg, MSCI, Refinitiv Eikon, FactSet, Morningstar and more. The agencies use different methodologies, information and weighting in the how they rate E-, S- and G-scores and can cause variation of the ratings of the companies. It can influence the representativeness of the data used in the thesis research and is considered in the thesis research.

The chosen agencies for the thesis research are Refinitiv Eikon and FactSet due to large transparency and historical data collection. The appendix introduces the methodology and data collection from Refinitiv Eikon and FactSet creating ESG-ratings.
ESG-rating are secondary data and provided by Refinitiv Eikon, the methodology is presented below, to create transparency of the data used in the thesis research.

Figure A.1 – ESG-rating construction from Refinitiv Eikon[48]



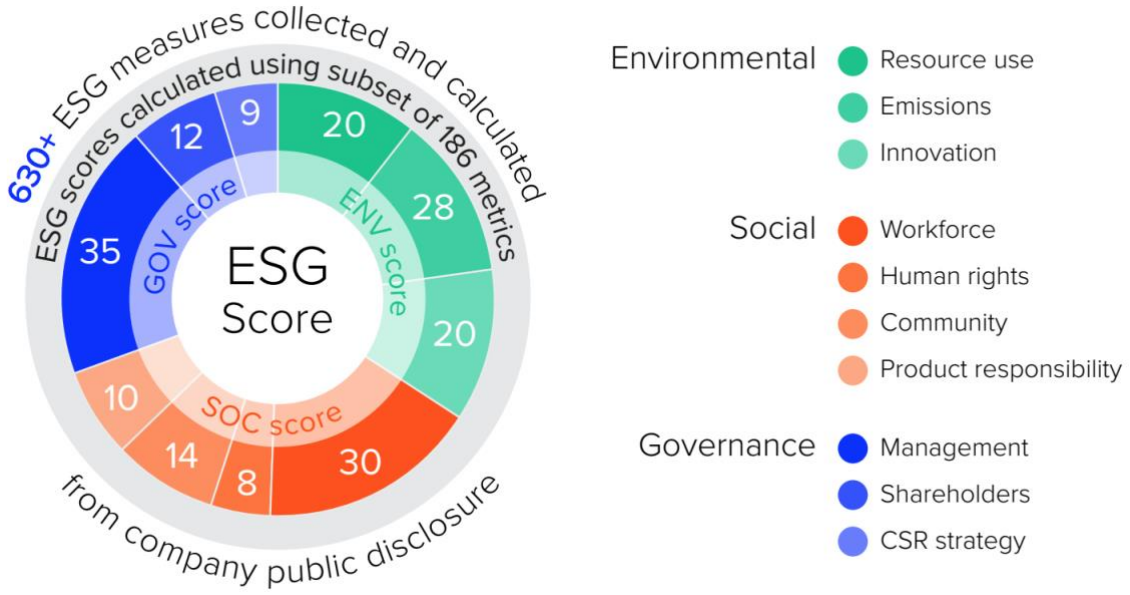
[48] https://www.refinitiv.com/content/dam/marketing/en_us/documents/methodology/refinitiv-esg-scores-methodology.pdf

The ESG-ratings are based on Environmental (E), Social (S) and Governance (G) factors. Where the Environmental factor is based on: The resources use, Emission use and Innovation. The Social factor is based on: Workforce, Human Rights, Community and Product Responsibility and the Governance factor is baes on: Management, Shareholders and CSR Strategy.

The ESG-measures consist of over 500 different ESG-metrics and 186 comparable measures and covering more than 70% of the global market capitalization since 2002[49]. The data collected from Refinitiv in the thesis research is viewed as secondary data, as it is collected from Refinitiv and not the researcher self.

The E-, S- and G-factors each consist of subcategories that receives scores on behalf of the 186 ESG-metrics, and the distribution of the categories is shown below.

Figure A.2 – ESG-metrics



The final ESG-rating depends on 10 subset categories, and the ratings can be different on each factor, where a company can have a high rating on E and low rating S at the same time, the final ESG-rating is the total of the ratings mentioned above[50].

Refinitiv Eikon is an independent agency, collecting their data from annual reports, CSR-reports, companies-webpages, Stock exchanges, NGO-webpages and News sources. The data

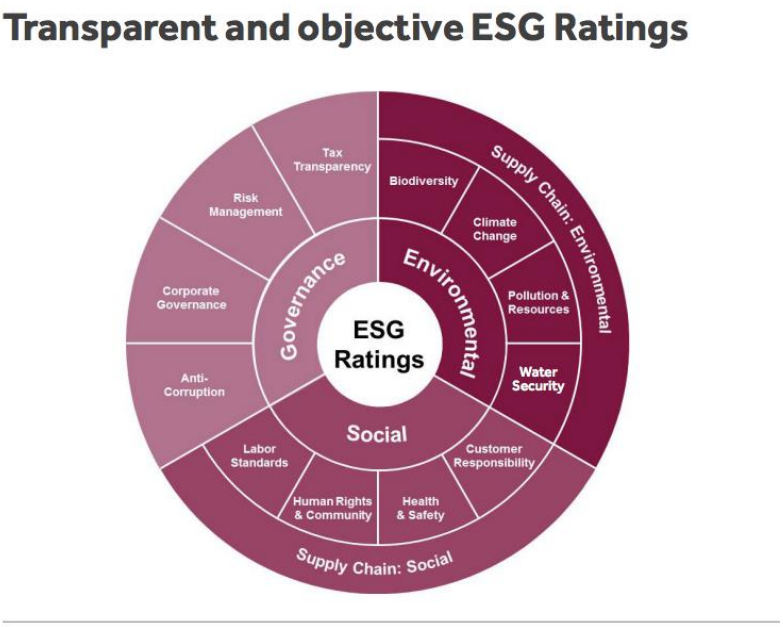
[49] https://www.refinitiv.com/content/dam/marketing/en_us/documents/methodology/refinitiv-esg-scores-methodology.pdf
[50] https://www.refinitiv.com/content/dam/marketing/en_us/documents/methodology/refinitiv-esg-scores-methodology.pdf

is public available, partly stated by the companies themselves. Refinitiv Eikon provides up-to-date, comprehensive and objective data and undergo careful process to standardize the information[51].

All the inputs result in an output grade and are divided into first (0-25), second (>25-50), third (>50-75) and lastly (>75-100) and the highest rating is 100 while the lowest is 0[52].

ESG-rating are secondary data and provided by FactSet, the methodology is presented below, to create transparency of the data used in the thesis research.

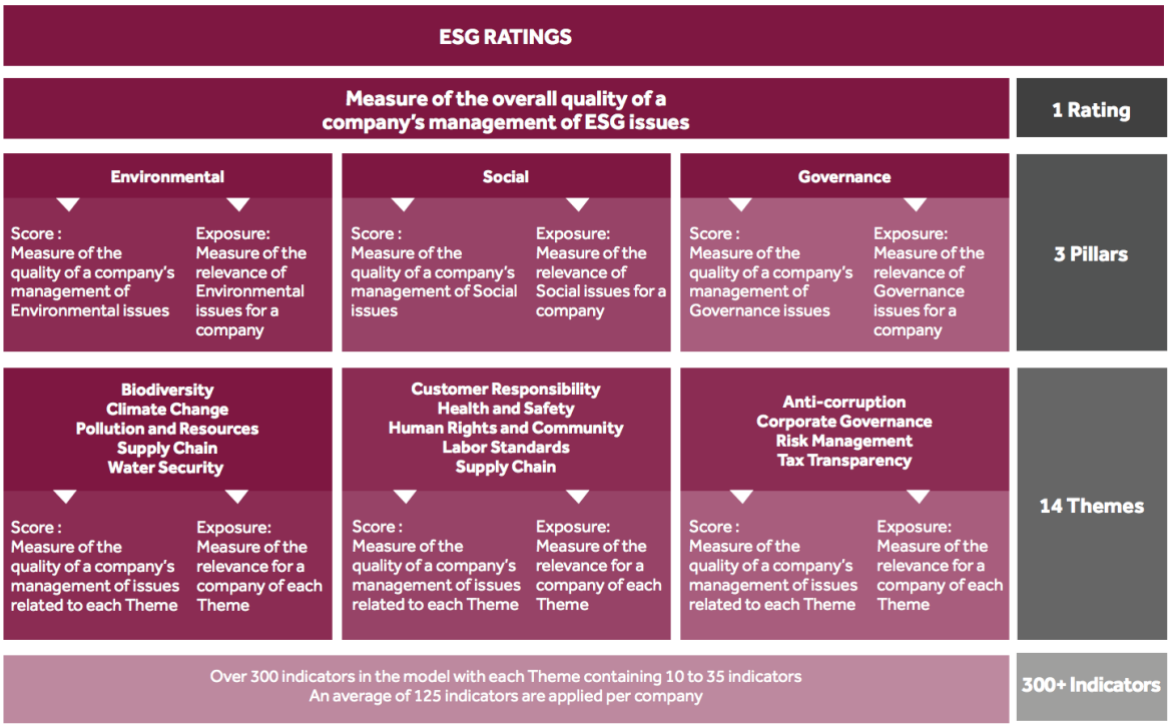
Figure A.3 – FactSet FTSE ESG-metric[53].



FactSet is collecting their data from FTSE Russell. The ESG-ratings are based on Environmental (E), Social (S) and Governance (G) factors. Where the Environmental factor is based on: Water security, Pollution, Climate change and Biodiversity. The Social factor is based on: Labor standards, Human Rights, Health & Safety and Customer responsibility and the Governance factor is baes on: Anti-corruption, Corporate Governance, Risk management and Tax transparency.

[51] https://www.refinitiv.com/content/dam/marketing/en_us/documents/methodology/refinitiv-esg-scores-methodology.pdf
[52] https://www.refinitiv.com/content/dam/marketing/en_us/documents/methodology/refinitiv-esg-scores-methodology.pdf
[53] https://research.ftserussell.com/products/downloads/ESG-ratings-overview.pdf

Figure A.3 – FTSE ESG-ratings[54].



The ESG-measures consist of over 300 individual indicators assessments that are applied to each companies' unique circumstances. "The ESG-ratings are comprised of an overall rating that breaks down into underlying Pillar and Theme exposure and ratings[55]". The ESG-ratings is accessed through FactSet and includes 7.200 securities in 47 developed and emerging markets.

[54] https://research.ftserussell.com/products/downloads/ESG-ratings-overview.pdf
[55] https://research.ftserussell.com/products/downloads/ESG-ratings-overview.pdf

2. Fama & French 5-factor regression – R-studio results.

High ESG-rating portfolio result

```
> Master_thesis_calculations_high_ESG_rating <- read_excel("Master thesis
- calculations high ESG-rating.xlsx")
> View(Master_thesis_calculations_high_ESG_rating)
> ###Fama & French 5-factor regression 4.1.5###
> lm1 <- lm(Master_thesis_calculations_high_ESG_rating)
> summary(lm1)

Call:
lm(formula = Master_thesis_calculations_high_ESG_rating)

Residuals:
       Min         1Q     Median         3Q        Max
-0.0303876 -0.0075435  0.0004798  0.0089759  0.0189973

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) -0.001125   0.001538  -0.731    0.468
`Mkt-RF`     0.949405   0.037763  25.141   < 2e-16 ***
SMB         -0.063651   0.065990  -0.965    0.339
HML          0.263336   0.051078   5.156 3.55e-06 ***
RMW          0.052951   0.083356   0.635    0.528
CMA         -0.009906   0.090495  -0.109    0.913
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.01111 on 55 degrees of freedom
Multiple R-squared:  0.9499,    Adjusted R-squared:  0.9454
F-statistic: 208.7 on 5 and 55 DF,  p-value: < 2.2e-16
```

High ESG-rating portfolio result only significant factors

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0,973333427
R Square	0,94737796
Adjusted R Square	0,945563407
Standard Error	0,01108848
Observations	61

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0,12838894	0,06419447	522,0998801	8,20092E-38
Residual	58	0,00713135	0,00012295		
Total	60	0,13552029			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	-0,000684341	0,00148924	-0,4595239	0,647575784	-0,00366538	0,002296697	-0,00366538	0,002296697
Mkt-RF	0,939898751	0,0304634	30,8533766	1,11099E-37	0,878919631	1,000877872	0,878919631	1,000877872
HML	0,252028421	0,03594326	7,01184017	2,79996E-09	0,180080162	0,323976681	0,180080162	0,323976681

Low ESG-rating portfolio result

R 4.2.0 · /cloud/project/

```
> library(readxl)
> Master_thesis_calculation_low_ESG_rating <- read_excel("Master thesis -
calculation low ESG-rating.xlsx")
> View(Master_thesis_calculation_low_ESG_rating)
> lm2 <- lm(Master_thesis_calculation_low_ESG_rating)
> summary(lm2)

Call:
lm(formula = Master_thesis_calculation_low_ESG_rating)

Residuals:
      Min        1Q    Median        3Q       Max
-0.038393 -0.007712 -0.000368  0.006781  0.036670

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept)  0.002702   0.001993   1.356  0.18054
`Mkt-RF`     0.921415   0.048912  18.838  < 2e-16 ***
SMB          0.119537   0.085472   1.399  0.16756
HML          0.199982   0.066158   3.023  0.00380 **
RMW          0.077047   0.107965   0.714  0.47847
CMA         -0.396863   0.117212  -3.386  0.00132 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.01439 on 55 degrees of freedom
Multiple R-squared:  0.926,     Adjusted R-squared:  0.9192
F-statistic: 137.6 on 5 and 55 DF,  p-value: < 2.2e-16
```

Low ESG-rating portfolio result only significant factors

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0,960903206
R Square	0,923334971
Adjusted R Square	0,91929997
Standard Error	0,014382133
Observations	61

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	3	0,1419984	0,0473328	228,831381	9,54638E-32
Residual	57	0,01179021	0,00020685		
Total	60	0,15378861			

	Coefficients	*Standard Erro*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	0,002556351	0,00196006	1,30422139	0,19740022	-0,0013686	0,006481302	-0,0013686	0,006481302
Mkt-RF	0,952067422	0,04301378	22,1340101	1,1399E-29	0,865933815	1,038201029	0,865933815	1,038201029
HML	0,236136509	0,06043872	3,90704045	0,00025033	0,115110067	0,35716295	0,115110067	0,35716295
CMA	-0,409192041	0,11665333	-3,5077612	0,0008891	-0,642786313	-0,175597768	-0,642786313	-0,175597768

2.1 Fama & French 5-factor regression Excel result on sector-based portfolios

Consumer Non-Cyclicals sector.

High ESG-rating Consumer Non-Cyclicals portfolio result

SUMMARY OUTPUT High ESG-rating Consumer Non-Cyclicals portfolio

Regression Statistics	
Multiple R	0,719982026
R Square	0,518374118
Adjusted R Square	0,474589947
Standard Error	0,025516239
Observations	61

ANOVA

	df	SS	MS	F	Significance F
Regression	5	0,038541578	0,007708316	11,83930415	8,54698E-08
Residual	55	0,035809314	0,000651078		
Total	60	0,074350892			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95,0%	Upper 95,0%
Intercept	0,021136037	0,005659986	3,734291322	0,000448545	0,009793172	0,032478903	0,009793172	0,032478903
Mkt-RF	0,905690113	0,140688719	6,437546093	3,1351E-08	0,62374362	1,187636606	0,62374362	1,187636606
SMB	-0,326823195	0,250188541	-1,30630761	0,196884646	-0,828212236	0,174565845	-0,828212236	0,174565845
HML	-0,123907713	0,17712991	-0,699530154	0,487168905	-0,478883987	0,23106856	-0,478883987	0,23106856
RMW	1,068117535	0,417033079	2,561229765	0,013202965	0,232364569	1,903870501	0,232364569	1,903870501
CMA	0,769830475	0,361074925	2,132051886	0,037483914	0,046220155	1,493440796	0,046220155	1,493440796

Low ESG-rating Consumer Non-Cyclicals portfolio result

SUMMARY OUTPUT Low ESG-rating Consumer Non-Cyclicals portfolio

Regression Statistics	
Multiple R	0,788924515
R Square	0,622401891
Adjusted R Square	0,58807479
Standard Error	0,042892287
Observations	61

ANOVA

	df	SS	MS	F	Significance F
Regression	5	0,166786993	0,033357399	18,13150179	1,37244E-10
Residual	55	0,101186154	0,001839748		
Total	60	0,267973147			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95,0%	Upper 95,0%
Intercept	0,039263914	0,009514324	4,126821384	0,00012568	0,020196784	0,058331045	0,020196784	0,058331045
Mkt-RF	1,620830361	0,236494922	6,853552487	6,55289E-09	1,146883946	2,094776776	1,146883946	2,094776776
SMB	0,624092745	0,420561932	1,48394968	0,143530868	-0,218732202	1,466917692	-0,218732202	1,466917692
HML	0,071291793	0,297751836	0,239433596	0,811659425	-0,525416221	0,667999807	-0,525416221	0,667999807
RMW	0,565571866	0,701024263	0,806779302	0,423268722	-0,839312151	1,970455882	-0,839312151	1,970455882
CMA	0,155625717	0,606959726	0,256402047	0,798597064	-1,060748756	1,372000189	-1,060748756	1,372000189

Finance sector.

High ESG-rating Finance portfolio result.

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0,867514968
R Square	0,75258222
Adjusted R Square	0,730089694
Standard Error	0,041590747
Observations	61

ANOVA

	df	SS	MS	F	Significance F
Regression	5	0,289387112	0,057877422	33,4592138	1,60676E-15
Residual	55	0,095138465	0,00172979		
Total	60	0,384525576			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95,0%	Upper 95,0%
Intercept	0,043352992	0,009225617	4,699196778	1,7891E-05	0,024864441	0,061841543	0,024864441	0,061841543
Mkt-RF	1,58389549	0,229318634	6,90696375	5,35765E-09	1,124330679	2,043460302	1,124330679	2,043460302
SMB	0,156595868	0,407800247	0,384001406	0,702457989	-0,66065409	0,973845827	-0,66065409	0,973845827
HML	1,545322352	0,288716745	5,352382141	1,74307E-06	0,966721064	2,123923639	0,966721064	2,123923639
RMW	-0,46549251	0,679752126	-0,684797431	0,496347603	-1,827746212	0,896761192	-1,827746212	0,896761192
CMA	-0,796709837	0,588541918	-1,353701092	0,181368763	-1,976174198	0,382754524	-1,976174198	0,382754524

Low ESG-rating Finance portfolio result.

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0,81859349
R Square	0,670095303
Adjusted R Square	0,640103966
Standard Error	0,030433482
Observations	61

ANOVA

	df	SS	MS	F	Significance F
Regression	5	0,103469908	0,020694	22,34296264	3,719E-12
Residual	55	0,050940827	0,0009262		
Total	60	0,154410734			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95,0%	Upper 95,0%
Intercept	0,024786175	0,006750724	3,6716319	0,000546453	0,0112574	0,0383149	0,0112574	0,0383149
Mkt-RF	1,212259635	0,167800894	7,2243932	1,61767E-09	0,8759791	1,5485401	0,8759791	1,5485401
SMB	-0,120129042	0,298402467	-0,4025739	0,688822183	-0,7181409	0,4778829	-0,7181409	0,4778829
HML	0,60742674	0,211264681	2,875193	0,00573232	0,1840429	1,0308106	0,1840429	1,0308106
RMW	-0,370587124	0,497399677	-0,745049	0,459414134	-1,3673984	0,6262241	-1,3673984	0,6262241
CMA	-0,742549299	0,430657807	-1,7242211	0,090284843	-1,6056068	0,1205082	-1,6056068	0,1205082

Technology sector.

High ESG-rating Technology portfolio result.

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0,83047186
R Square	0,68968351
Adjusted R Square	0,66147292
Standard Error	0,028899756
Observations	61

ANOVA

	df	SS	MS	F	Significance F
Regression	5	0,102093015	0,020418603	24,44768113	7,19662E-13
Residual	55	0,045935774	0,000835196		
Total	60	0,14802879			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95,0%	Upper 95,0%
Intercept	0,025229411	0,006410515	3,935629525	0,000235281	0,012382452	0,038076369	0,012382452	0,038076369
Mkt-RF	1,389379809	0,159344397	8,719351503	5,95898E-12	1,070046501	1,708713117	1,070046501	1,708713117
SMB	-0,072806141	0,283364171	-0,256934886	0,798187799	-0,64068063	0,495068348	-0,64068063	0,495068348
HML	0,078005144	0,200617782	0,388824674	0,698907085	-0,324041876	0,480052164	-0,324041876	0,480052164
RMW	0,210015306	0,472332715	0,444634258	0,658328917	-0,736560607	1,156591219	-0,736560607	1,156591219
CMA	-0,669935054	0,408954369	-1,638165782	0,107096193	-1,489497924	0,149627816	-1,489497924	0,149627816

Low ESG-rating Technology portfolio result.

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0,753480838
R Square	0,567733373
Adjusted R Square	0,528436407
Standard Error	0,04419423
Observations	61

ANOVA

	df	SS	MS	F	Significance F
Regression	5	0,141086854	0,02821737	14,4472571	4,9653E-09
Residual	55	0,107422148	0,00195313		
Total	60	0,248509003			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95,0%	Upper 95,0%
Intercept	0,024524819	0,009803119	2,50173628	0,015363228	0,00487893	0,04417071	0,00487893	0,04417071
Mkt-RF	1,377454299	0,243673439	5,6528701	5,81125E-07	0,88912181	1,86578678	0,88912181	1,86578678
SMB	0,349654425	0,433327581	0,80690554	0,423196602	-0,5187535	1,2180623	-0,5187535	1,2180623
HML	-0,378748632	0,306789733	-1,2345545	0,222245047	-0,993569	0,23607173	-0,993569	0,23607173
RMW	0,12915194	0,722303006	0,17880576	0,858747259	-1,3183756	1,57667951	-1,3183756	1,57667951
CMA	-2,072151184	0,625383254	-3,3134101	0,001634285	-3,3254472	-0,8188551	-3,3254472	-0,8188551

Healthcare sector.

High ESG-rating Healthcare portfolio result.

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0,571178958
R Square	0,326245402
Adjusted R Square	0,264994985
Standard Error	0,041568009
Observations	61

ANOVA

	df	SS	MS	F	Significance F
Regression	5	0,046017583	0,009203517	5,326419204	0,000462006
Residual	55	0,095034467	0,001727899		
Total	60	0,14105205			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95,0%	Upper 95,0%
Intercept	0,022372599	0,009220574	2,426378207	0,018556266	0,003894156	0,040851042	0,003894156	0,040851042
Mkt-RF	1,081219346	0,229193263	4,717500557	1,67833E-05	0,621905783	1,54053291	0,621905783	1,54053291
SMB	-0,087343866	0,407577299	-0,214300125	0,831105567	-0,904147026	0,729459294	-0,904147026	0,729459294
HML	-0,233422707	0,288558901	-0,808925684	0,422043458	-0,811707667	0,344862254	-0,811707667	0,344862254
RMW	-0,177371401	0,679380499	-0,261078146	0,795007375	-1,538880347	1,184137545	-1,538880347	1,184137545
CMA	0,87579772	0,588220157	1,488894436	0,142227193	-0,303021817	2,054617257	-0,303021817	2,054617257

Low ESG-rating Healthcare portfolio result.

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0,749649214
R Square	0,561973944
Adjusted R Square	0,522153393
Standard Error	0,041879175
Observations	61

ANOVA

	df	SS	MS	F	Significance F
Regression	5	0,123758535	0,02475171	14,11266132	7,0435E-09
Residual	55	0,096462592	0,00175387		
Total	60	0,220221127			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95,0%	Upper 95,0%
Intercept	0,0199457	0,009289596	2,14710088	0,03620959	0,00132893	0,03856247	0,00132893	0,03856247
Mkt-RF	1,665315634	0,230908936	7,21200169	1,6951E-09	1,20256379	2,12806748	1,20256379	2,12806748
SMB	0,067742535	0,410628302	0,16497288	0,869570183	-0,75517497	0,89066004	-0,75517497	0,89066004
HML	-0,710875143	0,290718967	-2,44523139	0,017705847	-1,29348897	-0,12826131	-1,29348897	-0,12826131
RMW	-0,360919124	0,68446614	-0,52730019	0,60010581	-1,73261992	1,01078167	-1,73261992	1,01078167
CMA	-0,514690352	0,592623398	-0,86849482	0,388897535	-1,70233418	0,67295348	-1,70233418	0,67295348

Industrial sector.

High ESG-rating Industrial portfolio result.

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0,820728648
R Square	0,673595513
Adjusted R Square	0,643922378
Standard Error	0,039529137
Observations	61

ANOVA

	df	SS	MS	F	Significance F
Regression	5	0,177353766	0,035470753	22,70051715	2,79381E-12
Residual	55	0,085940396	0,001562553		
Total	60	0,263294161			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95,0%	Upper 95,0%
Intercept	0,035972356	0,008768313	4,102539958	0,000136197	0,018400263	0,053544447	0,018400263	0,053544447
Mkt-RF	1,626135033	0,217951544	7,460993399	6,62666E-10	1,189350377	2,062919688	1,189350377	2,062919688
SMB	0,313104373	0,387586007	0,807831982	0,422867531	-0,463635343	1,089844089	-0,463635343	1,089844089
HML	0,343389382	0,274405352	1,25139462	0,216087101	-0,206531233	0,893309997	-0,206531233	0,893309997
RMW	0,811768512	0,64605751	1,256495743	0,214246809	-0,482959672	2,106496695	-0,482959672	2,106496695
CMA	-0,389667863	0,559366499	-0,696621036	0,488973833	-1,510667385	0,731331659	-1,510667385	0,731331659

Low ESG-rating Industrial portfolio result.

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0,797584135
R Square	0,636140452
Adjusted R Square	0,603062311
Standard Error	0,034848117
Observations	61

ANOVA

	df	SS	MS	F	Significance F
Regression	5	0,116772494	0,023354499	19,23144521	5,10847E-11
Residual	55	0,066791519	0,001214391		
Total	60	0,183564014			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95,0%	Upper 95,0%
Intercept	0,019748382	0,007729974	2,554779836	0,013423055	0,004257168	0,035239596	0,004257168	0,035239596
Mkt-RF	1,330575214	0,192141836	6,92496356	5,00605E-09	0,94551437	1,715636059	0,94551437	1,715636059
SMB	0,230312038	0,341688275	0,674041384	0,503108178	-0,454446567	0,915070642	-0,454446567	0,915070642
HML	0,057767813	0,241910414	0,238798372	0,812149495	-0,42703149	0,542567116	-0,42703149	0,542567116
RMW	-0,134973514	0,569551718	-0,236982016	0,813551215	-1,276380663	1,006433634	-1,276380663	1,006433634
CMA	-1,346568987	0,493128373	-2,730666211	0,008476304	-2,334820331	-0,358317643	-2,334820331	-0,358317643

2.2 Fama & French 5-factor regression Excel result on Value & Growth portfolios

Growth Portfolio

FF5-factors result.

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0,94540607
R Square	0,893792637
Adjusted R Square	0,884137422
Standard Error	0,016584903
Observations	61

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	5	0,127312408	0,025462482	92,57097392	1,63343E-25
Residual	55	0,015128246	0,000275059		
Total	60	0,142440654			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	0,004335458	0,002296823	1,887589277	0,064361792	-0,000267478	0,008938394	-0,000267478	0,008938394
Mkt-RF	0,89109494	0,056382398	15,80448798	4,18418E-22	0,778102088	1,004087791	0,778102088	1,004087791
SMB	0,052253332	0,098526558	0,530347681	0,598005735	-0,145198303	0,249704966	-0,145198303	0,249704966
HML	0,040982127	0,076262142	0,537384942	0,593169396	-0,111850621	0,193814874	-0,111850621	0,193814874
RMW	0,066469864	0,124454628	0,534089125	0,595432145	-0,182942785	0,315882512	-0,182942785	0,315882512
CMA	-0,422960567	0,135113619	-3,130406607	0,002793709	-0,693734311	-0,152186823	-0,693734311	-0,152186823

Growth Portfolio

FF5- only significant factors result.

SUMMARY OUTPUT Growth-portfolio 2 factors

Regression Statistics	
Multiple R	0,944293528
R Square	0,891690268
Adjusted R Square	0,887955449
Standard Error	0,016309353
Observations	61

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0,127012945	0,063506473	238,7506385	1,01241E-28
Residual	58	0,015427709	0,000265995		
Total	60	0,142440654			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	0,003980377	0,002170293	1,834027547	0,071781615	-0,000363936	0,00832469	-0,000363936	0,00832469
Mkt-RF	0,920119421	0,046369595	19,84316283	1,56483E-27	0,827300592	1,01293825	0,827300592	1,01293825
CMA	-0,353262623	0,102038522	-3,462051551	0,001013239	-0,557514916	-0,14901033	-0,557514916	-0,14901033

Value Portfolio

FF5-factors result.

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0,95797644
R Square	0,91771886
Adjusted R Square	0,910238757
Standard Error	0,017982392
Observations	61

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	5	0,19836588	0,039673176	122,6879879	1,51757E-28
Residual	55	0,017785153	0,000323366		
Total	60	0,216151033			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	-0,005827096	0,002490359	-2,339861768	0,022948095	-0,010817888	-0,000836305	-0,010817888	-0,000836305
Mkt-RF	1,054506689	0,061133331	17,24929217	7,53402E-24	0,931992756	1,177020623	0,931992756	1,177020623
SMB	0,168074827	0,106828671	1,573311975	0,121382075	-0,046014614	0,382164268	-0,046014614	0,382164268
HML	0,471084683	0,082688195	5,697121385	4,93773E-07	0,305373838	0,636795529	0,305373838	0,636795529
RMW	0,02397052	0,13494151	0,177636373	0,859661172	-0,246458309	0,29439935	-0,246458309	0,29439935
CMA	-0,207055943	0,146498657	-1,41336411	0,163183605	-0,500645812	0,086533925	-0,500645812	0,086533925

Value Portfolio

FF5- only significant factors result.

SUMMARY OUTPUT Value-portfolio 2 factors

Regression Statistics	
Multiple R	0,953594453
R Square	0,909342381
Adjusted R Square	0,906216256
Standard Error	0,018380902
Observations	61

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0,196555295	0,098277647	290,8848632	5,81735E-31
Residual	58	0,019595738	0,000337858		
Total	60	0,216151033			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	-0,007006762	0,00246865	-2,838296935	0,006240999	-0,011948303	-0,002065222	-0,011948303	-0,002065222
Mkt-RF	1,124624344	0,050497884	22,27072205	4,16385E-30	1,023541846	1,225706842	1,023541846	1,225706842
HML	0,439812324	0,059581622	7,381677594	6,692E-10	0,320546749	0,559077898	0,320546749	0,559077898

2.3 Fama & French 5-factor + value and growth factor regression Excel result High- and Low ESG-rating portfolio.

Low ESG-rating portfolio

FF5-factors + value and growth factor result.

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0,973552109
R Square	0,947803708
Adjusted R Square	0,940909858
Standard Error	0,012306767
Observations	61

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	7	0,145761414	0,020823059	137,4853998	1,16706E-31
Residual	53	0,008027195	0,000151457		
Total	60	0,153788609			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	0,001448226	0,00192884	0,750827627	0,456077171	-0,002420536	0,005316988	-0,002420536	0,005316988
Mkt-RF	0,447827844	0,118586497	3,77638142	0,000404102	0,209973453	0,685682235	0,209973453	0,685682235
SMB	0,081586562	0,07475136	1,091439158	0,280016612	-0,06834568	0,231518803	-0,06834568	0,231518803
HML	0,13771097	0,073029738	1,88568348	0,064823488	-0,008768134	0,284190075	-0,008768134	0,284190075
RMW	0,046960897	0,092592421	0,507178624	0,614133396	-0,138755981	0,232677775	-0,138755981	0,232677775
CMA	-0,200191754	0,108837203	-1,839368792	0,071465139	-0,418491538	0,018108029	-0,418491538	0,018108029
Growth	0,418081221	0,110178339	3,794586356	0,000381509	0,197091459	0,639070983	0,197091459	0,639070983
Value	0,095814553	0,101615909	0,942908978	0,350005907	-0,10800115	0,299630255	-0,10800115	0,299630255

High ESG-rating portfolio

FF5-factors + value and growth factor result.

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0,98079896
R Square	0,9619666
Adjusted R Square	0,95694332
Standard Error	0,009861587
Observations	61

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	7	0,130365992	0,018623713	191,5017149	2,75112E-35
Residual	53	0,005154297	9,72509E-05		
Total	60	0,13552029			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	-0,001403658	0,001545606	-0,908159823	0,367904864	-0,004503752	0,001696436	-0,004503752	0,001696436
Mkt-RF	0,594812297	0,095025042	6,259532077	6,97656E-08	0,4042162	0,785408393	0,4042162	0,785408393
SMB	-0,098465634	0,059899325	-1,643852137	0,106126549	-0,218608465	0,021677198	-0,218608465	0,021677198
HML	0,191253244	0,058519765	3,26818204	0,001903278	0,07387746	0,308629027	0,07387746	0,308629027
RMW	0,033718998	0,07419562	0,454460764	0,651353114	-0,11509857	0,182536566	-0,11509857	0,182536566
CMA	0,119669987	0,087212794	1,372160914	0,175793292	-0,055256725	0,294596699	-0,055256725	0,294596699
Growth	0,241742521	0,088287465	2,738129589	0,008395059	0,064660291	0,418824751	0,064660291	0,418824751
Value	0,13198334	0,081426269	1,620893866	0,110975531	-0,031337073	0,295303752	-0,031337073	0,295303752

High ESG-rating portfolio

FF5-factors + value and growth only significant factors result.

SUMMARY OUTPUT High ESG - corrected regression

Regression Statistics	
Multiple R	0,977629175
R Square	0,955758804
Adjusted R Square	0,95343032
Standard Error	0,010256004
Observations	61

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	3	0,12952471	0,043174903	410,4639798	1,52092E-38
Residual	57	0,00599558	0,000105186		
Total	60	0,13552029			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	-0,001483244	0,001398726	-1,060425271	0,293423948	-0,004284145	0,001317656	-0,004284145	0,001317656
Mkt-RF	0,696371562	0,079285987	8,783034494	3,49797E-12	0,53760411	0,855139013	0,53760411	0,855139013
HML	0,272456765	0,03382107	8,055829343	5,55174E-11	0,204731241	0,340182289	0,204731241	0,340182289
Growth	0,251285845	0,076471593	3,286002483	0,001742102	0,098154121	0,404417569	0,098154121	0,404417569

Low ESG-rating portfolio

FF5-factors + value and growth only significant factors result.

SUMMARY OUTPUT Low ESG - corrected regression

Regression Statistics	
Multiple R	0,972215805
R Square	0,945203571
Adjusted R Square	0,94128954
Standard Error	0,012267165
Observations	61

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	4	0,145361542	0,036340386	241,491102	1,33001E-34
Residual	56	0,008427067	0,000150483		
Total	60	0,153788609			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	0,000491318	0,001727946	0,284336354	0,7772014	-0,002970174	0,00395281	-0,002970174	0,00395281
Mkt-RF	0,525819094	0,09734283	5,401723908	1,39693E-06	0,330817972	0,720820215	0,330817972	0,720820215
HML	0,208347601	0,051884937	4,015570075	0,000178269	0,104409582	0,31228562	0,104409582	0,31228562
CMA	-0,209051612	0,108131076	-1,933316673	0,058258632	-0,425664186	0,007560962	-0,425664186	0,007560962
Growth	0,469923353	0,099402808	4,727465581	1,57584E-05	0,270795601	0,669051106	0,270795601	0,669051106

3. AIC & BIC result from R-studio for Fama & French 5-factor model.

```
lm(formula = Growth_portfolio_2_factor)

Residuals:
      Min        1Q    Median        3Q       Max
-0.049037 -0.009389 -0.001476  0.011088  0.041802

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  0.00398    0.00217   1.834  0.07178 .
`Mkt-RF`     0.92012    0.04637  19.843  < 2e-16 ***
CMA         -0.35326    0.10204  -3.462  0.00101 **
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.01631 on 58 degrees of freedom
Multiple R-squared:  0.8917,    Adjusted R-squared:  0.888
F-statistic: 238.8 on 2 and 58 DF,  p-value: < 2.2e-16

> AIC(lm6)
[1] -324.1198
> BIC(lm6)
[1] -315.6763
```

3.1 AIC & BIC result from R-studio of Value- and Growth portfolio.

```
lm(formula = Growth_portfolio_5_factor)

Residuals:
      Min        1Q    Median        3Q       Max
-0.041368 -0.009820 -0.001661  0.008698  0.039323

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  0.004335   0.002297   1.888  0.06436 .
`Mkt-RF`     0.891095   0.056382  15.804  < 2e-16 ***
SMB          0.052253   0.098527   0.530  0.59801
HML          0.040982   0.076262   0.537  0.59317
RMW          0.066470   0.124455   0.534  0.59543
CMA         -0.422961   0.135114  -3.130  0.00279 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.01658 on 55 degrees of freedom
Multiple R-squared:  0.8938,    Adjusted R-squared:  0.8841
F-statistic: 92.57 on 5 and 55 DF,  p-value: < 2.2e-16

> AIC(lm4)
[1] -319.3155
> BIC(lm4)
[1] -304.5394
```

```
lm(formula = Value_portfolio_5_factor)

Residuals:
      Min        1Q    Median        3Q       Max
-0.050432 -0.009987 -0.002143  0.009967  0.046610

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) -0.005827   0.002490  -2.340   0.0229 *
`Mkt-RF`     1.054507   0.061133  17.249  < 2e-16 ***
SMB          0.168075   0.106829   1.573   0.1214
HML          0.471085   0.082688   5.697 4.94e-07 ***
RMW          0.023971   0.134942   0.178   0.8597
CMA         -0.207056   0.146499  -1.413   0.1632
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.01798 on 55 degrees of freedom
Multiple R-squared:  0.9177,    Adjusted R-squared:  0.9102
F-statistic: 122.7 on 5 and 55 DF,  p-value: < 2.2e-16

> AIC(lm5)
[1] -309.4457
> BIC(lm5)
[1] -294.6696
```

```
lm(formula = Growth_portfolio_2_factor)

Residuals:
      Min        1Q    Median        3Q       Max
-0.049037 -0.009389 -0.001476  0.011088  0.041802

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  0.00398    0.00217   1.834  0.07178 .
`Mkt-RF`     0.92012    0.04637  19.843  < 2e-16 ***
CMA         -0.35326    0.10204  -3.462  0.00101 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.01631 on 58 degrees of freedom
Multiple R-squared:  0.8917,    Adjusted R-squared:  0.888
F-statistic: 238.8 on 2 and 58 DF,  p-value: < 2.2e-16

> AIC(lm6)
[1] -324.1198
> BIC(lm6)
[1] -315.6763
```

```
lm(formula = Value_portfolio_2_factor)

Residuals:
     Min       1Q   Median       3Q      Max
-0.05508 -0.01029 -0.00113  0.01077  0.05294

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) -0.007007   0.002469  -2.838  0.00624 **
`Mkt-RF`     1.124624   0.050498  22.271  < 2e-16 ***
HML          0.439812   0.059582   7.382 6.69e-10 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.01838 on 58 degrees of freedom
Multiple R-squared:  0.9093,    Adjusted R-squared:  0.9062
F-statistic: 290.9 on 2 and 58 DF,  p-value: < 2.2e-16

> AIC(lm7)
[1] -309.5318
> BIC(lm7)
[1] -301.0883
```

4. Test of OLS-assumptions.

This analysis strives to determine the validity of both the High- and Low ESG-rating portfolio on behalf of the OLS-estimator assumptions. The OLS-estimators has been mentioned under the methodology-chapter 3.2 and are tested graphically or statistically. These assumptions must be done for the Fama & French 5-factor regression results to be reliable, are the OLS-assumptions not met, the validity and reliability will decrease.

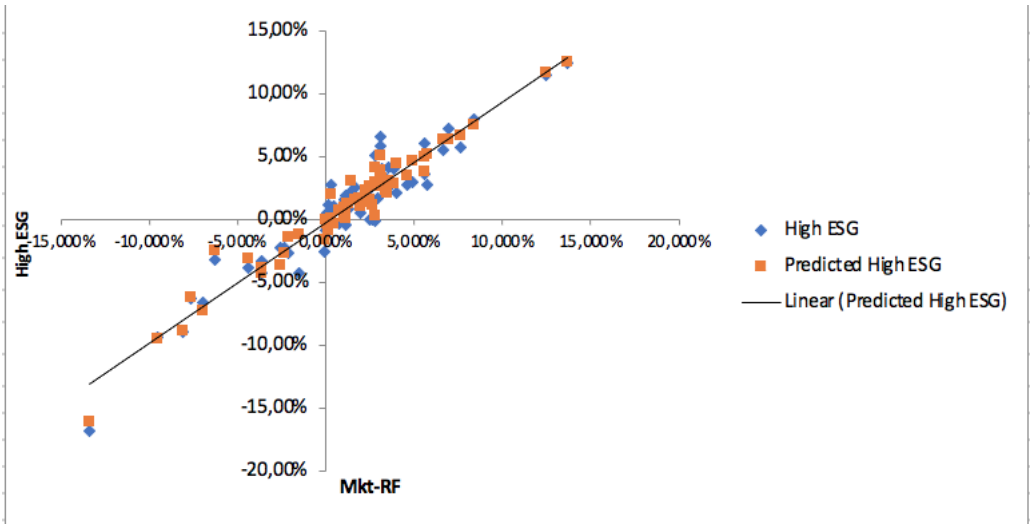
4.1.1 – Linearity in Parameters (TS1)

The first OLS-assumption is the linearity in the parameter which in this research analysis are the five factors of the Fama & French regression and TS1 have to meet the following:

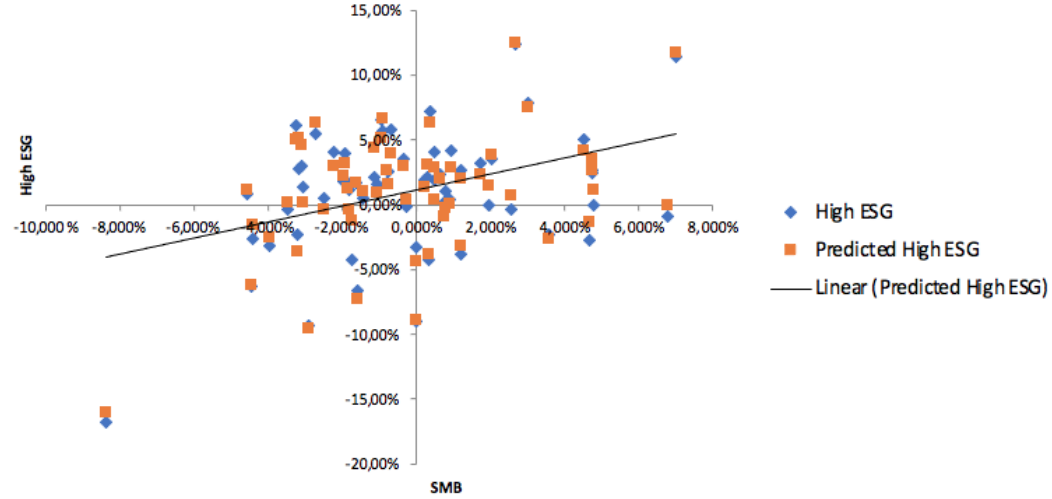
"TS1: Linear in parameters – meaning there should be linearity in the regression models parameters"

Figure 3.1.1.1 – High ESG-rating portfolio (Line Plot of Fit)

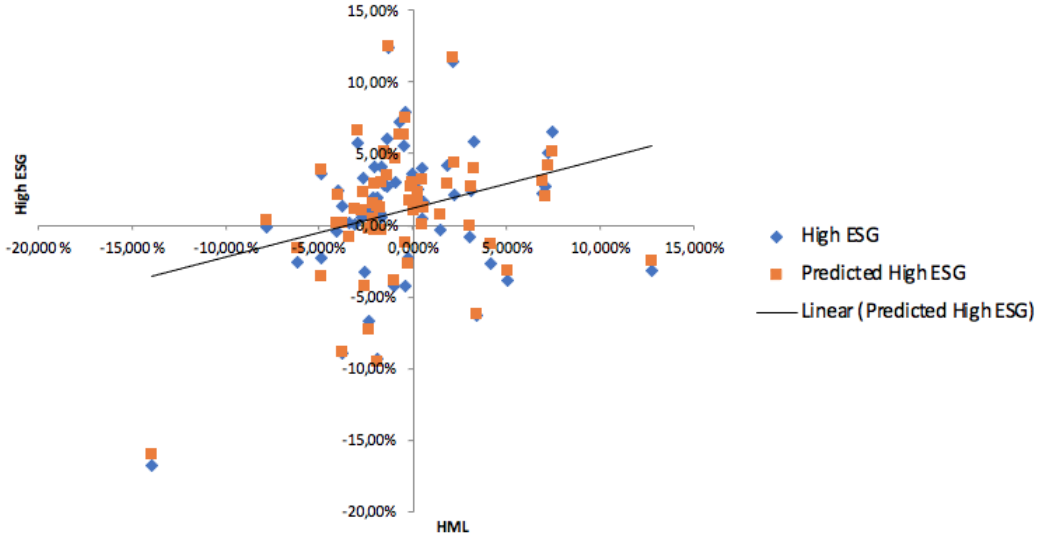
Line Fit Plot: Excess return of Mkf-RF



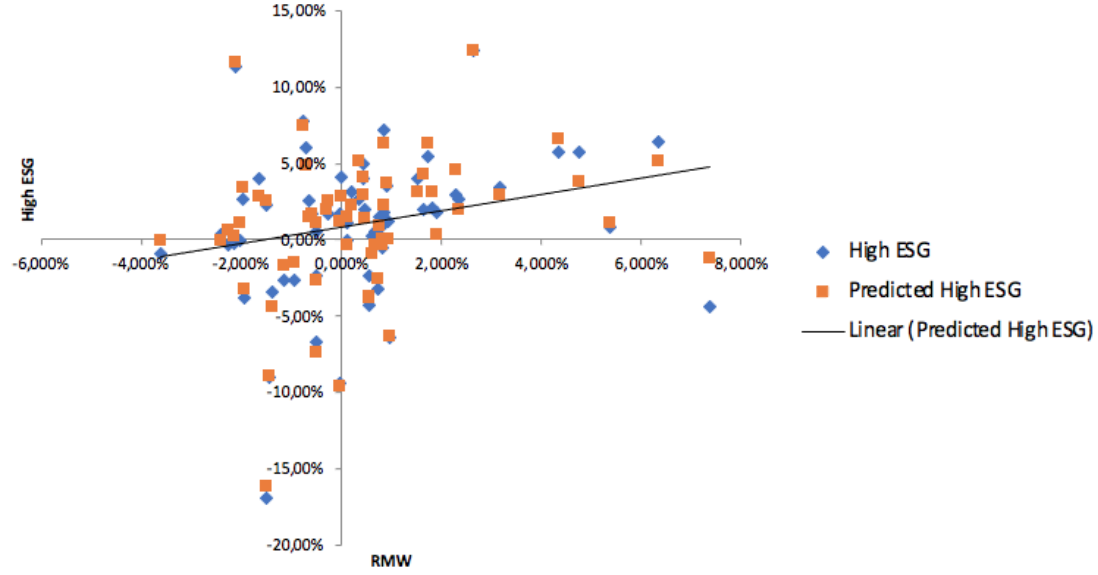
Line Fit Plot: Excess return of SMB



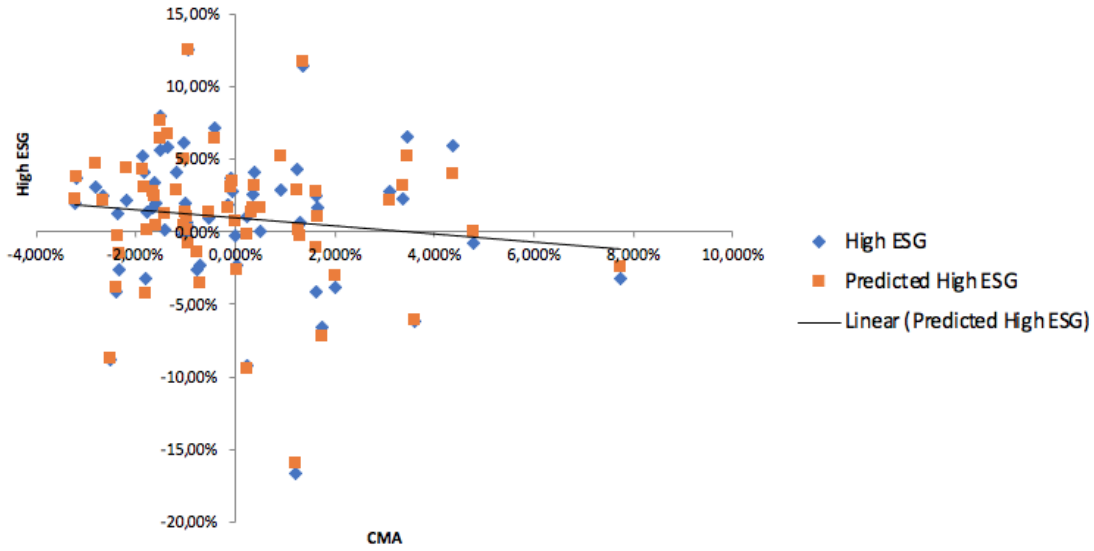
Line Fit Plot: Excess return of HML



Line Fit Plot: Excess return of RMW



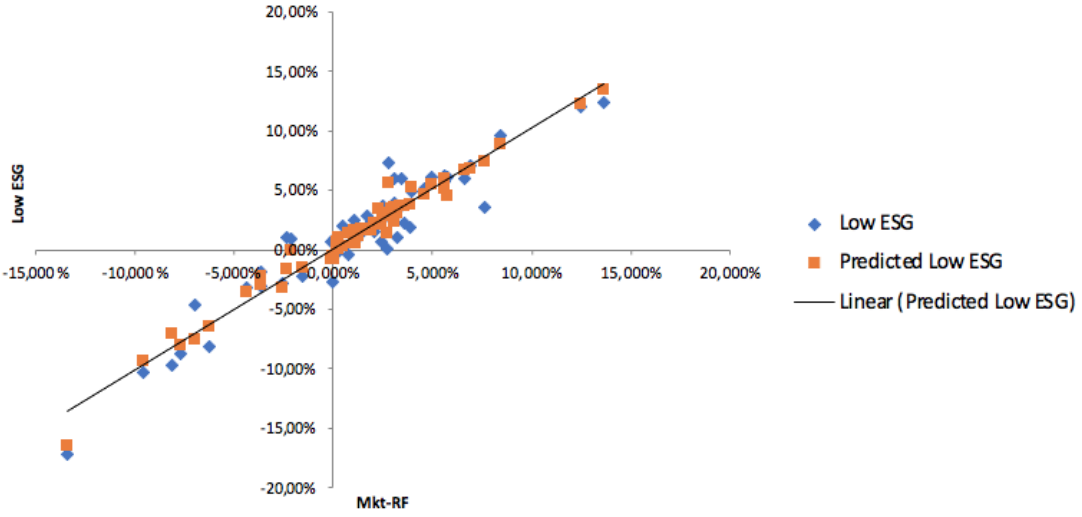
Line Fit Plot: Excess return of CMA



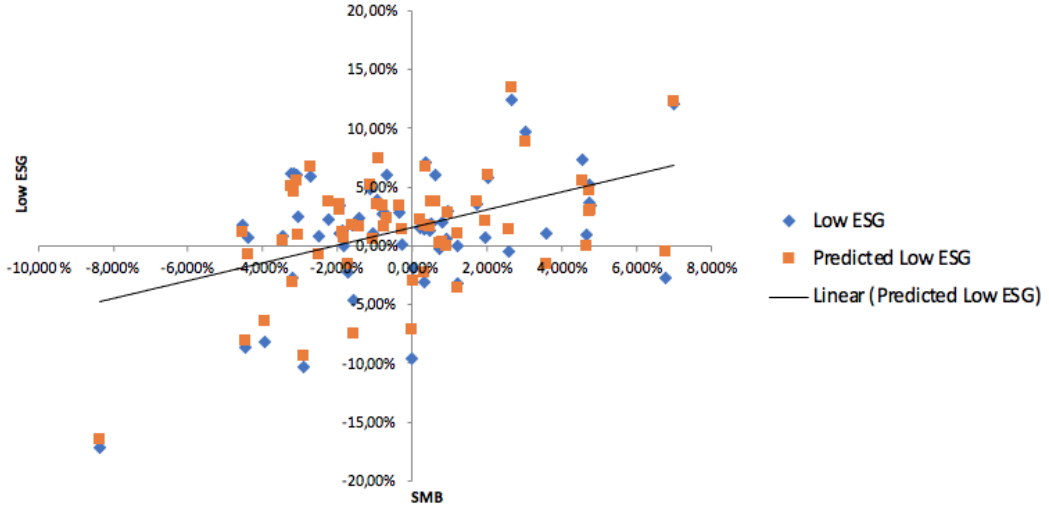
The results of the first test on the High ESG-rating portfolio presented above, indicates varying result of linearity. Giving a better visuality, both variables the dependent and independent variables have individual colors which are blue (dependent/Excess return of the portfolio) and orange (independent/the Fama & French 5-factors). Not surprisingly, the market factor (Mkf-RF) has a close to perfect linear relationship with the excess return of the portfolio. The linear relationship can be explained as the factor contains many of the stock in the portfolio and express same characteristics. The datapoint from the dataset of the remaining four factors, are spread and are further from perfect from linear relationship, most importantly the first assumption is accepted, and the analysis can proceed further.

Figure 3.1.1.2 – Low ESG-rating portfolio (Line Plot of Fit)

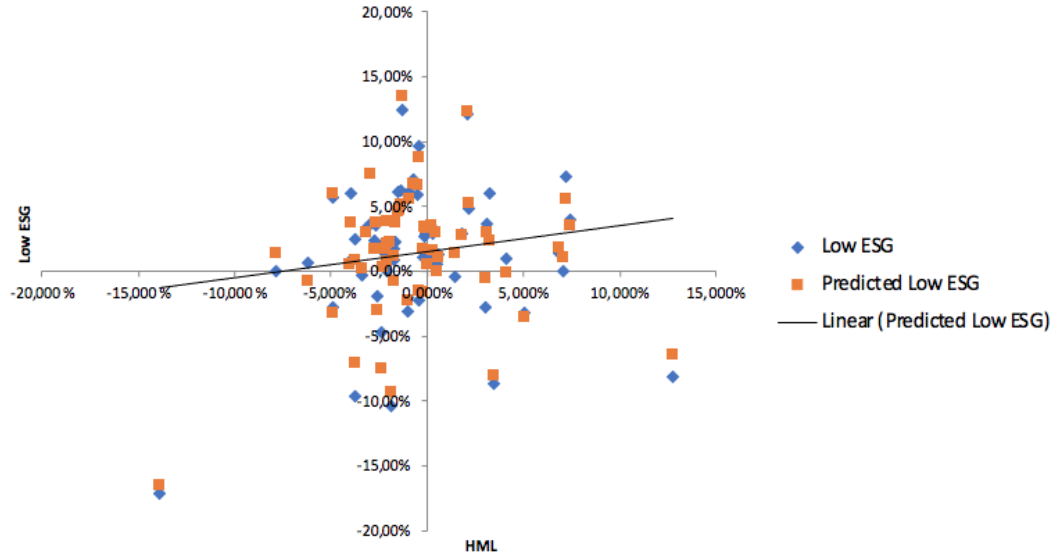
Line Fit Plot: Excess return of Mkf-RF



Line Fit Plot: Excess return of SMB

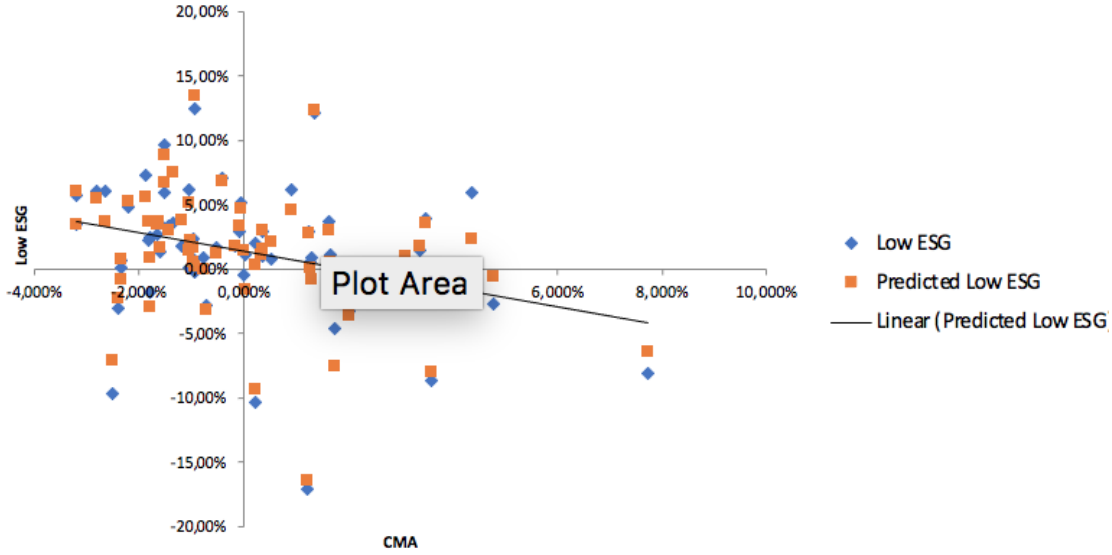


Line Fit Plot: Excess return of HML



Line Fit Plot: Excess return of RMW

Line Fit Plot: Excess return of CMA



The same approach from High ESG-rating portfolio is done for the Low ESG-rating portfolio and presented above. Again, only the market factor (Mkf-RF) has a close to perfect linear relationship with the excess return of the Low ESG-rating portfolio, and the datapoint from the dataset of the remaining four factors, are spread and are further from perfect from linear relationship and can be expressed acceptable if not better linear relationship than the High ESG-rating portfolio and therefore, the research's analysis proceeds to the second OLS-assumption.

4.1.2 – No Perfect Collinearity (TS2)

The second OLS-assumption is no perfect collinearity in the parameters, being the 5-factor of Fama & French 5-factor model, and the assumption has to meet the following.

"TS2: No perfect collinearity – in the sample (and therefore the underlying time series process) no independent variable is constant nor a perfect linear combination of the others".

The independent parameters are the for both the High- and Low ESG-rating portfolio and therefore, only one analysis has been conducted to test this OLS-assumption: No perfect collinearity. The results of the correlation between the five-parameters are presented below in the correlation-matrix.

Figure 3.1.2.1 – Correlation-matrix of each five-parameters.

Correlation	Mkf-RF	SMB	HML	RMW	CMA
Mkf-RF	1,00	0,39	0,08	0,17	-0,27
SMB	0,39	1,00	0,31	-0,34	0,01
HML	0,08	0,31	1,00	0,20	0,59
RMW	0,17	-0,34	0,20	1,00	0,11
CMA	-0,27	0,01	0,59	0,11	1,00

Source: Authors Creation

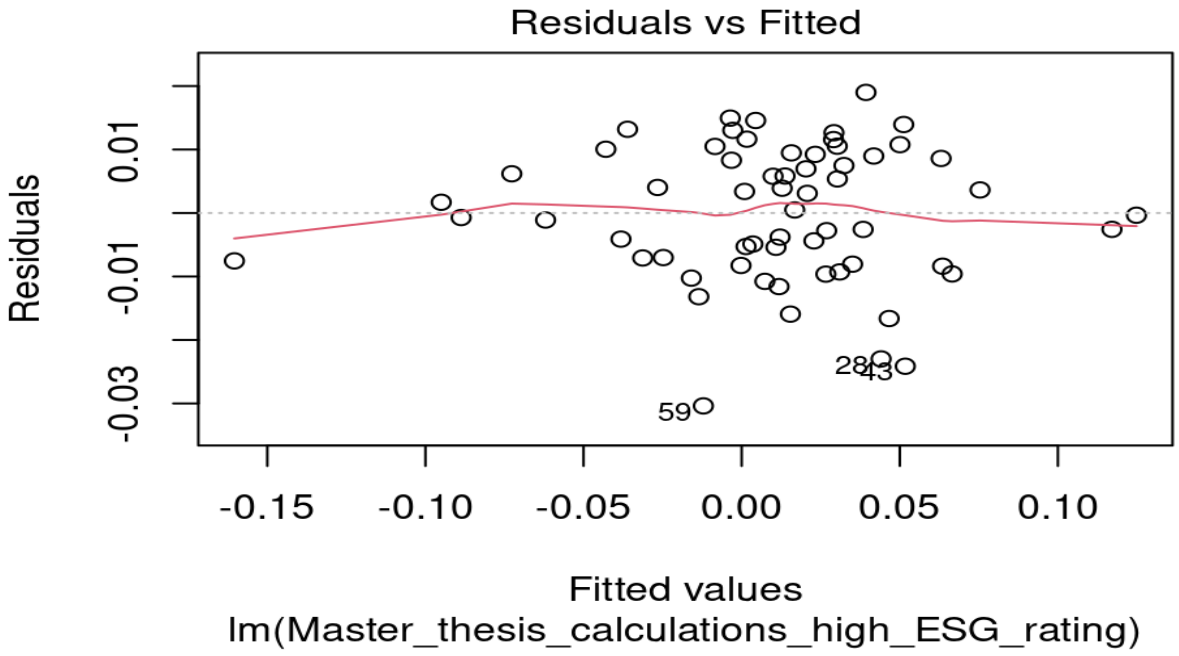
From the correlation-matrix result above, none of the five-parameters has a perfect collinear relationship. Somewhat, a strong correlation is found between the HML and CMA with the value of 0.59 but not perfect collinear. Since none of the five-parameters express perfect collinear relationship, the research's analysis proceeds to the third OLS-assumption.

4.1.3 – Zero Conditional Mean (TS3)

The thirds OLS-assumption Zero Conditional Mean which is tested by performing a residual vs. fitted plot and the Zero Conditional Mean assumption has to meet the following:

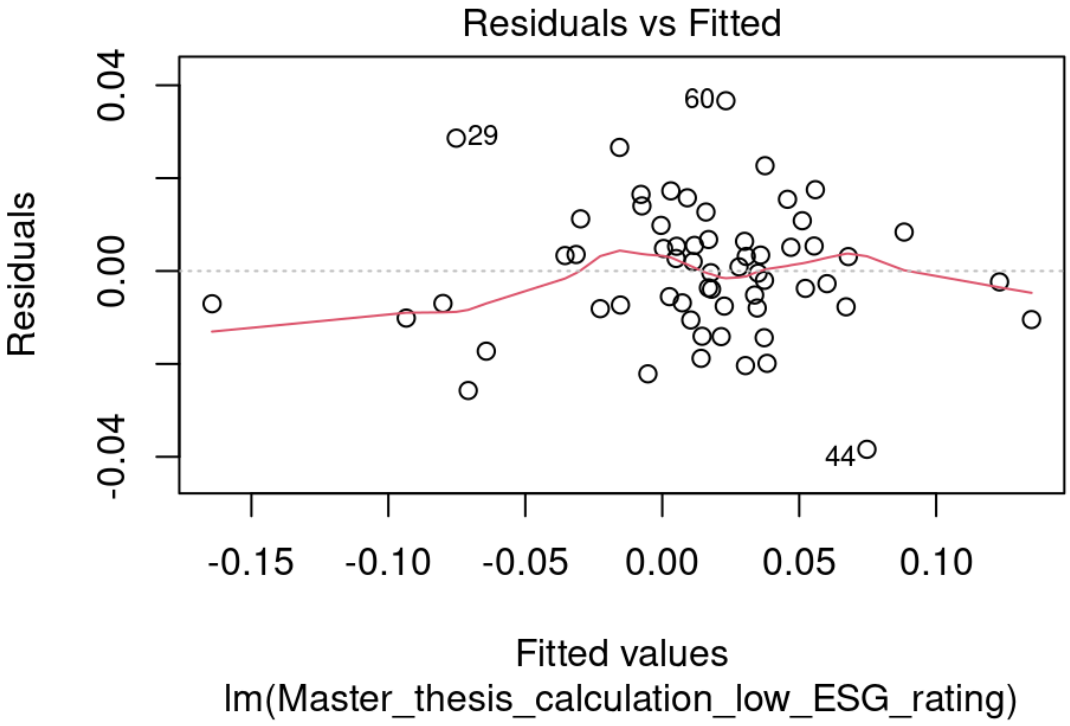
"TS3: Zero Conditional Mean – For each t, the expected value of the error ut, given the explanatory variables for all time periods, is zero".

Figure 3.1.3.1 – Residual vs. Fitted Plot (High ESG-rating portfolio)



Source: Authors Creation

Figure 3.1.3.2 – Residual vs. Fitted Plot (Low ESG-rating portfolio)



Source: Authors Creation

The result presented above in the Residual vs. Fitted plot indicates whether or not the residuals have a non-linear pattern. The High ESG-rating portfolio in figure 3.1.3.1, the linearity of the output seems to hold reasonably as the red-line is closed to the dashed-line (zero) indicating the High ESG-rating portfolio meet the third OLS-assumption of Zero Conditional Mean.

The result of the Residual vs. Fitted plot for the Low ESG-rating portfolio in figure 3.1.3.2, the plots are questionable, by observing the output there is an obvious pattern of the red-line, and as it can be observed it is not constant around the dashed-line (zero), indicating the conditional mean might differ from zero, and is caused by the outliers 29, 60 and 44 influencing the conditional mean.

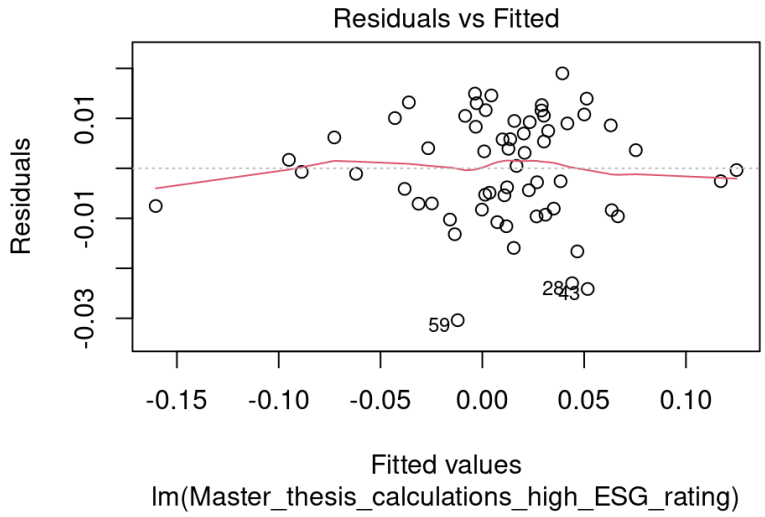
4.1.4 – Homoskedasticity (TS4).

The fourth OLS-assumption is Homoskedasticity which is tested by performing a Residual vs. Fitted- and Scale-location plot, for graphical interpretation of the variance in the error u.

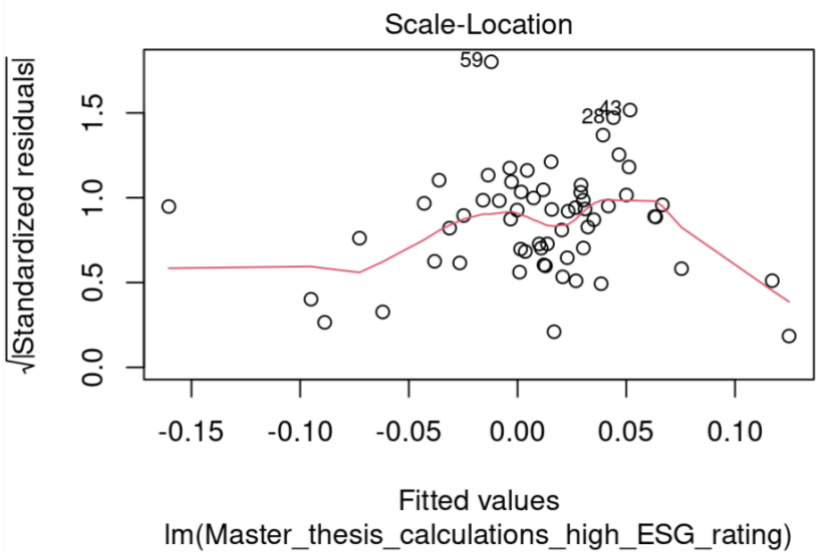
Furthermore, a Breusch-pagan test is conducted in this research to determine on a statistical basis, if the High- and Low ESG-rating portfolio suffers from Heteroscedasticity, and the OLS-assumption have to meet the following

"TS4: Homoskedasticity – Meaning the error u has the same variance given any values of the explanatory power".

Figure 3.1.4.1 – Residual vs. Fitted- and Scale-location plot (High ESG-rating portfolio)



Source: Authors Creation



Source: Authors Creation

The two plots represented above, represents the change of the residuals throughout the X-axis. Starting with the Residual vs. Fitted plot, observed from the red-line seems to be relative flat and constant around the dashed-line (zero). Looking at the Scale-location plot, the red-

line is more curved and is not constant, indicating a change in the residuals throughout the X-axis. To determine whether the regression of the High ESG-rating portfolio suffers from Heteroskedasticity the Breusch-Pagan test is conducted in this research.

Figure 3.1.4.2 – Breusch-Pagan test (High ESG-rating portfolio).

```
        studentized Breusch-Pagan test

data:  lm1
BP = 12.463, df = 5, p-value = 0.02897
```

Source: Authors Creation.

The hypothesis for the Breusch-Pagan test is following:

Null-Hypothesis (H0): Homoskedasticity is present (the residuals are distributed with equal variance).

Alternative-hypothesis: (Ha): Heteroskedasticity is present (the residuals are not distributed with equal variance).

The result from the Breusch-Pagan test shows a p-value of 0.02897, and with a significance level of 0.05 (5%), it can be concluded that heteroskedasticity is present in the regression for the High ESG-rating portfolio and must be corrected. If not, the OLS-estimation/assumption no longer produced the best estimator and standard errors computed by the least squares can be incorrect and misleading. This will affect the validity of the T-test and significance of the overall regression, for correction the Robust Standard Errors test is conducted.

Presented below is the standard errors of the current estimators for the High ESG-rating portfolio, followed by the model correct for heteroscedasticity.

Figure 3.1.4.3 – Summary statistics before Robust Standard Errors (High ESG-rating portfolio).

```
Residuals:
      Min        1Q    Median        3Q       Max
-0.0303876 -0.0075435  0.0004798  0.0089759  0.0189973

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) -0.001125   0.001538  -0.731    0.468
`Mkt-RF`     0.949405   0.037763  25.141  < 2e-16 ***
SMB         -0.063651   0.065990  -0.965    0.339
HML          0.263336   0.051078   5.156 3.55e-06 ***
RMW          0.052951   0.083356   0.635    0.528
CMA         -0.009906   0.090495  -0.109    0.913
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.01111 on 55 degrees of freedom
Multiple R-squared:  0.9499,    Adjusted R-squared:  0.9454
F-statistic: 208.7 on 5 and 55 DF,  p-value: < 2.2e-16
```

Source: Authors Creation

Figure 3.1.4.4 – Summary statistics after Robust Standard Errors (High ESG-rating portfolio).

```
t test of coefficients:

             Estimate Std. Error t value  Pr(>|t|)
(Intercept) -0.0011247  0.0012670 -0.8877    0.3786
`Mkt-RF`     0.9494051  0.0377440 25.1538 < 2.2e-16 ***
SMB         -0.0636507  0.0761362 -0.8360    0.4068
HML          0.2633357  0.0530540  4.9635 7.051e-06 ***
RMW          0.0529513  0.1347813  0.3929    0.6959
CMA         -0.0099055  0.0953085 -0.1039    0.9176
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Source: Authors Creation

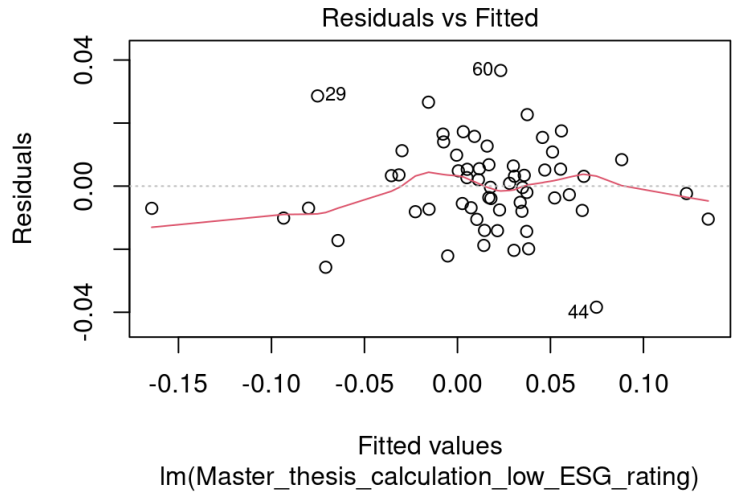
Comparing both summaries, the first notice are the coefficients that remain the same. When the Robust Standard Errors are used, the coefficients estimates do not change. This illuminates the purpose of using the correction as the regression model remains the same, just changing the standard errors, which are the source to the problem.

What changed in the summary is the standard errors and significance of the coefficients. The Mkf-RF and HML-factor has increased the significance of the correction, this is due the fact

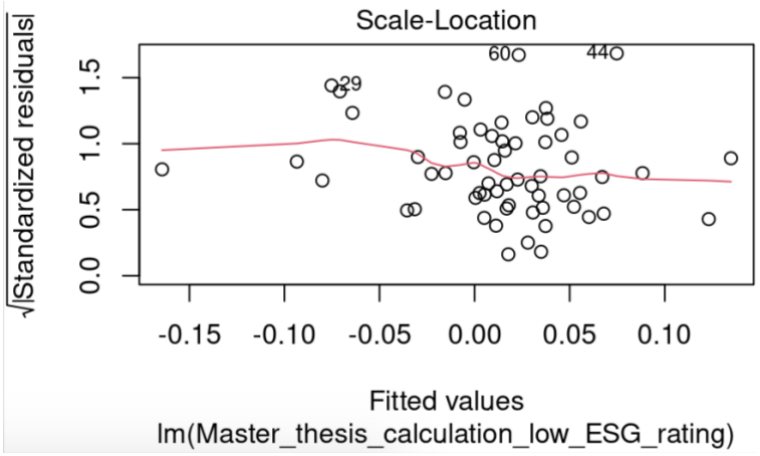
that the standard errors are captured to a higher degree. Now, the true standard error is known giving a more reliable significance, the coefficients with the best explanatory power are chosen for the regression model. In this research case with the High ESG-rating portfolio it is the Mkf-RF and HML-factors, the remaining SMB, RMW and CMA-factors are excluded from the regression model in the research.

The same approach as done above, is followed for the Low ESG-rating portfolio.

Figure 3.1.4.5 - Residual vs. Fitted- and Scale-location plot (Low ESG-rating portfolio)



Source: Authors Creation

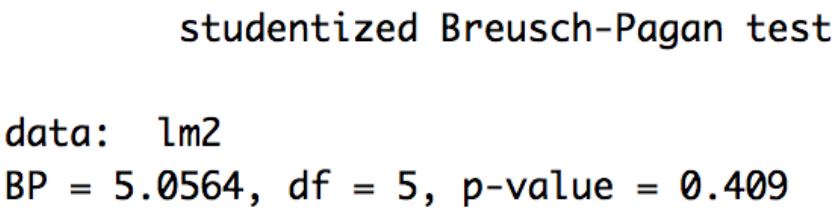


Source: Authors Creation

Compared to the High ESG-rating portfolio, the presence of heteroskedasticity is a bit more obvious in the Low ESG-rating portfolio. Only the Residual vs. fitted plot in figure 3.1.4.5 shows clear curved and more far away from the dashed/straight-line, while the Scale-location plot shows more straight line compared to the High ESG-rating portfolio, indicating there might not present Heteroskedasticity as the High ESG-rating portfolio, to support this

assumption of no Heteroskedasticity, the Breusch-Pagan Test is conducted for the Low ESG-rating portfolio.

Figure 3.1.4.6 - Breusch-Pagan Test (Low ESG-rating portfolio).



Source: Authors Creation

The Breusch-Pagan Test is significant at a significance level of 0.05 (5%) and shown in figure 3.1.4.6 of the BP-test the Low ESG-rating portfolio has no heteroskedasticity, since the p-value of the test is above 0.05 (5%) and therefore, homoscedasticity is present.

As the High ESG-rating portfolio has been tested and corrected for heteroskedasticity and the Low ESG-rating portfolio Breusch-Pagan Test conducted, indicating the research rejecting the null-hypothesis and heteroskedasticity both the High-and Low ESG-rating portfolio holds up to this assumption and can proceed to the fifth assumption regarding No Serial Correlation.

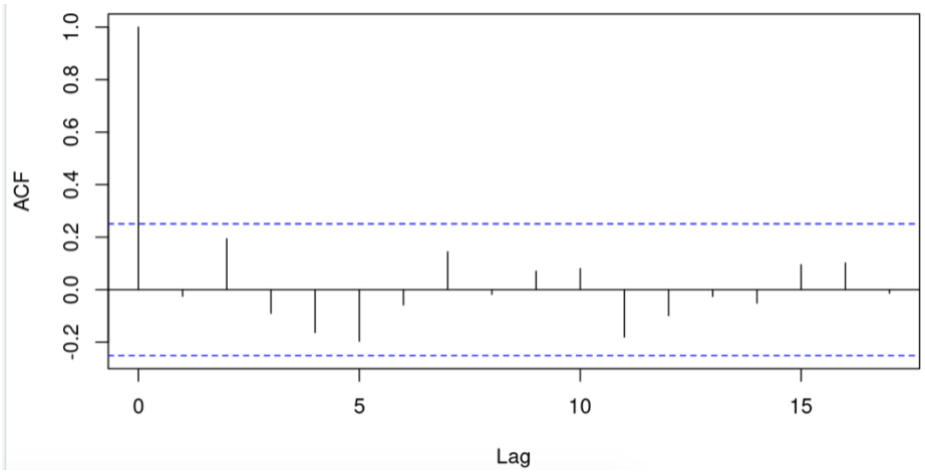
4.1.5 – No Serial Correlation (TS5).

The fifth assumption No Serial Correlation, is tested in this research by using an ACF-graph, conducting the Breusch-Godfrey and Ljung-box test and tests for the following:

"TS5: No Serial Correlation – Conditional on X, the errors in two different time periods are uncorrelated".

Figure 3.1.5.1 - Auto Correlation Function (High ESG-rating portfolio).

ACF of Regression model.



Source: Authors Creation

For the High ESG-rating portfolio regression to Serial Correlation, the vertical line has to over or under the dashed lines. In this research, one of the vertical lines in ACF-plot exceed the upper dashed line, the plot still shows that it might not be significant, due to the fact that none of the other vertical lines are close to exceeds the dashed lines, therefore, the research continues with the Ljung-Box- and Breusch-Godfrey test to either support or prove this is wrong.

Figure 3.1.5.2 - Breusch-Godfrey Test (High ESG-rating portfolio).

```
Breusch-Godfrey test for serial correlation of order up to 55

data:  `High ESG Excess return` ~ `Mkt-RF` + SMB + HML + RMW + CMA
LM test = 61, df = 55, p-value = 0.2691
```

Source: Authors Creation

The Breusch-Godfrey test above and the Ljung-box below use hypothesis testing, where the Null-hypothesis is the presence of Serial Correlation and if not significant, the regression model for the High ESG-rating portfolio does not suffer from Serial Correlation.

Figure 3.1.5.3 – Ljung-Box Test (High ESG-rating portfolio).

```
        Box-Ljung test

data:  data
X-squared = 55.22, df = 55, p-value = 0.4663
```

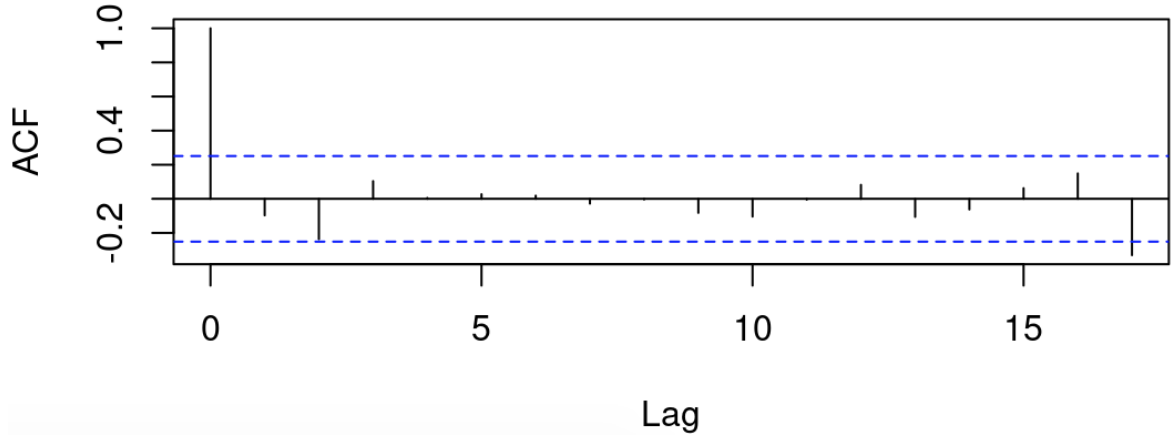
Source: Authors Creation

With a significance level 0.05 (5%), the Ljung-Box test is not significant, and the alternative-hypothesis is used in this research instead and meaning no Serial Correlation and the assumption is met for the High ESG-rating portfolio.

The same tests are done for the Low ESG-rating portfolio.

Figure 3.1.5.4 - Auto Correlation Function (Low ESG-rating portfolio).

ACF of Regression model.



Source: Authors Creation

Despite the fact one of the vertical lines in the ACF-plot exceeds the upper dashed line and one of the vertical lines exceed the lower and one is just around the dashed line, it does not seem significant, due to the fact that none of the other vertical lines are close to exceed the dashed line, therefore the research continues with both Ljung-Box- and Breusch-Godfrey test to either support or prove wrong.

Figure 3.1.5.5 – Breusch-Godfrey (Low ESG-rating portfolio).

```
        Breusch-Godfrey test for serial correlation of order up to 55

data:  `Low ESG` ~ `Mkt-RF` + SMB + HML + RMW + CMA
LM test = 61, df = 55, p-value = 0.2691
```

Source: Authors Creation

The Breusch-Godfrey test above and the Ljung-box below use hypothesis testing, where the Null-hypothesis is the presence of Serial Correlation and if not significant, the regression model for the High ESG-rating portfolio does not suffer from Serial Correlation.

Figure 3.1.5.6 – Ljung-Box Test (Low ESG-rating portfolio).

```
        Box-Ljung test

data:  data
X-squared = 52.824, df = 55, p-value = 0.5582
```

Source: Authors Creation

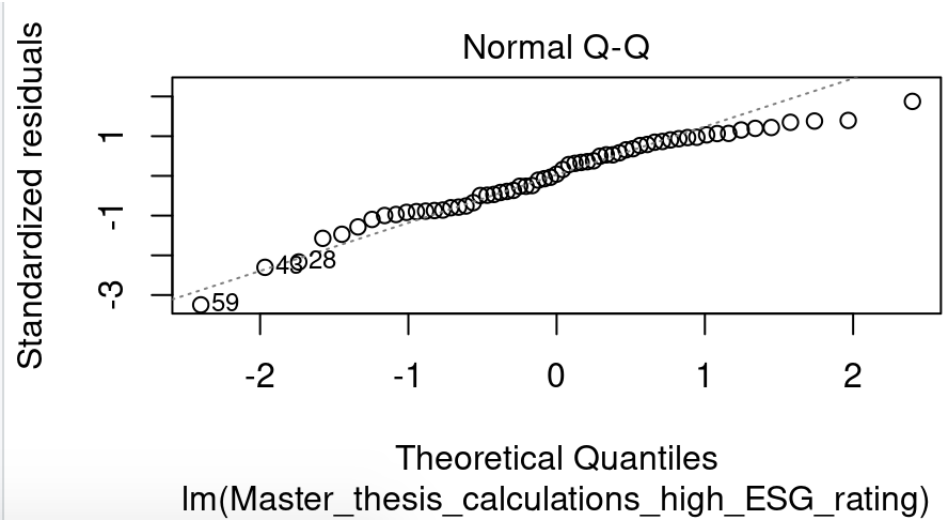
Both the Breusch-Godfrey and Ljung-Box test is insignificant at a significance level of 0.05 (5%) along with the ACF-plot which did not show significant sign of Serial Correlation, meaning the fifth assumption of No Serial Correlation is met and the research analysis can proceed to the last assumption.

4.1.6 – Normality (TS6).

The sixth and last assumption tested in this research analysis is the error u are independent and identical distributed. This is tested in the research analysis by using the Q-Q-plot giving a graphical point of view of this assumption the Sharpiro-Wilk normality test to support the Q-Q-plot and the following must be met:

"TS5: Normality – The error ut, are independent of the X and are independently and identically distributed as Normal (0, sigma^2).

Figure 3.1.6.1 – Normal Q-Q-Plot (High ESG-rating portfolio).



Source: Authors Creation.

From the Q-Q-Plot above from the High ESG-rating portfolio, the error *u* seems to follow the line, with the exception of three outliers 59, 49 and 28 but are still considered to indicate

normality, to support this, the research will continue with the Shapiro-Wilk normality test, which is presented below:

Figure 3.1.6.2 – Shapiro-Wilk Normality Test (High ESG-rating portfolio).

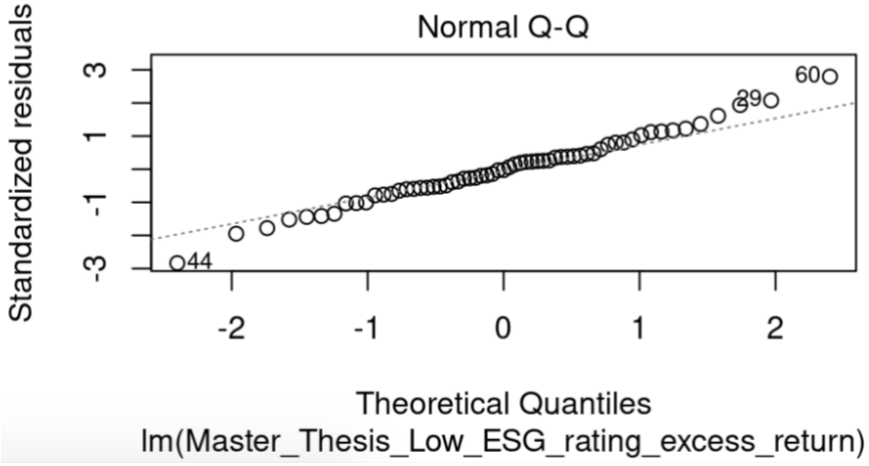
```
        Shapiro-Wilk normality test

data:  data
W = 0.81372, p-value = 0.0778
```

Source: Authors Creation.

As the Shapiro-Wilk normality test is insignificant, the null-hypothesis is not rejected, and the error *u* is normally distributed.

Figure 3.1.6.3 – Normal Q-Q-Plot (Low ESG-rating portfolio).



Source: Authors Creation.

From the Q-Q-Plot above from the Low ESG-rating portfolio, the error *u* seems to follow the line, with the exception of three outliers 44, 29 and 60 but are still considered to indicate normality, to support this, the research will continue with the Shapiro-Wilk normality test, which is presented below:

Figure 3.1.6.4 – Shapiro-Wilk Normality Test (High ESG-rating portfolio).

```
        Shapiro-Wilk normality test

data:  data1
W = 0.85514, p-value = 0.1731
```

Source: Authors Creation.

As the Shapiro-Wilk normality test is insignificant, the null-hypothesis is not rejected, and the error *u* is normally distributed.