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ESG FIVE-FACTOR MODEL: RISK & RETURN PORTFOLIO STRATEGY ON S&P500 COMPANIES AND TEN INDUSTRY PORTFOLIO

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Silvia Marie Assmuth Oreja

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Abstract

This paper contributes both to investigating the relationship between environmental, social and governance (ESG) factors with the risk and financial return of long-run stock returns of the S&P500 and 10 different industry portfolios and to reviewing the existing literature and research referring to this correlation. The applied framework is based on the multilinear regression analysis of the 4-factor model of Carhart ((3-Factor Fama-French Model + MOM) expanded by ESG factors created from a positive screening for the top 25% scoring portfolios of the S&P500 (long position) and a negative screening for the bottom 25% (short position). The sample data includes ESG data of FactSet and Bloomberg for +500 companies of the S&P500 from 2018 to 2023. Controversy has been found between previous empirical studies on the relationship between ESG scores and risk & return (positive, negative and non-existent). From the current paper one can reaffirm this debate since depending on the ESG score provider, the company sample, the particular timeframe and the regression analysis, the magnitude of the impact differs. Results from the study indicate that in 1 out of 4/5 cases a statistically significant relationship can be found, prevailing a negative correlation between ESG factors and return. Regarding the ESG factors of the regression, governance and environmental (only on environmental portfolios specifically energy aspects) factors show a high impact. Nonetheless, about risk, the trade off with return is not outweighed and either no additional risk (zero Sharpe ratio) or a higher risk is associated to the portfolios that do not outperform the benchmark. Findings imply that investors should generally not expect abnormal returns from companies and industries having higher ESG scores, except the above allowances.

Keywords

ESG, Environmental social governance, Financial performance, Corporate social performance, CSR, Investment, Sustainable Investing, Social responsible investing, Portfolio Strategy, Fama-French, Carhart, Intangibles, Market efficiency, Risk & return.

Resumen

Este trabajo contribuye tanto a la investigación de la relación entre los factores medioambientales, sociales y de gobernanza (ESG) con el riesgo y la rentabilidad financiera de los rendimientos bursátiles a largo plazo del S&P500 y de 10 carteras sectoriales diferentes como a revisar la literatura e investigación existentes referidas a esta correlación. El marco aplicado se basa en el análisis de regresión multilineal del modelo de 4 factores de Carhart ((Modelo Fama-French de 3 factores + MOM) ampliado por factores ESG creados a partir de una selección positiva para el 25% de las carteras con mayor puntuación del S&P500 (posición larga) y una selección negativa para el 25% inferior (posición corta). Los datos de la muestra incluyen datos ESG de FactSet y Bloomberg para +500 empresas del S&P500 de 2018 a 2023. Se ha encontrado controversia entre estudios empíricos anteriores sobre la relación entre las puntuaciones ESG y el riesgo y la rentabilidad (positiva, negativa e inexistente). A partir del presente trabajo se puede reafirmar este debate, ya que dependiendo del proveedor de la puntuación ESG, la muestra de empresas, el marco temporal concreto y el análisis de regresión, la magnitud del impacto difiere. Los resultados del estudio indican que en 1 de cada 4/5 casos se puede encontrar una relación estadísticamente significativa, prevaleciendo una correlación negativa entre los factores ESG y la rentabilidad. En cuanto a los factores ESG de la regresión, los factores de gobernanza y medioambientales (sólo en las carteras medioambientales, concretamente los aspectos energéticos) muestran un impacto elevado. No obstante, en lo que respecta al riesgo, la compensación con la rentabilidad no se ve contrarrestada. O bien, no se asocia ningún riesgo adicional (ratio de Sharpe cero) al retorno o un riesgo ligeramente mayor a las carteras que no superan el índice de referencia. Las conclusiones implican que, en general, los inversores no deberían esperar rendimientos anormales de las empresas e industrias con puntuaciones ESG más elevadas, salvo las excepciones mencionadas.

Palabras clave

ESG, Medioambiental social y gobierno corporativo, Rentabilidad financiera, Responsabilidad social de la empresa, RSE, Inversión, Inversión sostenible, Inversión socialmente responsable, Estrategia de cartera, Fama-French, Carhart, Intangibles, Eficiencia del mercado, Riesgo y rentabilidad.

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1. Introduction

Over the past few years, awareness has been raised through the general public on topics such as sustainability, social well-being and corporate governance, leading to the financial sector to adopt sustainable and responsible investments (SRI). From the start of 2018 until the start of 2020 there was an increase of 42% in the total assets managed in the US through sustainable investing techniques reaching $17.1 trillion according to the U.S. Forum for Sustainable and Responsible Investment (US SIF, 2020). Further, in order to meet the demand on information in such topics, in 2018, around 86% of companies of the S&P500 published reports on corporate social responsibility (CSR) and environmental, social and governance (ESG) practices in comparison to rough 20% in 2011 (Governance & Accountability Institute Inc, 2019).

One of the main reasons behind this upward trend in sustainable investing is the debate around the impact of ESG factors on companies' valuations. Different opinions and studies exist on whether companies that integrate ESG policies and strategies benefit from a better market valuation and less associated risk. There is a theory that studies this phenomenon of "Companies that do good, do well" and "Companies that do well, do good". The former refers to the fact that companies that adhere to good practices should have a series of competitive advantages that would than translate in a higher financial return. The latter takes the chicken-and-egg problem from the opposite perspective, id est, companies that already benefit from having good financial statements and valuations have the resources to impact ESG matters and society in a positive way. As for that when valuating an enterprise, one should look at several aspects from the company, also including knowing how well or bad they do in relationship with ESG dimensions. Until now corporate performance was mainly valued by its financial ratios and investors' main concerns dealt with acquiring a high rate of return by minimizing risks faced from the investments. The benchmark set was profitability (Hastalona & Sadalia, 2021). With the welfare of communities now being on the focus of corporate performance, the need to develop alternative portfolio strategies based on ESG performance has grown. ESG scores could be therefore viewed as a key metric on portfolio construction. There exist over twenty-five metrics associated to the three different ESG factors and more than a hundred companies that assign different ESG scores to the companies based on different criteria.

With a few notable exceptions, the empirical evidence generally supports the idea that companies with higher ESG scores have lower risk and consequently a lower capital costs (easier to be financed). On the other hand, there is much disagreement in the literature regarding how ESG performance relates to company value, this means, as ESG performance affects the risk and the financial performance of a company, as a result, the valuation made by the investor sees itself affected. Even among those that agree on the consequence of high values due to ESG performance there is discussion on how this value is reflected in stock prices (Gillan, Koch, & Starks, 2021).

As for that this work aims to answer the question behind the relationship between ESG factors and investment performance in the universe of 503 companies of the S&P500 and their impact in 10 Industry Portfolios, more specifically which ESG factor has the biggest impact on them.

2. Objectives

The objective behind this thesis is to examine the correlation between risk & return and ESG factors on enterprises of the S&P500 and 10 industry portfolios. More specifically, to determine if there is a positive or negative effect of the ESG Factors on the risk and return of these industries and the scores of ESG provided by different servers. Furthermore, the degree of impact of the different ESG metrics is analysed and conclusions of their effect on company valuation (risk and return) are presented. Then, the study aims to compare the impact of two different ESG scoring companies (FactSet & Bloomberg) and present both recommendations on the impact of the metrics on the companies and which ESG scoring company factoring is more accurate. Lastly, based on the results of the study, other recommendations on best ESG factor and industry will be proposed with the aim to facilitate ESG investments and portfolio building.

The relevance of this topic relies on the topicality of sustainability and ESG matters and investing. With the arrival of Covid-19, climate change, droughts and similar issues, the general public is looking for less risky investments and put special focus on companies that have consideration on ESG factors. As for that this study seeks to give a response to the impact of ESG factors on company valuations (risk, return and ESG score) and give recommendations on score and portfolio creations. Its main goal is not to determine in which companies to invest but to provide a framework in which to integrate ESG and facilitate the decision making on investment management and portfolio creation to maximize returns while minimising risk. On top of this, as the evaluation will be made on different providers of ESG data, a recommendation on the utility of these will be made.

3. Methodology

To reach the objectives stated above the study focuses on a quantitative analysis which will be complemented by a thorough literature review of studies and papers on the relationship of ESG and risk & return of companies. Foremost, a short introduction will be made on the topic and the importance of ESG factors in the investing world will also be reviewed. As there exist different theories on the correlation between them, different authors and statements are presented and further discussed. On a second step, data is collected from different sources such as FactSet & Bloomberg on S&P500 companies to compare their ESG ratings on the different factors. For this the author uses a special license given to the University and used Add-Ins integrated in Excel to download the data following a special extraction technique. The download process has taken several hours due to the huge amount of data and difficulty of extraction technique. Following this, a Python-script is coded to run different regression analysis following the paper of Edmans (2011): a) only on the top 25% performing companies to analyse if significant anomalies exist that cannot be explained by the Carhart Model (3-Factor Fama-French Model + MOM), b) the creation of a dummy variable based on being a top 25% company or not and measure if the beta of the dummy variable leads to abnormal statistically significant returns, and, c) the Carhart Model is extended by the different ESG factors to determine if these can explain abnormal statistically significant returns on 10 different industries. For this a dataset will be created combining the price data, ESG data and enriched with the data extracted from the web on the Fama-French 3 factor model and the MOM from the Carhart (1997) model and returns data from 10 industries. The aim is to capture the impact of the different factors on the performance of investments.

Lastly, results and conclusions are presented and based on these a recommendation will be made on ESG factors relevancy to top off performance of investment portfolios with the aim to encourage sustainable investing and facilitate ESG portfolio building.

4. Theoretical Framework – Literature Review

4.1. Investing and Portfolio Management

An investment is the temporary commitment of funds with the expectation of receiving future returns to compensate for the time the assets have been allocated, the rate of inflation and the risk of unpredictability of future returns (Reilly & Brown, 2012). As time has shown, investing in a single asset or on a random set of assets does not pay out the highest return with the lowest risk possible. Consequently, advances led to the construction of optimized portfolios creating synergies between assets and taking into consideration the correlation between them for a better risk and return calculation. As investors are risk averse, meaning, that for a given return they are willing to commit to a specific risk, the lowest between the choices available, different theories arose on how to construct portfolios and reach this goal. The *modern portfolio theory* was designed by Harry Markowitz (1952) and consisted of deriving the expected rate of return of the portfolio based on different assumptions and calculating the standard deviation of the rate of return as a measure of risk (Markowitz H. M., 1991). Later on, Sharpe (1964), Lintner (1965), Mossin (1966) and Black (1972) led to the development of the *Capital Asset Pricing Model* (CAPM) model. It expanded the portfolio theory on taking into consideration investors being able to invest in all the risky assets available in the market and adding the concept of lending or borrowing at the risk-free rate which designated the capital market theory (Reilly & Brown, 2012). Several empirical studies and research then led to the conclusion that even though the CAPM correctly tested the positive relationship between returns and systematic risk, a single beta model (risk) did not cover other market and non-financial aspects of risk such as firm size, skewness, book-to-market value, etc. The formula for the market beta of asset *i* according to the CAPM is then:

$$\beta_{Mi} = \frac{Cov(R_i, R_m)}{\sigma^2(R_m)}$$

Here the market beta of the asset *i* is calculated as the covariance between asset i's returns and the market portfolio divided by the variance, which stands for the systematic risk, of returns in the market portfolio. The returned value of beta for the asset will describe how the asset relates to the market portfolio (beta of market portfolio equals 1). As for that there are three possible outcomes: 1) If β_i = 1, the asset will follow the

behaviour of the market portfolio; 2) if β_i < 1, the asset is less volatile than the market portfolio, meaning less risky and 3) if β_i > 1, the asset is more volatile than the market portfolio, meaning more risk. With a higher volatility, a higher return is associated. Therefore, the beta is then multiplied by the Market Return minus the Risk-free rate (slope in the CAPM equation):

$$E(r_i) = r_f + \beta_{Mi}[E(R_M) - r_f]$$

The formula above describes the correlation of an additional return for every one more unit of risk for an investor. Adapting this formula to a regression analysis, one has to add two variables: α as the intercept of the regression line and ε as the residuals of the regression model.

$$r_i - r_f = \alpha + \beta(r_m - r_f) + \varepsilon_i$$

r_i= *The return on asset i*

r_f = *The risk-free interest rate in government bonds*

α =*Intercept of the regression line*

r_m = *Return of the market portfolio.*

β = *Beta value of the independent variable rm-rf*

ε_i= *residuals of the regression model*

Different frameworks have then emerged to meet the necessities that the CAPM was not able to cover multifactor models taking into consideration different macroeconomic risk factors. Ross (1976) postulated *The Arbitrage Pricing Model* which assumes that a financial asset's return can be calculated using the linear relationship between its expected return and various other factors that capture systematic risk (Hayes, 2020). The model itself aims to correct the arbitrage forming when the price deviates from its expected value, making the price sensitivity of every factor very relevant (βi coefficient).

Still the most well-known theory and used in current investment is the Fama-French-3-Factor- & 5-Factor-Model. There are three stock market factors: the overall market factor (same as in CAPM), the firm size factor (return spread of small minus large stocks) and the book to market factor (return spread of cheap minus expensive stocks) (Fama & French, 1993). And two additional factors dealing with bond-market factors:

investment factor (return spread of firms that invest conservatively minus aggressively) and profitability risk factor (return spread of most profitable firms minus the least profitable) (Fama & French, 2015). Combining the 3-Factor-Fama-French model, Carhart (1997) extended it with a momentum factor. Based on the theory of Jegadeesh and Titman's paper (1993) , he included into the regression analysis a factor that explained that there is a tendency that persists over several months for good and bad performers of stocks (Rehnby, 2016). In practical terms, the MOM factor stands for winners minus losers of stocks. He performed his first analysis on mutual funds instead of stocks.

$$r_i - r_f = \alpha + \beta_1(r_m - r_f) + \beta_{2i}(SMB) + \beta_{3i}(HML) + \beta_{4i}(WML) + \varepsilon_i$$

r_i= *The return on asset i*

r_f= *The risk-free interest rate in government bonds*

α =*Intercept of the regression line*

r_m = *Return of the market portfolio.*

$\beta_{1,2,3,4}$ = *Beta values of the independent variable rm-rf, SMB, HML AND WML*

SMB = *Return of the size factor*

HML = *Return of the Book to Market factor*

WBL = *Return of the momentum factor*

ε_i= *residuals of the regression model*

Based on the different models presented and the depth of this study, the Carhart Momentum Factor Model has been chosen to perform the regression analysis and expanding it by other ESG factors. It is one of the most established asset pricing models in the current decade and allows an expansion by other factors.

4.2. Screening Technique

In order to build the initial dataset and portfolio to carry out the analysis, the "screening" technique will be used. It is one of the methods used for managing Socially Responsible Investments (SRI) and involves choosing stocks that either meet sustainability standards (positive screening) or that do not fall below a given criterion and therefore excluding these (negative or exclusion). For instance, the case of businesses in sin stocks such as alcohol, tobacco and weapon amongst others and how a negative screening is the rule when building portfolios. Eliminating these kind of companies gives

a consistent threshold, but at the same time it eliminates the ability to select the most appropriate decision based on a context-specific judgment. Further, by narrowing this universe intentionally other concerns might arise in the investors' minds on potential investments such as 1) decreasing diversification, 2) returns could decrease, 3) increase of volatility due to usually larger firms getting dropped instead of smaller ones and 4) there are additional screening and monitoring costs to take into account. So, for that, the availability of a strong dataset and disclosure of KPIs is key for such a technique.

In the case of this study, a positive screening is conducted based on companies that are comprised in the top 25% of ESG scores (long position) and a negative screening for the bottom 25% (short position) to perform a preliminary exploratory risk and return analysis. Based on these results, the ESG factor to extend the Carhart-Momentum-Model is elected. De & Clayman (2015) argue and prove that the creation of portfolios restricting the universe by eliminating the worst ESG stocks actually has no cost on the model and showed how both high ESG scores and low volatility had positive contributions on returns each of them independently.

4.3. Environment, Social and Governance

These days people are using the concepts of ESG (Environmental, Social and Governance) and CSR (Corporate Social Responsibility) as synonyms but in fact ESG developed only a couple of years back from the CSR concept. Over the past 100 years different professors, businessman and authorities have contributed to the development of such terminology. In the following a brief summary of the most important landmarks will be made to better understand what ESG is and how the addition of an ESG factor can expand the Carhart Model.

The first definitional constructs can be traced as far back to the 1930s with the debate around it in the private sectors. Nonetheless, it was not until the year 1953 when Bowen (1953) presented a definition of the social responsibilities business executives should take into consideration and follow when making decisions (Latapí Agudelo, Jóhannsdóttir, & Davídsdóttir, 2019). The academic literature then developed a new understanding of the idea in the 1960s, acknowledging the importance of the connection between corporations and society (Davis, 1960), (Frederick, 1960) & (Walton, 1967), but this perspective was still limited to issues of employee satisfaction, management, and the

social welfare of the community, and it was primarily concerned with the creation of financial profit.

In the 1970s, the social momentum was impacted by the rising social expectations for business conduct brought on by an increased knowledge of the environment, human rights, and labour issues (Latapí Agudelo, Jóhannsdóttir, & Davídsdóttir, 2019). As a response, the Committee for Economic Development of the USA (1971) developed a new justification based on the idea that the social compact between business and society was changing and that the private sector was now expected to take on more social duties. As a result, CSR gained popularity throughout the 1970s, but it remained optional and had a narrow emphasis on issues like waste management, pollution, and human and labour rights.

It was then Carroll (1979) introduced the first unified definition of what CSR is. He placed specific expectations and responsibilities (economic, legal, ethical and discretionary) on enterprises and who integrated social and economic objectives as an aligned framework for enterprises and not as incompatible aspects. This then paved the way for the operationalization of CSR discussion in the 1980s and early 1990s, which advanced a fresh understanding of the idea as a method for making decisions (Jones, 1980) and was supported by the presentation of models and different frameworks for its application. Carroll itself then presented the "Pyramid of Corporate Social Responsibility" (1991) to further emphasize his previous point and visualize the four main responsibilities of corporations: economic, legal, ethical and philanthropic. It was likewise during this period when agreements around sustainability arose in an international level, somewhat reflecting a growing feeling of awareness regarding the effect of enterprises in socioeconomic levels (Latapí Agudelo, Jóhannsdóttir, & Davídsdóttir, 2019):

- Formation of the World Commission on Environment and Development in 1983,
- UN adoption of the Montreal Protocol in 1987,
- Creation of the IPCC in 1988,
- Creation of the European Environmental Agency in 1990,
- UN summit on the Environment and Development held in Rio de Janeiro, which translated into the adoption of the "Agenda 21" &

- UNFCCC in 1992.

CSR was seen as way to balance the challenges and opportunities of the time and its institutionalization began to spread globally as a result. In 1997, the Kyoto protocol was introduced: it "operationalizes the United Nations Framework Convention on Climate Change by committing industrialized countries and economies in transition to limit and reduce greenhouse gases (GHG) emissions in accordance with agreed individual targets" (United Nations).

ESG instead of CSR was then firstly introduced in 2004 (Gillan, Koch, & Starks, 2021) and refers to the integration and evaluation of company activities in the areas of environment, social and governance (Kim & & Li, 2021). They are considered non-financial performance indicators and help identifying issues related to corporate social responsibility (CSR), firm governance and ethics (The Financial Times LTD). According to the United Nations Principles for Responsible Investment (What is ESG Integration?) in 2005, ESG integration is the process of incorporating ESG considerations into standard fundamental analysis in the framework of investing and portfolio management. Later than in 2015 the Paris Agreement also known for as the COP21 is a pact reached by the presidents of more than 180 countries to cut greenhouse gas emissions and keep the rise in global temperature to less than 2 degrees Celsius (3.6 degrees Fahrenheit) by the year 2100. Finally, in the year 2015 in the Agenda 2030 by the UN a plan of action for people, planet and responsibility was developed. 17 Sustainable Development goals were integrated, and each recognizes an action in one area that will help contributing to a better society by 2030. This information is further summarized in **Table 1**:

Table 1. The 17 Sustainable Development Goals (SDG)

GOALS	EXPLANATION	TARGETS	EVENTS	PUBLICATIONS	ACTIONS
1. No Poverty	End poverty in all its forms everywhere.	7	67	48	1268
2. Zero Hunger	End hunger, achieve food security and improved nutrition and promote sustainable agriculture.	8	59	16	1195
3. Good Health and well-being	Ensure healthy lives and promote well-being for all ages.	13	26	46	1102
4. Quality Education	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.	10	29	10	1623

GOALS	EXPLANATION	TARGETS	EVENTS	PUBLICATIONS	ACTIONS
5. Gender Equality	Achieve gender equality & empower all women & girls	9	45	45	1418
6. Clean Water and Sanitation	Ensure availability and sustainable management of water and sanitation for all.	8	232	35	1327
7. Affordable and clean energy	Ensure access to affordable, reliable, sustainable and modern energy for all.	5	31	44	907
8. Decent work and economic growth	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.	12	66	47	1687
9. Industry, innovation and infrastructure	Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.	8	57	16	866
10. Reduced inequalities	Reduce inequality within and among countries	10	47	13	841
11. Sustainable cities and communities	Make cities and human settlements inclusive, safe, resilient and sustainable.	10	52	19	1035
12. Responsible consumption and production	Ensure sustainable consumption and production patterns.	11	17	15	1381
13. Climate Action	Take urgent action to combat climate change and its impacts.	5	27	35	1767
14. Life below water	Conserve and sustainably use the oceans, seas and marine resources for sustainable development.	10	69	40	2678
15. Life on land	Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.	12	22	33	1082
16. Peace, justice and strong institutions	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.	12	27	13	907
17. Partnerships for the goals	Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development.	19	162	73	1915

Source : *https://sdgs.un.org/goals.*

4.4. Risk & Return Correlation with ESG

Previous to this study, several other empirical papers and research have dealt with the relationship between ESG factors and financial investing and, consequently, different opinions and results have arisen on whether ESG factors have a positive, negative or no effect at all on company valuation, risk and return.

Before diving deeper into the different relationships and literature review amongst them a brief sign posting is presented with an overview of the contents:

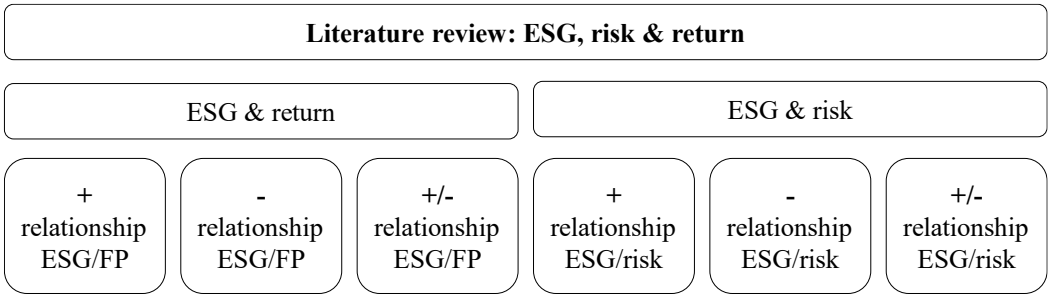

Figure 1. *Sign posting of different views of literature relating to ESG and risk & return.*

4.4.1. ESG and Financial Performance

Studies and research show more debate on the correlation between ESG and financial performance than on the matters of risk. Friede, Busch & Basen (2015) carried out a research on the relationship between ESG and financial performance from more than 2000 empirical studies and came to the conclusion that "roughly 90% of studies find a nonnegative ESG–CFP relation", meaning that there is either no real evidence of correlation between them and if there is it is mainly positive: the higher the ESG score, the better the financial performance. Others such as Albuquerque et al. (2018) and Bénabou et al. (2010) amongst others argue that ESG metrics can boost a company's value because consumers prefer to do business with companies that practice good corporate citizenship, workers show a higher productivity for these companies, material incentives defined by law and taxes increase their benefits and other similar effects that result from ESG investment considerations. But from these the instrumentalization of ESG may arise in order to attract clients and investors. Managers engaging in ESG activities for the mere purpose of enhancing "their own utility rather than the welfare of the shareholders" (Gillan, Koch, & Starks, 2021). This is also known for by the concept of "*Greenwashing*", here companies misrepresent themselves as eco-friendly and environmental responsible

engagers but that in reality they are quite the opposite (Mitchell & Ramey, 2011). This therefore leads to a negative correlation between firm performance and value and ESG. This leads to the question which of both metrics influences the other, in the sense, which is the trigger, and which is the causality among the others: ESG reputation (doing good) leading to better firm performance (doing well) or performing firms (doing well) leading to a better general reputation (doing good), also in aspects such as ESG. This is known for as the reverse causality. Hong, Kubik, & Scheinkman (2012), for instance, do contend that good financial performance results in corporate goodness. Their proof comes from the fact that even if the motivations for kindness are non-profit in nature, variation in business financial restrictions might lead to an erroneous link between profits and goodness. They demonstrate that financial limitations are in fact a significant determinant of corporate goodness using two identification methodologies. Firstly, during the Internet bubble, "previously constrained firms experienced a temporary relaxation of their constraints and their goodness temporarily increased relative to their previously unconstrained peers" (Hong, Kubik, & Scheinkman, 2012). Then, compared to its less constrained equivalent, a constrained firm's sustainability score rises more with its unique equity valuation and lower cost of capital. In conclusion, when businesses succeed and perform financially, they are more likely to do good. This is important and interesting to mention since firms with more resources are usually the ones having stronger ESG profiles. But once again the question arises on natural willing to do good or social pressure to contributing to society in such matters as ESG.

So having better understood the relationship between these two factors and the social believes on them, in the following, the different points of view on whether there is a positive, negative or no correlation at all between ESG and financial performance will be discussed.

a) Positive correlation between ESG and Financial Performance

But not all research leads to negative or non-existent correlation between ESG activities and financial performance. Even though, it is a general belief that the abnormal returns generated in ESG investments do not come from the ESG metric itself but that investors are either mispricing them due to an underestimation of benefits, an overestimation of costs or because of risk compensation for non-sustainability funds, some authors actually find a correlation and argue that the value of the ESG investments

actually appears positively once the intangibles related to ESG start generating value in the general market (Dorfleitner, Utz, & Wimmer, 2014). They found "positive mid- and long-term effects in all four dimensions, [environment, social, governance and economic,] of up to 6.82% abnormal return". This means that in the long run investments in firms with high ESG scores are actually profitable. That is why generally people do not think of a positive correlation between them, but because until the effect is visual to the general public and the stakeholders themselves some time needs to pass by. Once the efforts and the actual impact of such ESG implementations is realized by people, the firm value drives up. Still there are authors that defend that the positive return can also occur in the short-term. For instance, Dimson, Karakaş, & Li (2015) find abnormal positive returns paying off directly in investment activities that specifically targeted ESG matters.

The positive correlation view is further supported by other studies. For instance, in a study using the KLD seven categories, Gillan et al. (2021) found that companies having higher ESG rating would also have a higher firm value and operating performance (measurement carried out with Tobin's Q). This was further supported by Borghesi et al. (2014) and Gao et al. (2015) who found that firms with high operating performance and / or greater free cashflow actually are also achieving higher KLD scores. In the case of Gao et al. they used once again the Tobin's Q to explain this positive correlation between ESG firms and better financial performance. Also using the KLD ratings on a U.S. firm sample, a positive relationship is found between ESG ratings and firm performance, resulting in portfolios composed of firms with higher ratings outperforming the ones with lower (Statman & Glushkov, 2009). In these cases, a higher performance is a result of the high ESG ratings, but other authors such as Orlitzky et al. (2016) state that the positive association is actually reciprocal and simultaneous, meaning that high ESG ratings leads to a higher firm performance, but that at the same time that higher performance leads to having better ESG ratings. This was the result of a meta-analysis of 52 studies to bring some certainty on the broad spectrum of opinions regarding the matter.

There are other possible drivers found for this superior firm performance such as Servaes & Tamayo (2013) and Albuquerque, Yrjö, & Zhang (2018) who interpret and assure that this positive value is only driven in firms that have a high advertising investment. The latter authors proxied "product differentiation with advertising expenditures" and found out that the beta was 40% stronger in firms leveraging a higher expenditure of advertising relative to a firm without.

Others say the correlation is more visible in periods of crisis since it is there when sustainability plays a drastic role. In the case of governance a study was carried out by Lins, Servaes and Tamayo (2017) on ESG firms during crisis periods and came to the conclusion that the firms with high ESG scores actually performed better in terms of operations and returns than industry peers.

Further studies support this view by examining stock market reaction to specific ESG / CSR events impacting the general markets and life. Krüger (2015) found out by examining over 2000 positive and negative ESG events for US firms that the strongest market responses are caused by negative sustainability events that have an impact on communities or on the environment. Meanwhile for positive events no clear response is found, so that in the short-term the positive and negative events hit differently in the stock market. This is also due to the difference in content of the events and news provided. More legal and quantitative information can be found in negative events, which is consistent with the idea that unsustainable business conduct costs shareholders money. As for that everything that has a positive relation with ESG will also have a positive impact then in the stock market.

When taking a deeper look at the ESG triad, it is governance the one that outweighs the other two because it englobes better the quality of management of a firm (Starks., 2009; Duuren, Plantinga, & Scholtens, 2016). The first study specifies also that it is because of more knowledge on governance factors people invest more on this: 60% versus a 43% on environmental and social factors. Tsang, Frost, & Cao (2023) found in their research that in the past 30 years it is studies "related to accounting quality and corporate governance" the ones that have most been written about. Now the trend is lower, but still counting. If one sums these two streams one could come to the conclusion that due to more availability related to governance topic, more instructions on governance investing is available, therefore more people invest in these and as for that in the ESG triad governance outperforms the rest.

b) Negative correlation between ESG and Financial Performance

Different research has shown that the relationship between having a strong ESG profile and having financial benefits in a company is actually negative, id est, the link between ESG practices resulting in benefits for a firm is unfavourable.

For example, Bauer et al. (2004) found empirical evidence of a negative relationship between corporate governance procedures and performance ratios in companies included in the FTSE Eurotop 300. Because larger firms typically receive higher ratings and lower returns than smaller ones, it is possible that this occurrence is influenced by the size of the organization. As for that using the Fama-French Factor Model for the study is especially suitable since one of its factors takes this phenomenon into account. Nonetheless, in further research, Bauer et al. (2005) explored a "database containing 103 German, UK and US ethical mutual funds" and came to the conclusion that by applying a Carhart multi-factor model the above-mentioned ethical benchmark problems are overcome. From the 1990s to the early 2000s ethical mutual funds that were underperforming manage to match the performance of peers. As for that they explain the latter performing of ethical funds to a "catching up phase" that may come from investors' delays in learning about their ethical strategy. This is further supported by Di Giuli & Kostovetsky (2014). During a 3-year study, they discovered that higher corporate ESG ratings are linked to negative future stakeholder returns and a lower corporate ROA, implying that stakeholder gains "from social responsibility come at the direct expense of firm value". Still, they support Bauer et al. (2005) on the fact that the stock underperformance has a "direct market reaction to CSR with a lag resulting from delays in investors' learning about CSR policy changes" (Di Giuli & Kostovetsky, 2014).

Further, other authors such as Fisher-Vanden et al. (2011) and Kim & Lyon (2014) suggest that the negative correlation between strong ESG policies and poor firm performance lies on the perception of the investors: they penalize the firm's equity for the costly investments, so that no matter how engaging the environmentally-friendly activities are, they will experience atypical negative returns. This effect is even more significant in poor climate change related firms that seek joining groups to better these metrics, but that consequently suffer from lower firm value.

c) No correlation between ESG and Financial Performance

As far as there are studies identifying a negative correlation, some research actually states that there is no correlation at all between ESG and financial performance or that the correlation is ambiguous. In the study of Schröder (2006) 29 SRI stock indices were examined against conventional benchmark indices on financial performance. Results evidence a lack in the difference of risk-adjusted return between SRI indices and

the benchmark ones. In fact, they actually show a higher risk relatively to the benchmarked indices.

Another line of research supports the above mentioned and explains that even though a higher return in funds following CSR policies when comparing to peers exists, this positive effect is actually balanced off with the fact that this investment comes with a higher risk, so that all in all, there is no correlation (Humphrey, Lee, & Shen, 2012) and risk actually makes the investments less attractive. This is further backed up by Auer & Schuhmacher (2016) who carried out research on a dataset of ESG investing globally, and came to the conclusion that while in the "Asia-Pacific region and the US, ESG investors perform[ed] similar to the market", European investors would have to pay an extra price for being socially responsible, further supporting an absence of correlation to even a negative one in the case of Europe.

In the extensive study of Fisher Vanden and Thorburn (2011) regardless the negative correlation found in most research, it is discovered that firms following programs with "more general environmental commitments" do not experience abnormal returns neither positive nor negative when comparing industry peers.

4.4.2. ESG and Firm Risk

a) Inverse relationship between ESG and Firm Risk

In the case of the correlation between firm risk and ESG, several studies have examined the relationship and have concluded on an inverse link. The stronger the ESG profile and the higher the ESG scores the lower the systematic risk (Gillan, Koch, & Starks, 2021). Supported by De & Clayman (2015), they conclude that ESG ratings predict the strongest with respect to risk. Using the Chi-quare frequency to sustain their findings on the strong negative correlation between the ratings and volatility, the test statistically demonstrated that stocks with high ESG scores are more likely to be in the low volatility group, while stock with low ESG scores are more prone to be in the high volatility group. In this same line, Albuquerque, Koskinen and Zhang (2018) give a framework in which through the case of a product differentiation strategy, firms with high ESG scores cope with a relatively little price-elastic demand meaning less systematic risk. Consequently, benefits arise for investors when constructing their portfolios as thanks to the price volatility reduction they mitigate risk (Przychodzen, Gómez-Bezares,

Przychodzen, & Larreina, 2016) and benefit on higher forecasting accuracy (Czerwińska & Kaźmierkiewicz, 2015).

Moreover, SRI investments also benefit from a reduction of their cost of capital (Fernandez & Elfner, 2015) and, consequently, corporate credit ratings tend to be higher, while yields spread diminish (Seltzer, Starks, & Zhu, 2022), especially if the investments are made in countries that deal with stringent environmental regulations. Seltzer et al. (2022) use the Paris Agreement as a shock to prove the causality between climate regulation risk, corporate risk and pricing. This makes sense since as the risk is lower it is easier to be financed to a lower interest rate compared to peers.

b) Linear relationship between ESG and Firm Risk

Nonetheless, other authors are sceptic on the inverse relationship between risk and ESG scores in companies. For instance, Nofsinger and Varma (2014) state that outperformance due to SRI investments depends on the market situation, namely, during crisis ESG investments do benefit of the lower downside risk, but that in strong markets the reduction of risk does not help them outperform returns. Others like Becchetti et al. (2015) further supports this view assuring that CSR raises idiosyncratic risk for business. According to these authors, this is due to the fact that CSR limits elasticity in responding to negative productivity shocks and thus lowering the stakeholders' well-being and making returns of the "CSR stocks less predictable and less likely to follow stock market dynamics" (Becchetti, Ciciretti, & Hasan, 2015).

c) No relationship between ESG and Firm Risk

Further, in another study run on UK firms with high and low corporate social performance (CSP), no evidence is found whether firms' CSP ratings have any significant financial cost or benefit in terms of idiosyncratic risk (Humphrey, Lee, & Shen, 2012).

All in all, based on these contradictory results and studies amongst the scientific community, in this paper, the authors seek to explain the correlation, if any, between high ESG rated firms with their financial performance and risk through the extension of the Carhart Multi-Factor Model by adding an additional ESG factor. By carrying out a regression analysis one can measure the significance of the factor and drive conclusions on the effect of ESG on firm performance and risk.

5. Analysis & Results

5.1. Overview of Analysis Approach

This study aims to examine the correlation between risk & return and ESG metrics in portfolio investment. For that 500 companies of the S&P500 have been chosen as well as a portfolio of 10 industries covering these. The general approach followed to give an answer to this objective is a series of different multi-regression analysis identifying which factors do have a significant influence on the portfolios return as well as the risk associated to it. For that the Sharpe ratio[1] defined by Sharpe (1966) has also been calculated. Three general regression analysis were carried out as indicated in the Methodology section following the paper of Edmans that served as inspiration and guidance (2011):

a) A first analysis was run on only the top 25% performing companies against the Carhart Model to identify if the alpha was statistically significant and different to zero, meaning that there exist significant anomalies that cannot be explained by the Carhart Model (3-Factor-Fama-French-Model + Momentum Factor),
b) an analysis run against the Carhart Model with the addition of a dummy variable based on being a top 25% ESG factor scoring company (1) or not (0) to identify if the beta of the dummy variable could explain abnormal statistically significant returns, and,
c) an analysis where the Carhart Model has been extended by the different ESG factors to determine if these can explain abnormal statistically significant returns on 10 different industries. The ESG factor has been built based on the difference of returns between top 25% scoring companies and bottom 25% scoring companies for each of the ESG factors available for the study. More specifically, this means taking a long position on 25% top scoring companies and a short position on the bottom 25% scoring companies.

In the following the data collection, preparation, cleaning and analysis will be presented in more depth.

[1] Sharpe Ratio: Formula that "compares the return of an investment with its risk" (Fernando, 2023).

5.5.1. Data Sources & Acquisition Methods

To gather all the data needed for this study three different data sources were required. The factors from the Fama-French-3-Factor Model, the Momentum Factor from Carhart and the 10 Industry Portfolios were extracted from the Kenneth R. French Data Library[2]. For the two first datasets the data structure is daily and for the latter it is monthly. They all start end of June 1926. The three Factors of the Fama-French Model are Small Minus Big (SMB since small cap stocks tend to outperform large cap stocks), high minus low (HML since value stocks outperform growth stocks) and the excess return on the market (which is the market total portfolio's return less the risk-free rate).

Regarding ESG even though its relevance in the investment world has been growing in the past decades notably, there is still no official methodology designed to measure the different ESG factors. There exist different companies and data providers that give ratings to companies on ESG factors but each of these uses a different methodology and scoring system. Due to lack of a general method for valuing ESG factors, there exist different outcomes on the performance of ESG and portfolio management. As for this mismatch in scores, for this study two official providers have been selected to enrich the analysis and provide more accurate results: FactSet & Bloomberg. FactSet was selected since it is the most advanced platform in what relates to ESG factors and companies. In the case of Bloomberg, it is still in development: One can find scores on the different companies but not on individual categories. For further research it is recommended to combine both platforms with other data providers for a stronger dataset. As mentioned, both sources score the ESG factors in a different way. The former divides them in 27 different ESG scores and the latter only into 4 general ones.

More in depth, in FactSet one can find two companies publishing analysts' rankings: *True Value Labs (TVL)* and *Sustainalytics*. For this study only the former will be used for simplicity on ESG ranking, since the latter provides a risk score and not a rank. The score name is called "TVL_INSIGHT" (*Insight Score rating system*) and it assesses a company's long-term ESG (environmental, social and governance) performance. It is less affected by day-to-day events and provides a long-term view of a

[2] Kenneth R. French Data Library from Dartmouth.edu (https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html)

company's performance. The score is calculated using an exponentially weighted moving average of the Pulse, with a 6-month lag between the impact of an event and the score[3]. The initial Insight Score of a company is determined by averaging all Pulse data points collected during the first 14 days and goes from 0 to 100. As a result, a starting position is established for the cumulative average, which represents the company's past operations before the longer-term average is triggered. When a particular company or category has lower data update frequencies, the scoring methodology gradually decreases the impact of that category's Insight Score until it reaches a neutral score of 50. This protects companies from being unduly impacted by some data points that may not have been meaningful for all companies during a given period. All in all, the score is leveraged through an artificial intelligence algorithm that is fed by the companies' own ESG statements and its correlation with unstructured text that is captured form external stakeholders and general public's viewpoints about the company behaviour. FactSet divides their ESG findings in thirty different categories and each company of the S&P500 has a score respectively that goes from 0 (laggard) to 100 (leader):

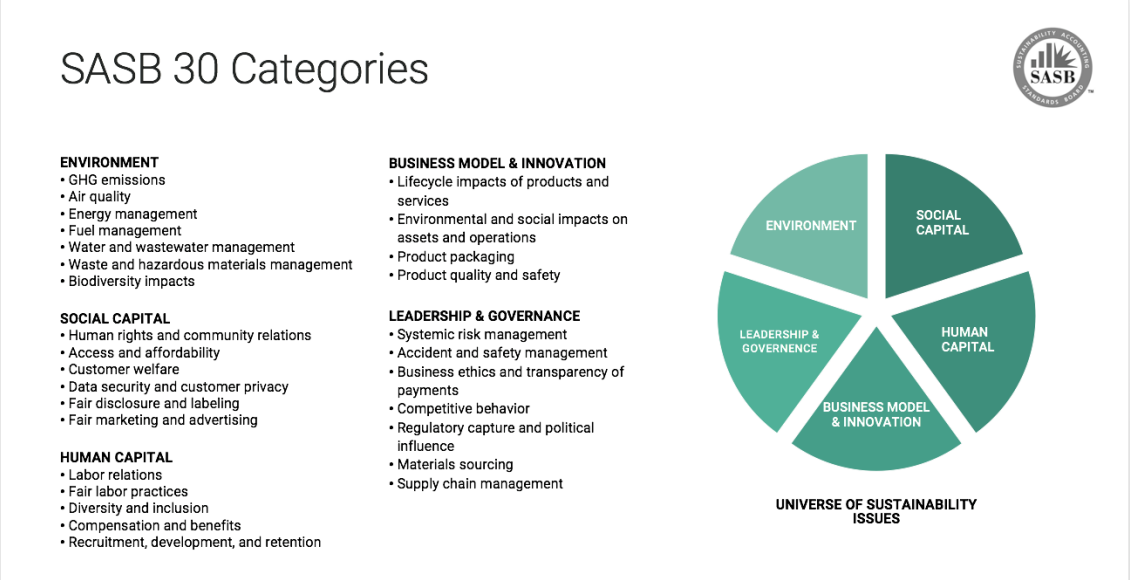

Figure 2. *Sustainability Accounting Standards Board (SASB) 30 Categories. FactSet True Value Labs.*

These individual category scores are then divided into 28 ESG subfactors with their respective scores for the companies. 26 are specific ones. The 27th called "All

[3] Factset: https://my.apps.factset.com/universalscreening/#/screen/reportGrid

Categories" is a generic one and aggregates all 26 categories by running a sum average[4]. The 28th, another relevant category to mention, is Materiality which aggregates only the material categories for each company using again the same logic as above, a running sum average[5] (FactSet). A summary of the ESG factor names can be found below:

Table 2. 28 ESG Factors available in FactSet.

1) ACCESS AND AFFORDABILITY	2) CUSTOMER WELFARE	3) HUMAN RIGHTS & COMMUNITY RELATIONS	4) SELLING PRACTICES AND PRODUCT LABELLING
5) AIRQUALITY	6) DATA SECURITY	7) LABOR PRACTICES	8) SUPPLY CHAIN MANAGEMENT
9) BUSINESS ETHICS	10) ECOLOGICAL IMPACTS	11) MANAGEMENT OF THE LEGAL AND REGULATORY ENVIRONMENT	12) SYSTEMIC RISK MANAGEMENT
13) BUSINESS MODEL RESILIENCE	14) EMPLOYEE ENGAGEMENT DIVERSITY & INCLUSION	15) MATERIALS SOURCING AND EFFICIENCY	16) WASTE AND HAZARDOUS MATERIALS MANAGEMENT
17) COMPETITIVE BEHAVIOUR	18) EMPLOYEE HEALTH AND SAFETY	19) PHYSICAL IMPACTS OF CLIMATE CHANGE	20) WATER AND WASTE WATER MANAGEMENT
21) CRITICAL INCIDENT RISK MANAGEMENT	22) ENERGY MANAGEMENT	23) PRODUCT DESIGN AND LIFECYCLE MANAGEMENT	24) ALL CATEGORIES
25) CUSTOMER PRIVACY	26) GHG EMISSIONS	27) PRODUCT QUALITY AND SAFETY	28) MATERIALITY

***Source**: TVL FactSet.*

More in depth, Bloomberg provides proprietary scores from 0 to 10 that allow investors to evaluate how well governments or companies disclose information and

[4] Factset: https://my.apps.factset.com/universalscreening/#/screen/reportGrid
[5] Factset: https://my.apps.factset.com/universalscreening/#/screen/reportGrid

perform on a variety of environmental, social and other issues. These scores can be used in portfolio construction and company research. Using its proprietary quantitative model, which incorporates frameworks, research and industry analysis, Bloomberg creates thematic and ESG scores[6]. The model seeks to reduce the amount of data noise, normalize data, correct for size bias and fill in information gaps. The transparency of Bloomberg's ESG scores allows investors to examine both the scoring formula and the company-reported data underlying each score. The four generic scores used in this study are: ESG score, Environmental Score, Social Score & Governmental Score.

5.5.2. Description of Datasets

a) Dataset 3FFF + Momentum Factors

The first dataset to be found in the Python script has daily information on the factors of the Fama French 3 Factor Model and the Risk-free rate of the market. The date was set as the index of the data frame and the date was transformed to a Year-Month-Day format. The same transformations were applied to the dataset with the daily Momentum factors of the Carhart Model and, consequently, both datasets were merged through a join command to the "factormodel4" data frame presented in Table 3:

Table 3. Extract of "factormodel4" data frame with information on the factor from Fama French 3 Factor Model and the Momentum Factor from Carhart.

Date	Mom	Mkt-RF	SMB	HML	RF
1926-11-03	0.56	0.20	-0.20	-0.33	0.013
1926-11-04	-0.50	0.59	-0.12	0.65	0.013
1926-11-05	1.17	0.07	-0.11	0.26	0.013
1926-11-06	-0.03	0.16	-0.29	0.05	0.013
1926-11-08	-0.01	0.52	-0.12	0.18	0.013

Since the other datasets as one will see in the following have monthly data, the "factormodel4" dataset has been resampled to monthly (last day of the month) and an extract from the 30th of April 2018 to the 28th of March 2023 has been extracted resulting in the following data frame in Table 4:

[6] Bloomberg: https://www.bloomberg.com/company/press/bloomberg-launches-proprietary-esg-scores/

Table 4. Extract of "factormodel4_monthly" data frame.

Date	Mom	MKT_RF	SMB	HML	RF
2018-04-30	0.0112	0.0039	0.0110	0.0050	0.00147
2018-05-31	0.0328	0.0266	0.0504	-0.0303	0.00132
2018-06-30	-0.0237	0.0051	0.0117	-0.0235	0.00126
2018-07-31	-0.0045	0.0320	-0.0214	0.0042	0.00168
2018-08-31	0.0494	0.0341	0.0108	-0.0387	0.00161

b) 10-Industry-Portfolio

The next dataset comprises a portfolio made out of 10 Industries: Non-Durables, Durables, Manufacturing, Energy, High Tech, Telecom, Shops, Health, Utilities & Others. Transformations also had to be done on the data set: The Date was set as the index and the same datetime format as in the previous data frame was applied. Additionally, since the data was presented as percentages each value was divided by a 100 to transform them to returns. Lastly, the data was also resampled to monthly and presented in Table 5:

Table 5. Extract of "industry10" data frame.

Date	NoDur	Durbl	Manuf	Enrgy	HiTec	Telcm	Shops	Hlth	Utils	Other
2018-02-28	-0.0417	-0.0608	-0.0526	-0.1038	-0.0140	-0.0486	-0.0469	-0.0351	-0.0518	-0.0391
2018-03-31	0.0000	-0.0223	0.0138	0.0091	0.0049	-0.0306	0.0169	0.0022	0.0513	0.0140
2018-04-30	0.0079	-0.0253	-0.0086	0.0971	0.0014	-0.0121	0.0188	-0.0017	0.0347	0.0095
2018-05-31	0.0245	0.0655	0.0495	0.0705	0.0662	-0.0222	0.0394	0.0770	0.0177	0.0348
2018-06-30	0.0680	0.0102	0.0002	0.0766	0.0060	0.0664	0.0362	-0.0259	0.0195	0.0030

c) Price returns + ESG Factors FactSet

As mentioned before there are several data providers that offer information regarding ESG factors. One of them is FactSet. As for that, data regarding price returns from 500 companies from the S&P500 were extracted from this same data source. This was done via a special license given to the author of this study. Via an Add-In in Excel. the companies from S&P500 were selected and following the taught technique downloaded onto an Excel Spreadsheet. Similar to the cases above, Date was set as the

index of the data frame and due to the returns being in percentage, they were divided by 100 and resampled to monthly in Table 6:

Table 6. Extract of "ret_sp500" data frame with data from FactSet.

Date	CTAS	RTX	WEC	MAA	AES	FAST	ANSS	ED	EQIX	LMT	...
2018-04-30	-0.003111	-0.046534	0.023729	0.011052	0.086481	-0.078957	0.030249	0.026628	0.004868	-0.052043	...
2018-05-31	0.068850	0.043374	-0.010304	0.021641	0.040347	0.063493	0.005732	-0.034828	-0.052795	-0.014722	...
2018-06-30	0.014213	0.000422	0.022493	0.074734	0.050505	-0.097071	0.068642	0.015031	0.081996	-0.062015	...
2018-07-31	0.103199	0.083980	0.024925	0.008576	-0.005409	0.189469	-0.032108	0.010503	0.020163	0.102135	...
2018-08-31	0.041866	-0.026216	0.024946	0.025975	0.015606	0.023509	0.099645	0.007449	-0.003590	-0.012926	...

The dataset consists of 503 columns and same number of rows as the previous datasets from the 30th of April 2018 to the 28th of February 2023.

As a last point all the previous datasets are combined into one called "regression_prep" that contains the four different factors for the modelling (MKT_RF, SMB, HML, Mom) the Risk-Free Rate and the 503 companies from the S&P500.

Parallel and following the same technique of extraction using the Excel Add-in from FactSet the scores presented before on ESG metrics were downloaded: 28 factors.

Since the whole analysis and regressions were made on each of the factors a loop was created to clean each dataset containing an ESG factor. The data frame had to be transposed, resampled to monthly, missing values were extrapolated with the forward fill technique and other NAs were dropped. Finally, the date was set as the index.

d) Price returns + ESG Factors Bloomberg

Following a similar technique than the one used for the extraction of data from FactSet, Bloomberg price return data of S&P500 companies as well as the ESG factors were downloaded. This was done via a special license given to the author of this study. Via an Add-In in Excel, the companies from S&P500 were selected and following the taught technique downloaded onto an Excel Spreadsheet. Similar to the datasets before, the date was set as the index of the data frame, NAs were filled with the technique of forward fill and dataset resampled to monthly. Since from Bloomberg prices were extracted instead of returns (due to not directly available), the returns are calculated as a simple return extracting current price minus the previous price and dividing it into the

previous price. Then to have the final returns, the risk-free rate had to be extracted from each value and frequency in this case is yearly (since no monthly data available). As for that all the previous datasets (factors and industries) were also set to yearly format as visible in Table 7. The dataset consists of 503 columns and 7 rows, one per year since 2016 until 2022 (December 31st).

Table 7. Extract of "returns_df" data frame with data from Bloomberg.

Date	MMM	AOS	ABT	ABBV	ACN	ATVI	ADBE	AAP	AMD	AES	...
2016-12-31	-0.000266	0.000241	-0.003567	-0.001549	-0.000911	-0.002792	-0.007175	-0.000868	-0.005768	0.000022	...
2017-12-31	-0.004959	-0.005198	-0.003282	-0.002696	-0.005070	-0.000605	-0.007181	-0.006904	-0.009075	-0.008820	...
2018-12-31	-0.019825	-0.020952	-0.015246	-0.018387	-0.017920	-0.020565	-0.010898	-0.022025	-0.017920	-0.014568	...
2019-12-31	-0.022111	-0.020213	-0.019361	-0.021766	-0.022159	-0.018611	-0.021370	-0.021370	-0.021370	-0.017608	...
2020-12-31	-0.004032	-0.002433	-0.001335	-0.001838	-0.003940	0.001686	-0.001030	-0.003940	0.004017	-0.002131	...
2021-12-31	0.000162	0.005660	0.002854	0.002636	0.004933	-0.002835	0.000000	0.005795	0.000000	0.000340	...
2022-12-31	-0.017429	-0.017513	-0.016379	-0.012244	-0.011775	-0.012674	-0.009602	-0.014009	0.000663	-0.012345	...

As a last point again, all the previous datasets are combined into one called "regression_prep" that contains the four different factors for the modelling (MKT_RF, SMB, HML, Mom) the Risk-Free Rate and the 503 companies from the S&P500.

Parallel and following the same technique of extraction using the Excel Add-in from Bloomberg the scores presented before on ESG metrics were downloaded: 4 factors.

Since the whole analysis and regressions were made on each of the factors a loop was created to clean each dataset containing an ESG factor. The date was set to the index and missing values were extrapolated with the forward fill technique and other NAs were dropped. Finally, the data was set to numeric.

5.5.3. Analysis 1 – S&P500 Abnormal Returns Top ESG-scored Companies

a) Explanation of Analysis Procedure

As a first step of this analysis the aim is to study if there are any significant anomalies in the regression analysis that cannot be explained by the three factors of Fama-French or the Momentum of Carhart in the companies of the S&P500:

$$r_p - r_f = \alpha + \beta_1(r_m - r_f) + \beta_{2p}(SMB) + \beta_{3p}(HML) + \beta_{4p}(MOM) + \varepsilon_p$$

r_p = The return on portfolio p

r_f = The risk-free interest rate in government bonds

α =*Intercept of the regression line*

r_m = *Return of the market portfolio.*

$\beta_{1,2,3,4}$ = *Beta values of the independent variable rm-rf, SMB, HML AND MOM*

SMB = *Return of the size factor*

HML = *Return of the Book to Market factor*

MOM = *Return of the momentum factor*

ε_p= *residuals of the regression model*

More specifically after a generic regression analysis a second is carried out in which only the companies are selected that do have an ESG score inside the top 25% of each ESG factor (r_p of only top):

$$r_p - r_f = \alpha + \beta_1(r_m - r_f) + \beta_{2p}(SMB) + \beta_{3p}(HML) + \beta_{4p}(MOM) + \varepsilon_p$$

The aim of this is to see if there exist significant anomalies that cannot be explained by the Carhart Model (3-Factor Fama-French Model + Momentum Factor) in the top performing companies for each factor. In parallel, as not only the return is relevant for this study, but it is also looking to see if the return is higher due to a higher risk, the volatility as well as the Sharpe Ratio are calculated.

b) Results & Findings

In this section the results and findings of both FactSet and Bloomberg will be presented as well as a table with a brief comparison for easiness to read.

FactSet

Looking at the results in ***Table 8*** obtained from the first regression analysis of the 502 S&P500 companies against the four factors of Market, SMB, HML and Momentum, one can find that 33 out of the 502 companies show an alpha value with a statistically significant p-value of *≤0.1, **≤0.05 and ***≤0.01. This means that there are companies that do show anomalies that cannot be explained with any of the four factors the regression analysis was run against.

The second step of this first analysis was to run a regression analysis building a portfolio with the companies that have a score inside the top 25% of an ESG factor. As for that 28-regression analysis were run this time (one for each factor). On top of that the return of each portfolio was calculated as well as the volatility and Sharpe ratio. In this case 8 out of 28 of the regression analysis show an alpha with a statistically significant p-value of *≤0.1, **≤0.05 and ***≤0.01.

Table 8. Extract of statistically significant results of first regression analysis of S&P500 companies against 4 factors (3 Fama French + Momentum Factor) of FactSet.

Company	α	β Mkt	β SMB	β HML	β Mom	R^2	P values α
MSFT	0,00962**	1,03281	-0,30643	-0,35247	0,11777	0,75204	0,02703
WST	0,01457*	1,11099	-0,33354	-0,79889	-0,13532	0,57313	0,08300
LLY	0,02251**	0,59158	0,50081	-0,13103	0,58946	0,18085	0,02484
COST	0,00998*	0,89431	-0,55441	-0,54110	0,00832	0,60231	0,08400
HSY	0,01303**	0,50165	-0,53514	0,19426	0,29303	0,27865	0,02308
SWK	-0,01409*	1,06514	-0,08561	0,29934	-0,43000	0,60963	0,09074
ODFL	0,01429*	1,09071	0,20242	-0,29543	0,03691	0,50856	0,09458
MMM	-0,01582**	0,93761	-0,13359	0,24799	-0,03043	0,59831	0,01047
TSCO	0,01695**	0,95160	0,19816	-0,10061	0,31528	0,41447	0,03315
AJG	0,01218*	0,85966	-0,17697	0,14001	0,32103	0,40166	0,07095
CCL	-0,02768*	1,68329	0,97047	1,24344	-0,58638	0,64510	0,05878
ORLY	0,01430*	0,94319	-0,22320	0,19013	0,13737	0,40644	0,07556
VFC	-0,02181**	1,20947	-0,29439	-0,02093	-0,50541	0,60189	0,01795
CDNS	0,02135***	0,96742	0,06781	-0,72818	-0,24647	0,61303	0,00521
AZO	0,01889**	0,64146	-0,23735	0,20422	-0,05200	0,26476	0,02875
PWR	0,02177**	0,93005	0,63110	0,27744	-0,09201	0,46916	0,02374
SNPS	0,01631**	1,21846	-0,04763	-0,58345	0,01658	0,68845	0,01501
MSCI	0,01348**	1,17869	-0,26568	-0,66712	-0,07690	0,68283	0,04364
CMG	0,01935*	1,12412	0,09750	-0,62359	-0,37115	0,53080	0,05717
MPWR	0,02048*	0,99671	0,27208	-0,60926	-0,33815	0,41897	0,08281
AAL	-0,02101*	1,21696	1,09064	1,11046	-0,17751	0,57737	0,08870
CDW	0,01246*	0,94754	0,00259	0,14250	-0,27672	0,62221	0,06486
ENPH	0,07304***	1,91587	2,24349	-0,56519	1,33241	0,26761	0,00917
TSLA	0,04390*	1,87186	0,17683	-1,14530	-0,42215	0,32218	0,08275
FTNT	0,02370*	1,22353	0,42017	-0,32161	0,21303	0,35011	0,06878
DISH	-0,02536*	1,59580	-0,19051	0,33651	-0,44611	0,52629	0,06277
MRNA	0,06197*	1,25894	1,06617	-1,05087	-0,50482	0,17481	0,05916
CTVA	0,01683**	0,61432	0,28746	0,49708	0,03911	0,43639	0,01487
VTRS	-0,02558**	1,27229	-0,69449	0,64541	0,02725	0,43399	0,02878
CARR	0,02487***	0,75992	-0,45853	-0,41430	-0,13791	0,42356	0,00111
OTIS	0,01268**	0,53205	-0,75110	-0,22319	-0,18971	0,44391	0,01621
MTCH	-0,02585**	0,48099	-0,10374	-0,66126	-0,78201	0,33241	0,02456
GEHC	0,13854***	-0,00281	-0,00179	-0,02965	-0,05795	0,08264	0,00000

This means that in these eight cases being part of the top 25% best scored companies for their respective ESG factors gives them anomalous returns that cannot be explained by the four factors of Fama-French and Carhart and that their ESG factor probably influences this abnormal return (this will be proved later with the second round of analysis). But one then has to examine if these abnormal returns come with a lower or

a higher risk involved. In ***Table 9***, these metrics can also be found. In six out of eight cases were the alpha showed an abnormal behaviour which was statistically significant the Sharpe ratio resulting from the returns and volatilities is negative but around zero. This is the results of the negative return of that portfolio as observed from the table. In terms of risk-adjustment this means that higher return comes with a higher risk then when comparing in between regression analysis and that a negative return actually leads to more risk. Consequently, the risk the portfolios are encountering is not being offset by its return (the higher the Sharpe ratio the better). Still these negative Sharpe ratios when rounded are ~0. This means that the investment is not generating any excess return for each unit of risk taken, relative to the risk-free rate.

Table 9. Extract of results of first regression analysis of top25% companies per ESG Factor run against 4 factors (3 Fama French + Momentum Factor) of FactSet.

TOP 25 COMPANIES ABNORMAL RETURNS					
FACTOR	**Alpha**	**P-value**	**Return**	**Volatility**	**Sharpe Ratio**
ACCESS AND AFFORDABILITY	0.00251	0.50826	0.0011	0.0503	0.0221
AIRQUALITY	0.00353	0.32899	-0.0061	0.0545	-0.1124
BUSINESS ETHICS	0.00458	0.19827	-0.0023	0.0608	-0.0372
BUSINESS MODEL RESILIENCE	0.00763	0.20217	0.0131	0.0632	0.2073
COMPETITIVE BEHAVIOUR	0.00631**	0.03836	-0.0035	0.0635	-0.0546
CRITICAL INCIDENT RISK MANAGEMENT	0.00567	0.24477	-0.0005	0.0733	-0.0068
CUSTOMER PRIVACY	0.00538	0.16509	0.0116	0.064	0.1819
CUSTOMER WELFARE	0.00497	0.13636	0.004	0.0605	0.0663
DATA SECURITY	0.00656*	0.05710	-0.0058	0.0628	-0.0919
ECOLOGICAL IMPACTS	0.00401	0.33468	-0.0004	0.0659	-0.006
EMPLOYEE ENGAGEMENT DIVERSITY & INCLUSION	0.00695**	0.02303	-0.0075	0.0686	-0.1086
EMPLOYEE HEALTH AND SAFETY	0.00258	0.43257	-0.0086	0.0512	-0.1686
ENERGY MANAGEMENT	0.00759**	0.01875	0.0014	0.0607	0.0227
GHG EMISSIONS	0.00432	0.24685	-0.0079	0.0688	-0.1155
HUMAN RIGHTS & COMMUNITY RELATIONS	0.00243	0.56669	0.0048	0.0671	0.0716

FACTOR	Alpha	P-value	Return	Volatility	Sharpe Ratio
LABOR PRACTICES	0.00454	0.20767	-0.0036	0.0659	-0.0544
MANAGEMENT OF THE LEGAL AND REGULATORY ENVIRONMENT	0.00604	0.15359	-0.0166	0.0598	-0.2778
MATERIALS SOURCING AND EFFICIENCY	0.00700	0.13144	-0.0041	0.0548	-0.0751
PHYSICAL IMPACTS OF CLIMATE CHANGE	0.00565	0.23682	0.0057	0.064	0.0887
PRODUCT DESIGN AND LIFECYCLE MANAGEMENT	0.00590*	0.07798	-0.0072	0.0519	-0.138
PRODUCT QUALITY AND SAFETY	0.00336	0.29386	-0.0072	0.062	-0.1155
SELLING PRACTICES AND PRODUCT LABELING	0.00479	0.11591	0.0101	0.0744	0.1352
SUPPLY CHAIN MANAGEMENT	0.00430	0.18260	-0.0047	0.0738	-0.0631
SYSTEMIC RISK MANAGEMENT	0.00161	0.67225	0.0135	0.0684	0.1977
WASTE AND HAZARDOUS MATERIALS MANAGEMENT	0.00517*	0.08493	-0.0031	0.069	-0.0443
WATER AND WATER MANAGEMENT	0.00427	0.43491	0.0039	0.0688	0.0572
ALL CATEGORIES	0.00722*	0.07054	-0.0018	0.0615	-0.0287
MATERIALITY	0.00712*	0.06031	0.0004	0.0708	0.006

Bloomberg

In the case of Bloomberg, very similar results were obtained. When looking at the results in ***Table 10*** from the first regression analysis of the 503 S&P500 companies against the four factors of Market, SMB, HML and Momentum, one can find that 31 out of the 503 companies show an alpha value with a statistically significant p-value of *≤0.1, **≤0.05 and ***≤0.01. This means that there are companies that do show anomalies that cannot be explained with any of the four factors the regression analysis was run against once again.

Table 10. Extract of results of first regression analysis of S&P500 companies against 4 factors (3 Fama French + Momentum Factor) of Bloomberg.

Company	α	β Mkt	β SMB	β HML	β Mom	R^2	P values α
AEE	0,0521**	0,26922	-0,71255	0,06716	-0,37389	0,542235412	0,02702
APA	-0,0544*	1,66371	0,72160	2,77564	2,81620	0,90547	0,08299
BIO	0,1187**	0,96747	-1,37E+15	-0,82001	-1,54E+16	0,9918	0,02483
BKNG	0,0641**	0,07604	-1,45E+15	-0,43629	-1,07E+16	0,8594	0,08400
CAH	-0,0171*	-0,40685	-0,758746	0,337442	-0,782773	0,90384	0,02307
CBOE	-0,0872*	1,91231	-2,07E+15	0,850461	0,793724	0,68581	0,09457
CMS	0,0734**	-1,75943	-2,03E+16	-0,326466	-1,03E+16	0,8258	0,01046
CAG	0,0433**	1,07539	-0,27987	1,105066	0,992429	0,80130	0,03315
DE	0,1145*	-0,18742	-1,20E+15	-0,413787	0,824902	0,67918	0,07095
EOG	-0,1152*	1,99355	2,01915	2,918106	2,104007	0,96905	0,05877
FISV	0,2411*	-0,93403	-5,20E+15	-1,48E+16	-2,84E+16	0,75424	0,07555
GD	-0,0425**	1,20762	0,305974	1,330614	0,703195	0,94945	0,01794
HPE	-0,0779***	1,09696	-0,066888	0,38578	2,48467	0,77775	0,00521
HON	-0,0059**	-0,00717	0,196513	0,050143	0,07781	0,72798	0,02875
INTU	0,1417**	0,00415	2,137175	0,203466	1,583899	0,81027	0,02374
INVH	-0,0680**	0,92340	-3,30E+16	-0,106564	-1,68E+16	0,69636	0,01500
OTIS	-0,0087**	0,12293	2,839251	0,125336	0,94328	0,98591	0,04364
PKG	-0,0711*	1,56007	1,040026	0,542228	0,719234	0,53162	0,05716
PAYC	0,4754*	-0,449490	-6,43E+15	-3,00E+16	-3,09E+16	0,91213	0,08280
PM	-0,0681*	0,999882	-0,557308	0,557587	0,263213	0,514185	0,08869
RTX	-0,0586*	1,116991	-1,64E+16	0,725398	0,303343	0,759845	0,06485
ROP	0,0737***	0,649654	-1,7E+16	-0,53159	-0,16307	0,79611	0,00917
SNA	0,0866*	-0,58880	0,62809	0,02511	-0,45768	0,47816	0,08275
SYF	-0,0734*	1,12456	-3,1E-15	0,04296	-1,6E-16	0,90093	0,06878
TDY	-0,0321*	2,21652	1,23410	1,73772	1,817045	0,82476	0,06276
WAB	-0,0880*	1,01711	0,86431	1,01773	0,71401	0,91110	0,05915
WTW	-0,0705**	1,08677	-1,5E-14	-0,06108	1,16820	0,87155	0,01486
XEL	-0,0412**	0,51306	-0,50452	0,12639	-0,05285	0,32895	0,02877
YUM	0,0509***	0,60708	0,88763	0,49407	0,79602	0,31474	0,00110
ZBRA	0,1466**	0,91579	-2,85E-16	-1,19E-16	-1,65E-16	0,68251	0,01621
ZBH	-0,0198**	0,42820	-1,77E-16	-0,33792	-0,25335	0,33235	0,02455
ZION	0,0070***	-0,85581	-2,16168	0,54539	-1,83056	0,93799	0,00000

Once again for the data retrieved from Bloomberg a second regression analysis was run by building a portfolio with the companies that have a score inside the top 25% of an ESG factor. Here only four regression analyses were run since there are only four ESG factors in Bloomberg. On top of this, the return of each portfolio was calculated as well as the volatility and Sharpe ratio. In ***Table 11***, these metrics are presented, and one can determine that Sharpe ratio resulting from the returns is negative in three out of the four cases. This is because the returns of these portfolios are negative. So that, the risk the portfolios are encountering is not being offset by its return (the higher the Sharpe ratio the better). This means that the investment is not generating any excess return for each unit of risk taken, relative to the risk-free rate, but that it is actually worsening it. Which would suggest actually not to invest in these. Only in the social factor the Sharpe ratio is positive still the number is almost zero which does not imply a good number, but that there is no excess return generated from this investment based on the risk adjustment.

Table 11. Results regression analysis of top25% companies per ESG Factor run against 4 factors (3 Fama French + Momentum Factor) of Bloomberg.

FACTOR	Alpha	Return	Volatility	Sharpe Ratio
ESG	0,16089*	-0,03157	0,25059	-0,12599
ENVIRONMENT	0,15392*	-0,02209	0,26518	-0,08330
SOCIAL	0,17218*	0,00515	0,25466	0,02021
GOVERNANCE	0,14363*	-0,01438	0,23994	-0,05992

All in all, and concluding the analysis and results from this first analysis point, one can say that there in both FactSet and Bloomberg data there are some companies whose excess return cannot be explained by the four factors model and that the excess return is actually being compensated with the risk as seen by the Sharpe ratio to the point that either to more return the risk increases the same or even more, being not reliable investments.

5.5.4. Analysis 2 – Carhart-Multifactor-Model extended by Top ESG-scored Companies Dummy Variable

a) Explanation of Analysis Procedure

The second verification being made in this study consists of analysing all the companies of the S&P500 and not only the top25% ones regarding ESG scores. The difference with the first part of the previous analysis is, that in this regression analysis a new factor has been added: a dummy variable. The dummy variable is created based on being a top 25% company (1) or not (0). As one can see in the equation below the Dummy Factor has been added into the original regression analysis (here r_p is the whole S&P500 portfolio and not only top 25% scoring companies):

$$r_p - r_f = \alpha + \beta_1(r_m - r_f) + \beta_{2p}(SMB) + \beta_{3p}(HML) + \beta_{4p}(MOM) + \beta_{5p}(DUM) + \varepsilon_p$$

With this regression the aim is to study if there is a difference in the returns of the portfolios based on if the beta of the dummy variable leads to abnormal statistically significant returns or not. In the python script the PanelOLS formula has been used. For it the returns and the rest of the variables have to appear stacked instead of the previous view. As for that, the necessary transformations have been done to transpose the dataset and put the Company as well as the Date as the indexes.

b) Results & Findings

In this section the results and findings of both FactSet and Bloomberg will be presented as well as a table with a brief comparison for easiness to read.

FactSet

In FactSet 28 different regression analysis have been run based on the portfolios built by each ESG factor. In ***Table 12*** one can find that there are only five out of the 28 portfolios that have a statistically significant beta, being this one negative. This would actually mean that there is a reverse correlation between the companies that are better scoring in a factor in particular compared to how the factor explains the excess return. As a consequence, one could actually say that being catalogized as a better performing company in a particular score namely “Access and Affordability”, “Airquality”, “Employee Health & Safety”, “GHG Emissions” and “Supply Chain Management” actually has a negative repercussion in the return of the portfolio.

Table 12. Results of second regression analysis of portfolios based on ESG Factors run against 5 factors (3 Fama French + Momentum Factor + Dummy) of FactSet.

FACTOR	Beta	P-value
ACCESS AND AFFORDABILITY	-0,244**	0,02778
AIRQUALITY	-0,227*	0,05399
BUSINESS ETHICS	-0,051	0,64609
BUSINESS MODEL RESILIENCE	-0,179	0,13911
COMPETITIVE BEHAVIOUR	0,064	0,56848
CRITICAL INCIDENT RISK MANAGEMENT	0,001	0,93290
CUSTOMER PRIVACY	0,046	0,69675
CUSTOMER WELFARE	-0,120	0,30609
DATA SECURITY	0,001	0,94935
ECOLOGICAL IMPACTS	-0,126	0,26046
EMPLOYEE ENGAGEMENT DIVERSITY & INCLUSION	0,112	0,29583
EMPLOYEE HEALTH AND SAFETY	-0,210*	0,05139
ENERGY MANAGEMENT	0,109	0,31180
GHG EMISSIONS	-0,187*	0,08586
HUMAN RIGHTS & COMMUNITY RELATIONS	0,020	0,86974
LABOR PRACTICES	-0,061	0,57233
MANAGEMENT OF THE LEGAL AND REGULATORY ENVIRONMENT	0,024	0,82580
MATERIALS SOURCING AND EFFICIENCY	-0,071	0,54327
PHYSICAL IMPACTS OF CLIMATE CHANGE	0,001	0,95715
PRODUCT DESIGN AND LIFECYCLE MANAGEMENT	-0,019	0,85996
PRODUCT QUALITY AND SAFETY	-0,084	0,43990
SELLING PRACTICES AND PRODUCT LABELING	0,033	0,77075
SUPPLY CHAIN MANAGEMENT	-0,208*	0,05476
SYSTEMIC RISK MANAGEMENT	0,040	0,83986
WASTE AND HAZARDOUS MATERIALS MANAGEMENT	-0,052	0,64220
WATER AND WATER MANAGEMENT	0,148	0,18906
ALL CATEGORIES	-0,076	0,47526
MATERIALITY	-0,104	0,40812

Bloomberg

In the case of Bloomberg, once again, very similar results were obtained. In this case four regression analysis were run one for each of the ESG factors and the corresponding dummy variable classification. In this case there is only one beta that has a significant statistically relevance: “ESG” general factor. From ***Table 13*** one can read that the beta in this case is also negative indicating again a reverse relationship between

the ESG factor and its expected return. This would mean that is again has underperformed compared to the market given its systematic risk, so that the return is less than expected.

Table 13. Results of second regression analysis of portfolios based on ESG Factors run against 5 factors (3 Fama French + Momentum Factor + Dummy) of Bloomberg.

FACTOR	Beta	P-value
ESG	-0,02707**	0,04102
ENVIRONMENTAL	-0,01215	0,33845
SOCIAL	-0,00230	0,85732
GOVERNANCE	-0,01290	0,29752

Concluding this second analysis part one could say that the Dummy factor is actually indicating that portfolios with companies that do have higher score in a particular ESG score actually perform worse than the market leading to lower expected returns. This would mean that there is an inverse relationship and that ESG factors do not explain abnormal returns but that on the contrary they worsen. This is applicable to both data sources FactSet and Bloomberg.

5.5.5. Analysis 3 – Carhart-Multifactor-Model extended by ESG Factors

a) Explanation of Analysis Procedure

In the third part of the analysis a new ESG factor is being created to measure if this one can explain abnormal statistically significant returns of 10 different industries. This new factor is being added to the Carhart Model, meaning the combination between the 3 Fama-French factor model and the Momentum factor.

For the creation of this factor the procedure followed is based on a paper written by Alex Edmans (2011). In his paper he also builds a new factor based on employee satisfaction. The methodology followed consists of extracting the portfolio of returns of the top 25% scoring companies per ESG factor and subtracting the portfolio of returns of the bottom 25% scoring companies per ESG factor. The resulting factor created for each of the 28 different ESG factors in the case of FactSet and the 4 different ESG factors in the case of Bloomberg can be found in ***Table 14*** and ***Table 15*** respectively. The factor creation goes in the former case from April 2018 to February 2023 in a monthly span and in the latter case from 2015 December to 2022 December but in a yearly span. For a better

understanding the previous equation is modified and the 5th factor is the respective ESG factor (different in each run):

$$r_p - r_f = \alpha + \beta_1(r_m - r_f) + \beta_{2p}(SMB) + \beta_{3p}(HML) + \beta_{4p}(MOM) + \beta_{5p}(ESG) + \varepsilon_p$$

Once all the factors have been created the study aims to analyse if this factor will be able to explain abnormal returns in portfolios build out of different industries (r_p is industry portfolio and no longer S&P500 portfolio). More specifically of 10 industries which are Non-Durables, Durables, Manufacturing, Energy, High Tech, Telecom, Shops, Health, Utilities & Others. Even though in the study only the results of these 10 industries will be presented. The python script also has included the same procedure with 5 industries and also against each company of the S&P500 in case the reader wants to dive deeper into them, the code can be found in the Appendix.

Table 14. ESG factors created from 25% top portfolios minus 25% bottom portfolios based on ESG scoring. Data source is FactSet.

Date	ACCESS AND AFFORDABILITY	AIRQUALITY	Business_Ethics	Business_Model_resilien ce	competitive_behaviour	crit_incident_risk_mgm t	cust_privacy	cust_welfare	data_security	eco impacts	employee engmt divers & incl	employee health and safety	energy mgmt	ghg emissions	human rights & x	labor practices	mgmt of legal and	materials sourcing and efficien	physical impacts of clim change	prod design and lifecycle mgmt	prod quality and safety	selling practices and prod	supply chain mgmt	systemic risk mgmt	waste and hazards	water and waste water mgmt	all categories	materiality
30/04/2018	-0,83	-0,23	-0,18	0,51	-0,11	0,3	1,19	0,28	-0,3	0,17	-0,23	-0,77	0,63	-1,27	-0,24	-0,39	-1,37	0,62	-0,15	-0,87	-1,83	1,89	-0,26	1,39	0,27	0,85	0,77	0,94
31/05/2018	-0,89	-0,77	0,92	1,14	1,06	-0,49	1,42	-1,1	1,73	-0,07	0,18	1,91	0,54	-0,51	-0,12	0,15	1,32	-0,81	0,6	0,73	0,95	1,65	-1,58	1,82	0,21	-0,88	0,28	0,67
30/06/2018	-0,76	-0,13	-1,35	-0,03	-0,73	0,75	0,9	-0,03	0,4	0,15	-0,59	-0,48	1,8	0,28	1,58	-1,58	-0,87	0,52	1,07	-1,13	0,65	0,23	0,28	1,91	-0,38	1,59	-0,12	0,62
31/07/2018	-1,04	0,84	0,42	-0,5	0,04	0,5	0,05	-0,17	-0,53	1,87	0,48	0,02	-1,33	0,54	-1,26	1,74	1,01	-0,94	-0,46	0,29	0,46	0,18	0,79	1,83	-0,69	0,6	0,06	-0,77
31/08/2018	0,84	0,54	-0,4	-2,83	-0,81	-0,05	1,78	0,06	-1,13	0,82	0,18	1,47	0,13	-0,72	0,81	0,12	0,74	0,31	0,99	-0,58	1,65	2,8	0,11	1,2	0,6	-0,51	-0,9	-0,51
30/09/2018	-0,63	0,85	0,32	-1,12	0,29	-0,4	-0,07	0,7	-0,4	0,35	-0,78	-0,05	-0,26	-0,53	0,55	0,25	-0,28	-0,13	0,94	-0,37	0,12	-0,19	-0,55	2	0,31	-0,06	-0,96	-0,22
31/10/2018	0,39	-1,05	-2,32	-0,02	-2,18	-0,06	-1,32	-0,53	-0,24	-0,98	-0,29	-1,38	-0,23	-0,48	-1,48	0,57	-0,81	0,63	0,29	-0,17	0,49	1,1	0,58	-4,75	-1,25	0,74	1,99	1,19
30/11/2018	0,18	1,47	0,49	-1,84	0,59	-0,43	0,78	0,63	0,86	1,2	1,36	0,86	1,25	0,43	-0,66	0,72	0,64	0,95	1,28	1,53	0,86	1,1	0,45	-1,51	-0,25	0,85	0,84	2,15
31/12/2018	-0,02	0,06	0,21	0,26	-0,77	1,39	-0,3	0,8	0,16	-0,31	0,67	0,12	0,4	-0,03	-2,03	0,3	-0,37	-0,86	0,16	0,59	0,73	0,18	-0,39	-0,55	-0,6	-1,59	0,68	-0,18
31/01/2019	-0,18	-0,14	0,18	-1,4	2,81	0,26	-0,37	0,36	2,28	1,42	-0,14	0,6	1,77	-0,85	0,42	1,7	0,68	0,68	0,68	1,93	-1,41	-0,39	-0,02	0,05	1,05	0,54	0,97	-1,83
28/02/2019	-0,8	0,74	0,76	0,86	0,61	1	1,12	0,23	0,3	-0,95	2,21	1,27	1,25	0,62	0,44	0,91	0,62	0,16	-0,7	0,47	0,28	0,4	1,1	-2,16	0,13	-0,35	0,46	-1,12

29/02/2020	31/01/2020	31/12/2019	30/11/2019	31/10/2019	30/09/2019	31/08/2019	31/07/2019	30/06/2019	31/05/2019	30/04/2019	31/03/2019	Date
0,04	1,63	-1,53	0,83	-0,6	1,36	-1,11	1,03	-1,66	1,78	1,65	-1,67	ACCESS AND AFFORDABILITY
0,34	1,14	-0,56	1	0,46	-1,73	0,58	-1,72	1,39	1,31	0,06	0,57	AIRQUALITY
1,3	-1,09	0,52	0,6	1,35	-1,27	-0,52	-0,67	2,09	-1,88	-0,12	0,69	Business_Ethics
-1,45	0,39	2,26	-1,62	-2,08	0,62	1,31	-0,84	1,48	-0,39	-2	1,89	Business_Model_resilien ce
-1,04	-0,57	0,4	0,94	-0,17	0,17	-0,56	-0,93	1,96	-0,45	0,67	-0,37	competitive_behaviour
1,24	0,97	0,45	0,48	0,23	-1,23	-0,27	-0,94	-0,1	0,94	0,8	1,48	crit_incident_risk_mgm t
2,21	0,88	-0,11	1,23	-0,88	-0,59	1,38	-0,6	1,12	2,21	-1,31	-0,12	cust_privacy
2,03	-1,82	-0,46	0,23	-0,03	-0,39	0,13	-0,55	0,97	-0,6	-0,38	0,56	cust_welfare
0,69	-0,57	0,54	-1,87	-0,8	-1,02	0,44	0,82	0,4	0,48	-0,62	0,32	data_security
0,15	0,72	-1,03	-0,07	-0,45	-0,64	0,31	-1,18	-1,73	1,21	-0,52	1,05	eco impacts
1,75	0,53	-0,66	0,47	0,35	0,21	0,13	1	-0,56	0,62	0,36	0,95	employee engmt divers & incl
0,81	-0,24	-0,05	-0,32	0,84	-0,09	-0,04	0,32	-0,09	-0,24	0,89	0,11	employee health and safety
0,6	0,36	-1,21	-0,02	-0,91	-0,56	1,44	-0,02	-1,66	1,45	-0,64	0,68	energy mgmt
-1,24	0,48	0,79	-1,08	-0,8	0,02	-0,05	-0,42	0,54	-1,36	1,71	0,91	ghg emissions
0,14	-1,83	0,73	0,99	-0,6	-0,27	-2,42	-0,65	0,52	-1,75	0,11	0,66	human rights & x
0,25	0,67	-0,33	0,29	0,48	-0,02	-0,17	0,18	0,53	-1,52	0,93	0,1	labor practices
-0,87	0,68	-0,02	2,04	0,7	-0,45	-0,3	-0,1	0,27	-0,86	-0,48	0,83	mgmt of legal and
-1,02	1,2	0,65	-0,12	-0,39	-0,8	1,92	-0,4	0,55	-0,16	0,77	0,32	materials sourcing and efficien
0,27	0,5	0,43	-0,82	-0,44	0,14	0,39	-1,52	-0,73	0,67	-0,96	0,63	physical impacts of clim change
1,26	0,81	-0,47	-1,47	0,23	0,44	1,1	-0,63	-0,2	0,89	0,03	0,04	prod design and lifecycle mgmt
0,63	0,31	-0,91	-0,27	0,51	-0,07	-0,73	-0,93	-0,96	0,84	0,79	0,27	prod quality and safety
0,17	0,11	-0,46	-1,13	0,5	-0,63	0,65	0,22	-0,35	1,27	0,54	-0,27	selling practices and prod
-0,8	-1,13	-0,61	-0,3	-1,19	0,53	0,15	0,46	-0,1	-0,16	-1,11	-0,41	supply chain mgmt
0,75	-1,83	0,22	1,39	-0,36	0,64	-1,66	-1,52	1,52	-1,04	-3,8	0,14	systemic risk mgmt
0,26	0,24	1,62	0,57	-1,19	-0,42	-0,38	1,01	0,18	-0,31	0,48	0,21	waste and hazards
0,95	-0,31	0,32	-0,53	0,11	-0,5	-0,28	1,4	-1,51	1,9	-0,64	1,55	water and waste water mgmt
-0,29	0,16	-0,18	-0,71	-0,29	0,71	0,96	-0,24	-0,43	0,57	0,01	0,1	all categories
-0,55	-0,68	2,04	-1,96	-1,03	1,78	0,21	-0,98	-0,17	-0,85	1,06	1,02	materiality

28/02/2021	31/01/2021	31/12/2020	30/11/2020	31/10/2020	30/09/2020	31/08/2020	31/07/2020	30/06/2020	31/05/2020	30/04/2020	31/03/2020	Date
-1,18	-1,71	1,94	-4,21	1,03	-0,43	-1,13	0,65	-0,16	-1,77	-2,05	-1,52	ACCESS AND AFFORDABILITY
-2,64	0,1	-1,57	-2,62	-1,94	0,19	1,12	0,99	-1,51	0,99	-4,73	5,13	AIRQUALITY
-2,36	0,9	-0,82	-0,36	-0,05	-0,16	0,15	1,45	-0,62	0,76	1,59	5,79	Business_Ethics
-1,17	-0,11	-1,42	-0,78	-0,51	-0,07	-4,36	-0,55	-0,54	-2,84	2,69	-0,19	Business_Model_resilienc
0,93	0,83	0,37	1,48	-0,46	0,35	-0,17	-1,57	1,14	-0,67	2,41	-4,17	competitive_behaviour
-2,18	-0,01	-0,61	-4,12	1,37	0,44	-0,28	2,46	0,33	1,66	1,58	2,05	crit_incident_risk_mgmt
-2,84	0,51	-0,87	-1,45	-0,16	-1,16	-1,13	0,72	-1,4	-0,45	-2,8	7,26	cust_privacy
-3,56	1,48	0,69	-3,7	1,09	0,62	-2,73	1,25	-0,99	-0,27	2,07	3,81	cust_welfare
1,65	1,93	0,29	0,84	-0,09	-1,1	-1,34	0,87	0,8	-0,27	4,15	-3,43	data_security
-0,44	-0,05	-0,99	-2,08	0,85	0,67	-0,52	0,84	0,95	-0,74	-1,84	0,38	eco impacts
-3,88	0,22	0,06	-3,66	2	0,32	-1,22	1,59	-0,29	-0,16	-0,17	4,78	employee engmt divers & incl
-0,55	-0,75	-0,25	-2,32	0,45	0,2	-1,06	1,71	0,24	-0,69	0,56	1,33	employee health and safety
0,36	0,63	-1,03	-1,19	-1,5	0,09	-0,39	0,59	0,47	1,21	0,62	0,71	energy mgmt
-0,36	-0,65	0,59	-1,43	1,28	-0,65	-1,12	0,02	0,17	-1,36	-1,23	1,48	ghg emissions
1,71	1,01	0,36	0,39	-1,61	-0,52	1,63	1,86	1,3	-0,52	6,93	1,71	human rights & x
1,89	0,15	-0,51	1,79	-1,38	-0,51	-0,41	-1,5	0,38	0	0,47	-0,85	labor practices
-1,73	-1,04	0,35	-2,85	3,22	0,48	-0,29	0,93	0,74	-2,09	-1,87	0,93	mgmt of legal and
1,43	-2,02	-0,44	-0,36	0,45	-0,5	-0,41	-0,02	-2,09	0,3	-3,98	0,86	materials sourcing and efficien
-0,15	-0,33	-0,16	1,85	-0,37	-0,44	1,27	-1,63	1,9	-1,67	0,24	-1,01	physical impacts of clim change
-1,23	0,27	-0,25	-1,05	1,59	1,55	-1,25	1,66	0,88	-0,5	-0,43	-1,28	prod design and lifecycle mgmt
1,57	-1,12	-0,44	-0,57	-1,13	-0,79	1,62	-0,29	2,22	-1,56	-1,2	-0,4	prod quality and safety
0,13	-0,55	1,32	0,66	-0,96	0,81	2,42	-0,2	2,62	0,64	-2,1	-1,9	selling practices and prod
-0,76	-1,19	-0,13	0,2	0,37	-0,89	-0,8	0,45	0,4	-1,69	0,78	-1,13	supply chain mgmt
3,22	0,93	0,47	3,82	-0,76	-1,48	-0,55	-1,77	3,19	-3,74	2	-0,93	systemic risk mgmt
-2	-0,44	-0,55	0,02	0,03	0,49	0,49	1,12	-1,3	1,16	1,97	1,27	waste and hazards
-0,2	-1,61	-0,26	-2,77	-0,28	2,25	1,6	1,04	-1,85	0,42	-0,9	2,89	water and waste water mgmt
-0,69	-0,62	-0,1	-1,53	0,18	0,8	-0,93	-0,27	0,92	-2,62	-0,48	-1,34	all categories
1,15	1,01	0,03	1,01	0,12	0,77	-0,87	0,63	1,75	-2,93	1,04	-1,06	materiality

28/02/2022	31/01/2022	31/12/2021	30/11/2021	31/10/2021	30/09/2021	31/08/2021	31/07/2021	30/06/2021	31/05/2021	30/04/2021	31/03/2021	Date
-1,42	-0,88	1,29	-1,91	1,23	-0,03	1,11	0,33	-1,07	-0,32	2,16	1,39	ACCESS AND AFFORDABILITY
-3,26	-1,27	0,24	-1,47	-1,73	-1,62	-0,86	0,77	-1,11	-0,53	0,61	-0,86	AIRQUALITY
-1,4	-2,55	-0,51	-0,18	-0,61	0,39	-0,68	1,43	0,48	0,94	0,16	-1,66	Business_Ethics
0,83	3,58	0,79	-0,3	0,53	0,85	-0,87	-0,83	-0,72	-0,46	0,76	1,41	Business_Model_resilien ce
-0,55	-0,04	-1,16	0,19	0,07	-0,05	-0,11	0,53	0,1	1,75	1,04	-0,37	competitive_behaviour
-0,01	-3,6	-0,24	0,97	-0,1	-0,63	1,76	0,46	0,35	-1,01	1,28	-0,05	crit_incident_risk_mgm t
0,52	-1,71	-0,45	1,11	1,18	-1,66	0,07	1,37	2,53	-0,89	0,66	-0,33	cust_privacy
-0,77	-2,64	1,17	2,2	0,14	-0,2	-0,18	1,64	0,35	0,22	-1,11	0,93	cust_welfare
0,16	-0,53	-1,66	0,08	0,96	0,95	0,14	0,36	1,23	0,55	-0,04	-0,35	data_security
0,62	1,02	-0,53	-1,54	-0,19	0,69	0,17	0,39	0,4	0,88	-0,46	0,77	eco impacts
-0,55	-3,42	-0,45	2,43	2,7	-2,52	0,47	2,43	1,63	-0,25	-0,05	1,1	employee engmt divers & incl
-1,51	-1,53	0,6	0,92	-0,64	-0,23	-0,22	0,19	0,56	-1,14	-0,52	-0,85	employee health and safety
-0,71	0,1	-0,7	-0,31	-0,37	0,61	0,26	1,05	0,61	0,31	-0,83	-0,14	energy mgmt
0,65	0,03	0,72	1,38	-0,55	-0,72	-0,41	-0,49	-0,9	0,15	-1,78	-0,28	ghg emissions
0,37	-1,94	-0,38	-0,01	1,59	1,74	0,9	0,27	0,56	0,68	0,96	-2,05	human rights & x
-2,96	-0,28	-0,24	0,15	0,61	0,42	0,19	0,32	1,59	-0,48	-1,1	-1,35	labor practices
0,36	-2,8	1,14	0,15	-0,04	-1,37	0,12	2,14	-0,09	1,21	1,22	-0,15	mgmt of legal and
1,27	1,08	0,82	-0,25	-0,37	0,3	0,49	0,82	-1,35	0,39	-0,9	0,91	materials sourcing and efficien
-2,64	-0,96	0,03	0,43	-1,1	-1,28	0,71	-0,13	1,24	-1,08	1,01	0,27	physical impacts of clim change
-0,96	-2,32	0,35	1,9	0,96	-0,93	0,33	0,9	-1,77	-0,01	-0,91	1,51	prod design and lifecycle mgmt
-0,22	0,45	-0,5	-0,63	-0,83	-0,1	1,53	0,94	-0,16	0,05	0,2	1,53	prod quality and safety
-0,1	-3,52	-0,43	0,81	-0,38	0,57	-0,12	1,5	0,72	-1,25	0,76	-2,16	selling practices and prod
-0,62	-1,35	0,74	-0,92	-0,56	-0,8	0,04	1,62	-0,12	-0,22	-0,28	0,47	supply chain mgmt
0,6	0,53	-1,27	-0,51	1,03	0,95	0,47	0,61	0,77	-0,7	0,61	-1,93	systemic risk mgmt
-1,18	0,33	-0,6	0,38	0,55	0,32	-1,74	0,47	-0,11	-1,16	-0,33	-0,57	waste and hazards
-0,18	-0,36	0,9	0,99	2,04	0,48	0,06	-0,28	-0,16	0,22	0,64	-0,64	water and waste water mgmt
-2,11	-0,49	0,48	0,86	0,66	-0,36	0,13	-0,13	-1,14	-1,2	-1,52	0,68	all categories
-1,4	0,81	-0,35	1,21	0,75	0,72	-0,67	-0,7	-0,83	-1,28	-0,29	-1,49	materiality

28/02/2023	31/01/2023	31/12/2022	30/11/2022	31/10/2022	30/09/2022	31/08/2022	31/07/2022	30/06/2022	31/05/2022	30/04/2022	31/03/2022	Date
-0,68	-1,75	-0,04	0,06	-1,52	0,64	0,73	-0,54	1,68	-0,56	-2,33	-1,63	ACCESS AND AFFORDABILITY
0,33	-1,3	0,8	0,11	0,49	-0,38	-1,63	0,19	0,36	-1,87	-1,53	1,21	AIRQUALITY
0,26	-0,06	-0,82	0,42	-0,2	-1,02	-1,2	-0,21	0,9	1,4	-0,66	-1,37	Business_Ethics
-1,95	-3,7	1,89	-0,31	0,43	-1,59	-0,88	-0,74	-0,44	2,02	1,85	3,72	Business_Model_resilien ce
-0,32	-0,3	0,46	2,01	1,29	-1,15	-1,51	1,49	-0,93	0,85	-2,2	1,37	competitive_behaviour
0,88	0,67	-0,13	1,62	-3,11	0,05	-1,25	1,2	1,04	-1,6	-0,28	-2,7	crit_incident_risk_mgm t
0,11	-1,21	0,94	-0,49	-0,53	0,74	-0,33	1,07	2,73	0,14	-1,06	-0,03	cust_privacy
-0,55	-1,31	-0,09	1,84	-0,69	-0,25	-0,57	0,12	0,52	1,41	0,62	-0,8	cust_welfare
0,03	1,26	-0,87	-0,05	0,34	-1,81	-0,8	1,42	-1,03	2,14	-0,13	1,07	data_security
0,12	-0,91	-0,47	-0,24	-1,21	0,29	0,14	1,31	0,05	-2,04	0,04	-0,11	eco impacts
0,58	-1,64	0,42	-0,6	-1,91	1,03	0,01	1,86	2,13	1,79	-0,5	0,62	employee engmt divers & incl
0,34	1	-1,1	-0,31	-2,18	0,33	0,03	0,71	-0,53	1,3	-1,08	-1,94	employee health and safety
0,52	0,88	-0,44	0,6	-0,67	-0,47	-0,09	0,64	0,07	-1,74	-0,24	2,41	energy mgmt
-1,11	-0,76	1,58	0,79	-1,1	0,24	1,35	-1,23	-0,3	1,73	-0,19	-2,69	ghg emissions
-0,49	1,55	-2,55	-1,38	1,55	-1,44	-1,17	2,36	-2,29	-1,93	-0,54	-1,34	human rights & x
0,9	1,38	-1,5	-0,39	-0,13	0,07	0,63	0,2	-0,08	0,38	-1,23	0,24	labor practices
0,75	1,11	0,89	0,86	-0,19	0,88	-1,23	0,1	0,51	0,94	-1,78	-1,81	mgmt of legal and
-0,39	-0,52	0,15	-1,5	1,66	0,55	0,6	1,48	0,28	-0,77	2,45	-0,51	materials sourcing and efficien
-1,84	1,44	-1,44	0,99	-1,25	-1,15	-0,44	2,24	-1,63	1,35	-0,21	-0,21	physical impacts of clim change
1,46	0,58	-0,29	0,59	0,71	0,2	-1,16	1,64	1,26	0,79	-0,84	-0,29	prod design and lifecycle mgmt
0,28	0,22	-0,8	-1,66	-1,26	0,15	0,61	-0,09	-1	-0,21	0,46	0,17	prod quality and safety
2,3	1,3	-1,01	-0,6	-1,54	1,08	-0,14	1,3	0,37	-1,58	-1,33	-0,25	selling practices and prod
-0,9	-1,23	-0,5	-0,15	1,06	-0,59	-0,9	-0,29	0,35	1,76	1,2	-0,75	supply chain mgmt
0,15	-1,45	-0,53	-2,23	4,18	-0,43	0,05	0,54	-1,05	1,44	1,14	4,95	systemic risk mgmt
0,05	0,2	-0,92	0,21	0,9	-0,62	-0,91	1,63	0,56	-0,2	-0,42	-0,97	waste and hazards
-0,87	-0,56	-0,46	0,83	-1,25	-0,44	0,29	0,15	1,8	-0,64	2,52	-2,23	water and waste water mgmt
-0,3	0,8	0,03	0,13	-0,23	-1,11	1,04	0,42	0,83	2,67	1,31	-0,34	all categories
-0,37	1,13	-0,55	-1,1	-0,27	-1,95	1,69	1,18	-1,59	3,02	1,21	0,48	materiality

Table 15. ESG factors created from 25% top portfolios minus 25% bottom portfolios based on ESG scoring. Data source is Bloomberg.

Date	ESG	ENVIRONMENTAL	SOCIAL	GOVERNANCE
31/12/2015	-0,07827	-0,08616	-0,04787	-0,05264
31/12/2016	0,00748	-0,03351	0,00733	0,01113
31/12/2017	-0,05831	-0,05027	-0,00784	-0,08872
31/12/2018	-0,08024	-0,02123	-0,14809	-0,04085
31/12/2019	-0,14119	-0,12712	-0,04019	-0,12016
31/12/2020	-0,14718	-0,08602	-0,05777	-0,22090
31/12/2021	0,04412	-0,07707	0,11819	-0,05169
31/12/2022	0,06610	0,19435	-0,03284	0,12765

As mentioned, the aim of this last regression analysis is to capture the impact of the different factors on the performance of investments. For it the regression analysis this time used the LinearFactorModel model. As input variables for the model there are to data frames: portfolios and factors. In the former the 10 industries are added and, in the latter, the 5 factors: MKT_RF, SMB, HML, Mom and the newly created ESG Factor. Then the model is run, and it is adjusted to a robust fit. Initially the idea was to run a unique regression analysis of all the ESG factors against the 10 industries, but this is not possible with the LinearFactorModel since the number of test portfolio must be at least as large as the number of risk premia, including the risk-free rate if estimated. As for that, since the LinearFactorModel who makes the calculations in a two-step approach (1. Factor loadings and 2. Risk premia) has not the same number of portfolios than total factors (10 versus 28 in the case of FactSet), the methodology followed by the author of the study is to run each factor individually against the industries. Even though with Bloomberg one could use the initially thought method, for comparison purposes again the regression analysis will be done factor by factor and not all together.

b) Results & Findings

In this section the results and findings of both FactSet and Bloomberg will be presented as well as a table with a brief comparison for easiness to read.

FactSet

In FactSet 280 different regression analysis have been run against based on the portfolios of the 10 industries and complemented by the factors of Carhart and respectively a different ESG factor in each 10 runs. In Table 16 the results of these are presented, more specifically, the betas of the ESG factors as well as the corresponding p-value to determine if the factor is statistically significant and can explain the abnormal returns of the portfolio. For an easier visualization, classification and understanding the statistically significant betas have been marked with two characteristics: 1) to show the degree of statistical significancy an asterisk has been added to the beta based on the p-value being *≤0.1, **≤0.05 and ***≤0.01; 2) to show if the beta is positive or negative the cell has been coloured light green or light red.

Table 16. Regression Analysis Results on the ESG Factors impact on 10 different Industries. Data source is FactSet.

	ACCESS AND AFFORDABILITY	AIRQUALITY	BUSINESS ETHICS	BUSINESS MODEL RESILIENCE	COMPETITIVE BEHAVIOUR
Portfolio	Beta_factor_esg	Beta_factor_esg	Beta_factor_esg	Beta_factor_esg	Beta_factor_esg
NoDur	-0,15201	-0,08249	-0,39816	0,01801	-0,68679**
Durbl	-0,65643*	0,01355	0,38086	-0,05328	0,19245
Manuf	-0,21933	-0,00747	-0,29791*	-0,01081	0,28791
Enrgy	-2,92047***	-4,12929**	0,37987	3,78696***	2,29848*
HiTec	0,18041	-0,54815**	-0,45757*	-0,04949	-0,33947
Telcm	-0,35692	0,16602	-0,81653	-0,35282	-0,40042
Shops	-0,37142	-0,07731	-0,23679	-0,21776	-0,63288*
Hlth	-0,05075	0,34079	-0,27924	0,50914	0,73532
Utils	0,08054	0,06804	-0,29999	1,03772***	-0,14832
Other	0,36858**	-0,20001	-0,88118***	-0,23626*	0,17952
	CRITICAL INCIDENT RISK MANAGEMENT	**CUSTOMER PRIVACY**	**CUSTOMER WELFARE**	**DATA SECURITY**	**ECOLOGICAL IMPACTS**
Portfolio	Beta_factor_esg	Beta_factor_esg	Beta_factor_esg	Beta_factor_esg	Beta_factor_esg
NoDur	-0,04598	-0,27618	-0,23603	0,12503	-0,04302
Durbl	0,05164	-1,2165	-0,08807	0,94764**	-0,39709
Manuf	-0,23935	-0,49174**	-0,36277**	0,2016	0,14481
Enrgy	-1,8129	-1,6293	0,0964	4,73074***	-1,20711
HiTec	0,0488	-0,73121***	-0,40694	0,73470***	0,20028
Telcm	-1,23411***	-0,50641	-1,21845	0,6496	0,181
Shops	0,27693	-0,59944*	0,01567	0,04445	-0,04015
Hlth	-0,22398	-0,67131	-0,49256	0,68061	0,33808
Utils	0,18252	0,63246	0,63767	0,56796	0,07084
Other	-0,24678	-0,67517***	-0,74286***	-0,03899	0,12956

	EMPLOYEE ENGAGEMENT DIVERSITY & INCLUSION	EMPLOYEE HEALTH AND SAFETY	ENERGY MANAGEMENT	GHG EMISSIONS	HUMAN RIGHTS & COMMUNITY RELATIONS
Portfolio	Beta_factor_esg	Beta_factor_esg	Beta_factor_esg	Beta_factor_esg	Beta_factor_esg
NoDur	-0,49114**	-0,55595	0,41566	-0,00658	0,1165
Durbl	-0,61317	-0,00664	0,67546	0,01466	0,34557
Manuf	-0,34154**	-0,27284	0,24008	0,06272	-0,16446
Enrgy	-2,12685**	-2,49316**	2,55674*	-1,63872	4,15918***
HiTec	-0,42134*	0,18148	0,60320*	-0,14749	0,1609
Telcm	-1,46889***	-0,95543	1,10215*	-0,63849	0,1317
Shops	-0,4272	-0,82563*	0,82215*	-0,77410**	0,33233
Hlth	-0,90038**	-0,63995	1,06299*	-0,36392	-0,08048
Utils	0,70572	-0,1096	0,54158	0,30167	-0,80385**
Other	-0,43468**	-0,3194	0,17155	-0,18203	-0,45574***
	LABOR PRACTICES	**MANAGEMENT OF THE LEGAL AND REGULATORY ENVIRONMENT**	**MATERIALS SOURCING AND EFFICIENCY**	**PHYSICAL IMPACTS OF CLIMATE CHANGE**	**PRODUCT DESIGN AND LIFECYCLE MANAGEMENT**
Portfolio	Beta_factor_esg	Beta_factor_esg	Beta_factor_esg	Beta_factor_esg	Beta_factor_esg
NoDur	-0,52402	-0,18563	0,43053	0,2355	-0,20218
Durbl	0,63238	-0,68660*	-1,98238***	0,73613	0,2362
Manuf	0,24878	-0,20616	-0,08996	0,09548	0,36715*
Enrgy	1,01457	-4,10899***	-2,62009	-0,23299	-4,36984***
HiTec	0,48308	-0,40949**	-0,30349	-0,05361	-0,14435
Telcm	0,8993	-0,94516*	-0,13781	1,58843***	-1,19987**
Shops	-0,42781	-0,71004***	-0,65723	0,26102	-0,20393
Hlth	1,12338**	-0,82967**	-0,3929	-0,18414	-0,46959
Utils	-1,01741***	0,03299	0,44297	0,50332	0,67397*
Other	0,34871	-0,08635	0,28476	0,19905	0,07803

	PRODUCT QUALITY AND SAFETY	SELLING PRACTICES AND PRODUCT LABELING	SUPPLY CHAIN MANAGEMENT	SYSTEMIC RISK MANAGEMENT	WASTE AND HAZARDOUS MATERIALS MANAGEMENT
Portfolio	Beta_factor_esg	Beta_factor_esg	Beta_factor_esg	Beta_factor_esg	Beta_factor_esg
NoDur	-0,14741	-0,06145	0,34963	-0,1898	-0,15998
Durbl	-0,0557	-0,11503	-0,2604	-0,27701	0,37085
Manuf	0,13877	0,07459	-0,2911	0,03946	-0,35926
Enrgy	-1,76937	-2,83447*	-0,39374	2,71516***	1,56789
HiTec	0,14233	-0,04838	-0,22233	-0,26682	0,1099
Telcm	1,55429***	0,35914	-0,27952	0,30639	-1,35012**
Shops	-0,02818	-0,06482	-0,24698	-0,30947*	-0,03098
Hlth	-0,58822	-1,19259**	-1,30651*	-0,16372	0,40535
Utils	-0,75582*	-0,60064	1,05390**	-0,17733	-0,00591
Other	0,59280***	0,61234***	-0,23665	-0,13255	-0,91289***

	WATER AND WASTE WATER MANAGEMENT	ALL CATEGORIES	MATERIALITY
Portfolio	Beta_factor_esg	Beta_factor_esg	Beta_factor_esg
NoDur	0,52409*	0,18082	0,26836
Durbl	-0,71605	0,56167	0,97213**
Manuf	-0,14579	0,22492	0,23652
Enrgy	-0,67964	-1,81832	2,10159*
HiTec	-0,39578	-0,04244	0,2275
Telcm	-0,80284	-0,10061	0,71516
Shops	0,17437	-0,22827	-0,04084
Hlth	-0,43981	-0,25231	0,01381
Utils	-0,05882	1,18526***	0,49969
Other	-0,12474	0,16528	-0,14501

When analysing and looking into the different betas one comes to the conclusion that 73 out of the 280 betas are statistically significant. Looking deeper into it 46 out of the 73 betas are negative indicating that the corresponding ESG factor actually has an inverse relationship with the returns of the portfolio being analysed. Further, since the betas stands for the sensitivity of a portfolio's return to changes to a particular factor in this case, the negative beta indicates that when the ESG factor's return increases, the portfolio's return tends to decrease and vice versa. This means that having a better score in the ESG factor actually does not benefit the portfolio's return of an industry. On the other hand, there are 27 factors that have a positive beta indicating a linear relationship with the portfolio's return and suggesting that when an ESG factor is higher then, the return's portfolio will also be so. For more details, a brief summary has been carried out in ***Table 17***, where one can also find the degree of significance of these betas and in which of the industry portfolios these are to be found.

Table 17. Summary of Betas and Statistical Significance of ESG Factors per Industry Portfolio. Data source is FactSet.

	Neg. Relationship (red)	*	**	***	**Pos. Relationship (green)**	*	**	***	**Total**
NoDur	**2**	0	2	0	**1**	1	0	0	**3**
Durbl	**3**	2	0	1	**2**	0	2	0	**5**
Manuf	**4**	1	3	0	**1**	1	0	0	**5**
Enrgy	**7**	3	1	3	**7**	3	0	4	**14**
HiTec	**5**	2	2	1	**2**	1	0	1	**7**
Telcm	**5**	1	2	2	**3**	1	0	2	**8**
Shops	**6**	4	1	1	**1**	1	0	0	**7**
Hlth	**4**	1	3	0	**2**	1	1	0	**6**
Utils	**3**	1	1	1	**5**	1	2	2	**8**
Other	**7**	1	1	5	**3**	0	1	2	**10**
Total	**46**	16	16	14	**27**	10	6	11	**73**

From the table above it can be read that it is the portfolio of the Industry of Energy where most of the betas are statistically significant namely in 14 (out of the 28-regression analysis run against this portfolio). On top of this they are equally distributed having 7 positive relationships and 7 negative and 3 to 4 ** and *** statistically significant betas and 3 * statistically significant betas. This indicates that this sector is actually the one where ESG factors have the highest impact. This industry is then followed by the category Other where

we englobe all the industries not specified in the test, so no further comments can be made on it. Then in a third and fourth tied position, one can find Utilities and Telecommunications industries with 8 statistically significant betas. In the case of Utilities 62.5% of them have a positive relationship, while in Telecommunications its 62.5% the ones that have a negative relationship with the portfolios return. The industry that has the least statistically significant betas and therefore no relationship can be identified between ESG factors, and better or worse portfolio's returns is the industry of No Durables.

Now, looking deeper into each of the factors instead of into the Industry Portfolios, one can extract also valuable information. In ***Table 18*** a summary is presented where one can find how many times an ESG factor has been statistically significant and to what extent.

Table 18. Summary of Betas and Statistical Significance of ESG Factors. Data source is FactSet.

	Neg. Rel. (red)	*	**	***	**Pos. Rel. (green)**	*	**	***	**Total**
ACCESS AND AFFORDABILITY	**2**	1		1	**1**		1		**3**
AIRQUALITY	**2**		2		**0**				**2**
BUSINESS ETHICS	**3**	2		1	**0**				**3**
BUSINESS MODEL RESILIENCE	**1**	1			**2**			2	**3**
COMPETITIVE BEHAVIOUR	**2**	1	1		**1**	1			**3**
CRITICAL INCIDENT RISK MANAGEMENT	**1**			1	**0**				**1**
CUSTOMER PRIVACY	**4**	1	1	2	**0**				**4**
CUSTOMER WELFARE	**2**		1	1	**0**				**2**
DATA SECURITY	**0**				**3**		1	2	**3**
ECOLOGICAL IMPACTS	**0**				**0**				**0**
EMPLOYEE ENGAGEMENT DIVERSITY & INCLUSION	**7**	1	5	1	**1**		1		**8**
EMPLOYEE HEALTH AND SAFETY	**2**	1	1		**0**				**2**
ENERGY MANAGEMENT	**0**				**5**	5			**5**
GHG EMISSIONS	**1**		1		**0**				**1**
HUMAN RIGHTS & COMMUNITY RELATIONS	**2**		1	1	**1**			1	**3**
LABOR PRACTICES	**1**			1	**1**		1		**2**
MANAGEMENT OF THE LEGAL AND REGULATORY ENVIRONMENT	**6**	2	2	2	**0**				**6**
MATERIALS SOURCING AND EFFICIENCY	**1**			1	**0**				**1**

	Neg. Rel. (red)	*	**	***	Pos. Rel. (green)	*	**	***	Total
PHYSICAL IMPACTS OF CLIMATE CHANGE	**0**				**1**			1	**1**
PRODUCT DESIGN AND LIFECYCLE MANAGEMENT	**2**		1	1	**2**	2			**4**
PRODUCT QUALITY AND SAFETY	**1**	1			**2**			2	**3**
SELLING PRACTICES AND PRODUCT LABELING	**2**	1	1		**1**			1	**3**
SUPPLY CHAIN MANAGEMENT	**1**	1			**1**		1		**2**
SYSTEMIC RISK MANAGEMENT	**1**	1			**1**			1	**2**
WASTE AND HAZARDOUS MATERIALS MANAGEMENT	**2**		1	1	**0**				**2**
WATER AND WASTE WATER MANAGEMENT	**0**				**1**	1			**1**
ALL CATEGORIES	**0**				**1**			1	**1**
MATERIALITY	**0**				**2**	1	1		**2**
Total	**46**	14	18	14	**27**	10	6	11	**73**

Here one can see that it is three ESG factors the ones that have more significant betas namely “Employee, Engagement, Diversity & Inclusion” (with 8), “Management of the Legal and Regulatory Environment” (with 6) and “Energy Management” (with 5). The first relates to Social and Governance topic, the second to Governance & Environmental topic and the third one to Environmental topic. In the former two, the betas show a negative relationship with the portfolios 7/8 and 6/6 of the cases. Indicating that actually having a higher ESG factor leads to a lower return’s portfolio. Only in the latter case (“Energy Management”) the relationship is positive in all of the cases making sense since from the previous table one also read that the industry that was most affected by these was the Energy Sector.

The ESG factors that have the least statistically significant betas and therefore account for not having a relationship or an impact in the explaining of abnormal returns in the industry portfolios are: “Ecological Impacts” (with 0), “Critical Incident Risk Management” (with 1), “GHG Emissions” (with 1), “Materials Sourcing and Efficiency” (with 1), “Physical Impacts of Climate Change” (with 1), “Water and Waste Water Management” (with 1) and lastly the sum of all categories together with 1. Here one can read that it is the Environmental factor the one that has the lowest impact on the portfolio’s return.

Other more specific insights one can get from ***Table 16 and 18*** is the deeper relationship of each ESG factor with the industries. For instance, in the case of the Data Security factor one can see that with a *** statistically significant positive beta, its industries such as High Technology, Energy and Durables the most impacted, which actually makes sense since the data and confidentiality in these is key for a proper business development. Another curious insight is that Business Ethics and Customer Privacy Factors have a negative statistically significant impact on the portfolios of Manufacturing and High Technology, which in the latter case can lead to controversy with data security. Id est, data security is relevant for a higher return, but customer privacy and business ethics actually have the reversed effect.

Bloomberg

In the case of Bloomberg in this third analysis, 40 different regression analysis have been run against based on the portfolios of the 10 industries and complemented by the factors of Carhart and respectively a different ESG factor in each 10 runs. In ***Table 19*** following the same structure as when presenting the results for FactSet, the betas of the ESG factors as well as their corresponding p-value to determine if the factor is statistically significant or not are presented. Goal is to determine if these can explain the abnormal returns of the portfolio. Once again, for an easier visualization, classification and understanding the statistically significant betas have been marked with two characteristics: 1) to show the degree of statistical significancy an asterisk has been added to the beta based on the p-value being *≤0.1, **≤0.05 and ***≤0.01; 2) to show if the beta is positive or negative the cell has been coloured light green or light red.

Table 19. Regression Analysis Results on the ESG Factors impact on 10 different Industries. Data source is Bloomberg.

	ESG		ENVIRONMENT		SOCIAL		GOVERNANCE	
Portfolio	β	p-value	β	p-value	β	p-value	β	p-value
NoDur	-0,58900	0,53147	0,08437	0,89648	0,53188	0,41375	-0,02474	0,97774
Durbl	-0,99634**	0,02400	0,38836	0,36629	-0,09236	0,87816	0,13248	0,79398
Manuf	-1,13808*	0,06758	0,35442	0,53590	0,07822	0,91565	0,04407	0,94707
Enrgy	-3,45615**	0,01130	2,36810**	0,01274	-1,95396	0,28247	1,80436	0,27608
HiTec	-1,14740***	0,00750	0,35831	0,46845	-0,04360	0,94800	0,01561	0,97780
Telcm	-0,82184	0,45798	0,68997	0,26290	-0,08733	0,91727	0,74071	0,37145
Shops	-0,35649	0,69497	0,21123	0,70139	0,33844	0,55811	0,26395	0,73852
Hlth	-3,17708**	0,01389	1,30909	0,31267	-0,45959	0,80579	0,50266	0,74640
Utils	-0,85546	0,22816	-0,29716	0,52882	0,06851	0,89587	-0,93143*	0,09676
Other	-1,04887**	0,03032	0,52774	0,20251	-0,24244	0,70128	0,30731	0,55561

Looking at the above table and at the different betas of the four factors, one reaches the conclusion that 8 out of the 40 betas are statistically significant. Looking deeper into it this time almost all, namely 7 out of 8, betas are negative indicating that the corresponding ESG factor actually has an inverse relationship with the returns of the portfolio being analysed. As in FactSet results analysis, the beta stands for the sensitivity of a portfolio's return to changes to a particular factor, so that the negative beta indicates the reversed relationship meaning that having a better score in the ESG factor actually does not benefit the portfolio's return of an industry but contrary it reduces it. The 8th factor that has positive beta indicating a linear relationship with the portfolio's return and suggesting that when an ESG factor is higher then, the return's portfolio will also be so, is the Environmental factor. The details on these findings are summarized in ***Table 20***. One can see that the only positive relationship is found in the portfolio of the Energy Industry with a second degree of significance.

Table 20. Summary of Betas and Statistical Significance of ESG Factors per Industry Portfolio. Data source is Bloomberg.

	Neg. Relationship (red)	*	**	***	Pos. Relationship (green)	*	**	***	Total
NoDur	**0**				**0**				**0**
Durbl	**1**		1		**0**				**1**
Manuf	**1**	1			**0**				**1**
Enrgy	**1**		1		**1**		1		**2**
HiTec	**1**			1	**0**				**1**
Telcm	**0**				**0**				**0**
Shops	**0**				**0**				**0**
Hlth	**1**		1		**0**				**1**
Utils	**1**	1			**0**				**1**
Other	**1**		1		**0**				**1**
Total	**7**	2	4	1	**1**	0	1	0	**8**

When comparing the information in Table 18 and 19 one can see that the Factor of Social has no statistical significance in the betas at all, and that Environmental and Governance only have one each. In the case of Environmental as said it is positive and in the case of Governance it is negative. This one is affecting specially the sector of Utilities. The fact of the Governance factor being relevant in this industry makes sense since the utility companies are often subject to government regulations because of the nature of their services. More specifically, there are regulations regarding pricing, quality, safety and other aspects. What is interesting is that the relationship between this factor and the returns is actually negative, meaning that a higher scoring in the Governance factor leads to a lower return in the Utilities portfolios return.

Lastly, it is the general ESG factor the one that has most of the significant betas. As mentioned already the relationship between these and the portfolios is negative, more specifically, with the portfolios of the industries of a) Durables, b) Manufacturing, c) Energy, d) High Technology, e) Health, f) Utilities and g) Other industries. In the case of Energy one can see that even though in the category of Environmental it had a positive relationship, probably the reverse relationship in social and governance (even though separately not statistically significant) accounts for the negative relationship in the general ESG factor.

Concluding this third analysis part, several results and insights have been gathered. In both cases (FactSet and Bloomberg) there are more regression analysis that do not show any statistical significance than that they do, stating that the factors are not able to explain abnormal returns in portfolios built out of 10 different industries. FactSet has 26% statistically significant betas in the Factors and Bloomberg amounts to 20%. If one looks further into them one can see that most of them the relationship is negative having 63% negative betas FactSet and 87.5% Bloomberg. The industries that show a higher influence of the ESG factors are in both cases the Energy sector. Regarding the factors that have more times significant betas in the case of FactSet we have Governance and Environmental, and for Bloomberg it is the general ESG factor. Within these in FactSet the Environmental factor shows a positive relationship with the returns of the industry portfolios while the other two have a reverse relationship. In the case of Bloomberg, the same results are achieved.

In the next section, these results as well as the other analysis results and the knowledge gathered from the literature review will be further discussed.

6. Discussion & Insights

Once having analysed the results of the three regression analyses run in this study, several conclusions and insights can be reached. In the following, the main results and key findings will be presented as well as the insights resulting from them. For an easier follow a comparison table can be found between FactSet and Bloomberg. In a second step, these conclusions and insights will be compared with the outcomes of the previous literature review. Lastly, final conclusions on it will be drawn and suggestions and next steps will be indicated.

6.1. Summary of Key Findings

Before diving deep into the key findings of the analysis run in this study a brief recap on the objective behind these is made. The goal of this investigation is to examine the correlation between risk & return and ESG metrics in portfolio investment of 10 different industries taking the scores available of companies of the S&P500. As presented in the previous section three different multi-regression analysis have been run to identify which factors and aspects, if any, have a significant influence on the portfolios return as well as the risk associated to it:

I. **Analysis 1:** Alpha significance analysis to determine if there are abnormal returns not explained by the model + only top 25% performing companies against the Carhart Model to determine if there are significant anomalies in the top ESG scoring companies portfolios that cannot be explained by the Carhart Model (3-Factor-Fama-French-Model + Momentum Factor).
II. **Analysis 2:** Creatin of a dummy variable based on being a top 25% ESG factor scoring company (1) or not (0) and added to the Carhart 4-Factor model as a new factor to identify statistically abnormal returns being explained by the dummy variable (look at beta).
III. **Analysis 3:** Creation of an ESG factor based on the difference of returns between top 25% scoring companies and bottom 25% scoring companies for each of the ESG factors. The Carhart Model is extended by the ESG factors to determine if these can explain abnormal statistically significant returns on 10 different industries.

From these three analysis important findings have been found which are presented in form of a comparison in ***Table 21*** between FactSet and Bloomberg and that will be commented on in the next section of Interpretation of Results.

Table 21. Summary of Results of Regression Analysis. Data sources are FactSet and Bloomberg.

Nr.	TOPIC	FACTSET	BLOOMBERG
0.	Number of ESG Factors	28 (*26 specific + 2 general*)	4 (*3 specific + 1 general*)
ANALYSIS 1: General Abnormal Returns + Top 25% Scoring Companies Abnormal Returns			
1.	General Alpha Significance	• 33 out of 502 companies are significant. • 25 out of these 33 have a positive Alpha.	• 31 out of 503 companies are significant. • 13 out of these 31 have a positive Alpha.
2.	Top 25% Scoring Companies Portfolio Alpha Significance	• 8 out of 28 factors are significant. • 8 out of 8 have a positive Alpha	• 4 out of 4 factors are significant. • 4 out of 4 have a negative Alpha
3.	Risk & Sharpe Ratio of Top 25% Scoring Companies Portfolio	The Sharpe Ratio is negative very close to zero.	The Sharpe Ratio is negative very close to zero, except for *social* factor where it is positive, but also close to zero.
ANALYSIS 2: Dummy Variable Significance of Beta			
4.	Beta Significance	• 5 out of 28 factors are significant (Access and Affordability, Airquality, Employee Health & Safety, GHG Emissions and Supply Chain Management). • They are all negative.	• 1 out of 4 factors is significant (ESG). • They are all negative.

ANALYSIS 3: ESG Factor Regression Analysis			
5.	ESG Factor Beta Significance	• 73 out of 280 betas are significant. • 27 out of 73 are positive. • 46 out of 73 are negative.	• 8 out of 40 betas are significant. • 1 out of 8 are positive: *environmental* factor. • 7 out of 8 are negative.
6.	Which sector has more impact (more significant betas)?	• Energy Sector: 14 out of 73 betas are significant. 7 are positive and 7 are negative. • Other Sector: 10 out of 73 betas are significant. 3 are positive and 7 are negative. • Utilities Sector: 8 out of 73 betas are significant. 5 are positive and 3 are negative. • Telecommunication Sector: 8 out of 73 betas are significant. 3 are positive and 5 are negative. • Barely an impact in the Non-Durables Sector with 3 out of 73 significant betas.	• Energy Sector: 1 out of 8 betas are significant. 1 is positive. • 7 out of 8 betas are negative in sectors: a) Durables b) Manufacturing c) Energy d) High Tech e) Health f) Utilities g) Others
7.	Which factor has more impact (more significant betas)?	• Social & Governance: "Employee, Engagement, Diversity & Inclusion" (with 8) • Governance & Environmental: "Management of the Legal and Regulatory Environment" (with 6) • Environmental: "Energy Management" (with 5). Other Environmental Factors barely do have an impact.	• Environmental (with 1 positive) • Governance (with 1 negative) • Social no statistical significance • ESG general (with 6 negative)

6.2. Interpretation of results

From the above table one can read several insights responding to the objective of this study and shed light on the current discussion of which is the correlation between risk and return metrics and ESG scorings. For a simpler guidance insights and interpretation of the results will be done following the results numbers from 1 to 7 from ***Table 21***.

- **Insight 1:** From the first analysis one can read that in each of the 502 regression analyses, the alpha of the regression shows a number different than zero, indicating that there is an aspect that the already known factors (Carhart Momentum Factor + 3-Fama-French Factors) are not taking into account which leads to abnormal returns. On top of this, the alpha is statistically significant in 6.6% of the cases in FactSet and 6.2% of the cases in Bloomberg. Further, 75% of the cases in FactSet account for a positive alpha, being the number in Bloomberg drastically lower with 42%. Even though these numbers are not too high, they permit the study to continue forward trying to examine if it is the ESG factors the one that might have an impact on the excess returns of the portfolios and if this relationship is positive (FactSet 75% could indicate so) or negative (Bloomberg 42% indicate so).
- **Insight 2:** In a second step of the first analysis, thanks to just taking into account the top 25% scoring companies for each of the factors and building a portfolio with each of them (28 regression analysis), the results show differences regarding FactSet and Bloomberg. In the former case, only having 8 out of 28 factors having a significant alpha would indicate that actually ESG factors may not be the only aspect contributing to the excess returns in the portfolios, but that at least 1 out of 4 are. In the latter case, in Bloomberg, all of the factors (4 factors and 4 regression analysis) show significant alphas leading to the conclusion that the ESG factors could be explaining this. The next difference again is that FactSet has positive alphas (8/8) and Bloomberg has negative alphas (4/4). So that one indicates that the higher scores in a factor the higher the excess return, while the other suggests the higher the ESG factor scores, the lower the excess return one gets. This indicates controversy and shows that depending on the dataset used one can obtain different and opposite results. It is because of this that the next step of the analysis

aims to shed more light on which of the datasets might be more reliable or if both or none.

- **Insight 3:** When looking at excess returns one also has to look at the other side of the coin, namely the risk that comes associated with that excess return. It is for that reason that a good metric to evaluate the trade off is the Sharpe ratio. And it is here where both data sources show similar results. In both, the Sharpe ratio is slightly negative being rounded to zero. Only in Bloomberg the social factor shows a slight positive behaviour but that rounded also is zero. For the negative cases, even though they are almost zero, this means that the risk-free rate is slightly greater than the portfolio's projected return. In terms of risk-adjustment this means that higher return comes with an even higher risk when comparing in between regression analysis. So that, the risk the portfolios are encountering is not being offset by its return (the higher the Sharpe ratio the better). As the numbers are almost zero, this means that the returns are around the same as the Risk-free rate. Consequently, the investment is not generating any excess return for each unit of risk taken, relative to the risk-free rate.
- **Insight 4:** The second regression analysis focuses on giving a response to the differences between top 25% scoring companies portfolios and others. Studying the significance of the beta of the dummy variable indicates that in FactSet only in 5 out of 28 regression analysis and therefore factors the beta is significant and in Bloomberg only in 1 out of 4 regression analysis. This leads to the conclusion that generally (most of the cases) there is not a real difference between being categorized as a top 25% company compared to not being one. So that, this dummy variable does not really explain the excess returns found in the portfolios.

  Further, the dummy variables that are significant, show a negative number indicating that if this factor is to explain the excess returns the effect is actually the contrary as expected: being better positioned actually has a negative repercussion in the excess return of the portfolio.
- **Insight 5:** Looking now at the construction of an ESG factor to set a final decision on the correlation, if any, between risk and return and ESG topics, the first insight acquired shows, that 26% of the betas in FactSet and 20% in Bloomberg show a statistically significant beta in the ESG factor explaining the excess returns of

portfolios. In FactSet from the 73-regression analysis with a significant beta 27 show a positive number and 46 a negative. This leads to assuring that the correlation between returns and ESG factors is reverse and that having better scores does not lead to higher returns, but the opposite. In the case of Bloomberg, the results show similar findings, namely 7 out of the 8 significant betas are also negative.

- **Insight 6:** Looking now into the sectors that have had more ESG factors impacting them, similarities and differences appear in between datasets. From FactSet we conclude that the Energy sector is the one that is most impacted by ESG factors namely in 14 out of the 28-regression analysis run against this portfolio it showed a significant beta. Regarding if the correlation is positive or negative, we can see that it is 50-50 and it depends on the ESG factor (there are environmental, social and governance factors that show positive or negative correlation with this portfolio, so no pattern can be extracted). Regarding the energy sector in Bloomberg, it also has 1 positive beta namely when being run against the environmental factor. As this is the case in both datasets a conclusion gathered is that the environmental factor has an impact on the energy sector in a positive correlation, meaning the better it scores here, the higher the excess returns.

  In FactSet, we then have other sectors with significant betas but since the content of this sector is not defined, no conclusions can be extracted from this one. The utilities sector has been impacted in 8 of the 28 regression analyses run against it, having 62.5% of them a positive beta. In the case of telecommunications, it's the reverse where in 5 out of the 8 cases (62.5%) it has had a negative beta. Here, one can state that depending on the sector the same factors can influence positively or negatively. Utilities companies due to having a lot of regulations and having to comply with many environmental and governance laws, has probably therefore a positive correlation between higher scores and a higher excess return, while telecommunications do not have such strict laws, so therefore the extra investment in ESG does not pay off and the relationship is mainly reverse. Sectors where barely an impact has been measured is non-Durables. Why this sector has no correlation with the ESG factors is a point that could be studied in further research and will be mentioned in next steps.

In Bloomberg, the ESG general factor has had a negative impact in the sectors of a) Durables, b) Manufacturing, c) Energy, d) High Tech, e) Health, f) Utilities and g) Others. What is interesting is that in Bloomberg Telecommunications has no significant effect unlike before with FactSet. Here once, again depending on the dataset different outcomes can be found.

- **Insight 7:** Last insight resulting from the third analysis is in regard to which factors have impacted the most the different portfolios in terms of quantity. In FactSet, it has been "Employee, Engagement, Diversity & Inclusion" (with 8 significant betas), "Management of the Legal and Regulatory Environment" (with 6 significant betas) and "Energy Management" (with 5 significant betas). As already mentioned before in the results section, the first relates to Social and Governance topics, the second to Governance & Environmental topics and the third one to Environmental topics. So that, Governance & Environmental topics are the ones that have a higher impact. The first two factors have a negative relationship with the portfolios and the latter (environmental) has a positive relationship in all of the cases. From this one can read that in the case of Environment when talking about Energy it is the factor with the highest impact and also it is this same sector the one that has been impacted the most by the ESG factors, so there is a clear outcome on Energy and risk and return.

  Regarding Bloomberg, it provides further evidence on the positive beta of environmental factors and on top of it on the portfolios of energy. Social factor has no statistical significance again and the general ESG factor shows a negative correlation with the already mentioned industries.

Having obtained these insights, they will now be compared with the literature review before proceeding to make conclusions and recommendations.

6.3. Comparison of findings with existing literature

Before comparing the insights and results gathered from the quantitative study conducted, a brief summary of the findings in the literature review will be presented.

Throughout recent years more and more companies have been occupying themselves with topics regarding CSR and ESG practices. As stated before, in 2018 around 86% of the

companies of the S&P500 had published reports on it compared to the rough 20% in 2011 (Governance & Accountability Institute Inc, 2019). One of the reasons behind this upward trend is the debate about the impact ESG and CSR matters have on companies' valuations. In this environment, several research and studies have resulted in a general controversy whether the correlation between ESG and financial performance as well as risk is positive, negative or non-existent.

From the readings and with a few notable exceptions, the general statement regarding risk supports the fact that higher ESG scores benefit from lower risk and therefore a lower capital cost. In regards, to return there is much more disagreement than on the matters of risk:

- **Positive Return Correlation**: One school of thought argues that there exists a positive relationship between return and high ESG scores. Albuquerque et al. (2018) and Bénabou et al. (2010) state that as consumers have the preference of doing business with companies that practice good corporate citizenship as a result the good ESG metrics can boost a company's value. On top of that less taxes and incentives by law can be observed and should be taken into account. The question on which of both metrics influences the other first is also debated: ESG reputation (doing good) leading to better firm performance (doing well) or performing firms (doing well) leading to a better general reputation (doing good). Not minding the causality, the statement is clear that the outcome should be better. Further, Statman & Clushkov (2009) did an analysis using KLD ratings on a U.S. firm sample and found too a positive relationship between ESG ratings and firm performance, resulting in portfolios composed of firms with higher ratings outperforming the ones with lower. Important to mention is that in between all the ESG factors, the one that actually outperforms the other two is governance (Starks., 2009) & (Duuren, Plantinga, & Scholtens, 2016). More people invest in this factor due to having more information on it. This is further supported by Tsang, Frost, & Cao (2023) who argue that its studies related to governance the ones that have been most written about in the past 30 years. As for that more people invest in these.
- **Negative Return Correlation**: Another school of thoughts has proven that higher corporate ESG ratings are linked to negative future stakeholder returns and a lower

corporate ROA (Di Giuli & Kostovetsky, 2014). The higher scores in ESG matters comes at the expense of firms' value.

- **No Return Correlation**: A last school of thought argues that there is actually no significant correlation between ESG higher scores and higher returns. Friede, Busch & Basen (2015) proved in research with more than 2000 empirical studies that "roughly 90% of studies find a nonnegative ESG–CFP relation" and if then positive. In the study of Schröder (2006) similar results were achieved using 29 SRI stock indices: there is lack in the difference of risk-adjusted return between SRI indices and the benchmark ones, actually showing a higher risk. Lastly, in the research of Fisher, Vanden and Thorburn (2011) they state that this lack of correlation is specifically found in companies scoring higher in environmental commitments, in the others the correlation is most likely negative.
- **Negative Risk Correlation (lower risk):** Authors such as Gillan, Koch & Starks (2021) have found that the stronger the ESG profile and the higher the ESG scores the lower the systematic risk. Further supported by Albuquerque, Koskinen and Zhang (2018), a framework is given explaining that thanks to the little price price-elastic demand in high ESG scoring companies, less systematic risk is obtained.
- **Positive or No Risk Correlation (negative or no additional risk):** Here authors state that depending on the market situation there can be a positive or no risk correlation. In strong markets the excess return comes with a higher risk so that it does not outperform the benchmark (Nofsinger & Varma, 2014). Further supported by Humphrey, Lee, & Shen (2012) with a study on UK firms where no evidence was found whether firms' CSP ratings have any significant financial cost or benefit in terms of idiosyncratic risk.

Having presented a recap of the literature review, the comparison between this and the insights of the quantitative study will be done in ***Table 22*** for easier understanding.

Table 22. Comparison Table on Literature Review Insights and Regression Analysis Insights.

	Quantitative Study	Literature Review
Insight 1	Alpha different than zero. Significant in ~6% of the regression analysis. 75% positive alpha in FactSet vs 58% negative alpha in Bloomberg	Alpha represents the performance that cannot be attributable to any of the factors used in the regression analysis. Since 3-Factor-Fama French Model could not explain them all, Carhart Model was formulated and then 5-Factor-Fama French Model.
Insight 2	Only looking at portfolios with top performing companies related to ESG scores; 8/28 and 4/4 significant alphas (positive 8 and negative 4)	Both literatures can be found supporting FactSet case and Bloomberg case: on a U.S. firm sample a positive relationship between ESG ratings and firm performance has been found while another study in the U.S. shows the opposite negative correlation.
Insight 3	Regarding risk, in both datasets the Sharpe Ratio is negative to almost zero indicating that actually the investment is not generating any excess return for each unit of risk taken or that in case of negative is actually lowers the return.	The literature review supports this statement with evidence from other studies where it shows that in strong markets the excess return comes with a higher risk, so that it does not outperform the benchmark and that there is no strict evidence on the correlation between both.
Insight 4	Having a dummy factor that should explain the better return of top scoring companies in ESG factors, has proven to fail. No general significance in the beta and cases were significant it is negative, so better ESG scores show reverse return trade-off.	Literature review proves both that there is no correlation as stated before and that in most cases it can be negative meaning that high scores in ESG matters do come at the expense of firms' value.
Insight 5	ESG Factor was created: between 20-26% of the betas show a statistically	Again, backed up with literature review, other studies have also proven that

	significant beta meaning that ESG factors could explain the excess returns in the portfolios. In both, FactSet and Bloomberg, the beta of these is mostly negative indicating a reverse relationship between ESG scores and portfolio returns.	existing a relationship between return and ESG scores, this is negative: higher ESG ratings are linked to negative future investor returns.
Insight 6	Energy sector is the most impacted in FactSet and the environmental factor has the highest impact on it. The beta is positive meaning that higher ESG score in environmental (energetic factor), the higher the portfolio return of the industry of energy. Depending on the sector the same ESG factors can influence positively or negatively. In Bloomberg, general ESG factor shows a negative impact on the sectors.	Different to the results found, the literature review states that in companies with higher scoring in environmental factors, there is actually no correlation with excess returns and in case of having it is most likely negative. The controversy between datasets and impact of ESG factors on the different industries is further proof of the general existent debate on the impact of ESG scores in risk and return.
Insight 7	Governance is the factor that has had most times an impact on the portfolios of the different industries (significant betas), followed by Environmental. Governance has a negative relationship with the return and environmental positive again. Social does not really have statistical significance.	Literature review states that Governance factor has the highest impact on return metrics since it is the factor about the one most has been written about in the past decades and is therefore the most well-known. Regarding Environmental factor having an impact as already stated in the Insight 6, actually literature review indicates there is no impact and if negative. No specific comments have been found on the social factor.

6.4. Discussions of implications and significance

From the above table and the results and insights sections, one can come to several conclusions.

It is expected that the alpha of a regression analysis is different than zero since until now there has not been a model created that contains all the factors that can explain the excess returns of portfolios. As for that, this study aims to examine if the ESG factor can actually explain part of this excess return. There exists controversy within the quantitative study depending on the dataset if the correlation between return and ESG factors is positive or negative. This is a perfect proof of the debate that has already been generated in the society around this topic. Depending on the sector the same ESG factors can influence positively or negatively. It leads to conclude that there are more factors involved that should explain a portfolios excess return since the explanation of the ESG factor depends on too many metrics (dataset, time of study, companies, industries, ESG scoring procedure, etc.). The quantitative study indicates and gives further proof on the school of thought of the relationship between ESG scores and returns, in the cases the beta is significant, is negative. This means that higher ESG scores are linked to negative future investor returns. Regarding the environmental score, there exists controversy between quantitative and qualitative study. The former indicates that the higher the environmental score (energy management) is on sectors such as the energy sector, the higher the portfolio return. The latter suggests that in general a higher scoring in environmental factors does not show a correlation with the excess returns and if there is one it should be negative. On the Governance factor again literature and regression analysis come to the same conclusion that this factor has the highest impact on return metrics since it is the factor that has been most talked about in the last decades plus the most well-known topics.

Regarding risk and ESG correlation both quantitative and qualitative studies show that there is either no risk or a higher risk involved in the higher excess returns of the portfolios. Id est, that the excess return comes with a higher risk that does not outperform the benchmark.

7. Conclusions & Next Steps

7.1. Recap of Objectives and Research Questions

Once concluded the thorough analysis on the literature review and the several regression analyses run on two different datasets (FactSet and Bloomberg) conclusions will be stated. The aim behind this investigation was to explore if there exists any correlation between risk & return and ESG factors on enterprises of the S&P500 and 10 industry portfolios and, in case of existence, this correlation is positive or negative. More specifically, to determine the positive or negative effect of the ESG Factors on the risk and return as well as the degree of impact on them, different servers and data has been used to enrich the results. Consequently, a comparison between these two has been made and goal is to present recommendations on the impact of the metrics on the companies and which ESG scoring company factoring is more accurate. Lastly, further recommendations are made on the insights gathered with the aim to facilitate ESG investments and portfolio building.

7.2. Conclusions and Recommendations

Over the past few decades, more and more people and societies have raised interest and awareness on topics such as sustainability, social well-being, and corporate governance. Consequently, several firms and companies in the financial sector have been forced to adopt sustainable and responsible investments (SRI) in order to cope with the needs and asks of investors as well as regulations. Nonetheless, high controversy and debate has been generated about the real implications of sustainable and responsible investments. Namely, it is the case that several different studies and research have demonstrated opposite views on the impact of ESG factors on companies' valuations. Some argue that integrating ESG policies and strategies can benefit the company from a better market valuation and a less associated risk, while others take the opposite approach and actually state that companies incur in higher risks and lower valuations.

The different regression analysis as well as the literature review have shed light on this topic and the conclusions and recommendations extracted from the discussion in the previous section are presented.

- All in all, the main conclusion is that the current models are not able to explain the excess returns of portfolios and therefore significant alphas appear in the regression analysis. As for that, an ESG factor has been proposed to determine if this factor could enrich the current models and give an explanation to the excess returns and risk associated with them. Conclusion is that in most of the cases there is no statistical relevance to state that there is a correlation between ESG factors and return. Nonetheless, in 20% to 26% of the cases there is a significant beta meaning that in 1 out of 4/5 cases one can explain the excess returns of portfolios with this ESG factor.
- Regarding the question on whether this correlation is positive or negative, there exists controversy in the literature review as well as in the quantitative study. Depending on the dataset the correlation between the return and the ESG factors is positive or negative. This proves that the study has limitations, and that literature is correct in having different school of thoughts on the outcome of this relationship. There have to be more factors apart from the ESG ones that should explain the excess returns. Also, the scoring technique used in each of the datasets has an influence as well as the companies selected, the timings and other aspects. Nonetheless, making a general analysis, most of the cases of significant beta in both datasets show a negative correlation between ESG factors and return of portfolios of the 10 industries.
- Conclusions on which factors do have the most impact on the portfolios are controversial between literature review and quantitative study. In the regression analysis, the factor of energy management categorized as environmental has proved having most significant betas. Specifically, on the portfolio of the energy industry the impact has been high. With this the conclusion reached is that environmental factors do have an important effect on portfolios and companies related to environmental works. Nonetheless, literature states the contrary, saying that in general companies scoring higher in environmental factors do not show a positive correlation with the excess returns.

  For the governance factor impact on excess returns, both qualitative and quantitative research agree: it has the highest impact on return metrics since it is the factor most well-known by society since it can be found in more papers compared to the other factors. Recommendation therefore is to watch out specifically for portfolios that contain governance factors in this case.

- Lastly, regarding risk and ESG correlation both quantitative and qualitative studies show that there is either no risk or a higher risk involved in the higher excess returns of the portfolios. Id est, that the excess return coes with a higher risk that does not outperform the benchmark.

Bearing all of these points in mind, the study concludes that in most cases there is not a direct significant relationship between ESG factors and firm valuations, but that in 1 out of 4 cases this relationship actually shows a significant negative correlation. Factors related to governance show a high impact and environmental factors impact portfolios related to environmental work the most. Regarding risk, the trade off with return is not outweighed and either no additional risk (zero Sharpe ratio) or higher risk that does not outperform the benchmark can be found (negative Sharpe ratio).

7.3. Next Steps of Future Research

Given the broad scope of the subject and all the different factors that can influence the results of the studies, it has not been possible to give a 100% clarification on the topic in this final degree work, so there are several future points of analysis and discussion that can be developed to reach further conclusions and acquire more evidence on the findings stated in the present work:

- Further study the correlation between return and the environmental factors in regard to environmental companies as well as other industries to proof if the relationship is positive or negative (quantitative versus qualitative statements).
- Broaden the scope of the analysis by bringing in further data sources and not limiting the study to only two datasets. Here also a comparison on the procedure to score companies in each factor should be made to better understand what is impacting the most the factors.
- Broaden the scope of the analysis by bringing in further companies and portfolios to study (vs. S&P500 and 10 industry portfolios).
- When measuring the direct excess return of portfolios also taking into account other benefits that are not reflected in the valuation of firms but that could provide for a reason to invest in sustainable investments such as taxation (usually lower for eco-friendly companies), regulations (usually less strict for eco-friendly

companies), more incentives (donations and financial aids for eco-friendly companies), a higher resilience (in case of unexpected ESG catastrophic events for eco-friendly companies), etc.

- Further study on why the social factor has the least impact on excess returns.
- Study why the Non-Durables Sector is the only one showing no correlation with the ESG factors.

Annexes

In this section, one can find snippets of the code used to run the different regression analyses. In case the reader is interested in further information or the whole script, please do refer to the author of this work.

1) Data upload of Fama French Factors to Python:

```
famafrench = pd.read_csv('3famafrench_def.csv', skipfooter=1,
engine='python')

famafrench['Date'] = pd.to_datetime(famafrench['Date'],
format='%Y%m%d')

famafrench=famafrench.set_index('Date')

famafrench.head()
```

2) Regression Analysis on portfolio S&P500 companies FactSet:

```
# Define dependent variable (excess returns for each company)
y = regression_prep.filter(regex='^x_') #like='x_',
y.head()


# Define independent variables (market excess return, size, value,
momentum)
X = regression_prep[['MKT_RF', 'SMB', 'HML', 'Mom']]


# Add constant to independent variables
X = sm.add_constant(X)

# Run regression for each company
results = []
double_res = pd.DataFrame()

param = {}
for i, col in enumerate(y.columns):
    model = sm.OLS(y[col], X).fit()
    results.append([col, model.params[0], model.params[1],
model.params[2], model.params[3], model.params[4], model.rsquared,
model.pvalues[0]])
    param[col]=model.summary()
    double_res.loc[col, 'Alpha'] = model.params[0]
    double_res.loc[col, 'p-value'] = model.pvalues[0]
```

```
# Convert results to pandas dataframe

results_df = pd.DataFrame(results, columns=['Company', 'Alpha',
'Beta_Mkt', 'Beta_SMB', 'Beta_HML', 'Beta_Mom', 'R_squared', 'P-
values'])

results_df= results_df.round(4)

# Print regression results
results_df.head()
```

3) Factor ESG calculation:

```
factor_esg = return_portfolios_top[sheet_name]['return_port'] -
return_portfolios_bottom[sheet_name]['return_port_bottom']

factor_esg = pd.DataFrame(factor_esg, columns=['factor_esg'])
```

4) 10 industries regression analysis (LinearFactorModel):

```
industry10prep = factormodel4_monthly.join(factor_esg ,
how='inner') #hacemos un join
industry10prep = industry10prep.join(industry10, how='inner')

portfolios3=industry10prep[['NoDur', 'Durbl', 'Manuf', 'Enrgy',
'HiTec', 'Telcm', 'Shops', 'Hlth', 'Utils', 'Other']]
factors3 = industry10prep[['MKT_RF', 'SMB', 'HML', 'Mom',
'factor_esg']]

mod3 = LinearFactorModel(portfolios=portfolios3, factors=factors3,
risk_free=False)
res3 = mod3.fit(cov_type='robust')

# Save results of 10 industries
factor_results_10industries[sheet_name] = res3.full_summary

# Extract the beta and p-value for factor_esg
beta_factor_esg = res3.params['factor_esg']
pvalue_factor_esg = res3.pvalues['factor_esg']

# Create a new DataFrame row for factor_esg
factor_esg_result = pd.DataFrame({
            'Sheet name': sheet_name,
            'Portfolio': portfolios3.columns,
            'Beta_factor_esg': beta_factor_esg,
            'Pvalue_factor_esg': pvalue_factor_esg
             })
```

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