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The relationship between ESG ratings, investment factors, and credit ratings

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Master in Business Economics and Competition

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PhD, María Folqué González-Valerio, Head of Sustainability,
FundsPeople

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Resumo

O investimento responsável, a abordagem de investimento que considera os critérios *Environmental, Social e Governance* (ESG), é cada vez mais relevante nos mercados financeiros. Conseqüentemente, as agências de *ratings* ESG tornaram-se num *player* fundamental. Uma vez que o ESG e o investimento por fatores estão a tornar-se mais relevantes para a indústria de gestão de ativos, a questão científica desta Dissertação investiga a relação que os fatores de investimento e os *ratings* de crédito podem ter com os *ratings* ESG.

A base de dados inclui *ratings* ESG da Sustainalytics e Refinitiv Eikon, fatores de investimento da Morningstar, e *ratings* de crédito da Thomson Reuters. A nossa amostra contém 825 empresas cotadas publicamente nos EUA em 2021. Para examinar a relação, realizámos uma análise descritiva e de regressão. A análise descritiva inclui a análise da estatística descritiva, matriz de correlação, e *scatter plots*. Incluímos também uma análise setorial para ver que setores têm melhores ou piores *ratings* ESG. Finalmente, dividimos a nossa amostra tendo em conta as 25% piores e melhores empresas em termos de *ratings* ESG a fim de tirar conclusões mais concretas. Na análise de regressão, realizámos regressões robustas envolvendo o método Newey-West.

Os resultados da presente Dissertação sugerem que um gestor de ativos, ao ter em conta empresas com determinados fatores de investimento, ou com *ratings* de crédito mais elevados, pode estar a adicionar *alpha* enquanto tem um portefólio alinhado positivamente com melhores *ratings* ESG. Os resultados são mais claros relativamente ao *rating* ESG da Refinitiv Eikon.

Palavras-chave: ratings ESG, ratings de crédito, investimento por fatores, investimento responsável, alocação de ativos

Classificações JEL: G11, M14

Abstract

Responsible investing, the investment approach that considers Environmental, Social, and Governance (ESG) criteria, has been gaining relevance in the financial markets. Consequently, ESG rating agencies have become key players in the field of responsible investment. As ESG and factor investing are becoming more important to the asset management industry, we investigate the relationship that investment factors and credit ratings may have with ESG ratings overall, and individual pillars.

The dataset includes ESG ratings from Sustainalytics and Refinitiv Eikon, investment factors from Morningstar, and credit ratings from Thomson Reuters. We use a sample of 825 publicly-listed firms in the U.S. at the end of 2021. To examine the relationship, we conduct a descriptive and regression analysis. The descriptive analysis includes analysis of the general descriptive statistics, correlation matrix, and scatter plots. We also include a sectorial analysis of firms to see which sectors have, on average, better or worse ESG ratings. Finally, we split our sample taking into account the 25% worst and best companies in terms of ESG ratings in order to draw more sample-specific conclusions. In the regression analysis, in order to analyse the relationship of our variables, we conduct eight robust regressions involving the Newey-West method.

Our findings suggest that an asset manager, by investing in companies according to certain investment factors, or sectors, or with higher credit ratings, may be adding alpha while having a portfolio positively aligned with better ESG ratings. The results are more conclusive according to the Refinitiv Eikon ESG Rating.

Keywords: ESG ratings, credit ratings, factor investing, responsible investment, asset allocation

JEL Classification System: G11, M14

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List of acronyms

ESG – Environmental, Social, and Governance

UN – United Nations

CSR – Corporate Social Responsibility

GRI – Global Reporting Initiative

SASB – Sustainability Accounting Standard

TCFD – Task Force on Climate-Related Financial Disclosures

CDP – Carbon Disclosure Project

U.S. – United States

NYSE – New York Stock Exchange

OTC – Over-the-counter

SS – Size Score

MS – Momentum Score

VS – Volatility Score

VGS – Value/Growth Score

QS – Quality Score

YS – Yield Score

E – Earnings

BV – Book value

R – Revenue

CF – Cash flow

D – Dividend

W – Weighted average

ROE – Return on Equity

1. Introduction

Today, almost every economic agent cares about sustainability, from investors to companies. If in a not-so-distant past profit was basically the main goal of these agents, today, profit is certainly present, but within certain conditions. These conditions include the actions of economic agents having a positive and sustainable impact on society. Companies, investors, and all stakeholders involved in the supply chains are changing their mindsets and, at the moment, they are concerned with integrating sustainability factors while creating economic value. What has driven this change? Mainly regulatory pressure and raising environmental and social awareness of society.

The term ESG has defined the criteria to be taken into account by companies and investors who wish to introduce sustainability concerns into their business activities and into their relationship with capital markets. Whether Environmental (E), Social (S), or Governance (G), these factors are already and will be increasingly on the research agenda becoming more decisive when it comes to the time to invest. This means that, currently, investors are not only interested in financial indicators but also in sustainability metrics. This integration is related to the inclusion of ESG factors in investment decisions, an approach better known as ESG investing or responsible investing. In fact, this broad investment approach is becoming increasingly popular among asset managers. Its objective is, generally, to contribute to sustainable development, for example, by promoting a resource-efficient economy, or simply by investing in companies that minimize negative impacts on the environment and society (Fan & Michalski, 2020).

The final goal of asset managers is to have better returns than a specific benchmark, but, driven by investors' demand and preferences, they have been pushed to care about whether their investment has an ESG tilt. In this venue, they tend to avoid investing in companies operating in controversial sectors, such as tobacco, carbon extraction, and weapons, among others. These sectors either violate specific norms or don't align with ESG values. In line with this approach, investors may decide to invest only in companies that achieve the best ESG scores. To do this, however, investors need extensive and high-quality quantitative and qualitative data about how sustainable the companies in their portfolios are (Sipiczki, 2022). This explains the emergency of ESG ratings and well-known rating agencies whose objective is to assess ESG risks (or ESG performance) of the companies. They offer tools for investors to measure how a company adopts good (or bad) ESG practices. The better the ESG performance, or the lower the ESG risk, the better the score/rating obtained.

Given the need to know more about ESG investing, the primary focus of this Dissertation is to investigate whether or which investment factors have any relationship with ESG ratings and whether or how credit ratings relate to these ESG ratings. Therefore, our main research question is: what is the relationship between investment factors and credit ratings with ESG ratings? Our secondary research objectives are: (i) understand the main concepts behind ESG ratings, investment factors, and credit ratings; (ii) comprehend how ESG ratings, factor investing and credit ratings are built; (iii) understand how these three areas relate to each other; (iv) check whether ESG can be considered an investment factor itself; (v) observe whether credit ratings are already incorporating ESG factors in their methodologies; (vi) assess whether asset managers are highly exposed to a certain investment style or sector while investing according to ESG ratings; and (vii) determine whether an asset manager wanting to invest following some financial characteristics of firms, which would also imply investing in highly rated ESG companies.

Though there are already some reference papers on ESG ratings, factor investing, and credit ratings, much less is known about the interconnection of these three areas.

A deeper knowledge of the relationship ESG ratings may have with investment factors and credit ratings is extremely relevant in our opinion. First, understanding the relationship between investment factors and credit ratings with ESG ratings contributes to more financial literacy in the ESG research camp, which is currently growing and has become a very relevant topic. Second, this knowledge could help asset managers and investors. That is, if an investment factor is highly correlated with an ESG rating, this information could be valuable for asset managers. They could decide, for example, to invest in larger companies, with lower volatility or with higher credit ratings, given that this could also imply selecting companies with better ESG ratings. The market opinion that smaller companies may have such good ESG ratings as larger companies is recurrent, but is that the case? And, does choosing companies with better credit ratings imply choosing companies with better ESG ratings? These and other questions will be addressed in this Dissertation. Moreover, the investigation of how two mainstream ESG ratings differ can help asset managers to understand each rating approach, and to recognize the differences and similarities between them. This knowledge can facilitate the implementation of more informed investing approaches.

Another example of how our research could contribute to the work of an asset manager could be the following: when building portfolio allocation, knowing that an investment factor would be highly correlated with an ESG rating, the professional could select an ETF of that investment factor and, at the outset, would know that they would be choosing companies with better or worse ESG ratings. It's clear that a good ESG rating matter because companies (and investment funds) "that score well on ESG metrics are believed to better anticipate future risks and opportunities, be more disposed to longer-term strategic thinking, and focused on long-term value creation" Sepe (2022: 1).

We do not expect all investment factors to have any relationship with ESG ratings, because these factors have very distinct characteristics among themselves. We rather expect at least one ESG rating to have a significant relationship with at least one of the investment factors. In this way, we would be able to answer the research question and state that by the end of 2021, if a fund manager wanted to do a quantitative filter to choose companies based on a certain investment factor, this would also imply choosing companies with a better or worse ESG rating.

Consequently, this Dissertation will focus more on the concept of ESG, explaining why this is relevant and how it is interlinked with the other two themes under study. To give a structural answer to the questions and objectives we mentioned above, the present Dissertation is organised as follows: Chapter 1 introduces the three themes under study; Chapter 2 reviews the main literature; Chapter 3 presents the data and the variables used; Chapter 4 describes the methodology behind our investigation; Chapter 5 shows the results and the discussion of them; and Chapter 6 summarizes the main conclusions and some limitations we had.

1.1. Contextualization of the themes

The term ESG encompasses three pillars of criteria: Environmental, Social, and Governance. Within each of these pillars, there are several parameters to be measured depending on the company or the industry. Within the E criteria, these can range from water management to energy consumption to biodiversity. The S factor includes criteria such as employee diversity, human rights, or safety conditions. Finally, G issues are all those related to company management: from the independence of the board of directors to executive remuneration, including risk management. In the investment decision process, the objective is not to look only for these three pillars, but rather to complement them with financial indicators. The purpose of ESG ratings is to classify and compare ESG performance and risks of companies, countries, or other investment assets. For that purpose, they rate firms according to a specific methodology, just like companies are classified by credit rating agencies (Simonek et al., 2021).

But which are the reasons for including ESG factors in investment decisions? We have identified four main reasons supported by academic research – which we will address in more detail in the literature review. First, we should mention the positive effect of ESG on the solvency of companies. If we consider the G criteria, a company concerned about having effective risk management during more turbulent and more volatile times ends up having more resilience and confidence from investors. The second reason is that ESG allows investors to access more complete information about companies. Plus, it is possible to check whether a company is more or less transparent regarding the information it passes to its shareholders.

These two reasons take us to the third: ESG allows investors to have greater control over the impact of investments. For example, a responsible investor with specific concerns can directly choose what type of asset is more aligned with these concerns and the impact on society. Last but not least, we shouldn't forget that this investment segment is gaining increasing relevance, as we will show in the next subsection (Simonek et al., 2021).

Table 1.1 shows a summary of the traditional vs. ESG approach from the point of view of an asset owner, asset manager, and a firm.

Table 1.1 – The relationship among asset owners, asset managers, and firms with ESG

Diferent approaches	Asset Owner	Asset Manager	Firm
Traditional approach	Maximize financial performance	Invest based on financial attributes	Maximizde shareholder value
ESG approach	Align values	Consider ESG attributes	Adjust business model and enhance governance
	Aim for the sustainability of the world	Aim for sustainability of the investment	Enhance Corporate & Social Responsibility (CSR)

Source: Adapted from Desclée et al. (2017)

Another major theme of this Dissertation is factor investing, which is an investment strategy that aims to collect risk premiums through exposure to investment factors, such as value, low volatility, momentum, quality, size, or dividend yield. These factors are the foundation of investing, and many professionals and academics argue that they are important and persistent drivers of return (Bender et al., 2013). Interest in factor investing started, mainly, with Ang et al. (2009), which investigated why the active management of Norway Global Fund was disappointing. They made a major finding: a large percentage of the active management returns could be attributed to these factors alone.

The goal of credit ratings, which is the third main theme of this Dissertation, is to classify the creditworthiness of an issuer, whether a company, a country or a financial instrument. Mainly, credit rating relates to the ESG theme from the perspective of green bonds. However, our focus won't be limited to green bonds but whether they have any specific relationship with ESG ratings.

1.2. Relevance of the themes

Sustainable investing and ESG criteria have been gaining traction since 1990s, with the creation of the Dow Jones Sustainability Index. This was the first equity global index to introduce ESG criteria (Schmutz et al., 2020). The companies in this index are not only the largest in terms of market-cap, but they also have to meet minimum levels of ESG criteria to be included. Later, in 2006, the United Nations (UN) supported the 6 Principles of socially responsible investment (UN PRI) to encourage companies to disclose more ESG information (Sievänen et al., 2013). In 2015, a more in-depth approach was pursued. The UN launched the 2030 Agenda, which comprises the 17 Sustainable Development Goals. This

framework consists of a series of initiatives with three main goals: eradicate poverty, protect the planet, and redress inequality. The main idea is that all market players who contribute to these goals could be more valued by investors, who will also have more certainty about the fate and impact of their investments (Sætra, 2021).

Regarding the evolution of this megatrend in terms of data, various surveys, studies, and data are published frequently. Morningstar (2022) data show that of the nearly 2.8 trillion of dollars invested globally in sustainable funds, almost 2.3 trillion were in Europe. That is 82% of the total asset volume. The United States accounts for 12%. In fact, Europe is not only a leader in socially responsible investment in terms of assets under management, but the region also leads in terms of flows and in number of funds. By number of products, Europe is the region with the largest number of registered ESG funds. At the end of March 2022, it had almost 5.000 ESG funds, representing 77% of the total. The United States had 555 (9%).

Although investing with ESG criteria is gaining interest globally, it is not growing at the same pace in all regions and has different starting points in some areas. The Capital Group ESG Global Study (2022) show that the adoption of ESG factors is now widespread, with the proportion of ESG users increasing to 89%, up from 84% in 2021. Europe has the highest percentage (93%), while Asia-Pacific experienced the largest increase in ESG users of all regions. The most commonly cited motivations for adopting ESG criteria are meeting client needs and making a positive impact on society. However, North American investors place much more importance on meeting customer needs, while European investors are most motivated by achieving a positive impact. The study also found that Europeans are most likely to view ESG as an essential element of their investment approach, while North American investors are the least convinced about ESG.

Figure 1.2 presents another way to visualize the growing interest of ESG. It shows the amount of interest of individual people by the Google searches for the ESG term. The figure confirms that, in 2020, ESG became broadly popular and that more people are interested in knowing more about this theme.

Figure 1.2 – Google trends search in the last five years for ESG



Source: Author based on data from Google Trends

Companies have also been changing their mindset about ESG issues. This is reflected in the survey that Fidelity (2022) conducts each year among its 160 analysts. Appendix A shows the proportion of analysts that believe ESG awareness is increasing at the majority of companies and the drastic change in terms of sustainability themes. Whereas in 2019, globally, just 30% of companies worldwide acknowledged an emphasis on ESG factors, this percentage is in 2022 close to 80%.

Although not so recent, the concept of factor investing is of increasing interest to investors. According to Invesco (2022), 91% of the 241 investors that participated in the survey state that they use factor investing to optimize or reduce portfolio risk, 85% to improve returns and 65% to better control portfolio weightings. Plus, the study highlights one main trend among factor investors: the rise of ESG. With regard to ESG, 78% of respondents affirmed that they had incorporated ESG considerations into their portfolios, although 41% of investors still consider these criteria to be completely independent of factor investing. According to this study, investors believe that ESG enhances investments performance, for example through the mitigation of risks. However, the study presents a lack of consensus regarding whether ESG should be considered as an investment factor.

The integration of sustainability into risk management leads us to 2019 when the European Union announced the European Green Deal. In this program, it is established the need to incorporate sustainability into credit ratings. With more demand for this integration, the development of methodologies and measures to evaluate ESG aspects of companies has become one of the top priorities for credit rating agencies. This factor explains the recent wave of acquisitions of ESG data providers given the need to incorporate ESG concerns into their credit analysis methodologies.

2. Literature Review

To understand the relationship between ESG ratings, investment factors and credit ratings, we begin by reviewing the foundational literature and concepts supporting these three topics. Furthermore, we also present subtopics in this section with relevant points connecting factor investing and credit ratings with ESG – our main theme. These subsections present literature on the heterogeneity of ESG rating data, which is probably the biggest challenge nowadays in this industry, and how ESG is being integrated into factor investing and credit ratings.

2.1. ESG ratings

The increasing demand for information on ESG factors has made the reporting of information by firms more sophisticated on these topics, but has also boosted the development of rating agencies. In fact, the demand from responsible investors requiring ESG information has led to ESG ratings becoming an essential tool for investors (Avetisyan & Hockerts, 2016). In this context, it is essential for an investor to know the purpose and methodology behind a certain ESG rating.

In its essence, ESG ratings represent a way for investors to obtain a view of a company's exposure, risk, and/or performance on ESG issues. According to Simonek et al. (2021: 355), these ratings can be defined as: "Quantitative or qualitative evaluations of a company, country, financial product or fund, based on a comparative assessment of their approach, disclosure, strategy or performance on ESG issues". Nowadays, with the growth of sustainable investing, these agencies influence the behaviour of companies and investors. In fact, managing and addressing ESG issues has become an essential part of a competitive company, as these issues influence risk management and, ultimately, performance (Galbreath, 2013).

The growth and consolidation of ESG rating providers have already been addressed by Avetisyan and Hockerts (2016). They mention that the development of these agencies has been made through organic growth, partnerships, and/or mergers and acquisitions.

While this market exploded mostly in the last decade, according to Sipiczki (2022), there are at least more than 600 ESG ratings and rankings available around the world. With time, more financial data providers have entered this market contributing to the consolidation of this industry segment. Bloomberg, MSCI, and S&P are some examples. They created full ESG services (like ESG research and indexes) and nowadays provide data and products related to ESG to their clients (Avetisyan & Hockerts, 2016).

For example, according to Eccles and Strohle (2018), Morningstar bought Sustainalytics, and Asset 4 is owned by Thomson Reuters since 2009. “With the jump of these big players into the market, ESG ratings are now solidly in the mainstream, as these companies have resources and very high credibility within the mainstream investment community”, affirms Avetisyan and Hockerts (2016: 16). Figure 2.1 shows in a more complete and visual way the acquisition history in the ESG market. It is evident the significant interest of traditional research agencies in specialized ESG companies.

Figure 2.1 – ESG industry merger and acquisition history



Source: European Commission (2020)

These rating agencies collect ESG data – both quantitative and qualitative – from companies in a variety of ways, like surveys, company reports, company communications, interviews with personnel, presentations, stakeholders, government reports, and with the help of artificial intelligence (Douglas et al., 2017; Simonek et al., 2021). Some of the questions that these ESG ratings will be looking for when evaluating a company are: what are the levels of self-disclosure around ESG metrics; how exposed is the company to significant risks in certain areas; how much has the company been doing to manage such risks; has the company been involved in controversial incidents on any pillar of ESG; or whether the company is well-placed to capitalize on opportunities in this area (Desclée et al., 2017).

But what is the process of building an ESG score? And how does the vast amount of raw information translate into a rating that will influence an asset manager’s investment decision? According to an article of FundsPeople (2021), the first step is to find and transform the raw data input to create the ESG data. Secondly, the potential to turn that ESG data into ESG valuations is critically analysed. Then, these ESG valuations are expressed into higher-level signals, such as ESG scores. The final and fourth step is to design complex models that take into account multiple ESG factors to create a final ESG rating. In addition to these, one of the most crucial steps is to determine which of the ESG factors have the potential to impact a company and by what percentage.

According to FundsPeople (2021), at Sustainalytics, they take into account a company's history of controversies or the country in which the company operates. For example, the risk of a mining operation in Switzerland is not the same as in Venezuela. To address this challenge, ESG rating agencies sometimes incorporate analysts experience into the process, so they have a certain degree of influence in these cases.

As such, this diversity in collecting information can be amplified due to the cultural differences of the companies analysed. For instance, different countries have different S or G best practices, and companies can weigh the factors around that differently, making it hard for these agencies to collect data on some factors. In addition, different industries may not be evaluated in the same way, as E considerations of a bank are not the same as in an energy company's. This leads to ESG rating agencies collecting information from different bases and weighting differently the various ESG aspects they take into consideration, which can result in the rating being a stew of confusing information. On top of this, there is currently no universal standard for defining what are exactly ESG issues. That is, the factors that these ESG rating agencies consider relevant for their methodologies when building their scores can vary from agency to agency. Each provider has a distinct method for assigning company-specific ratings (Li & Polychronopoulos, 2020). The result is a proliferation of scores around the various agencies given to the same company. According to Escrig-Olmedo et al. (2019), this divergence has led to several challenges that need to be addressed, like: (i) lack of transparency, (ii) commensurability, (iii) trade-offs among criteria, (iv) lack of an overall score, (v) and stakeholders' preferences. Some papers that explored this issue are the following: Scalet and Kelly (2010); Delmas and Blass (2010); Escrig-Olmedo et al. (2014); Chatterji et al. (2016); and Liern and Pérez-Gladish (2018).

Table 2.1 shows some ESG data providers available, while it also presents what services they offer. The two providers that we use for this research are Sustainalytics and Refinitiv Eikon. The reason for considering these agencies as ESG data providers is that there could be a high discrepancy between the scores these agencies provide in connection to the same company. For example, in our case, Sustainalytics, which is the rating provided by Morningstar, measures ESG risk. On the other hand, Refinitiv Eikon, with ratings provided by Thomson Reuters, measures ESG performance. This means that with Sustainalytics, the lower the score a company has, the better, since this reflects the fact that the company is managing ESG risks relatively well. As for Refinitiv, the higher score a company has, the better because this means that the company is doing well in ESG performance. Consequently, as they measure different magnitudes, it may be interesting to check whether there are companies with very high ESG performance and, at the same time, that have a high ESG risk, or vice versa.

Table 2.1 – Summary of some ESG service providers

PRODUCT	BLOOMBERG	MORNINGSTAR (SUSTAINALYTICS)	MSCI	LSE (STSE RUSSELL)	THOMSON REUTERS (REFINITIV)	MOODY'S (VIGEO EIRIS)	WORLD BANK
Data	X	X	X	X	X	X	X
Ratings	X	X	X	X	X	X	X
Screening		X	X				
Voting advisory							
Benchmarks	X		X	X		X	
Controversies	X	X	X		X	X	

Source: Adapted from Simonek et al. (2021)

Due to the difficulties faced by the ESG rating agencies, when selecting a rating provider is essential to know the quality and quantity of the data they provide, but also how they access that data, which sources they rely on, and the methodology they use (Douglas et al., 2017). In Table 2.2 we have a general view of the scope of data of our two ESG data providers. Although Refinitiv Eikon has more indicators available, Sustainalytics has a bigger market coverage than Refinitiv. In general terms, the final overall ESG score of a company is the result of adding the scores in each of the key domains or indicators considered by the rating agency (Escrig-Olmedo et al., 2014). Consequently, it is noteworthy to observe the different methodologies adopted by both of these agencies in the context of the different indicators and key issues they consider.

Past research on ESG has focused heavily on the relationship between ESG and a given company's financial performance, mainly investigating whether more sustainable companies or investment funds can deliver higher returns to investors than less green companies or traditional investment funds. In this regard, Engelhardt et al. (2021) have studied ESG ratings and stock market performance during the COVID-19 crisis and found that the highest ESG rated European companies delivered higher returns with lower volatility. This finding regarding volatility will be important to our research, as we will take volatility into account as an investment factor, and our data period will be precisely after 2020. Besides that, they have also found that the S factor was the predominant driver of the returns, suggesting that findings related to this factor may be more relevant to investors. In the same sense, Sharma et al. (2022) find that better ESG scores indicate better financial performance.

Table 2.2 – Scope of the data considered in the methodologies of our ESG rating providers

RATING PROVIDER	TARGET MARKET	MARKET COVERAGE (number of firms)	INDICATORS	KEY ISSUES
Sustainalytics	Investors	more than 6500	70	21
Refinitiv Eikon	Investors	more than 6000	400	178

Source: Adapted from Douglas et al. (2017)

Regarding specific literature related to ESG ratings, Escrig-Olmedo et al. (2019) have addressed how they have been integrating sustainability principles into their assessment processes. Their conclusion is that, in order to give a more complete score to investors, they have been integrating new criteria into their models, mainly within the E and G spaces. Meanwhile, Serafeim and Yoon (2022) find a positive relationship between ESG rating and future ESG news, emphasizing the importance that these ratings have nowadays.

Furthermore, Scalet and Kelly (2010) investigate the impact of these ratings on the behaviour of firms. Scalet and Kelly (2010: 69) primary finding is that “being dropped from a corporate social responsibility (CSR)¹ ranking appears to do little to encourage firms to acknowledge and address problems related to their S and E performance”, suggesting that companies tend to pay less attention to these ESG pillars specifically. Another relevant research is Hughes et al. (2021), which suggests that higher ESG scores have been assigned to bigger companies, as these have more resources to fill out the questionnaires that the ESG agencies send to them.

Meanwhile, Lopez et al. (2020) address the link between sectors and ESG ratings, in the same way we are going to address in this Dissertation. They found out that the sector with the lowest relationship is energy. “The companies in this sector may be harder to evaluate, as they are highly regulated or because significant investments in infrastructure make it harder to identify the relevant ESG risks and the appropriate strategies to deal with those risks”, justify Lopez et al. (2020: 16). According to them, financials, technology, and consumer cyclical sectors are the ones with the highest ESG scores.

As for Chatterji et al. (2014), they have analysed the convergence of certain ESG ratings and found a lack of agreement across different agencies. Moreover, a contributing factor for that is that these agencies are known for being in constant revision of their models due to the complex and dynamic nature of ESG, which can create a problem of comparability.

2.1.1. Divergence of ESG ratings

Even in the face of the growth of the ESG market, challenges still remain for its further evolution. One big challenge is that the resulting ratings given to a firm can diverge from provider to provider, and can

¹ Alternation between the terms ESG and CSR is common. But their difference is that ESG is an external view of the company, and CSR is more an internal view.

be completely unequal (Billio et al., 2020). Most of the literature that we found in this area is about the lack of common agreed standards for ESG measurement.

On this point, Chatterji et al. (2016) take an important first step by analysing how ESG rating providers define what they intend to measure and how they do it. This is particularly important because it is the key point on why these ratings diverge. In a further extension, Li and Polychronopoulos (2020) confirm that this divergence has to do with the different methodologies that each analysis agency uses to evaluate companies. For example, in our case, Refinitiv only collects data from public sources and does not offer any input, while Sustainalytics collects public data, but creates data to combine their own methodology to issue the score (Zumente & Lāce, 2021).

Another relevant paper that analyses the ESG rating criteria and finds heterogeneity is Billio et al. (2020). They share the idea that the alternative definitions of ESG affect the investment industry, companies and sustainable investments, because it can lead to the identification of different ESG portfolios, and consequently the creation of different ESG indices. Also, ESG rating uncertainty, according to Avramov et al. (2022), reduces investors' demand, the risk-return trade-off, and the economic welfare for ESG-sensitive agents. "In the presence of rating uncertainty, investors are less likely to make ESG investments and actively engage in corporate ESG issues", adds Avramov et al. (2022: 664).

Berg et al. (2019) identify three big drivers that create this divergence. First, the raters use different categories, leading to disagreement about what is actually relevant or not for measurement. Second, raters measure identical categories differently. Third, they argue that raters measure different categories with different weights. In fact, Berg et al. (2019) find that the correlation between the ESG ratings given by six different data providers is, on average, 0.54. In contrast, the correlation between the credit ratings of Moody's and S&P is usually 0.99. Brandon et al. (2021) also investigates the average correlations between the ESG ratings of seven different providers in the market and find that it is about 0.45, with the lowest correlation being for the G pillar and the highest for the E pillar. Appendix B shows exactly those differences. It exhibits the average, minimum, and maximum correlation between the seven providers for the 500 companies of the S&P Index. In this Dissertation, we will test the correlation between the ESG Rating of Sustainalytics and Refinitiv Eikon.

If we look at ESG ratings and credit rating methodologies, we can see that credit ratings are largely one-dimensional, since they measure identical financial data, while ESG ratings are multifaceted. We can observe this feature just by looking at the different factors that they gather together. For example, ESG ratings analyse the payment of the CEO; the independence of the board; how is the work environment of the company; how diverse is the company; water conservation; and/or carbon emissions. Plus, ESG rating agencies will weight these factors differently, as one rating agency may think that G is more important in one specific company, while another rating agency may feel that S is more important on a regular basis.

Mackintosh (2018) shares the view that these ratings are a series of opinions by agencies about what really matters for them. Actually, he presents a practical example of this divergence. He picked up the scores given to five companies by Sustainalytics, FTSE Russell, and MSCI. As shown in Appendix C, he found out that Tesla, in E issues, is ranked by MSCI at the top of the industry. In contrast, FTSE came to the opposite conclusion, rating Tesla as the worst carmaker globally on E issues. Such differences are likely to lead to significantly diverse investment recommendations and, therefore, create confusion and mislead investors.

All these papers have the goal of explaining the drivers of the ESG rating disagreement and its possible consequences. This research topic is rich in literature, but various researchers reach heterogeneous conclusions. This literature shows the importance for investors to analyse and understand the methodology and approach adopted by each ESG rating data provider.

Stubbs and Rogers (2012) find that these issues can be addressed by increasing the transparency of the rating agencies. In fact, this disagreement is the reason that sustainability disclosure initiatives have been relevant in minimising rating uncertainty, bringing a clear taxonomy and reporting frameworks. In this regard, we highlight initiatives like the GRI (Global Reporting Initiative) framework, the SASB (Sustainability Accounting Standard Board), the TCFD (Task Force on Climate-Related Financial Disclosures), the CDP (Carbon Disclosure Project), or the Climate Action 100+. Actually, in terms of ESG regulation, which is a very important topic in this area to address this challenge, policymakers are focusing on these three topics. Firstly, information from companies to provide investors with the information that they need to be able to allocate their capital. Secondly, information on investment products in order for investors to easily identify the companies or products that are most likely to allocate their capital to sustainable activities, or that are more able to invest in a transition to more green activities. Finally, taxonomy, so that there is a common definition of sustainability for the whole market (FundsPeople, 2022).

Currently, and according to Candriam (2022), the E taxonomy is the most advanced as it is based on scientific considerations and has defined objectives. The S taxonomy, on the other hand, is still in design and will be based to a greater extent on international standards and values.

However, as the literature indicates, the cause of many of the challenges associated with implementing ESG criteria is a lack of comparable, consistent, and high-quality data. This difficulty affects all asset managers and, to some extent, the entire financial sector. Yet, Christensen et al. (2020) document that more ESG disclosure does not appear to be helping to resolve this disagreement issue. For example, they mention that companies disclosing lost-time accident rates need to be judged on that disclosure, which they argue increases subjectivity and leads to a higher degree of disagreement.

Meanwhile, Tamimi and Sebastianelli (2017) explore the state of S&P 500 firms in terms of ESG disclosure and find that the highest levels of disclosure are on G and the lowest on E metrics. In respect of specific S policies, they find large variability in disclosing data. Their findings also show that large-cap companies disclose more ESG data than mid-cap companies. One possible justification for that is that larger companies have more resources to report this type of information, plus, they have a reputational risk to maintain. In examining transparency among sectors, they find that the financial sector demonstrated less transparency in S metrics, contrasting with the materials, consumer staples, and utilities sectors. This may have to do with the greater pressure that these industries face in reporting their ESG impacts to society, since it is in their best interest to mitigate reputational risk (Tamimi & Sebastianelli, 2017).

Lopez et al. (2020: 35) concluded that “the focus when it comes to ESG ratings should not be on agreeing on a single definition, but on standardization of the data, achieving greater clarity in the labelling of the ratings and more transparency regarding their objectives”. Without standardization of the information passed on ESG performance and risks, there can be many different interpretations from investors and agencies and may, therefore, not help investors and management in the investment analysis process (Douglas et al., 2017; Billio et al., 2020; Simonek et al., 2021).

In sum, this noisy information from ESG rating agencies results in at least two consequences. First is that companies do not understand clearly what to improve around their ESG performance. Secondly, it represents a challenge for decision-makers (Escrig-Olmedo et al., 2010). But this is, apparently, something that does not worry the experts from the ESG rating agencies. In an interview with FundsPeople (2021), the Head of ESG Analysis at MSCI, Aurélie Ratte, said that ESG ratings should be considered only as a benchmark. The professional shares the view that one ESG rating may better suit an investor need, while another ESG rating may better suit another investor view around ESG. In the same interview, Simon MacMahon, Head of ESG Analysis at Sustainalytics, noted that investors that use these ratings should understand what they are measuring, as some agencies measure ESG performance, while others ESG risk.

In the face of these challenges, alternative ESG rating agencies have emerged, characterised by much greater use of artificial intelligence compared to the traditional ESG agencies (Hughes et al., 2021).

The future is still large for this industry and has many challenges – but also opportunities – ahead. The reporting (by companies) and ratings methodologies (by agencies) only has one way to go: further development in the upcoming years, mainly due to investors demand and regulatory pressures, making methodologies more transparent and standardised as possible.

2.1.2. Sustainalytics ESG Rating methodology

Although ESG rating agencies do not disclose to the public their complete methodologies for evaluating companies, in this Dissertation, it is fundamental to know more about the methodologies adopted by both of the rating agencies whose data will be used in this research.

Sustainalytics, a company owned by Morningstar, is a global provider of ESG analysis and ratings, which has the goal of helping investors integrate sustainability factors into their investment decisions. According to Garz and Volk (2018: 6), Sustainalytics ESG Risk Ratings “are designed to help equity and fixed income investors identify and understand financially material ESG-related risks within their investment portfolios and assess how these risks might affect long term investment performance”.

In other words, Sustainalytics ESG Risk Rating measures how well companies manage their material ESG risks. This point of measuring ESG risks makes sense because ESG risks materialise through traditional financial risks: credit risk, market risk, and operational risk (EBA, 2021). Thus, this rating has a clear objective: it intends to measure the potential impact of ESG issues on enterprise value. Because of its nature, it provides a measure of risk that allows to make cross-sector comparisons of companies. That is, companies in different sectors usually have a different set of material ESG risks, and each of those risks has a unique weighting depending on their importance. Besides, there could be some unmanageable risks and the rating distinguishes what those are and what are the risks that are manageable. For example, a pure integrated oil company, due to the nature of the business, can probably not manage all of its carbon-related risks as long as it continues to be an oil company.

In addition to the management of ESG factors dimension, it introduces a second dimension into the methodology: the material ESG risk exposure of a company. “Exposure is evaluated at the subindustry level, enhancing the granularity of the rating compared to other systems, and adjusted at the individual company level to take the specific context into account”, states Garz and Volk (2018: 6). The risk exposure determines which issues are selected and how much these issues contribute to the final rating outcome.

The two dimensions (exposure and management) are finally condensed into a single metric of unmanaged risk which also represents the final rating outcome. To better understand how they arrive at the final ESG risk rating, Appendix D describes the risk rating decomposition of Sustainalytics.

The companies in the universe of this rating are then classified in five categories of ESG risk: (i) negligible, (ii) low, (iii) medium, (iv) high, and (v) severe. A score encompassed between 0 to 10 is considered negligible, from 10 to 20 low, from 20 to 30 medium, from 30 to 40 high, and 40 plus is severe. The lower the score, the lower the exposure the company has to ESG risks. In fact, Garcia et al. (2017) conclude that firms that are most exposed to ESG risks (like energy firms) have the greatest incentive to invest in ESG disclosure to inform shareholders and avoid conflicts of interest.

2.1.3. Refinitiv ESG Rating methodology

The methodology behind the Refinitiv ESG Rating is completely different from the one used by Sustainalytics. Instead of measuring risk, Refinitiv ESG Rating is designed to evaluate a company’s ESG performance, commitment, and effectiveness across 10 main themes. According to the paper that presents the methodology behind this rating, Refinitiv (2022: 3) presents that “the scores are based on relative performance of ESG factors with the company’s sector (for environmental and social) and country of incorporation (for governance)”.

Moreover, the company clarifies that they do not have a model defining what a good or bad sustainable metric is. The agency extracts ESG company data from their annual reports, website, stock exchange filings, corporate social responsibility strategy, news, and NGO website.

Refinitiv Eikon, similarly to Sustainalytics, also takes into account ESG materiality weightings. Each metric materiality for each industry has its own importance, and the transparency with which a company reports the ESG data is also evaluated. The agency considers more than 630 company-level ESG factors, which an analyst manually picks for each company. From those 630+ ESG measures, ESG scores are finally calculated based on a subset of metrics found in company public disclosures. “These are grouped into 10 categories that reformulate the three pillar scores and the final ESG score”, documents Refinitiv (2022: 6). In the end, the ESG overall score represents the relative sum of the E, S, and G category weights. Table 2.3 shows in a more visual way how this can be represented and each weight for the 10 themes. These weights vary from industry to industry for the E and S categories. Appendix E describes the interpretation of Refinitiv ESG scores.

Table 2.3 – Refinitiv ESG Rating composition and weight

ESG Score		
Environmental	Social	Governance
Recourse use (20%)	Workforce (30%)	Management (35%)
Emissions (28%)	Human rights (8%)	Shareholders (12%)
Innovation (20%)	Community (14%)	Corporate Social Responsibility strategy (9%)
	Product responsibility (10%)	
186 ESG metrics out of 450 total are used as basis for ESG scoring		

Source: Author adapted from Refinitiv (2022)

2.2. Factor investing

Concerning factor investing, the research by Bender et al. (2013) accurately presents the foundations of this strand. According to Bender et al. (2013: 2), “a factor can be thought of as any characteristic relating to a group of securities that is important in explaining their return and risk”. This concept is relatively older than ESG, as it started to be researched as early as the 1970s, when Ross (1976) proposed a different theory than the Capital Asset Pricing Model of what drives stock returns. Ross (1976) suggested that a multifactor model – named Arbitrage Pricing Theory – may be better to explain stock returns than a single factor model. Arbitrage Pricing Theory showed that the expected return of an asset can be modelled depending on macroeconomic factors. As research emerged, however, it became clear that certain types of stocks could explain a lot of these differences in returns. In fact, the reason why we care about factors is because those performance differences have been consistently positive, which has an obvious benefit to investors. However, the purpose of this literature review is not to understand how these factors have exhibited significant return premium, but rather what they are, how factor-based strategies are constructed, and the dynamics that exist between investment factors and asset managers.

In essence, factor investing is an investment approach that aims to quantify particular characteristics, or factors, of a stock. In other words, it’s an investment style that aims to collect greater risk-adjusted returns through exposure to equity factors (Bender et al., 2013). Nowadays, there are a lot of different types of factors, from macroeconomic to statistical and fundamental factors – these last ones are also known as equity factors.

Equity factors are the ones that are relevant for this Dissertation, and they are the most popular investment factors nowadays. These factors are quantitative characteristics common across a set of securities and are often categorized through metrics of size, value, growth, momentum, quality, yield, and volatility (Fan & Michalski, 2020). These are supported by solid academic explanations as to why they have historically provided a premium return, and have been proven to be highly correlated to stock market returns (Bender et al., 2013). Appendix G (or Table 3.2 in this Dissertation) summarizes how the factors we will consider in this Dissertation can be characterized.

The original studies on factor investing were done with the goal to identify which stock characteristics explained returns. In fact, research on size and value factors emerged in Fama and French (1992). They observed that smaller-cap stocks outperformed larger-cap stocks over time, and that value stocks outperformed growth stocks. The explanation behind this performance difference is that the characteristics of small companies are riskier in nature and more volatile than large companies. Thus, investors expect higher returns in order to be compensated for taking on the additional level of risk (Fidelity, 2016). As for the outperformance of value stocks, the characteristics of these stocks have been long ago studied by the seminal work in this field, namely Benjamin Graham (1949). “He argued that expensive stocks with lofty expectations leave little room for error, while cheaper stocks that can beat expectations may afford investors more upside”, cited in Fidelity (2016).

The concept of momentum investing has a lot to do with price trend analysis in order to predict future returns. The first paper published around this concept was Jegadeesh and Titman (2001), which verified the momentum effect of stocks. They showed that stocks that had performed better in the past were likely to do so again in the future.

Regarding the quality factor, companies with higher profit margins, lower debt levels, and stronger balance sheets tend to outperform those with weaker fundamentals (Bender et al., 2013; Fidelity, 2016).

As for volatility, the objective with this factor is to capture low volatile companies, meaning owning stocks that have lower risk than the market. Research shows that this investment approach has also outperformed the broader market over time (Haugen & Heins, 1975). Blitz and Vliet (2007) further contribute to the factor investing literature and provide empirical evidence that low-volatility stocks produce high risk-adjusted returns.

Meanwhile, the base behind the yield factor is that favouring companies with higher yields over those with lower yields can be expected to produce higher returns over time (Blume, 1980).

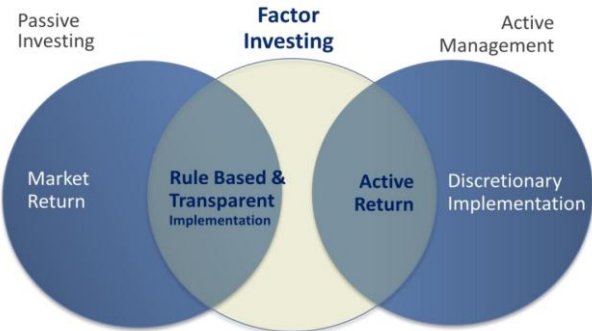
As these investment approaches were providing greater returns to investors, experts turned these factors into investment strategies – which, in turn, evolved into what we now know as factor investing. As a result, a growing number of institutions changed or added to their traditional asset allocation a factor allocation approach. There are also researches that have investigated the correlation between factors returns, and they have found that they are not highly correlated (Bender et al., 2013; Fidelity, 2016). This suggests, for example, that these factors can be combined into a single portfolio.

In fact, passive and active investing plays a big part in factor investing. According to Fidelity (2018), approximately 15 years ago, traditional index providers began to launch indices that aimed to represent these investment factors. Essentially, this allows investors to have exposure to factors through passive vehicles that replicate factor indexes (Bender et al., 2013). Over the past few years, ETF providers have been making factor strategies available to their clients, with the hope that they would be used by investors as tools to gain exposure to different styles. These are usually products that replicate dynamic indexes, with a structure that gives exposure to very specific market segments, very different risks, and multiples with which, sometimes, the investor may not feel comfortable given the high sectorial or geographical concentration that some of them may present (FundsPeople, 2020).

According to Fidelity (2018), in 2016, there were about 600 factor-based US-domiciled ETFs. According to their calculations, this means that 31% of the total US domiciled ETFs were factor-based ETFs. As can be seen in Figure 2.2, factor investing can combine the best of two worlds: transparency (of passive investing) and active return (of active investing). In sum, according to the authors, factor allocations can bring cost efficiency, transparency, flexibility, and diversification.

From our perspective, understanding how these factor indexes are designed is quite important. Ielasi et al. (2020) explain that an asset manager who takes a smart beta approach builds portfolios that follow an index passively, although the weights of its securities depend on systematic factors – such as those mentioned above. Fidelity (2016: 2) summarizes that “factor-based investment strategies are founded on the systematic analysis, selection, weighting, and rebalancing of portfolios, in favour of stocks with certain characteristics that have been proven to enhance risk-adjusted returns over time”.

Figure 2.2 – Passive factor allocations combine the attractiveness of both passive and active investment strategies



Source: Bender et al. (2013)

Koedijk et al. (2014) identified three approaches of implementing factor investing in the investment process: (i) the risk due diligence approach; (ii) using factor tilts in asset allocation; and (iii) factor-based optimization. The first approach intends to check for undesirable concentrations or deficiency exposure to certain factors. The second consists in applying factor tilts to the existing asset allocation. The third pretends to replace traditional investment approaches, optimizing them with the use of factors. In fact, Fidelity (2018) reviews what questions should an investor consider when selecting a factor-based ETF. Among others, they state that an investor should pay attention to the targeted factor, how the provider defines the factor, whether the ETF is constrained or unconstrained, the rebalancing frequency, and the universe of investment.

2.2.1. ESG in factor investing

Regarding ESG and factor investing, Simonek et al. (2021: 70) considers that “ESG factors have also been successfully integrated into factor investing and smart beta funds, reflecting the penetration of ESG within a much more complex product offering by asset manager”. In fact, this field of study is rich in academic literature, mostly about ESG integration, where the main objective of investors is to understand the risk-return profile associated with investing in a portfolio of companies that incorporate ESG factors into their business decisions. However, in this subsection, since we will investigate the relationship between investment factors and ESG ratings, we focus more on presenting articles that link investment factors, or financial variables, with ESG factors.

First, in this topic, one important paper to take into consideration is Bender and Sun (2018), which explores the relationship between factors and ESG. They find that highly rated ESG stocks tend to have positive value factor exposure, negative momentum, high quality, low volatility, and larger-cap. In the same context, Crespi and Migliavacca (2020) show that the growth trend in ESG scores is enhanced by the size and profitability of financial firms.

Zumente and Lāce (2021) also state that the rate of ESG rating availability is higher when we take in consideration the market capitalization of a firm, implying that there is a tendency that larger companies tend to be awarded with an ESG score. The authors justify that smaller companies suffer from the lack of resources to devote to sustainability implementation and reporting and, consequently, they are often not rated with an ESG score, or they are low rated. In the meantime, Krueger (2015) notes that companies with high ESG scores are better at managing risk, which leads to higher valuation multiples. This might be related to the growth factor, as this investment factor is known to be linked with higher valuation multiples.

Giese et al. (2019) suggests that changes in a company's ESG characteristics may be an effective financial indicator. They find that companies with higher valuations are usually in a better financial position and, consequently, can afford to spend more on improving their ESG profile, leading to higher ESG scores. More specifically, they show that companies with high ESG ratings have higher competitive profile than their peers, leading to higher profitability, thus resulting in a higher dividend yield. Moreover, because high rated ESG companies tend to have better risk management practices, they are also less volatile than their peers. This particular finding in respect to volatility is also documented by Zhang et al. (2021), which suggests a similar finding for individual E, S, and G ratings, and by Burger et al. (2022). Ultimately, all of this translates into a lower cost of capital and cost of equity for these companies. That is, the cost of funding is greatly improved.

Kim and Li (2021) suggest that the G pillar has the most influence on the correlation between ESG and company's financial success. In fact, this research has some similarities with ours, since it analysed the relationship between ESG with the financial performance of companies and also incorporated credit ratings.

In contrast to other studies, Limkriangkrai et al. (2017) find that high rated ESG firms tend to increase their financial leverage, which is likely to impact negatively the firm quality level. Particularly for ESG individual pillars, they state that firms with a low E score and a high G score tend to raise less debt. Moreover, they comment that firms with low G ratings have lower dividend yields. Finally, for S ratings, they do not find an impact on corporate financing decisions.

In sum, companies with more stable earnings and less volatility tend to be larger and mature, with experienced management teams that could be more thoughtful about their ESG impact. Therefore, they tend to actively seek to minimize risk stemming from ESG considerations, and they usually report a lot of sustainability data – which is a good sign for investors –, and makes them have better ESG profiles. Smaller companies, on the other hand, may not have this ESG consideration given that, in general, they do not provide much ESG data.

Melas et al. (2016) address the integration of ESG in factor investing and find that MSCI ESG Ratings have a positive correlation with size, quality, and low volatility. More importantly, Melas et al. (2016: 7) state that “the average level of correlation between factors and ESG scores is low, i.e., ESG scores are a largely independent, new source of information”. Breaking down ESG by pillars, they find that, on average, larger companies tend to have better ESG scores, and that the strongest relationship is with the E pillar score, and weaker for S and G scores. Their results in terms of correlation between value, momentum, and low size factors with ESG are negative or zero, suggesting that integrating ESG factors into strategies that have the goal to get exposure to these factors may be more difficult.

Simonek et al. (2021) also mentions the uncertainty to what degree the ESG factors may correlate with quality, value, or momentum factors. However, funds with high E ratings typically have strong quality and momentum factor loadings, according to Madhavan et al. (2020).

Focusing on the growth factor, Luo and Bhattacharya (2006) investigate the relationship between a firm's CSR and its market value. Ultimately, the authors suggest that companies that are aware of these topics drive consumer satisfaction, which can result in higher future cash flows and increase the firm's growth perspective. This finding is directly related to the growth factor, since it is based on the future growth prospects of the companies. On the other hand, Kaiser (2020) conclude that, on average, firms with higher ESG ratings tend to have value characteristics, whereas firm with lower ESG scores tend to have growth and momentum characteristics. About the momentum factor, Kaiser and Welters (2019) take an important step by investigating the impact of ESG integration on momentum portfolios. In fact, they refer that the combination of the two themes is particularly interesting given the risk-mitigation effect of ESG factors, and the evidence on momentum returns being highly exposed to crash risk. Their findings suggest that momentum investors can incorporate ESG criteria with the objective of reducing their overall portfolio risk, particularly during a momentum crash.

All of these studies suggest that some investment factors can be naturally ESG friendly and be positively correlated with ESG performance – the literature shows conclusive evidence with size, quality, and low volatility factors. However, regarding the other investment factors, there are findings from researches that present minor contradictions, leading to the view that there is not such a strong consensus on the relationship they have with ESG. In this Dissertation, we pretend to clarify some of these relationships by investigating and verifying whether these investment factors mentioned are really positively (or negatively) correlated to higher (or lower) ESG scores.

2.3. Credit ratings

Regarding our third main theme under study, credit ratings are an independently and forward-looking fundamented opinion about the ability of a company to pay back debt on time, provided by banks or credit rating agencies. It details a fundamented opinion about credit risk as, for lenders, to avoid incurring in potential credit losses, they need to know the creditworthiness of the issuer (borrower). The issuer can be any entity that seeks to borrow money, such as companies. These ratings, which typically range from AAA (highest rate) to D (lowest rate), provide investors with a unique terminology to describe different levels of creditworthiness to help them make more informed decisions. The higher the credit rating, the lower the probability of default. The ratings are usually divided in two groups, which are investment grade (for the higher classifications) and high yield (for the lower classifications). Companies with lower credit ratings pay higher interest rates and embody greater risks

than those with higher ratings. Although there are corporate and sovereign ratings, in the context of this Dissertation the focus is on corporate ratings. From a company's perspective, credit ratings affect a company's ability to obtain financing, pay off debt, and remain in business (Gray et al. 2006).

There are three main agents involved in a credit rating evaluation: the investor, who is interested in knowing the creditworthiness of the issuer; the issuer, who wants to have their debt rated; and the credit rating agency, who does the credit evaluation (Mão de Ferro, 2013). There are several reasons for the importance of these ratings. First, they summarize quantitatively and qualitatively the financial situation of the company. Second, as described by Kisgen (2006), credit ratings directly affect capital structure decisions of companies, given the costs (or benefits) of different classifications, and these ratings can provide investors a signal of a firm's overall quality, showing that this variable can have a link to the investment factor quality. Third, in the universe of equities, these ratings obviously have a direct link with companies' stock returns, regardless of whether it is an upgrade or downgrade rating change (Goh and Ederington, 1993).

Although these credit rating agencies adopt different rating scales, there is a significant equivalence across agencies and the corresponding scores, which, in contrast to what happens with ESG ratings, facilitates comparison. This means that the rating agencies use broadly similar methodologies in arriving at their final credit rating. Every credit rating agency provides an overview of the rating methodology, but, generally, the credit analysis focuses on: (i) business risk and (ii) financial risk. On business risk, it evaluates the strength of the business from a more macroeconomic perspective, like the market position, geographic diversification, and competitive dynamics, among others. On financial risk, the analysis is aimed at the financial health of the company: total sales, profitability, liquidity, and financial forecast, among others (Santos, 2015).

The basis of the models used by credit rating agencies is the model prepared by Altman (1968). This model is the basis of the consequent group of models by Kaplan and Urwitz (1979) and Ederington (1985).

From these articles, it is possible to identify relevant variables and financial ratios such as long-term debt to equity, long-term debt ratio, interest rate coverage, profit margin, and return on equity, among others. Additionally, it has been noted that companies' profit indicators with higher credit ratings are impacted negatively by high leverage indicators (Chodnicka-Jaworska, 2021).

The primary source of credit ratings data for this Dissertation is Refinitiv (Thomson Reuters). A Thomson Reuters overview of their credit risk model indicates that their combined credit risk model (StarMine CCR) combines three credit risk models: (i) the StarMine Text Mining; (ii) the StarMine SmartRatios; (iii) and the StarMine Structural. The combination of these three generate the final credit risk rating (Yan et al., 2014).

Yan et al. (2014) starts by presenting that there is an extensive literature on credit risk modelling. From pioneer works, there has been an evolution of accounting ratio analysis (Beaver, 1968) and market-based models (Merton, 1974). To explore the benefits of both of these approaches, StarMine has developed a corporate debt risk model that includes models evaluating a company's credit risk through both accounting ratio analyses – the StarMine SmartRates – and market-based methods – the StarMine Structured Credit Risk Model. In addition to these, the third approach applies cutting-edge machine learning algorithms that mines the language in textual data from multiple sources – the StarMine Text Mining. The StarMine CCR combines the outputs from these three approaches in a logistic regression framework (Yan et al., 2014).

2.3.1. ESG in credit ratings

There is growing momentum to incorporate ESG factors into credit risk assessments, as it is well documented that these risks should affect corporate risk. Our objective with this subsection is to know at what level are ESG factors incorporated in credit risk analysis from the perspective of a potential investor in a company, and what previous research has been advanced on these two topics.

There are various reasons to think that credit risk and ESG are related, but the primary one is that credit risk also demonstrates some extreme-risk characteristics because it is concerned with a company that might eventually go bankrupt – which is the same line of argumentation for equity risk. ESG analysis of a corporate issuer can, for example, reveal exposure to long-term investment risks, such as climate change. This means that the integration of ESG risks and opportunities in credit analysis is a key step for financial institutions to price products accurately. Therefore, it is also increasingly recognised that companies with stronger ESG scores are less likely to suffer from defaults and more likely to be profitably in the long term (Simonek et al., 2021).

Miralles-Quirós and Miralles-Quirós (2017) finds that ESG factors can be significant in assessing financial risks, and Zeidan et al. (2015) suggests that taking ESG factors into account in credit policies could lead to a better measure of credit risk. Actually, Kiesel and Lücke (2019) concludes that credit rating agencies are considering ESG factors in their rating decisions and, more important, Desclée et al. (2017) finds a positive relationship between high ESG scores and higher credit ratings.

A research paper by the Governance & Accountability Institute (2022) presents how credit rating agencies — specifically Fitch, Moody's, and S&P Global — are integrating ESG factors into their risk analysis methodologies. The analysis concludes that Fitch is leading the way in terms of the development and integration of an ESG methodology. The company has devolved ESG templates that have specific scores for each sector and general issue risk categories. Their scores vary from 1-5 with higher scores indicating greater materiality to the credit decision. Depending on the entity being scored, subfactors scores drive the overall result.

The majority of the past research on these two themes focuses on investigating the relationship between sustainability criteria and the performance of a company and its credit rating. Attig et al. (2013) concludes that credit rating agencies tend to give high ratings to firms with good S performance. In fact, they show that companies with strong CSR practices receive better credit ratings, leading to lower financing costs. Their findings suggest that a company's performance on these issues conveys important non-financial information that rating agencies may use when assessing a company's creditworthiness. Hoepner et al. (2016) also finds that S and E activities statistically impact loan financing, reducing costs. In the meantime, Nandy and Lodh (2012) finds that by considering a firm's E consciousness in loan contracts, banks can reduce their default risk. Thus, usually, these types of companies get more favourable loan contracts than firms with lower E score.

The findings of Hentilä (2022) conclude that there is a positive relationship between ESG and credit ratings, and having a higher ESG disclosure score means that companies can obtain a better credit rating. Furthermore, Chodnicka-Jaworska (2021) confirm the significant impact of ESG factors on credit ratings. They confirm that among the overall three pillars, the most important one for credit rating agencies are E-issues. Seltzer et al. (2022) further investigate and conclude that companies with lower E scores tend to have poorer credit ratings and higher yield spreads. In addition, Desclée et al. (2017) confirms that issuers with higher credit ratings are better able to comply with E issues than those firms with lower credit quality. More recently, Aslan et al. (2021: 10) found that “the aggregated ESG scores and its corresponding pillar scores negatively affect the probability of credit default, which indicates that ESG may induce higher credit ratings and thereby lower the cost of capital of the firms”.

In respect specifically to the G pillar, Bhojraj and Sengupta (2003) finds a positive correlation between corporate governance and firm's credit rating. They argue that, because of the higher transparency, good corporate governance reduces a firm's default risk by mitigating agency cost, monitoring effects and reduce information asymmetries.

In contrast to the previous literature, Goss and Roberts (2011) show that ESG concerns do not affect the interest rate spreads of debt. As Jang et al. (2020) observe, from the three ESG pillars, only higher E scores reduce the cost of debt for small firms. Chodnicka-Jaworska (2021) argue that a negative relationship between an ESG rating and credit ratings can be explained by a number of facts. For instance, large investments in ESG issues could trigger agency conflicts between management – who may benefit from the investment – and shareholders – who would have to support the costs. They also note that maintaining a high level of ESG score, requires a lot of costly maintenance relations with stakeholders and increases in fixed costs, which can be seen as a waste of costly resources. Bannier et al. (2022) investigate the relationship between CSR and credit risk and finds that only E aspects are negatively related with various measures of credit risk for U.S. firms. It is also important to note Yang (2020), which investigate the shift towards ESG in the credit rating business. He finds that there may be no effect of ESG on credit ratings, as news about issues around sustainability do not seem to contribute to the determination of credit rating downgrades. However, he also finds a positive effect from S scores to a grade increase in credit ratings.

Overall, the general consensus of the academic literature suggests that credit analysis and ESG are aligned, and that the topics of sustainability have influence on how the credit rating agencies analyse firms' creditworthiness. In fairness, not only these factors contribute to a better society, but they are also aligned with firms in the sense that these should face lower financing costs – more specifically the cost of equity and the cost of debt. The literature also shows the importance of reporting news and metrics about ESG factors, as an active disclosure about these issues will attract analysts attention and, possibly, increase the ESG rating of a specific firm. That will also possibly imply a more positive image of the company, allowing it to attract more socially responsible investors, as well as expand the company's investor base, thus reducing the firm's risk, the company cost of equity, and increasing firm value overall. At the same time, firms with better performance may invest more in topics related to ESG issues (Ghoul et al. 2011).

These studies show the relevance of ESG issues to a firm's financial performance and, importantly, that companies can reduce their risk management by paying more attention to ESG matters, benefiting shareholders and stakeholders. We have reviewed relevant investigations that related credit ratings with ESG scores and individual pillars, which is exactly what are we going to do in this Dissertation. We contribute to the literature by investigating and verifying whether high (or low) ESG scores are correlated or may be a cause/consequence of high (or low) credit ratings. Moreover, we observe if companies in the investment grade or high yield space have, on average, differences on their ESG ratings. We additionally decompose the ESG overall score into its pillars in order to see if there are any pillars that might have a stronger relationship with credit ratings.

3. Data and variables

This chapter will specifically present the dataset used to answer our main research question. Firstly, we carefully describe the sample and give a short description of the data and corresponding data sources. Secondly, we explain in detail the variables used, more specifically, the dependent and independent variables, and how they can be interpreted.

3.1. Data

This study obtained data from two well-known and respected agencies among investors: (i) Thomson Reuters and (ii) Morningstar². Thomson Reuters (Refinitiv Eikon) and Morningstar (Sustainalytics) are two of the third-party providers of ESG ratings for a vast number of companies on their respective platforms: Refinitiv Eikon and Morningstar Direct.

Initially, our database consisted of around 21.000 companies that traded on U.S. stock exchanges. However, for a multiplicity of reasons, many of these companies did not show ESG data either on Morningstar Direct or Refinitiv Eikon. Consequently, those companies that did not show the data were filtered out (i.e., not considered) in our final sample. After applying this criterion, we only address companies that have financial information in the other key variables that we are considering in this research. Thus, we reduce the initial global database to 906 firms. Subsequently, we also did not consider companies that did not meet the requirements to be listed on a U.S. standard stock exchange, such as the New York Stock Exchange (NYSE) or Nasdaq. Thus, we eliminate securities traded over-the-counter (OTC), which could distort the analysis as many of these companies are not required to report financial information to the U.S. Securities and Exchange Commission. In the end, we end up with a sample comprising with 825 companies, all traded on the NYSE and Nasdaq stock exchanges.

The reasons for considering companies only traded in the U.S. have to do with standardization and normalization of the financial data. For example, if companies traded on European stock exchanges were considered, there could be inconsistency in our database, as ESG and tax reporting rules in Europe vary quite significantly in relation to those in the United States (European Commission, 2020).

The time period from which the data was collected is comprised between January 2021 and December 2021. ESG ratings from Sustainalytics and Refinitiv Eikon are dated as of the latest available on the respective platforms. In fact, most have references from 2020, since, at the time of writing this Dissertation, few companies had reported data from 2021.

² The reason we choose these two specific ESG data providers have been already explained in the literature review.

Concerning investment factors, the data for these variables are all extracted from Morningstar Direct and are referenced to December 2021. In fact, Morningstar, for most of these investment factors, provides the data directly without having to resort to further calculations, but there were two exceptions: the Quality and Yield Score. For these two specific variables, we had to calculate their scores according to the formula that is presented in Morningstar's methodology about investment factors. We further contacted Morningstar Support in order to understand whether the data fields we were using in Morningstar Direct to calculate these scores were the correct ones. The next subsection will present the calculations behind the scores of these factors. Lastly, we obtained the credit ratings data from Thomson Reuters (Refinitiv Eikon). In order to simplify data extraction, the indicator that we took into consideration was the credit combined implied rating. This field closely resembles the S&P's credit ratings in terms of classifications. These ratings are displayed on a qualitative basis so, in order to simplify our analysis, we converted them to a numeric scale from 5 to 100 (see Appendix F). This conversion process was based on the conversion carried out by Ferri et al. (2000). Table 3.1 shows the variable's names used in this study, the corresponding abbreviations, the platform from where the data were taken, the extraction date, the data type, and also the range of values. It is important to note the different scales of the variables and the different value ranges.

Table 3.1 – Data summary

Variable name	Abbreviations	Data taken from	Data extraction date	Data type	Data range	Data period
Sustainalytics ESG Risk Score	SESGS	Morningstar Direct	December 2021	Quantitative continuous	[0, 100]	2021-01 to 2021-12
Sustainalytics Environmental Risk Score	SES	Morningstar Direct	December 2021	Quantitative continuous	[0, 100]	2021-01 to 2021-12
Sustainalytics Social Risk Score	SSS	Morningstar Direct	December 2021	Quantitative continuous	[0, 100]	2021-01 to 2021-12
Sustainalytics Governance Risk Score	SGS	Morningstar Direct	December 2021	Quantitative continuous	[0, 100]	2021-01 to 2021-12
Refinitiv ESG Score (%)	RESGS	Thomson Reuters	December 2021	Quantitative continuous	[0, 100]	2021-01 to 2021-12
Refinitiv Environmental Score (%)	RES	Thomson Reuters	December 2021	Quantitative continuous	[0, 100]	2021-01 to 2021-12
Refinitiv Social Score (%)	RSS	Thomson Reuters	December 2021	Quantitative continuous	[0, 100]	2021-01 to 2021-12
Refinitiv Governance Score (%)	RGS	Thomson Reuters	December 2021	Quantitative continuous	[0, 100]	2021-01 to 2021-12
Size Score	SS	Morningstar Direct	December 2021	Quantitative continuous	[-100, 400]	2021-01 to 2021-12
Momentum Score (%)	MS	Morningstar Direct	December 2021	Quantitative continuous	[0, 100]	2021-01 to 2021-12
Volatility Score	VS	Morningstar Direct	December 2021	Quantitative continuous	[0, 104]	2021-01 to 2021-12
Value/Growth Score	VGS	Morningstar Direct	December 2021	Quantitative continuous	[-100, 400]	2021-01 to 2021-12
Quality Score	QS	Morningstar Direct	December 2021	Quantitative continuous	[-2, 1]	2021-01 to 2021-12
Yield Score (%)	YS	Morningstar Direct	December 2021	Quantitative continuous	[0, 23]	2021-01 to 2021-12
Credit Rating	CR	Thomson Reuters	December 2021	Quantitative discrete	[0, 100]	2021-01 to 2021-12

Source: Author

It should be noted that we had to adjust some outliers, and we did this via winsorizing. This technique consists of “replacing the outlier original value by the nearest value of an observation not seriously suspect”, explains Tukey (1962: 18). We did this, first, because we have a sample big enough to do so and, second, because our outliers greatly distorted our analysis of the data. In addition, we tested scatter plots with and without outliers and how the results were affected without the outliers.

3.2. Variables

In this subsection, we describe all the variables, the calculations supporting them, and how they are interpreted.

Regarding ESG ratings, the methodology of Sustainalytics and Refinitiv was already detailed in the literature review section.

Concerning investment factors, the Size Score (SS) represents the score a company has relative to its size. The SS can vary from -100 (a small company) to 400 (a larger company in terms of market capitalization). That is, a sizeable company like Amazon will have a SS of 400, while a much smaller company will have a score closer to -100. Second, Momentum Score (MS) is represented as a percentage and the values can vary from 0 to 100. It refers to the momentum effect in a stock performance. That is, a higher percentage represents a stock that in the previous six months (with reference to December 2021) was a top-performing stock (Strauts et al., 2019). Third, as per the various literature that sustains that the standard deviation is an adequate measure of stock risk and volatility (Blitz & Vliet, 2007; Brender et al., 2013), the described Volatility Score (VS) represents the annualized daily standard deviation of the stocks in the past five years. The reason to include the past five years and not only 2021 is that the behaviour of a stock within a year may not be representative of its overall behaviour. Fourth, as a stock can be characterized as more value or as more growth, in Value/Growth Score (VGS), values closer to -100 represent more value stocks, whereas values closer to 400 extremely high growth stocks. The companies that are positioned in the middle of these two scores, with scores around 150, are the so-called core or blend companies.

Fifth, the Quality Score (QS) is not given directly by Morningstar, but we calculate the scores based on the literature exhibited by the company. The higher the score of this factor, the higher is the level of profitability and also the lower is the financial leverage. For the calculation of this score, we calculate the total debt of the company, then the total capital, and we standardize the score based on the z-score. Finally, for the Yield Score (YS), we combine the dividend yield with the buyback yield for each company. Thus, a firm with a higher value in this metric means it pays more dividends and/or has a higher buyback yield (Strauts et al., 2019). The formulas behind each calculation of investment factors are based on the academic literature, such as Blume (1980), Banz (1981), Fama and French (1992), Sloan (1996), Carhart (1997), Jegadeesh and Titman (2001), Ang et al. (2006), and Asness et al. (2019).

The SS is calculated based on the natural logarithm of a company's market capitalization. According to Strauts et al. (2019: 3), " cap_1 is the market capitalization that corresponds to the breakpoint between mid-cap and small-cap stocks for the stock's respective style zone and cap_2 is the market capitalization that corresponds to the breakpoint between large-cap and mid-cap stocks for the stock's respective style zone".

$$\text{SizeScore}_{2021} = -100 * [1 + \frac{\ln(\text{marketcap}) - \ln(\text{cap}_1)}{\ln(\text{cap}_2) - \ln(\text{cap}_1)}] \quad (1)$$

The Value Score represents a weighted average (W) of prospective earnings (E), book value (BV), revenue (R), cash flow (CF) and dividend (D). The P_{2021} represents the price of the stock by the end of 2021 (Strauts et al., 2019).

$$\text{ValueScore}_{2021} = [W_E * \frac{E}{P_{2021}} + W_{BV} * \frac{BV}{P_{2021}} + W_R * \frac{R}{P_{2021}} + W_{CF} * \frac{CF}{P_{2021}} + W_D * \frac{D}{P_{2021}}] \quad (2)$$

The Growth Score of a stock is the weighted average of the company's growth rates in earnings, book value, revenue and cash flow (Strauts et al., 2019).

$$\text{GrowthScore}_{2021} = W_E * E_{\text{growth}} + W_{BV} * BV_{\text{growth}} + W_R * R_{\text{growth}} + W_{CF} * CF_{\text{growth}} \quad (3)$$

The MS is the trailing 12-month returns (r_{2021}) and the trailing one-month return of a stock ($r_{\text{december}_{2021}}$) (Strauts et al., 2019).

$$\text{MomentumScore}_{2021} = \ln(1 + r_{2021}) - \ln(1 + r_{\text{december}_{2021}}) \quad (4)$$

The QS is the sum of a company's profitability and financial leverage. ROE is the trailing 12-month return on equity (ROE) and z indicates a z-score. Total debt, according to Morningstar, is the sum of the current debt and current capital lease obligation, the long-term debt, and the long-term capital lease obligation. Total Capital is the sum of the long-term debt and capital lease obligation with total shareholder's equity (Strauts et al., 2019).

$$\text{QualityScore}_{2021} = \frac{1}{2} [ROE_z + (1 - \frac{\text{Total Debt}_{2021}}{\text{Total Capital}_{2021}})_z] \quad (5)$$

The YS is the sum of trailing 12-month buyback and dividend yield of a company.

$$\text{YieldScore}_{2021} = \text{Buyback Yield}_{2021} + \text{Dividend Yield}_{2021} \quad (6)$$

The VS is represented as the trailing 12-month volatility of daily return of a stock. In this case, since our VS is from 2016 to 2021, R_5 is the stock return at that time and \bar{R} is the average return over those five years (Strauts et al., 2019).

$$\text{VolatilityScore}_{2021} = \sqrt{\frac{1}{5-1} \sum_{t=1}^5 (R_5 - \bar{R})^2} \quad (7)$$

Complementing this explanation of the variables, Table 3.2 provides a summary description of the investment factors in table format.

Table 3.2 – Description of the investment factors used according to Morningstar

Factor	Description
Size	The size factor describes the market capitalization of a company. A higher exposure to the size factor indicates larger market capitalization.
Value	The value factor captures excess returns to stocks that have low prices relative to their fundamental value.
Growth	The growth factor captures company growth prospects using historical earnings, sales and predicted earnings.
Momentum	The momentum factor describes how much a stock has risen in price over the past year relative to other stocks, calculated by subtracting the trailing 1-month return from the trailing 12-month return. A higher exposure to the momentum factor indicates the company has performed well recently.
Quality	The quality factor describes the profitability and financial leverage of a company, based on an equally weighted mix of trailing 12-month return on equity and debt-to-capital ratios. A higher exposure to the quality factor indicates a higher quality of the firm.
Yield	The yield factor describes the dividend and buyback yield of a company, based on the trailing 12 months. A higher exposure to the yield factor indicates higher yield for investors.
Volatility	The volatility factor describes the maximum observed spread in long-term returns, based on the trailing 12-month standard deviation of daily returns. A higher exposure to the volatility factor indicates larger variation in long-run outcomes.

Source: Morningstar

4. Methodology

This chapter will go over the empirical method adopted in this research in order to analyse the relationship between investment factors and credit ratings with ESG ratings. It should be stressed that the empirical analysis is constructed mainly based on ESG ratings and the respective three pillars' scores.

Our main goal, and main research question, is to study the relationship between ESG ratings, investment factors, and credit ratings. Regarding 2021 (since our data have this reference period), we want to show the characteristics in terms of credit ratings and investment factors of companies with higher or lower ESG scores. Therefore, we perform a cross-sectional study.

There are many potential ways to find out what is the relationship among three different topics, but, in the case of the present Dissertation, we propose both a descriptive and regression analysis framework. Bewick et al. (2003: 451) argues that “the most commonly used techniques for investigating the relationship between two quantitative variables are correlation and linear regression”.

Consequently, in the descriptive section, a correlation analysis, which is a technique used to quantify the associations between continuous variables, is carried out (Khamis, 2008). We mainly analyse various correlation matrices in order to describe the strength and direction of the relationship of all our variables. Additionally, with the help of scatter plots, we show whether there is a linear, logarithmic, or no relationship between ESG ratings, investment factors, and credit ratings. In addition, we observe which sectors of our sample have higher or lower ESG ratings by looking at box plots. At last, in an attempt to get a clearer picture of these relationships, we select from our sample of 825 companies the 25% with the highest and lowest ESG scores from Sustainalytics and Refinitiv Eikon. In this last part we repeated a similar descriptive analysis, but applied to smaller samples in order to verify our findings more clearly.

Pereira et al. (2019: 7), explains that “the main difference between regression and correlation analysis is that in the correlation we only know that there is an association between variables, but we do not know which variable is the variable that depends on the other”. So, when it comes to the regression analysis, our main objective is to check which of the ESG ratings (and individual pillars of the ESG ratings) depend on some or simply no investment factors and credit ratings. Since we collected the data for the ESG overall score and for each pillar (E, S and the G), it is also possible to individually check how the ESG scores have any relation with individual or multiple investment factors and the credit ratings.

With the regression analysis, our aim is to find out whether any of our dependent variables (ESG ratings and its individual pillars) are somehow related/associated with our independent variables (the different investment factors and credit ratings). This way, we are able to show which variables are most correlated with ESG ratings, as well as the strength of that relationship.

We build our regressions using EViews and developing robust regressions, involving the Newey-West method (1987). This method allows us to use the most appropriate standard errors and p-values for regression validation, which appropriately supports our findings. According to Alimohamadi et al. (2020: 1696), “the Newey approach estimates the coefficients by ordinary least squares regression, but due to possible heteroscedasticity and autocorrelations the Newey–West standard errors are used to handle them”. In total, we perform eight multiple regressions, each for every dependent variable presented in Table 4.1. The Table 4.1 provides a summary about which of our 15 variables will be considered dependent and/or independent in the regressions.

These are two examples of our regressions:

$$RESGS_{2021} = \beta_0 + \beta_1SS_{2021} + \beta_2MS_{2021} + \beta_3VS_{2021} + \beta_4VGS_{2021} + \beta_5QS_{2021} + \beta_6YS_{2021} + \beta_7CR_{2021} + \varepsilon_{2021} \quad (8)$$

$$SESGS_{2021} = \beta_0 + \beta_1SS_{2021} + \beta_2MS_{2021} + \beta_3VS_{2021} + \beta_4VGS_{2021} + \beta_5QS_{2021} + \beta_6YS_{2021} + \beta_7CR_{2021} + \varepsilon_{2021} \quad (9)$$

Table 4.1 – Possibility of different regressions combinations

VARIABLE NAME	VARIABLE CODE	VARIABLE TYPE
Sustainalytics ESG Risk Score	SESGS	Dependent variable
Sustainalytics Environmental Risk Score	SES	Dependent variable
Sustainalytics Social Risk Score	SSS	Dependent variable
Sustainalytics Governance Risk Score	SGS	Dependent variable
Refinitiv ESG Score (%)	RESGS	Dependent variable
Refinitiv Environmental Score (%)	RESGS	Dependent variable
Refinitiv Social Score (%)	RSS	Dependent variable
Refinitiv Governance Score (%)	RGS	Dependent variable
Size Score	SS	Independent variable
Momentum Score (%)	MS	Independent variable
Volatility Score	VS	Independent variable
Value/Growth Score	VGS	Independent variable
Quality Score	QS	Independent variable
Yield Score (%)	YS	Independent variable
Credit Rating	CR	Independent variable

Source: Author

5. Results and discussion

This fifth chapter presents the estimation findings, as well as a discussion of our descriptive statistics and regression analysis. It should be mentioned that, given the current context of incipient maturation of ESG ratings, some disparate results from the literature may be observed due to the use of different information providers.

5.1. Descriptive statistics results and discussion

Table 5.1 describes the summary statistics of our 15 variables for the 825 companies included in the data sample. We present the data divided by ESG overall rating, individual pillars, investment factors, and credit ratings. The mean for ESG ratings indicates that the companies in our sample have low ESG unmanaged risk (23.3), and medium ESG performance (56.3%).

Table 5.1 – Descriptive statistics of the variables

Variable name	Mean	Standard Error	Median	Standard Deviation	Sample Variance	Skewness	Minimum	Maximum	N
ESG Rating									
Sustainalytics ESG Risk	23.301	0.261	22.698	7.51	56.33	0.60	6.99	51.25	825
Refinitiv ESG Score (%)	56.308	0.605	57.820	17.38	301.96	-0.35	8.06	94.48	825
Environmental Rating									
Sustainalytics E Risk Score	6.516	0.188	4.640	5.41	29.28	1.21	1.02	25.73	825
Refinitiv E Score (%)	47.845	0.957	50.890	27.49	755.77	-0.23	0.00	97.15	825
Social Rating									
Sustainalytics S Risk Score	9.703	0.140	9.723	4.02	16.15	0.31	1.21	26.01	825
Refinitiv S Score (%)	60.302	0.672	61.704	19.30	372.30	-0.29	7.86	96.65	825
Governance Rating									
Sustainalytics G Risk Score	7.216	0.090	6.545	2.60	6.74	1.15	1.75	16.95	825
Refinitiv G Score (%)	56.250	0.725	57.750	20.81	433.21	-0.28	5.72	99.11	825
Investment Factors									
Size Score	147.131	2.613	140.530	75.06	5633.70	0.44	-27.75	400.00	825
Momentum Score (%)	39.226	0.785	37.709	22.56	508.88	0.34	0.36	97.55	825
Volatility	37.106	0.418	34.273	12.01	144.16	1.51	19.29	103.72	825
ValueGrowth Score	128.999	4.324	120.109	124.19	15424.04	0.24	-100.00	400.00	825
Quality Score	-0.0003	0.010	0.025	0.28	0.08	-1.50	-1.75	1.00	825
Yield Score	2.603	0.109	1.920	3.12	9.72	2.29	0.00	23.00	825
Credit Rating									
Credit Rating	62.200	0.556	65.000	15.98	255.26	-0.30	15.00	100.00	825

Source: Author

As expected, because of the nature of the ratings, the average values of the Sustainalytics ESG Risk Rating are lower than the mean values of the Refinitiv ESG Rating. In terms of individual pillars, on average, these companies have lower unmanaged E risks (6.5) and higher unmanaged S issues (9.7). This indicates that the companies in our sample manage E risks better than S ones. However, in general, the ESG unmanaged risk score is low, with the maximum value in our sample not exceeding 26.01, suggesting that these companies pay, in general, attention to ESG risks. In contrast, the mean values of the Refinitiv ESG Rating show that these companies have better performance on S issues (60.3%) and worse on E ones (47.8%). Consequently, these two ESG ratings are somewhat contradictory, showing that, on the one hand, these companies have a low unmanaged E risk, but, on the other hand, they also have, on average, the lowest performance in this pillar. In the same way, the Sustainalytics Rating shows that, on average, these companies have higher S unmanaged risks, but the Refinitiv Rating show that these companies also have high performance on the S pillar. This disconnect may suggest that because companies are reporting information on these pillars, some may not be so highly rated according to a particular methodology that focus more on reported metrics, although according to a different methodology that focuses more on the transparency and disclosure the said firms may be more highly rated.

Figure 5.1 below exhibits the Pearson Correlation matrix, which helps to visualize the relationships between the set of variables used in this research by displaying their correlations coefficients. We add to the matrix a colour range, whereby if a coefficient value is redder, it means that the correlation is strong and negative, while if it is bluer, it means that the correlation is strong and positive. The white colour indicates that there is no correlation between the two variables. A positive correlation between two variables indicates that if one variable increases, so does the other. A negative correlation indicates that if one variable decreases, the other variable increases. The asterisks indicate the significance levels. An asterisk indicates that the correlation coefficient is statistically significant with a p-value less than 0.05 and two asterisks indicate that the p-value is less than 0.01.

The matrix show that there is not a strong positive or negative linear relationship between any investment factors or credit ratings with ESG ratings, with values varying in a range between -0.295 and 0.423. The strongest positive coefficient is between the SS and the RESGS, with this relationship being significant statistically. This result is in line with some literature demonstrating that the size – or market capitalization – of firms tend to influence positively their ESG performance, as these companies have more recourses to invest in ESG issues (Melas et al., 2016; Crespi and Migliavacca, 2020; Zumente and Lāce, 2021). On the other side, the strongest negative coefficient is between the VS and the RESGS, being statistically significant. This result is also in line with some literature that showed that high volatile stocks may be an indicator of worse ESG performance, as these companies tend to not pay as much attention to ESG factors (Giese et al., 2019; Zhang et al., 2021; Burger et al., 2022).

Figure 5.1 – Pearson Correlation matrix of the variables used in this study

Variables	SESGS	SES	SSS	SGS	RESGS	RES	RSS	RGS	SS	MS	VS	VGS	QS	YS	CR
SESGS	1														
SES	0.671**	1													
SSS	0.696**	0.041	1												
SGS	0.423**	-0.180**	0.410**	1											
RESGS	-0.134**	0.032	-0.176**	-0.189**	1										
RES	-0.098**	0.144**	-0.208**	-0.261**	0.848**	1									
RSS	-0.154**	-0.047	-0.138**	-0.141**	0.857**	0.698**	1								
RGS	-0.042	0.087*	-0.115**	-0.131**	0.652**	0.345**	0.302**	1							
SS	-0.054	-0.071*	0.011	-0.036	0.423**	0.402**	0.422**	0.158**	1						
MS	-0.029	0.017	-0.085*	0.009	0.100**	0.071*	0.157**	0.018	0.330**	1					
VS	0.131**	0.010	0.178**	0.071*	-0.295**	-0.287**	-0.222**	-0.217**	-0.299**	-0.127**	1				
VGS	-0.128**	-0.197**	0.047	-0.022	-0.212**	-0.229**	-0.135**	-0.176**	0.156**	0.215**	0.175**	1			
QS	-0.018	-0.090**	-0.019	0.206**	-0.105**	-0.194**	-0.092**	-0.013	0.010	0.065	-0.025	0.121**	1		
YS	0.014	0.038	-0.068	0.058	0.146**	0.165**	0.083*	0.103**	-0.033	-0.050	-0.217**	-0.426**	-0.079*	1	
CR	-0.057	-0.112**	0.018	0.062	0.113**	0.026	0.111**	0.098**	0.404**	0.319**	-0.413**	0.269**	0.404**	-0.034	1

** p-value < 0,01
* p-value < 0,05

Source: Author

It should be pointed out that, among the correlation coefficient values of SESGS, there are more negative correlations since this rating measures unmanaged ESG risk, which, as opposed to the Refinitiv ESG Rating, means that the lower the score, the better. In other words, when analysing the values of the coefficients of this specific rating, we have to bear in mind that lower values mean that companies are managing ESG risks better. So, the strongest negative correlation value is between the VGS and the SES, which is statistically significant. This means that companies that have more growth characteristics tend to also have lower E unmanaged risks. This may confirm the investigation done by Luo and Bhattacharya (2006), which suggests that firms that are aware of ESG issues drive consumer satisfaction, which can then lead to higher future cash flows and increase growth perspectives. Another possible justification is that sustainable companies, like growth companies, tend to trade at higher valuations than a non-green or value company (FundsPeople, 2022a). However, many researches point out that it is the value factor that has been linked to better ESG ratings (Kaiser, 2020). From our view, this may have to do with the fact that growth companies, having higher valuations, are usually in a better financial position and, consequently, can afford to spend more on improving their ESG scores.

In contrast, the strongest positive correlation is between the VS and the SSS, which is statistically significant. This means that companies that are more volatile tend to have higher S risks. This finding is in line with the literature consensus, because more volatile stocks have been associated with lower ESG scores. If we take this finding into account with Blitz and Vliet (2007), that suggest that low-volatility stocks produce high risk-adjusted returns, and also with Engelhardt et al. (2021), which document that highly ESG rated European companies deliver higher returns with lower volatility, we can induce that companies with better ESG ratings are less volatile, and that these firms tend to deliver higher returns to investors in comparison to companies with worse ESG ratings. Giese et al. (2019) justifies that high rated ESG companies tend to have better risk management practices, and consequently they are also less volatile than their peers.

Of investment factor variables, it is noteworthy to observe that the SS has the most positive and strongest relation with ESG ratings, namely with Refinitiv ESG Ratings, with all hypotheses tested with this rating, as this variable is statistically significant. On the other hand, the VS shows the strongest negative relationship with Refinitiv ESG Ratings, with also all hypotheses tested with this rating, as this variable is statistically significant. Quite in line with the literature, these results suggest that, in general terms, higher levels of standard deviation (that is, higher levels of volatility) tend to be related to worse ESG ratings. On the other hand, higher levels of market cap, and companies characterised as more growth than value, tend to be associated with higher ESG scores.

To note that the correlations between the Sustainalytics ESG Rating and investment factors shows a lot of values around 0, suggesting that there is an extremely weak relationship – or none at all – between this rating and our variables. Furthermore, if we look specifically at the correlation coefficients of the Sustainalytics ESG Rating with the Refinitiv ESG Rating, we observe that, as expected, they are mostly negative. The coefficient between the two overall ESG ratings is -0.134. Thus, in general, since they measure opposite things, it is possible to check that there is an inverse relation between Sustainalytics and Refinitiv ESG Ratings, as already detailed in the literature review. Therefore, it should not come as a surprise if, from now on, the results of these ratings show somewhat different findings – it is due to the way these metrics are designed. More importantly, this actually shows to investors the importance of comparing two different ESG ratings when it comes the time to invest, simply because they measure different things, in view of the fact that there is no consensual benchmark on this issue. That is, one ESG rating could show that a company has a really good ESG performance, but another could show that that company has been really poor on managing ESG risks.

Appendix H shows the individuals scatter plots for every dependent and independent variable that we are going to further adopt in this Dissertation. From the scatter plots, it is visible that some variables have a negative relationship between them, others neutral, and others indicate a positive relationship. Splitting the analysis by the two ESG ratings under study, it can be observed that while the scatter plots relating to the Sustainalytics ESG Rating with another variable mostly indicate a negative or no correlation, the scatter plots relating to the Refinitiv Eikon ESG Rating with another variable mostly indicate a positive correlation. Consequently, we can interpret that our findings with the Refinitiv Eikon ESG Rating might be clearer than our results with the Sustainalytics ESG Rating. The explanation for this is not clear, but in our view, the justification has to do with the differences in the methodologies of both of these rating agencies. Nevertheless, we cannot conclude whether the Refinitiv Eikon ESG Rating or the Sustainalytics ESG Rating methodology is better or worse. Simply, this shows that the Sustainalytics ESG scores of our companies do not have a linear relationship with our 15 variables.

Regarding sectors, Appendix I shows the number of companies in each sector in our database, and Appendix J illustrates the sector distribution both in Sustainalytics and in Refinitiv ESG Ratings. In Appendix J, it is important to note the number of outliers and the greater discrepancy of the scores in the Sustainalytics Ratings figures, reinforcing the fact that the interpretations of our findings related to this rating might be more confusing. The figures show that the sectors with the highest average score on the overall Sustainalytics ESG Rating, S, and G pillars, is real estate; and on the E pillar is financial services. Real estate seems to be a sector with companies that report ESG metrics, plus, these companies have been managing those risks relatively well. From our view, this must have to do with the fact that real estate companies are one step ahead of the rest sectors in terms of legislation, as they have incentives to build environmentally friendly buildings. Sonae Sierra (2021) details that "the higher the sustainability index of a building, the higher the rental premium and the higher the transaction prices". As for financial services, the companies accounted in this sector have naturally less E concerns, as they are mostly banks, insurance companies, and other types of fintechs with low carbon emissions, and with high innovation rates. This finding on financial sector is in line with the investigation done by Lopez et al. (2020). In contrast, the sectors with the worst average scores on the overall Sustainalytics ESG Rating and E pillar is energy; on the S pillar is healthcare; and on the G pillar is financials. This may suggest that, in fact, according to the academic literature, energy companies have some difficulties managing ESG risks, consequently, their ratings are worse, principally in respect to E pillar (Lopez et al., 2020). Meanwhile, healthcare sector surge as the worst managing S issues, which, according to FundsPeople (2022b), may have to do with the fact that there are problems of accessibility to generic medicines by the population, and with telemedicine – as a possible obstacle when there is no easy access to Internet and computer technologies by the population. Meanwhile, financial services appear to be one of the worst sectors managing G issues, suggesting that although the companies from this sector tend to have high E scores, topics like proper governance, management, and relationship with shareholders may be somewhat lacking.

With respect to the Refinitiv ESG Ratings figures, we can observe that, on average, the energy sector has the highest score on the overall ESG rating and on E pillar. As previously seen on the Sustainalytics Ratings figures, it is precisely this sector that registers the highest ESG risk. In this sense, we interpret that companies in this sector, despite still having many unmanaged risks in this area, are reporting their metrics and making improvements in order to lower their risk. In fact, the controversial and the contradictions around this sector might be strictly connected to regulations related to pollution reduction. As for the S pillar, on average, the healthcare sector exhibits one of the highest average performance, contrasting again with the results of the Sustainalytics Rating. This might also be related to the fact that healthcare and energy companies are in the spotlight more than most, so they are more pushed to report and better manage their ESG risks. For G pillar, it is the basic materials sector that has the highest average scores, possibly indicating that metrics are being reported by these companies regarding the acceleration of the energy efficiency theme to compensate for lower consumption, and the relocation of certain activities to a perimeter closer to the production and consumption sites (FundsPeople, 2022b). On the other hand, the sector with the lowest average values is communication services on the overall Refinitiv ESG Rating, and on the three individual pillars. This last sector may surprise some investors, as the communication services sector usually appears to be a non-controversial sector.

In sum, the consensus of our findings is that the real estate sector, on average, has one of the lowest overall ESG Risk Rating, but also the lowest risks scores for S and G metrics. In addition, companies in the financial services industry have the lowest E risks score. However, these companies tend to have high G risks. Moreover, companies inserted in the energy sector have better overall ESG and E scores. Nevertheless, they also have worse score when we take into account the unmanaged ESG risks. Healthcare companies tend to have better performance on S issues, but they also have the worst average scores when we take into account the S risks. Companies in the basic materials sector came out highlighted as high performance on G metrics. At last, communications services sector has the worst average scores on the Refinitiv ESG Rating.

These findings quite aptly exemplify the importance of looking at two ESG ratings that measure different magnitudes. That is, if an investor only guides himself by only one ESG rating, it may lead him to think that a particular sector or company has a high ESG risk (or low ESG performance) and, therefore, would not invest in it. However, if the same investor looks at two or both of these ratings, he would observe that although a company might be reporting less efficient sustainability metrics, they are improving their ESG performance (just by reporting).

Also, it is important to note that the levels of transparency, as addressed by Tamimi and Sebastianelli (2017), also affects the score that the companies get. According to the latter research, the G pillar has the highest level on transparency, in contrast to the E metrics. Meanwhile, the S pillar has a high level of variability on the reporting. This may justify some of our disparate findings, and may reinforce our findings related to the G pillar.

5.1.1. Analysis of a more restricted sample

After analysing our full sample, in order to have a clearer idea of what is the relationship that these three areas under study have with each other, we sort the data for each variable relative to the worst and best 25% rated companies. From that sample of 206 companies (25% of 825), we extract the data for every ESG rating, investment factor, and credit rating. We create a summary statistic for these specific samples, which can be seen in Appendixes K and L. Additionally, we also show the characteristics of the companies according to whether their credit rating is classified as investment grade (rated above BBB) or high yield (rated from BB to C), which can be observed in Appendixes M and N, respectively.

- **Analysis of the 25% best companies rated by Sustainalytics ESG Ratings**

Focusing on the data of the Sustainalytics ESG Ratings and only on the average values (shown in Appendix K), we can observe that these 206 best rated companies manage, on average, E risks better than S or G ones. Thus, we can interpret that the companies that best manage ESG risks tend to be companies who pay more attention to E risks, and less to S or G risks. Consequently, focusing our attention on the summary statistics of the SES and comparing them with the results of the overall rating, we see that these are mid-to-big cap companies, with lower momentum, and with higher levels of volatility. We also have more empirical evidence that companies labelled as growth firms, with more quality, with lower yields, and with higher credit ratings, are more aligned with better E scores.

- **Analysis of the 25% best companies by Refinitiv ESG Ratings**

With regard to the 206 best rated companies on the Refinitiv Eikon ESG Ratings, referenced in Appendix K, the average values of the scores of the three ESG pillars are very closely aligned, ranging from 81.3% of the RES to 84.1% of the RSS. From these scores, we realize that these companies, on average, manage S risks better than E or G ones. Thus, focusing our attention on the summary statistics of the RSS, and comparing them with the results of the overall rating, we conclude that these are mid-to-big cap companies, with higher momentum and with higher levels of volatility. The mean values also shows that these companies are more growth than value, with better quality scores, and lower yield rates. At last, we have more empirical evidence that higher credit ratings are aligned with better S scores.

Comparing these results with the companies best rated on the Sustainalytics ESG Ratings, the consensus is that higher ESG scores are related to mid-to-large cap companies, with higher stock volatility, with more growth characteristics, with higher quality, with lower yields, and with higher credit ratings. Momentum factor, however, does not show yet enough evidence to draw any conclusions. The academic literature confirms that large companies are associated with higher ESG ratings. However, in contradiction to the literature and with our previous findings, our empirical evidence is that more volatility is associated with higher ESG ratings. Regarding value/growth approaches, the literature is heterogeneous, and our results until now indicate that growth is aligned with higher ESG ratings. With respect to yield, the literature indicates that higher yields are associated with higher ESG scores, but our results indicate the opposite. Both the literature, as well as our results, confirm that companies with higher quality and higher credit ratings are aligned with better ESG ratings.

- **Analysis of the 25% worst companies by Sustainalytics ESG Ratings**

We now analyse the 206 worst companies rated by the Sustainalytics ESG Ratings, shown in Appendix L. Ideally, we should find that the investment factors that were positively related to higher ESG ratings are not associated with lower ESG ratings. In this sample, among the three pillars that make up the ESG, the S pillar sample has the highest average values of unmanaged risk. Precisely in SSS, we highlight the SS, which shows the highest average value of the three pillars, the MS, which shows the lowest average value, the VS, which shows the highest average value, the growth score being the highest among the three pillars of this rating, and the YS, with the lowest average value among the three pillars.

These results seem to contradict the previous ones, mainly at the level of the size, volatility and growth factors, as these factors now showed the highest averages values of a sample that corresponds to the worst rated companies. In the previous analysis, these factors also showed the highest averages values, but with regard to a sample that aggregated the best rated companies. Thus, we will need more in-depth analysis and evidence to conclude something about them. However, with the momentum factor showing the lowest average value, we conclude that lower momentum can be associated with companies that have worse ESG ratings and higher momentum with better ESG ratings. It should be recalled that in the sample that aggregates the 206 best ranked companies by Refinitiv ESG Ratings, this factor shows the highest average value. Along with the momentum factor, higher yields may in fact be related to higher ESG ratings.

- **Analysis of the 25% worst companies by Refinitiv ESG Ratings**

Analysing the sample that corresponds to the worst companies ranked by the Refinitiv ESG Ratings, illustrated on Appendix L, it's worth to emphasize that, among the three pillars of ESG, the average values of the RES are very low compared to the average values of the RSS and RGS. This means that the companies which are worst classified according to this rating, on average, have the worst

performance at the E level. This is a fact that was not evident when we critically examined the previous sample, as Sustainalytics shows that companies did not manage ESG risks well at the S level. In this case, we found exactly the opposite. It is precisely in the S pillar that this sample has, on average, better performance. This could suggest that although companies are revealing a lot of unmanaged risks at the S level, they are also reporting metrics and developing their S issues. It also reveals the score disparity that the ESG rating agencies provide at the S and E pillars.

Looking at the variable's values, these companies, at the E pillar, are small-to-mid cap companies, with lower momentum score and higher volatility. They are also more growth than value companies, with high quality score and lower yields. Among the three pillars of these ratings, they also show the highest credit ratings. Thus, from the analysis we conclude that there is a positive relation between bigger companies, and higher momentum score, with higher ESG scores. The findings regarding the VS, VGS, QS, YS, and CR are yet not evident – they do not clearly indicate a positive or negative relation with higher or lower ESG ratings. We will need more analysis to conclude our findings regarding these factors.

- **Analysis of investment grade vs. high yield companies**

In order to check the relation between credit and ESG ratings, in Appendixes M and N there is a summary statistic of companies whose credit rating is in the investment grade and high yield brackets, respectively. It seems that companies best rated in terms of credit rating (those that have investment grade classification) have, on average, lower E risks. Again, the same conclusion does not apply to the Refinitiv ESG Ratings because, on average, these companies seem to have lower performance on E topics. However, investment grade companies have the highest S scores in terms of performance. Meanwhile, firms rated with a lower credit rating (those that have high yield classification) have, on average, a marginally lower ESG overall risk than the sample mentioned before. In terms of individual pillars, the E and S unmanaged risk of high yield companies is higher, however, the G unmanaged risks are lower. As for ESG performance, all individual pillars show lower scores than the companies in the investment grade space. Consequently, in terms of credit ratings, there is a positive relation between higher credit ratings with higher ESG ratings, principally on E and S issues. This finding is in line with Desclée et al. (2017), Aslan et al. (2021), Hentilä (2022) and Seltzer et al. (2022), that suggests that ESG performance is positively associated with higher credit ratings.

5.2. Empirical results and discussion

This subsection critically analyses the results of the regressions made to answer our main research question. For the eight hypotheses that we are going to study, we ran a regression for the entire sample under study (825 companies), a second regression for the sample that considers the best 25% rated

companies by the two ESG rating agencies, as well as a third regression for the worst 25% rated. All of our outputs relating to our full sample and specific samples are shown in Appendix O. The first column presents the results for the full sample, the second for the best 25% companies in the specific hypothesis, and the third for the worst 25% companies. Statistical significance is denoted by *** if p-value<0.01, ** if p-value<0.05, * if p-value<0.1. Note that, in the analysis below, we will only highlight the variables with statistically significant coefficients, that is, the variables that influence the dependent variable under study.

Hypothesis 1 (H1): What is the relationship between Sustainalytics ESG Risk Rating with investment factors and credit ratings?

Table O1 (in Appendix O) presents the output of the H1. The results, for the full sample, show that the variables VS, VGS, and CR are statistically significant. As for the results of the best 25% companies rated by SESGS, no variables show statistical significance. The results of the worst 25% companies rated by SESGS show that three variables have statistical significance: SS, MS, and YS.

Hypothesis 1A (H1A): What is the relationship between Sustainalytics Environmental Rating with investment factors and credit ratings?

Table O2 (in Appendix O) presents the output of the H1A. The results, for the full sample, show that the variables MS and VGS have statistical significance. The results, for the 25% best companies rated by SES, show three variables with statistical significance: VS, QS and CR. As for the results for the worst 25% companies rated by SES, also three variables are statistically significant: MS, VGS and QS.

Hypothesis 1B (H1B): What is the relationship between Sustainalytics Social Rating with investment factors and credit ratings?

Table O3 (in Appendix O) presents the output of the H1B. The results for the full sample show that the independent variables MS, VS, QS and CR have statistical significance. With regard to the sample that aggregates the 25% best companies rated by SSS, only VS shows a statistically significant value. For the sample that corresponds to the 25% worst companies rated by this rating, the output shows no statistically significant variables.

Hypothesis 1C (H1C): What is the relationship between Sustainalytics Governance Rating with investment factors and credit ratings?

Table O4 (in Appendix O) presents the output of the H1C. The results for the full sample show that the independent variables VS, QS and YS are statistically significant. As for the results of the best 25% companies rated by SGS, none of our independent variables shows statistical significance. For the sample that corresponds to the 25% worst companies rated by SGS, only SS and VS are statistically significant.

Analysing the results of the specific samples, which show more concretely results, it can be noted that lower levels of credit ratings are associated with better Sustainalytics ESG scores. In contrast, lower SS, higher MS, lower YS, and value companies are associated with worst Sustainalytics ESG scores. To note that our results were only written for the more specific samples because the results showed more clarity. However, it is clear from the Appendix O, and from the information mentioned above, the variables that significantly influence each pillar of the ESG in each rating.

Hypothesis 2 (H2): What is the relationship between Refinitiv ESG Rating with investment factors and credit ratings?

Table O5 (in Appendix O) presents the output of the H2. The results for the full sample show that the coefficients of SS, VS, VGS and QS are statistic significant. As for the results of the best 25% companies rated by RESGS, the variables SS, VS, QS and CR are again statistically significant. The results of the 25% worst companies rated by RESGS only VS shows a coefficient statistic significant.

Hypothesis 2A (H2A): What is the relationship between Refinitiv Environmental Rating with investment factors and credit ratings?

Table O6 (in Appendix O) presents the output of the H2A. For RES, and for the full sample, the independent variables SS, VS, VGS, QS and CR are statistic significant. As for the results of the best 25% companies rated by RES, SS and QS are the only independent variables showing that their coefficients are statistic significant. For the sample that corresponds to the 25% worst companies rated by RES, SS is again statistic significant and also VGS. In fact, this hypothesis for the full sample shows the highest R-square of all our hypothesis tested, with Prob(F-statistic) being zero. It is possible to conclude that this is the regression that the dependent variable is best explained by the respective independent variables, confirming the validity of the model supported by the existence of statistical evidence.

Hypothesis 2B (H2B): What is the relationship between Refinitiv Social Rating with investment factors and credit ratings?

Table O7 (in Appendix O) presents the output of the H2B. The results for the full sample of RSS show that SS, MS, VS, VGS and QS are statistically significant variables. As regard to the specific samples, both for the sample of the best and worst companies rated, only SS is statistically significant.

Hypothesis 2C (H2C): What is the relationship between Refinitiv Governance Rating with investment factors and credit ratings?

Table O8 (in Appendix O) presents the output of the H2C. For the full sample, the relationship between investment factors and RGS is shown as SS, VS and VGS being statistically significant. For the sample that encompasses the 25% best companies best rated and 25% worst companies rated by RGS, only SS is statistic significant.

Thus, the results of the specific samples on the Refinitiv Eikon ESG Rating suggest that firms with higher SS, lower QS, and higher CR are associated with better ESG performance. In contrast, firms with lower SS and with more value characteristics tend to be associated with worse ESG performance.

In sum, higher size companies, with lower levels of quality, with higher credit ratings, and in the growth style, are associated with better ESG scores. On the other hand, lower size companies, who tend to be more value than growth, with lower yields, with higher momentum, seem to be associated with worse ESG scores. Thus, these findings are consistent with Crespi and Migliavacca (2020), Hughes et al. (2021), and Zumente and Lāce (2021). These papers concluded that bigger companies tend to have higher ESG scores. These findings are also in line with Luo and Bhattacharya (2006), Krueger (2015) and with Giese et al. (2019), which demonstrated that high ESG scores are associated with companies with higher valuation multiples – characteristics more associated to growth companies. As we have demonstrated, the growth factor is more associated with higher ESG scores than the value factor. However, in contrast with some academic papers, we have shown that lower levels of quality (profitability) are associated with lower levels of ESG scores. This may be related with Limkriangkrai et al. (2017) that concluded that high rated ESG firms tend to increase their financial leverage, impacting their financial quality. Regarding the momentum and yield factors, our findings indicate that higher levels of momentum (and yield) are associated with higher ESG scores, but lower MS (and YS) are associated with lower ESG scores. Finally, as Desclée et al. (2017), Aslan et al. (2021), Hentilä (2022) and Seltzer et al. (2022) argue, higher ESG scores are associated with higher credit ratings.

As detailed in the literature review, the results obtained have several explanations. Larger companies have advantage obtaining higher ESG scores, as these companies tend to have more recourses to provide information to the ESG rating agencies, and have naturally more ESG concerns because they tend to have more social responsibility in society.

Regarding momentum, the literature detailed that high rated ESG stocks outperformed lower rated ESG stocks. As such, more sustainable companies should usually have higher MS. However, our results regarding this factor and yield factor are not conclusive. We have indications that higher MS (and higher YS) are associated with higher ESG scores, and vice-versa. A possible explanation for this finding is the time-period of our Dissertation in comparison to other papers that investigated the same relationship between momentum (and yield) with ESG ratings. These may be more time sensitive investment factors, which, consequently, leads to several different findings among researchers.

As for volatility, this factor clearly showed in the descriptive analysis that has a negative relation with higher ESG ratings. The academic literature consensus, as our results, indicate that high rated ESG stocks have lower volatility, as these tend to be the mature companies in the stock market, that manage ESG risks better than smaller companies, which tend to be more immature companies.

Meanwhile, we find that growth companies tend to have higher ESG scores because these tend to be the companies most innovative, with higher attention to new tendencies in the market, like the ESG factors.

Quality factor, however, does not have a clear relation with ESG ratings. The expectation according to the literature review is that higher levels of firm quality is associated with higher ESG scores. However, our finding is that this investment factor tends to be negatively correlated with higher ESG scores. Nevertheless, the literature has also demonstrated contradictions regarding the analysis of this factor with ESG ratings. A possible justification for this result is that the interpretation of quality among companies and investors may be subjective, which makes the results of the papers that investigate this relationship vary. Just as we, Simonek et al. (2021) also mentions the uncertainty to what degree the ESG factors may correlate with quality factor.

At last, regarding yield, if we bear in mind that larger companies, that are usually more profitable, tend to have higher YS, we consequently have an explanation for the relation of this factor with ESG ratings (Giese et al., 2019). That is, bigger companies, which tend to have higher ESG scores, are in a better financial position to distribute dividends to shareholders in comparison with smaller companies. The factor investing research show that favouring companies with higher yields over those with lower yields can be expected to produce higher returns over time (Blume, 1980). If we take into account that favouring companies with higher ESG ratings over those with lower ESG ratings can also be expected to produce higher returns, consequently, this may mean that a combination of these characteristics will lead to a sustainable portfolio (with companies with higher yields) will achieve superior returns than a traditional portfolio.

Generally, size, volatility, and quality were the top three investment factors that showed more times statistical significance in our regressions. In Appendix P a summary of the results of the regressions is presented. These tables show, in summary, the variables that have more statistical evidence and their coefficient signs.

6. Conclusion

This sixth chapter presents the conclusion and the limitations we encountered in carrying out this Dissertation. Our conclusions are the result of: (i) an extensive literature review, where we were able to answer some secondary research questions; (ii) a critical descriptive analysis; (iii) and an extensive regression analysis. After these analyses, we reflected on the results obtained and framed them with the academic literature. In this chapter, we synthetically present our findings. Furthermore, we describe guidelines for future research around these themes.

The aim of this Dissertation is to analyse the relationship between ESG ratings, different investment factors and credit ratings. To critically examine this relation, we initially carry out an extensive literature review on these three main themes, where it was possible to respond to some of the research objectives. We also perform a descriptive and regression analysis. In the descriptive analysis we explore the general statistics of our sample, scatter plots, and correlation matrix. Moreover, we include a sector analysis, to check which sectors tend to have, on average, the best and worse ESG scores. In order to observe our findings more clearly, we then split the full sample between the top and bottom 25% companies rated in the ESG ratings; and between companies classified with investment grade and high yield ratings. In the regression analysis, we use ESG ratings from Sustainalytics and Refinitiv Eikon as the dependent variables, and investment factors (size, momentum, volatility, value/growth, quality, yield) and credit ratings as the independent variables. Our results are the culmination of these analyses. We discuss and present justifications for our results along Chapter 5. Our sample includes 825 firms registered on U.S. stock exchanges by January to December of 2021. In general, our research indicates that the companies in our sample pay more attention to E risks, than S or G risks. However, they tend to have high performance on S issues. Our findings also indicate that, in general, the real estate is a sector where companies manage ESG risks better than other sectors. Financial companies, on the other hand, manage E risks relatively well, but have high risks in terms of G. The energy sector stands out for getting the worst average scores in ESG unmanaged risks and the highest average scores in terms of ESG performance, highlighting the heterogeneity of the rating methodologies. The same occurs for the healthcare sector in S metrics. Communications services companies, meanwhile, tend to have the worst ESG scores in terms of performance.

Although it is possible to relate ESG ratings, investment factors, and credit ratings, their correlation depends on the variables and financial indicators that an investor/researcher may use. We find that the average level of correlation between these three themes is, in general, low, suggesting that ESG scores (mainly the Sustainalytics ESG Risk Rating) is a largely independent source of information for investors (Melas et al., 2016). Breaking down ESG by pillars, the levels of correlation between our variables and ESG scores are also disparate. Our results with the E pillar score are more conclusive, possibly suggesting that the disclosure, understanding and reporting by companies regarding these themes is higher than for S or G themes.

Nevertheless, we have empirical evidence that bigger companies, accounted as growth companies, with higher momentum, with higher yields, with lower volatility, or with higher credit ratings, tend to have higher ESG scores. These tend to be variables that have statistical significance and a positive relationship with better ESG scores. In opposite, the relation between quality and the association to lower or higher ESG scores is not clear. This variable has both been shown to be positively related to better ESG ratings, but also the reverse.

To mention that we also verify the divergence in score of companies between the Sustainalytics ESG Risk Rating and the Refinitiv ESG Rating (the correlation levels between these two ESG scores is negative), extolling the importance for an asset manager to look at several different ESG ratings in the investment process. Consequently, it is important to bear in mind that the results interpretations can vary according from which ESG provider is used by the researcher. Our findings seem to be more conclusive regarding the Refinitiv Eikon ESG Rating. In fact, the regressions with the bests R-squared values were the regressions done with this rating procedure, more specifically with the Refinitiv Environmental Rating.

This Dissertation comes at a time when it is urgent to integrate ESG factors in investment analysis. Madhavan et al. (2020: 70) observes: "Even in the absence of long time series for certain ESG data, a reasonable assumption is that if factors correlate highly with ESG attributes today, they did so in the past". Thus, asset managers should consider that managing factor exposure to obtain better ESG profiles either through direct strategies that may be related with ESG scores, or indirectly, targeting characteristics related to the factors with higher ESG scores, is possible and may be viable. In the end, if some factors have empirical evidence to be linked to excess returns, and if those factors have also been linked to higher ESG scores, the manager may be investing responsibly while also delivering more alpha to investors. In any case, investors should be careful when constructing a portfolio based on ESG data of external providers and based on investment factors in order to avoid unintentional biases in allocation. That is, overweighing certain financial characteristics may result in unnecessary and not so attractive exposures for an investor. Moreover, we suggest that investors should look, at least, for two different ESG ratings since, as one agency's scores can lead to somewhat different findings from those of another agency. Lastly, it is relevant to mention that a responsible investor may also take into account that the methodologies of these rating agencies vary more frequently over time than the methodologies of typical credit rating agencies, which reinforces the attention that an investor will have to undertake when understanding the agencies' methodologies.

The opinion of Rory Bateman, Head of Equities at Schroders, is that sustainability cannot be measured by quantitative analysis alone, which, in his view, reinforces the importance of an active investment approach, but also a fundamental, bottom-up, and forward-looking framework. In sum, he shares the opinion that ESG analysis corresponds to an opportunity for active responsible asset managers – which reinforces the importance of this Dissertation. "By their nature, active managers have a vested interest in the companies they invest in: sustainable companies are the foundation of sustainable profitability, so helping companies to be more sustainable is likely to benefit their overall portfolio and their clients' profitability. Their broad insight and knowledge of companies and sectors is key to initiating meaningful and thoughtful debates that help drive change, address challenges and ensure that companies' management teams are accountable for making the transition," affirms Rory Bateman in an interview with FundsPeople (2022c).

Thus, the results from the present Dissertation can help asset managers and financial community in general to better understand how ESG ratings are related to investment factors and credit ratings. However, it's important to note some potential caveats. This research is limited by the fact that we used variables with different scales. As such, we might employ more specific regression analysis (which is beyond the scope of the present document). Moreover, the research is performed using a more limited time period data and only includes U.S. firm's data. So, there still remain possibilities for researchers to use more extensive time periods and enlarge the sample country (although at this point there are several data limitations). Furthermore, given the fast growth of the ESG dimension, it might be normal that some information may be outdated quickly. It should also be pointed out the variability with which, for example, the investment factor value, growth, or quality, can be considered by various investors. That is, some investors may attach more importance to other financial indicators. To address this issue, we were guided by the formula of an independent analysis company known worldwide. Finally, because of the fact that the ESG data are inconsistent among data providers, the replication of a certain approaches may lead to different results if the same dataset is not used.

That said, in general, the present research contributed for a better clarification of ESG theme. From our extensive literature review, we provided a comprehensive knowledge about the connection of ESG ratings, investment factors and credit ratings. More specifically, the investigation of the connection between these three themes provides value for: (i) equity and fixed income asset managers; (ii) credit analysts; and (iii) asset allocators. For them, we provide findings of how investment factors, sectors, and credit ratings may relate with ESG ratings and E, S, and G individual pillars. We go in-depth for a sector and credit ratings analysis. Our conclusion suggests that an asset manager, by investing in companies according to certain investment factors, or sectors, or with higher credit ratings, may be adding alpha while having a portfolio positively aligned with better ESG ratings.

In the world of ESG there is still much to clarify. However, in our view, this research represents a step forward in that clarification. There is no doubt that players in the financial market are making their practices more sustainable and have made progress in this area, but the need to improve the methodologies of the various ESG investment approaches is high. As such, this Dissertation has aimed to provide answers to some investor's questions. The expectation for the future is the continuous evolution of processes that ensure respect for E, S or G issues by all organisations that have a significant impact on the economy. It is expected that positive developments in this area, which are expected to gain more importance in the coming years, will enable financial market players to play a decisive role in shaping a more sustainable future for the global economy.

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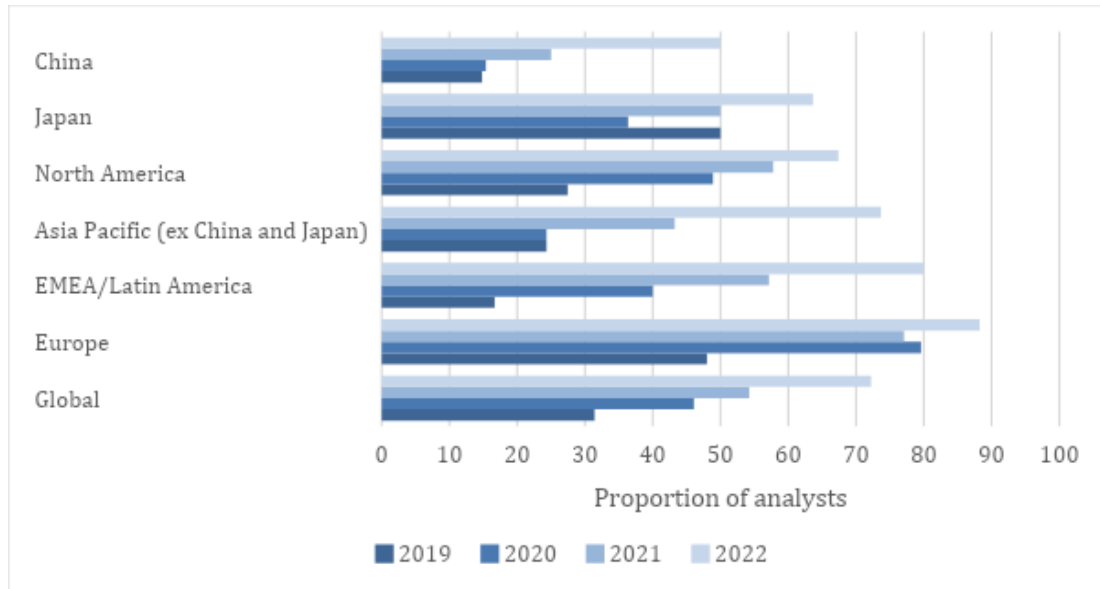
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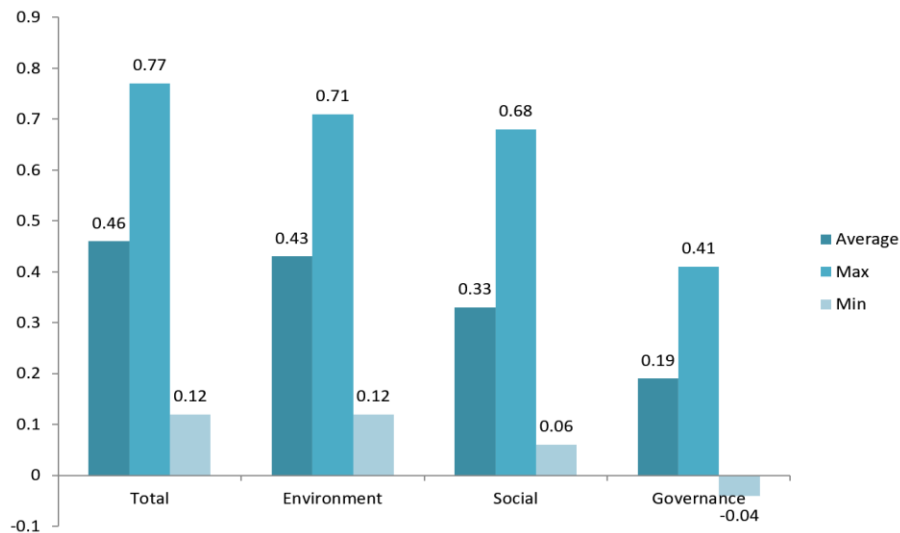
Appendices

Appendix A – Proportion of analysts that believe ESG awareness is increasing at majority of companies



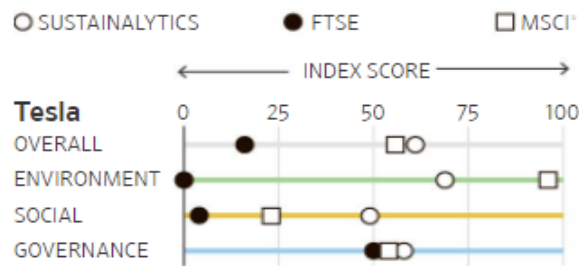
Source: Author adapted from Fidelity (2022)

Appendix B – Average, minimum, and maximum correlations across ESG rating providers



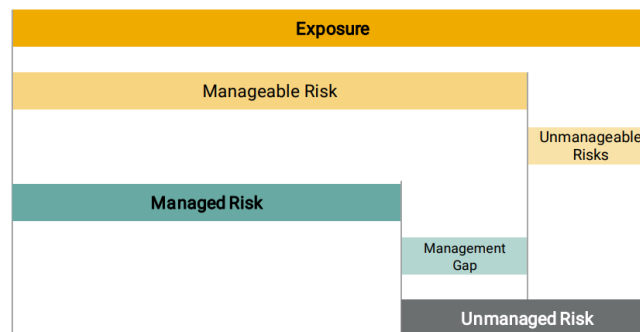
Source: Adapted from Brandon et al. (2021)

Appendix C – ESG score of Tesla at Sustainalytics, FTSE, and MSCI



Source: Mackintosh (2018)

Appendix D – Sustainalytics ESG rating risk decomposition



Source: Garz and Volk (2019)

Appendix E – Interpretation of Refinitiv ESG scores

Score range	Description
0 to 25	Indicates poor relative ESG performance and insufficient degree of transparency in reporting material ESG data publicly.
25 to 50	Indicates satisfactory relative ESG performance and moderate degree of transparency in reporting material ESG data publicly.
50 to 75	Indicates good relative ESG performance and above-average degree of transparency in reporting material ESG data publicly.
75 to 100	Indicates excellent relative ESG performance and high degree of transparency in reporting material ESG data publicly.

Source: Author adapted from Refinitiv (2022)

Appendix F – S&P alphanumeric ratings' conversion into numeric values

Credit rating	Standard and Poor's	Numeric equivalent
	AAA	100
	AA+	95
	AA	90
	AA-	85
Investment grade	A+	80
	A	75
	A-	70
	BBB+	65
	BBB	60
	BBB-	55
	BB+	50
	BB	45
	BB-	40
High Yield	B+	35
	B	30
	B-	25
	From CCC+ to CCC-	20
	CC	15
	C	10
	Default	D

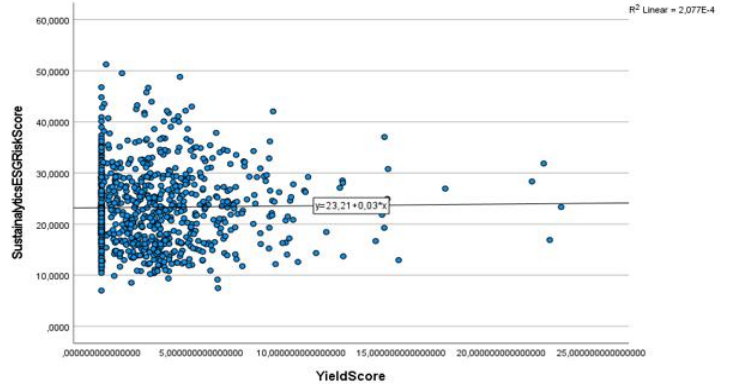
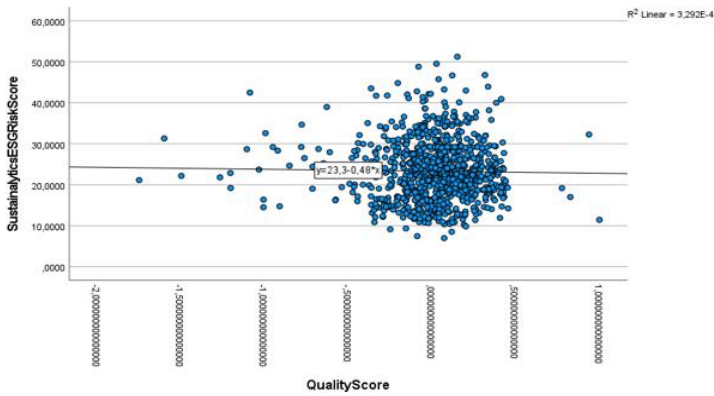
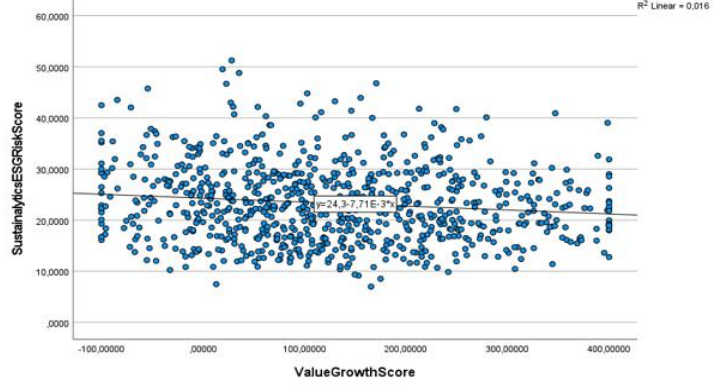
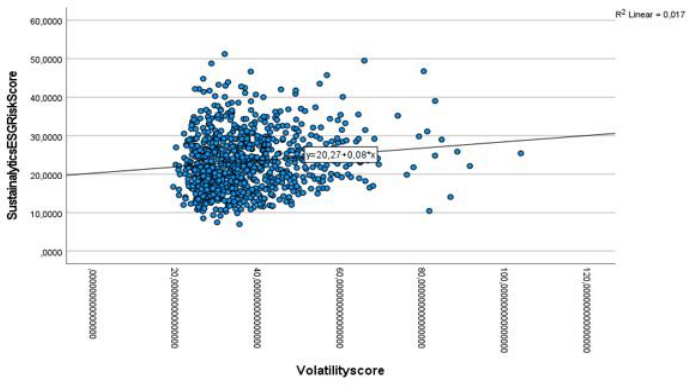
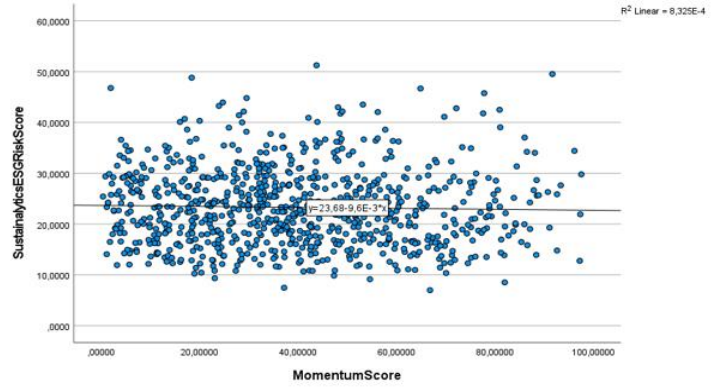
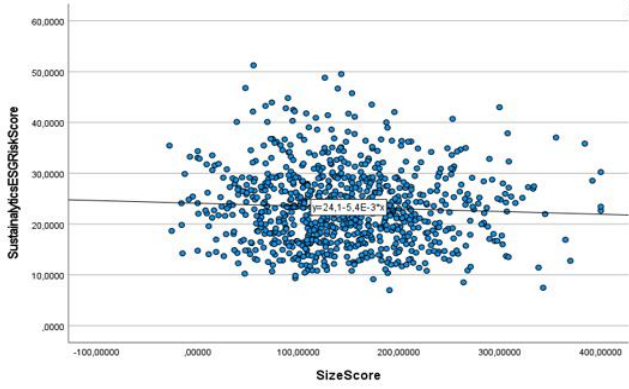
Source: Author adapted from Ferri et al. (2000)

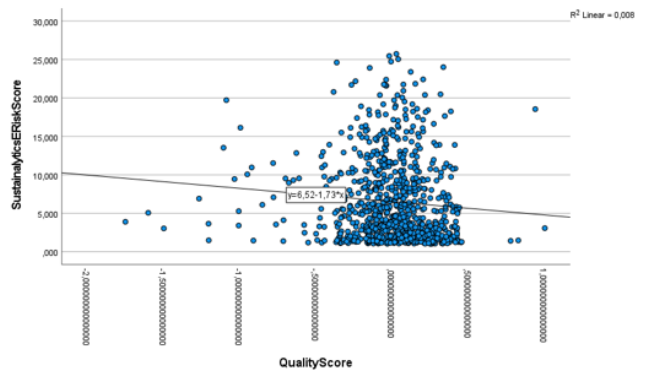
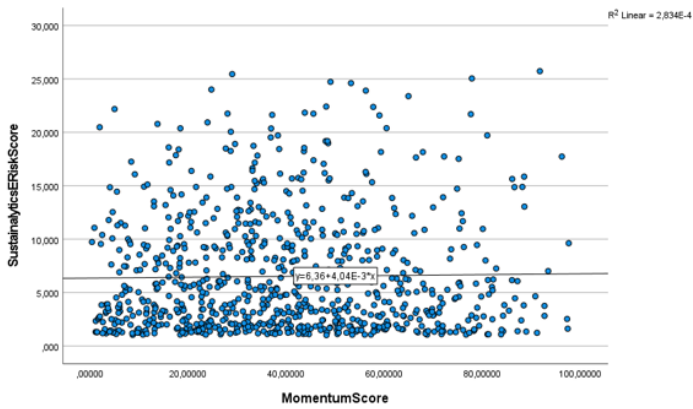
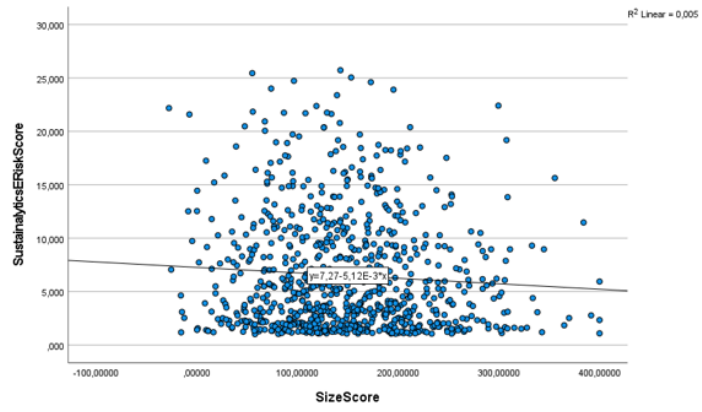
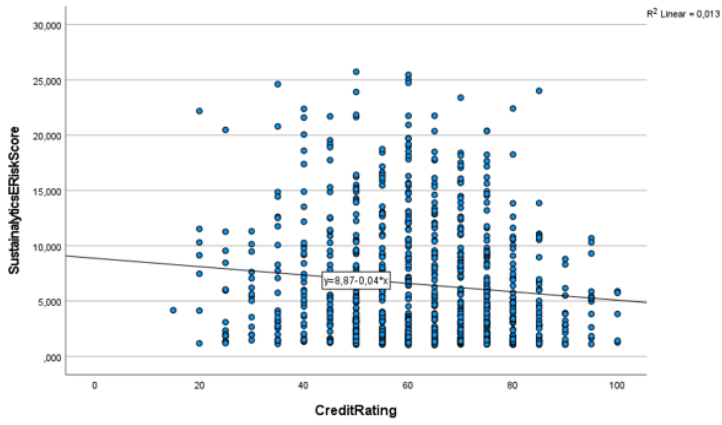
Appendix G – Description of the variables

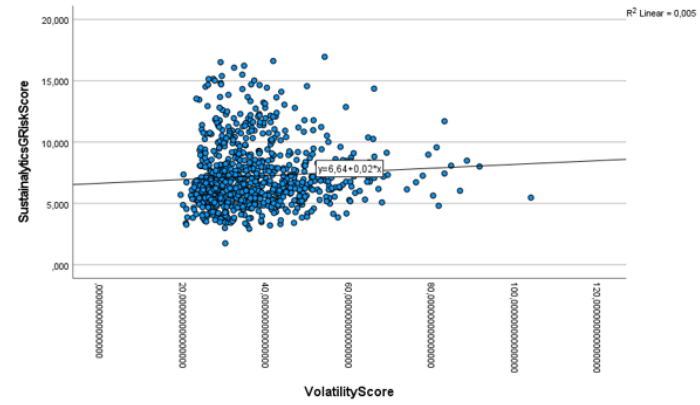
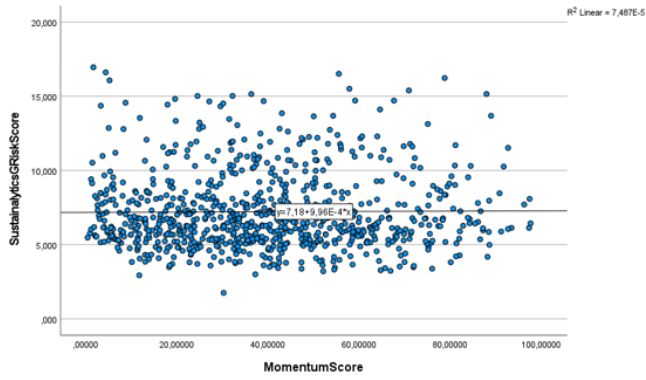
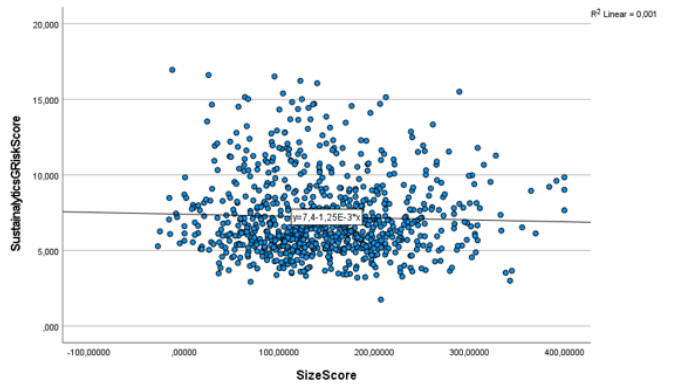
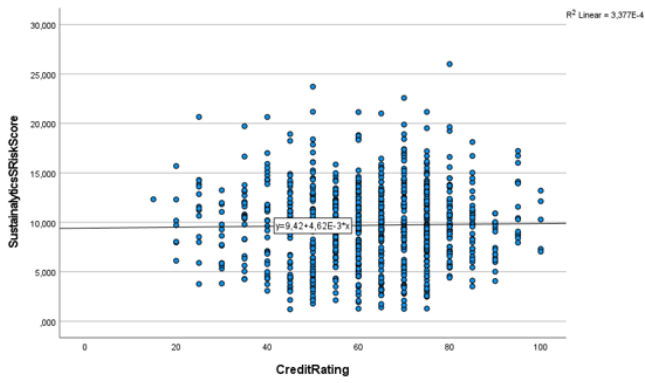
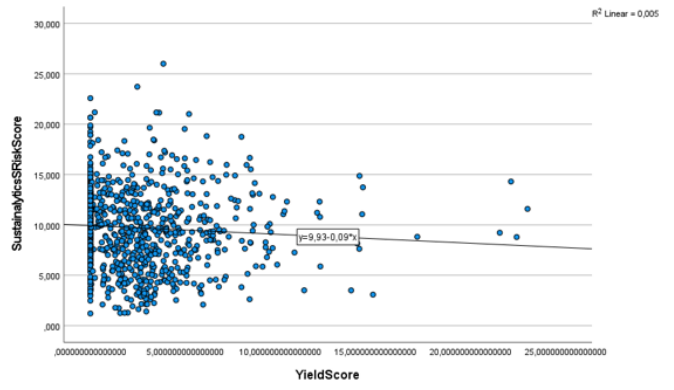
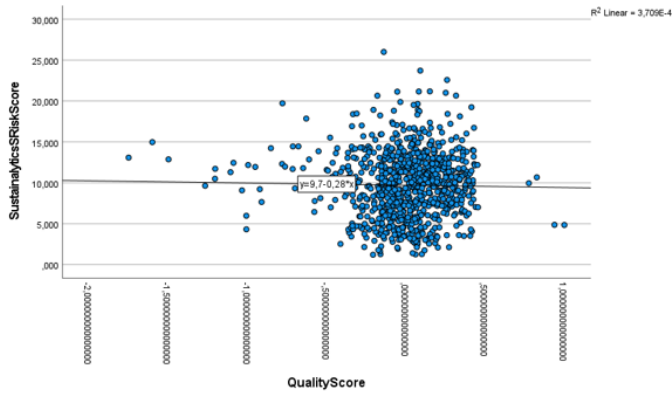
Variable's name	Descriptions	Abbreviations
Dependent variables		
Sustainalytics ESG Risk Score	The rating is designed to help investors identify the degree to which a company exposure to material ESG risks and how well the company is managing those risks. The scores show a quantitative measure of unmanaged ESG risk.	SESGS
Sustainalytics Environmental Risk Score	Environmental Risk Score measure the degree to which a company's economic value may be at risk to environmental risks factors. The score represents the unmanaged risk exposure after taking into consideration how well the company is managing such risks.	SES
Sustainalytics Social Risk Score	Social Risk Score measure the degree to which a company's economic value may be at risk to social risks factors. The score represents the unmanaged social risk exposure after taking into account a company's management of such risks.	SSS
Sustainalytics Governance Risk Score	Governance Risk Score measure the degree to which a company's economic value may be at risk to governance risks factors. The score represents the unmanaged governance risk exposure after taking into account a company's management of such risks.	SGS
Refinitiv ESG Score	Refinitiv Eikon ESG score measure a company's relative performance on fundamental ESG attributes and assigns a score in percentage between 0 and 100, similar to Sustainalytics. The score is based on the companies' self-reported information in the environmental, social, and governance pillars and then processed and compiled by Refinitiv's analysts	RESGS
Refinitiv Environmental Score	In this pillar of ESG score it is measured how well a company is performing in themes like emissions, waste, biodiversity, product innovation, energy, sustainable packaging, between others.	RES
Refinitiv Social Score	In this pillar of ESG score it is considered themes like how well a company is dealing with human rights, product responsibility, workforce, and community.	RSS
Refinitiv Governance Score	In this pillar of ESG score it is considered themes like company's performance about ESG reporting and transparency, management compensation and shareholders rights.	RGS
Independent variables		
Size Score	Represents the score of a stock based on the cumulative market capitalization. Big companies will get higher values.	SS
Momentum Score	Represents the momentum factor exposure of a stock as the log trailing 12-month return minus trailing one-month return. Higher values indicate larger momentum.	MS

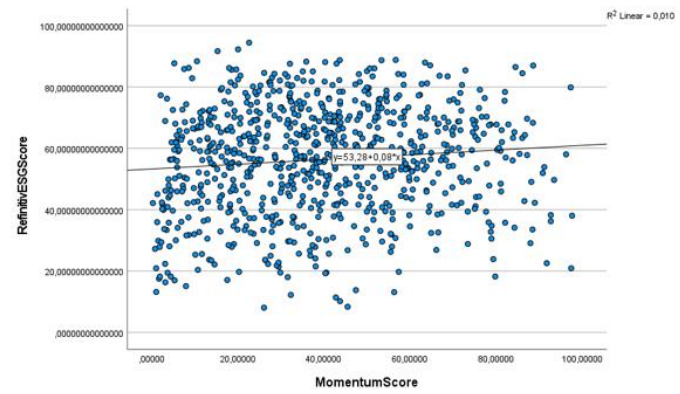
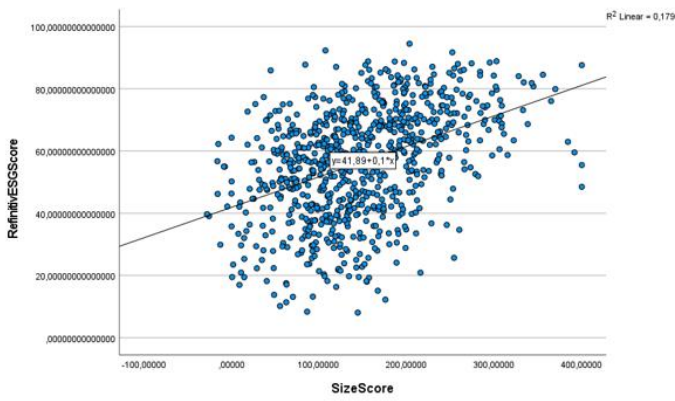
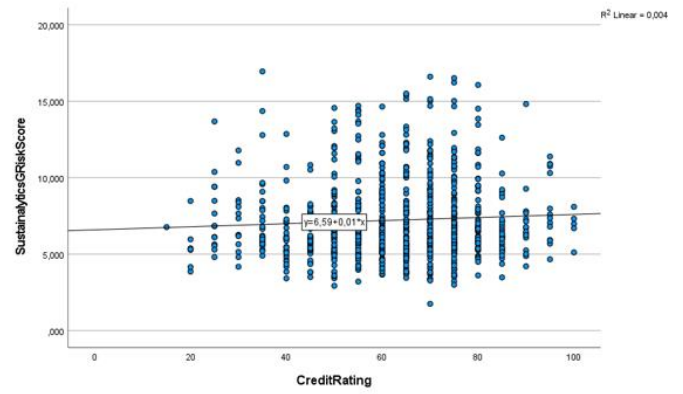
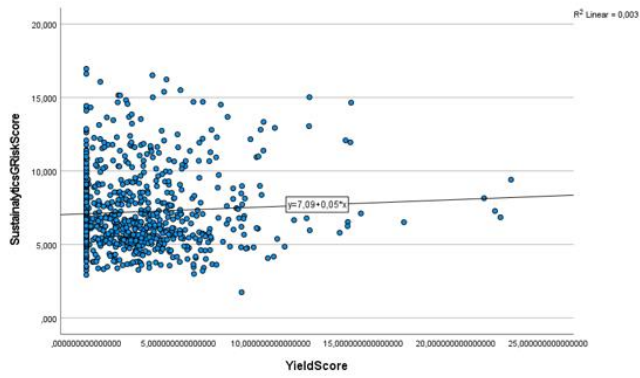
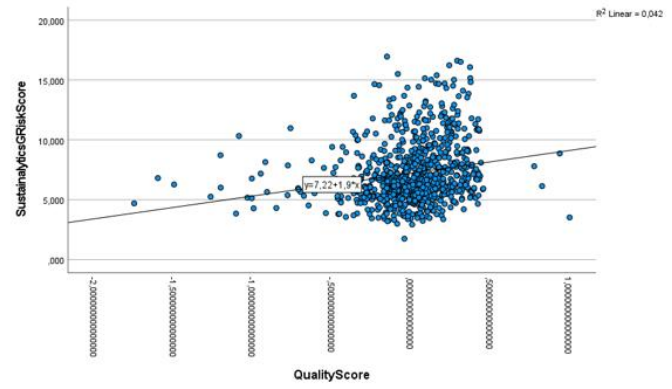
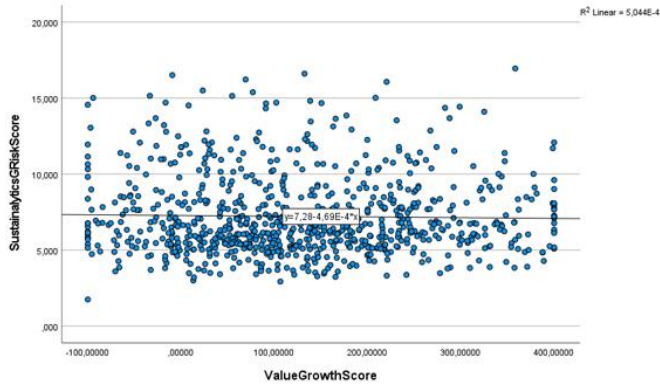
Volatility Score	Represents the annualized standard deviation of daily stock, as the volatility of a stock is widely used measure of risk. Higher values indicate higher volatility.	VS
Value/Growth Score	A stock can be either characterized as value or growth. In this camp, a higher score indicates a stock stronger growth orientation and a low exposure to the value factor. Low score indicates more value stocks, for example, as a stock having a low price relative to its book value, earnings and yield.	VGS
Quality Score	Represents the quality score of a stock as the equally weighted z-score of a company's profitability (trailing 12-month return on equity) and the z-score of its financial leverage (trailing 12-month debt/capital).	QS
Yield Score	Represents a total yield factor for stocks, more specifically, it sums the buyback and dividend yield of a company by the end of 2021.	YS
Credit Rating	Represents Thomson Reuter's credit rating implied by the current estimated forward one-year default probability from the StarMine Combined Credit Risk Model. This model calculates the probability that a company could default within 12 months.	CR

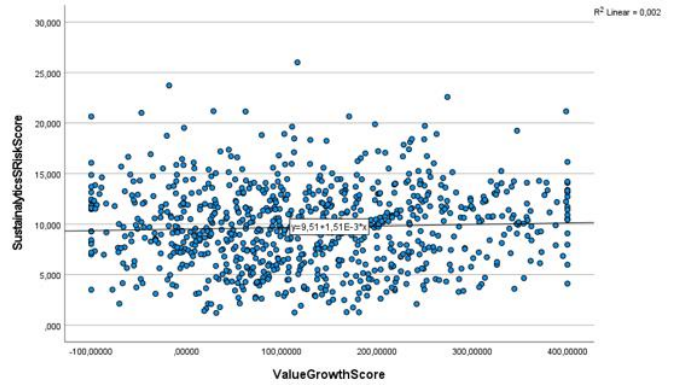
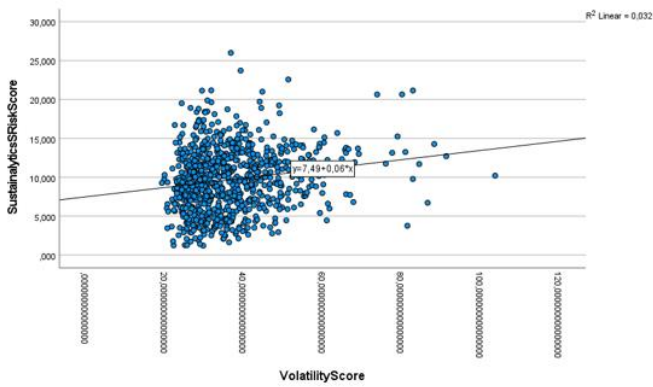
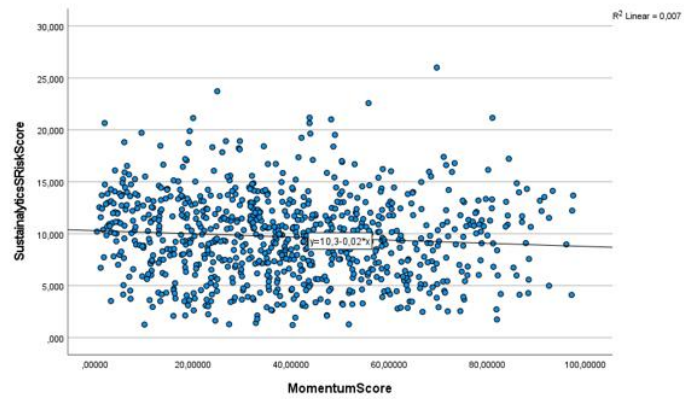
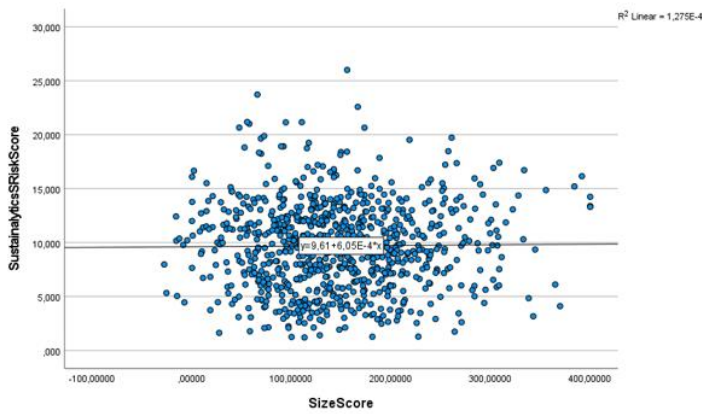
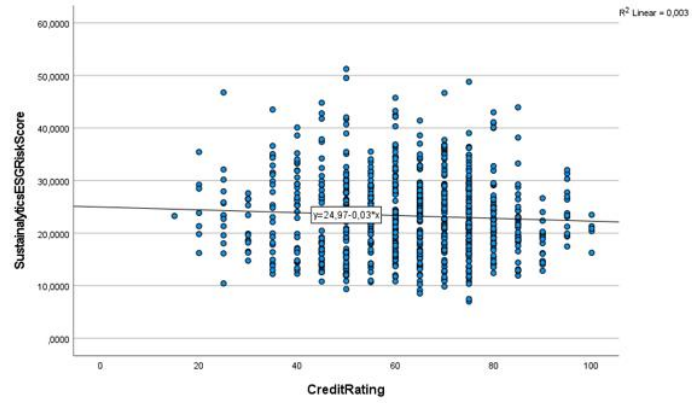
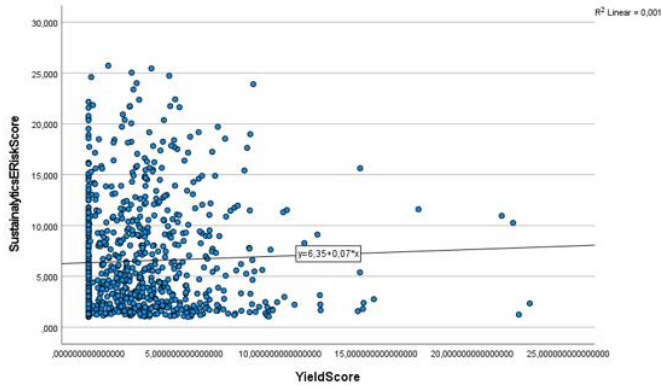
Appendix H – Scatter plots of all variables

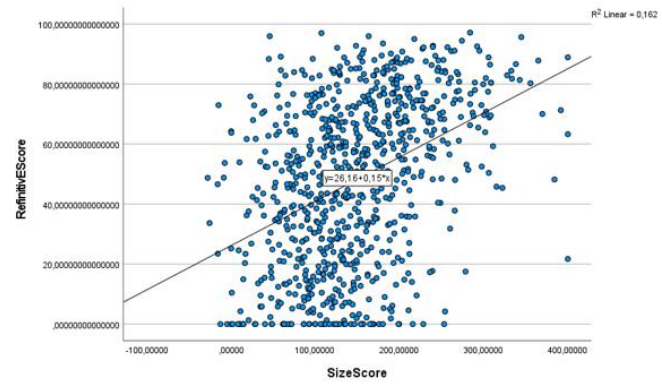
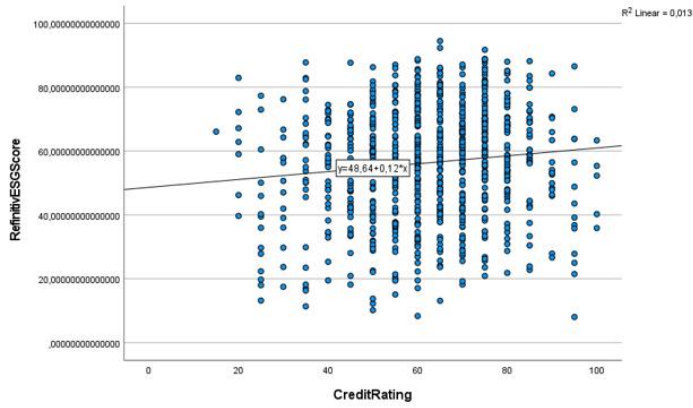
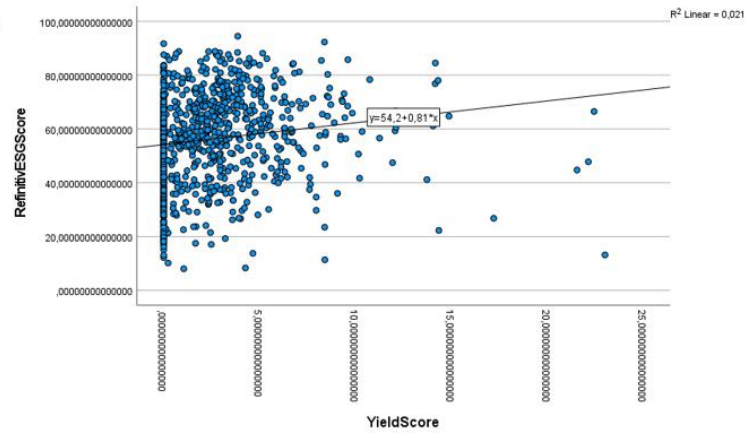
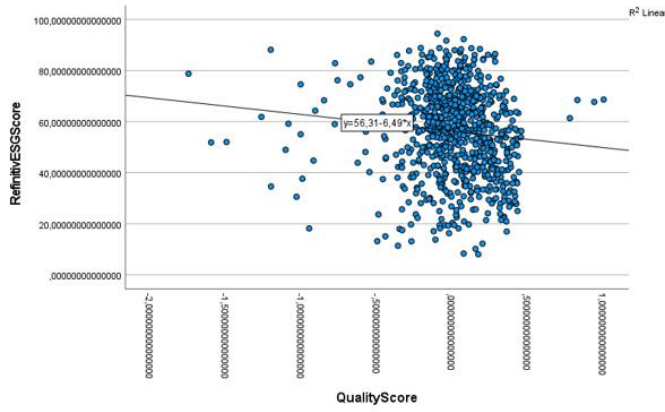
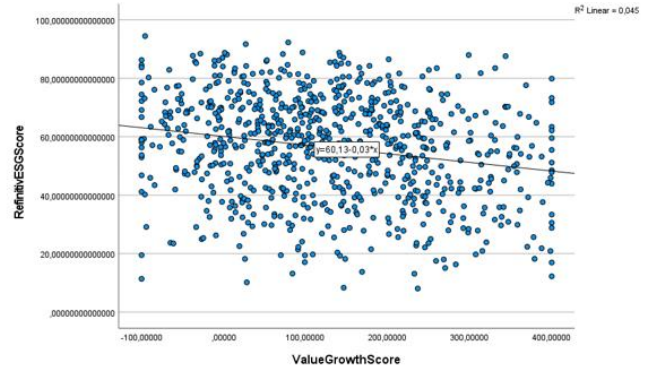
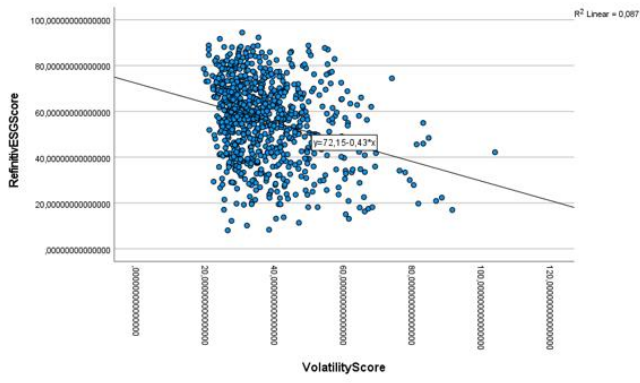


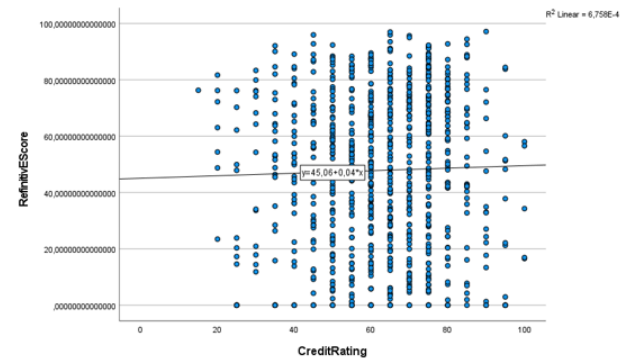
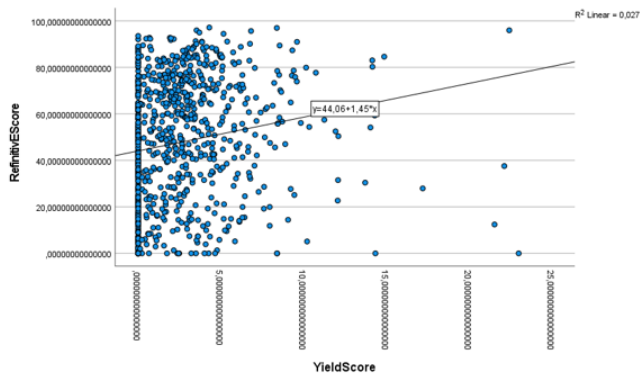
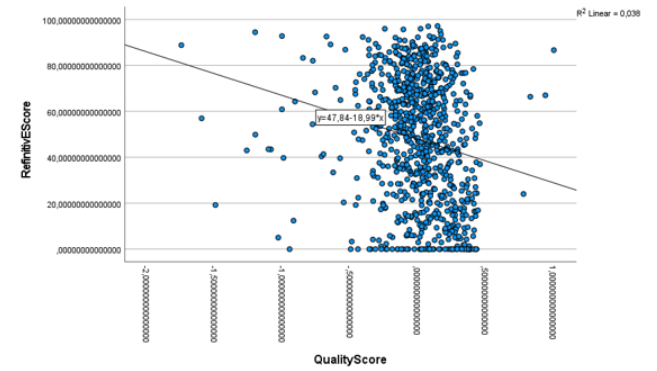
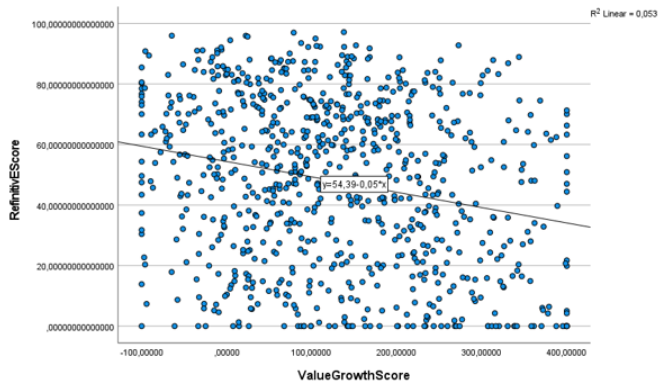
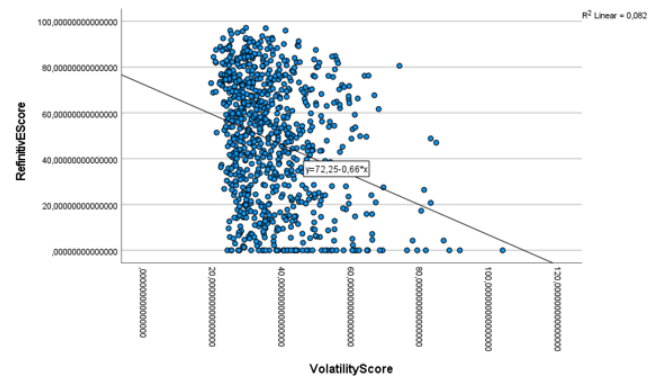
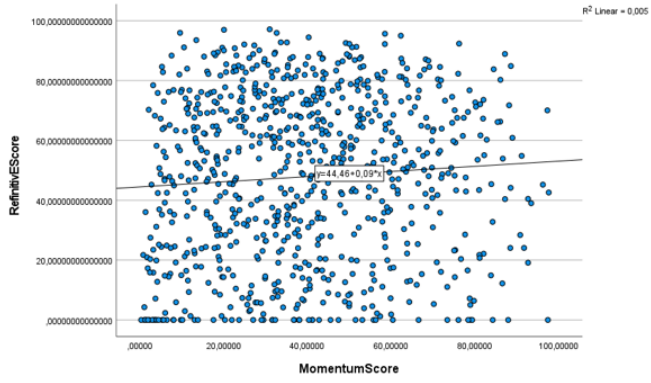


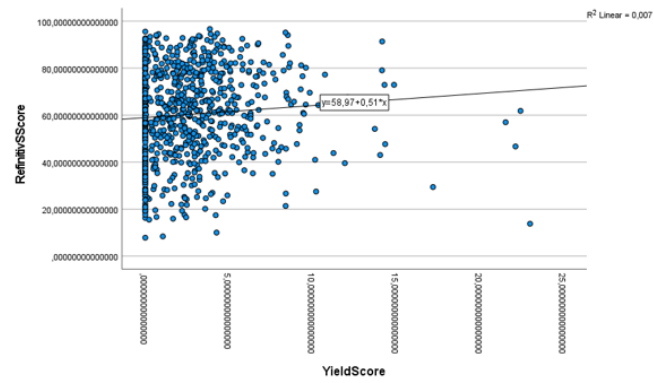
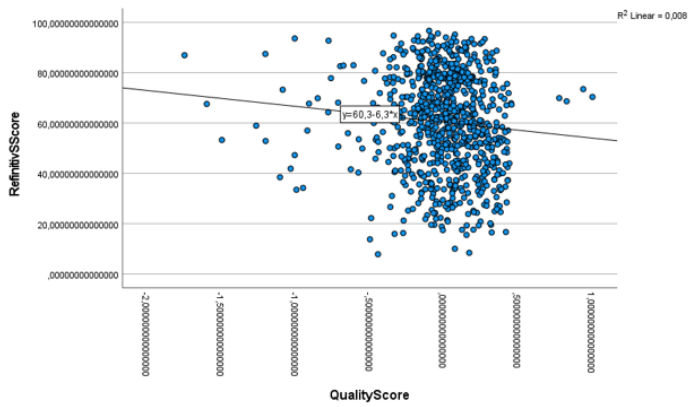
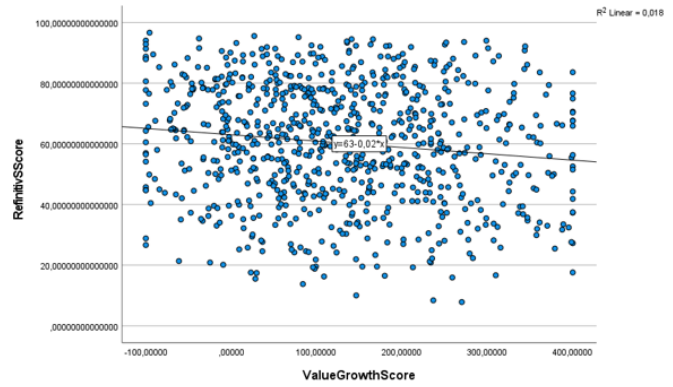
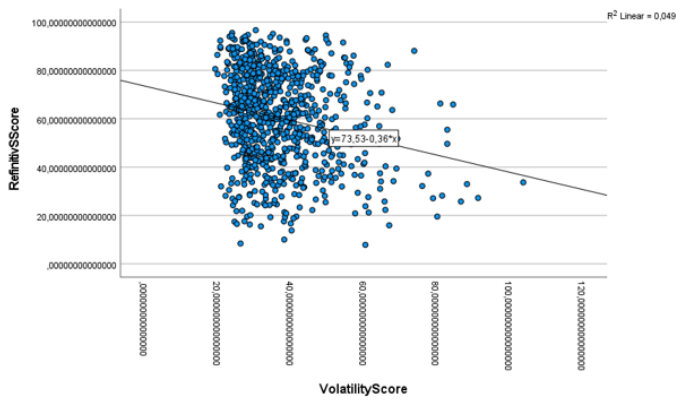
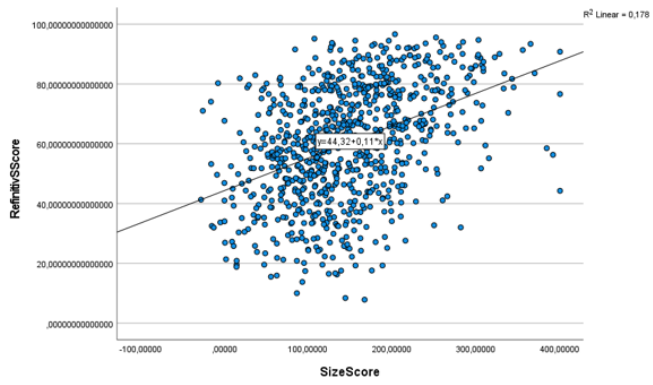


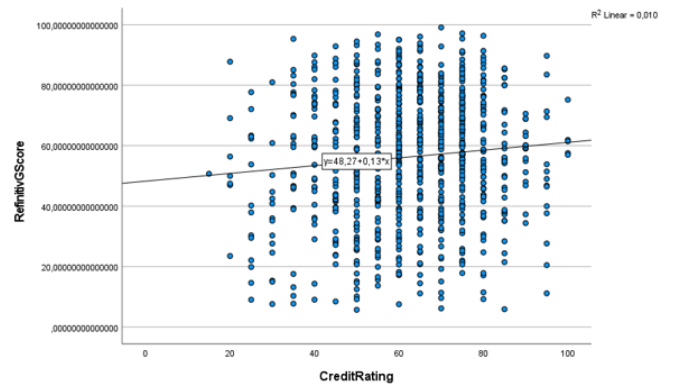
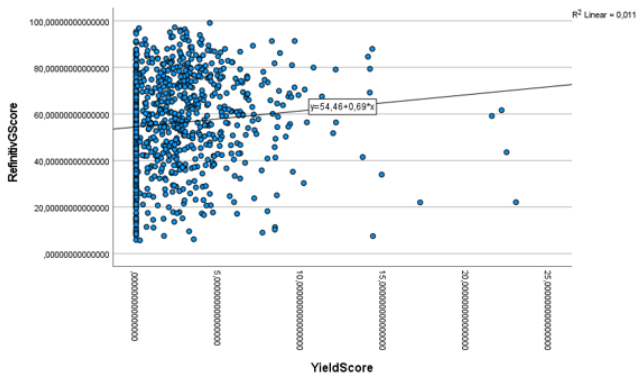
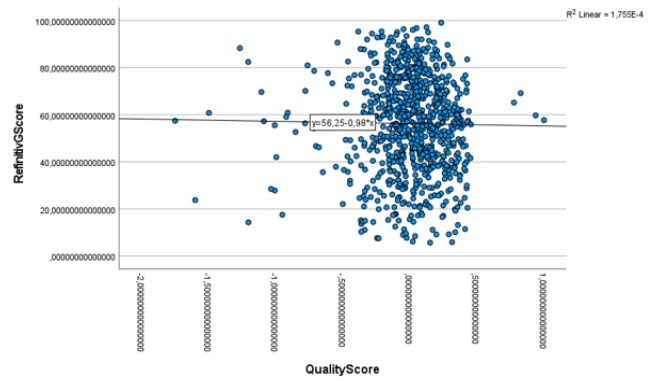
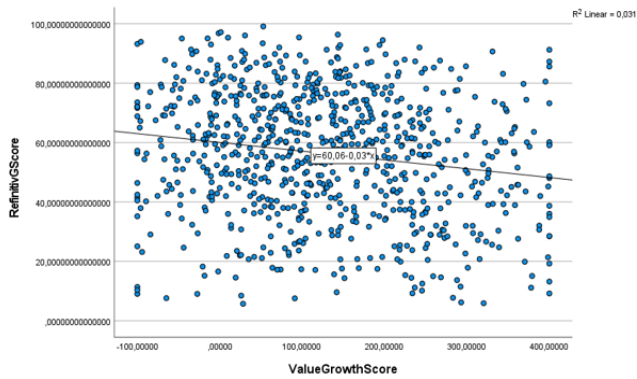
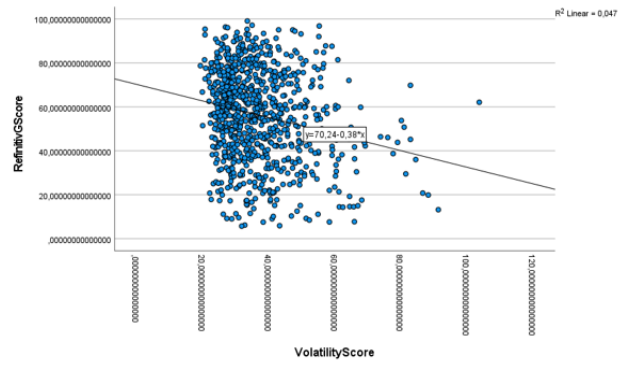
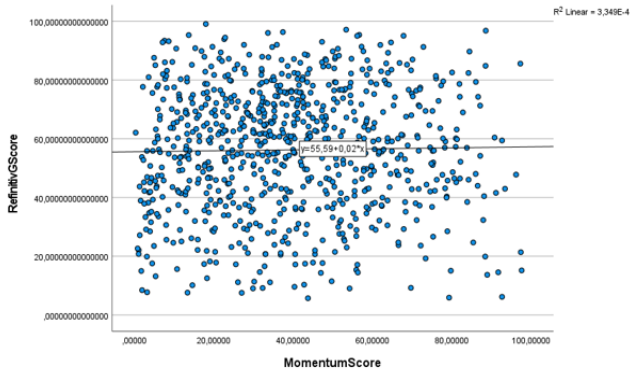
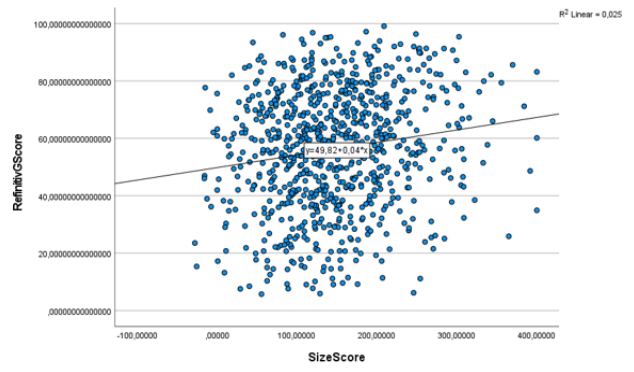
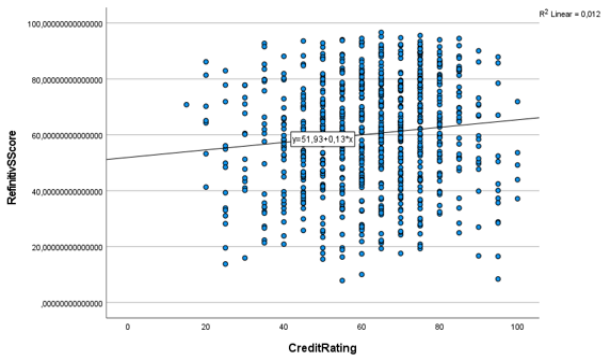










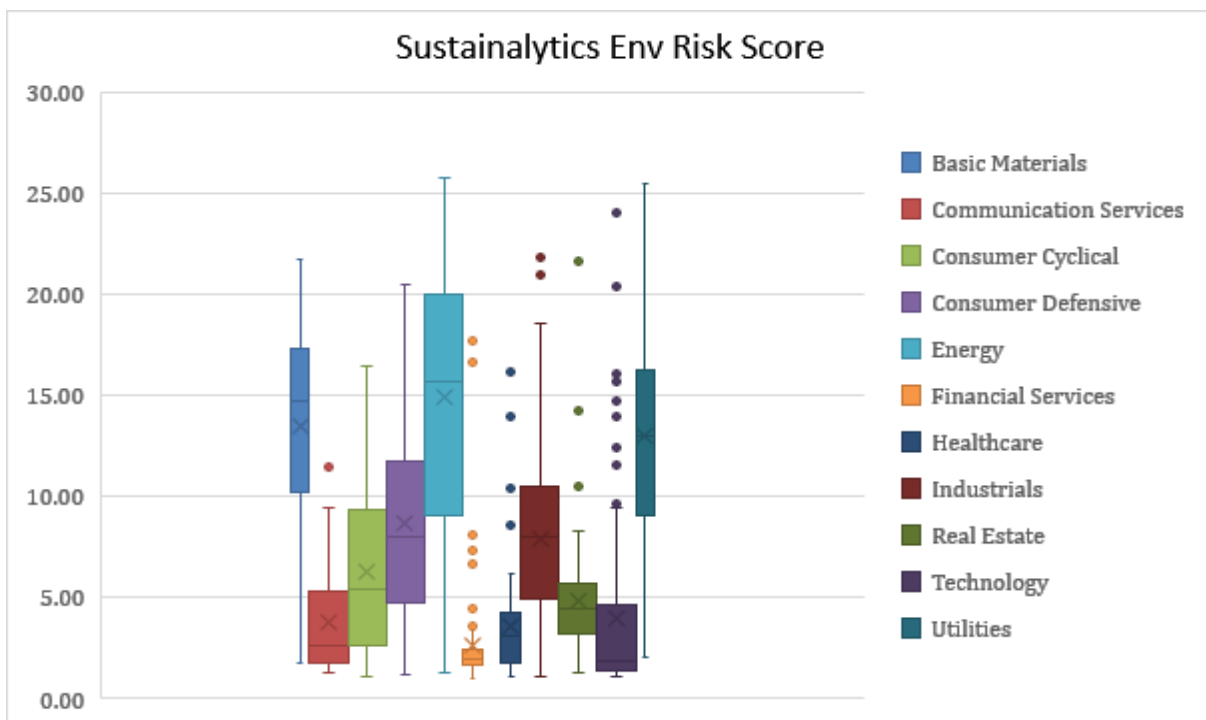
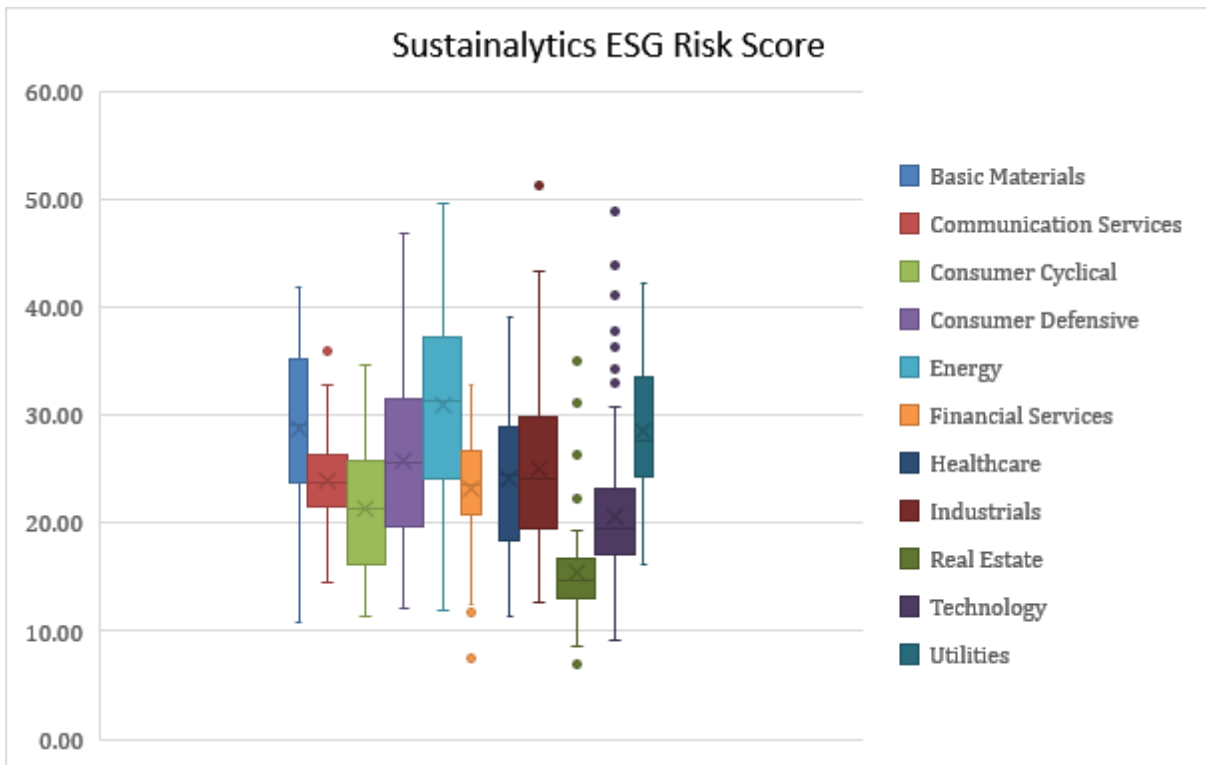


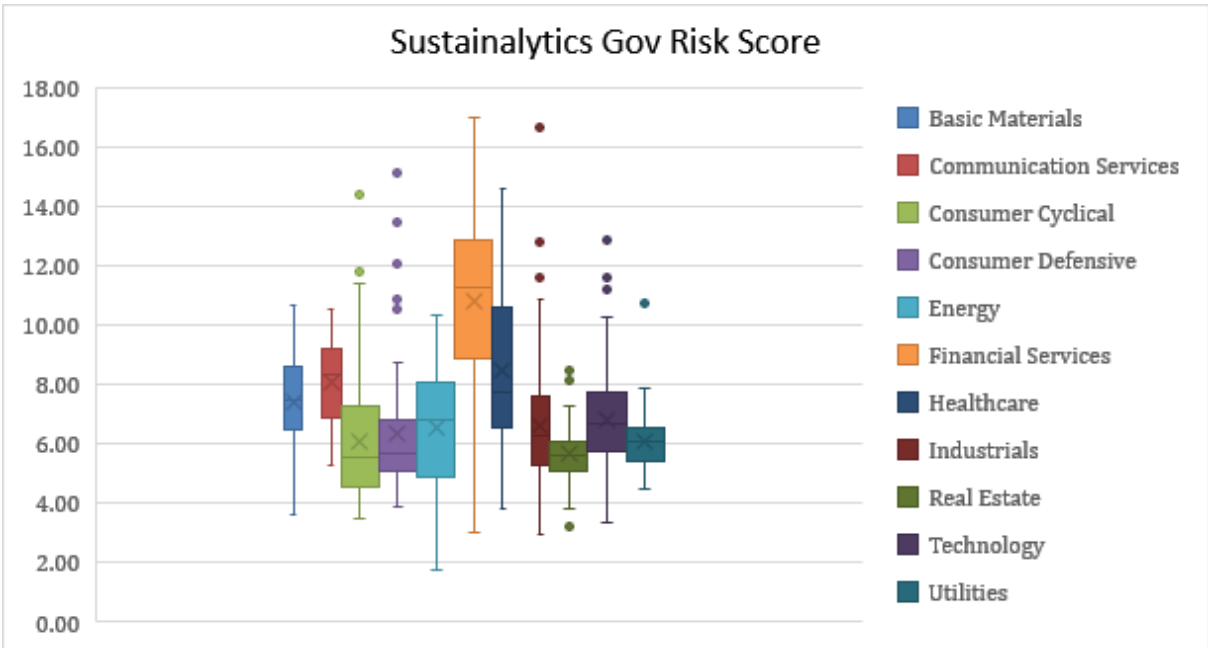
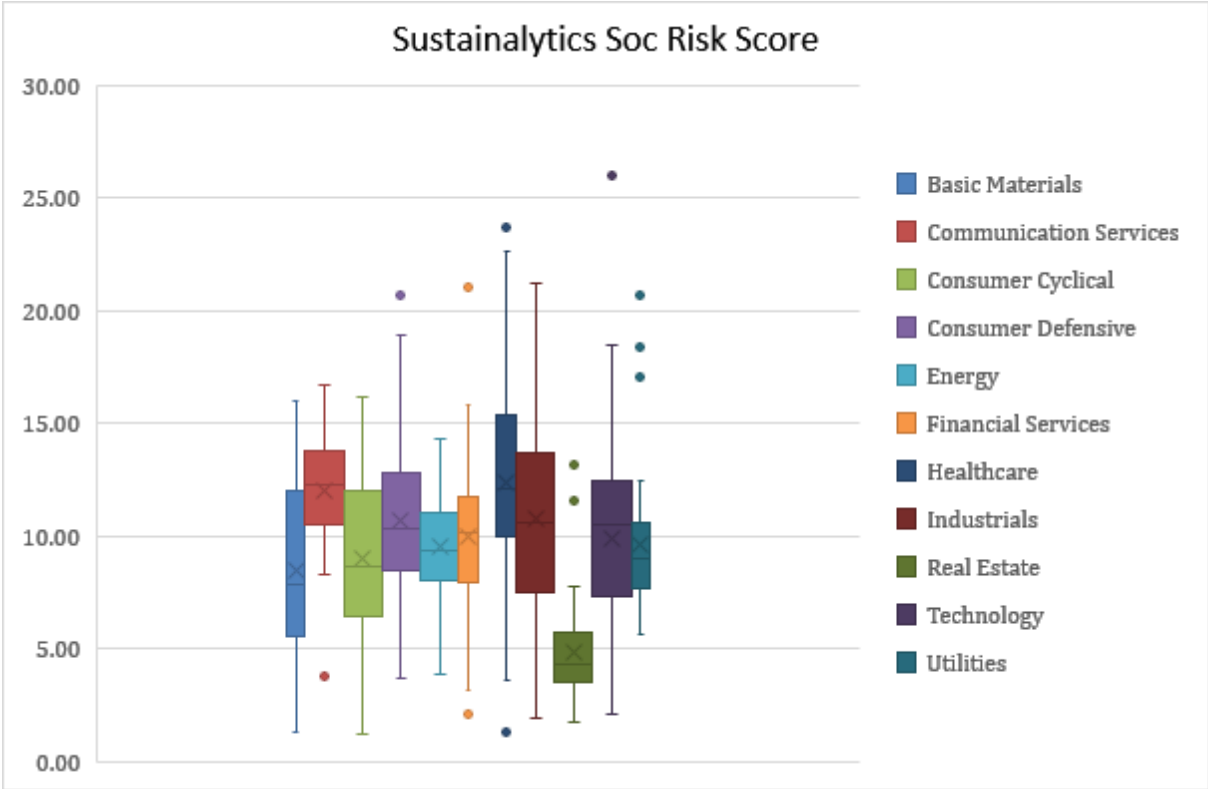
Appendix I – Number of companies in our sample from each sector

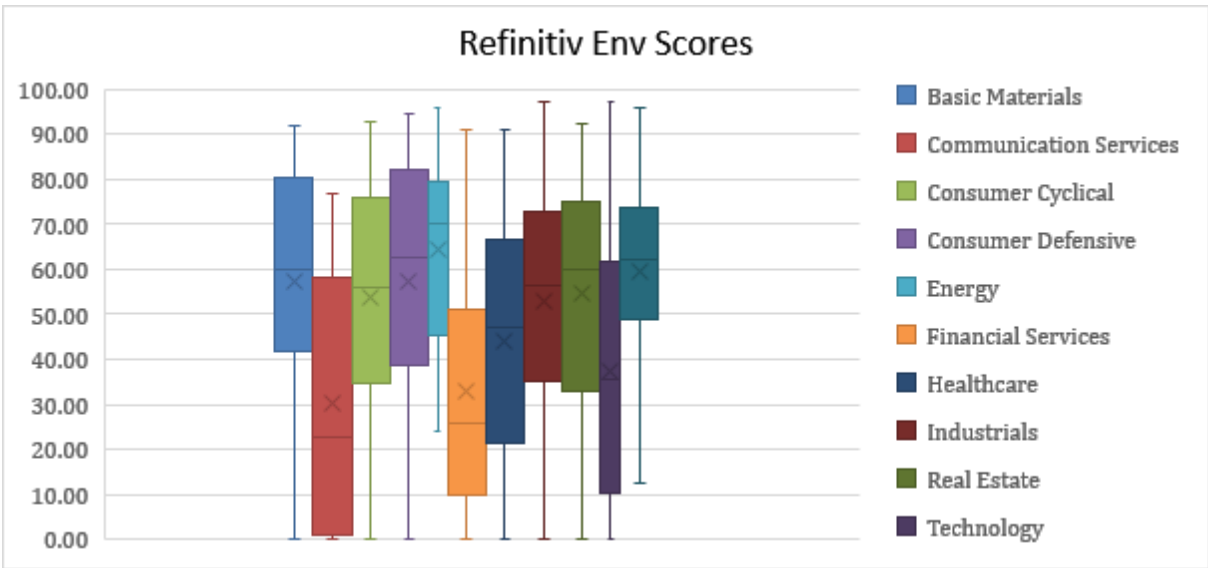
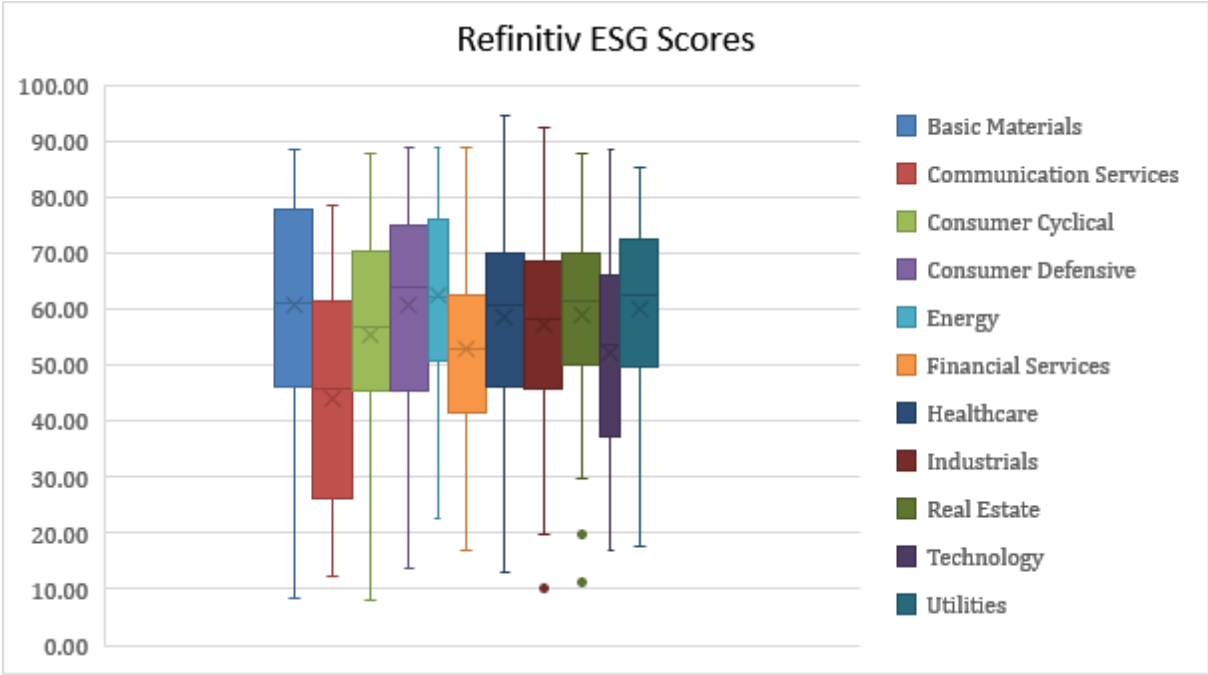
Sector classification in Morningstar	Number of companies	Sector wise % of companies
Basic Materials	46	6%
Communication Services	24	3%
Consumer Cyclical	103	12%
Consumer Defensive	61	7%
Energy	36	4%
Financial Services	106	13%
Healthcare	69	8%
Industrials	129	16%
Real Estate	73	9%
Technology	139	17%
Utilities	39	5%

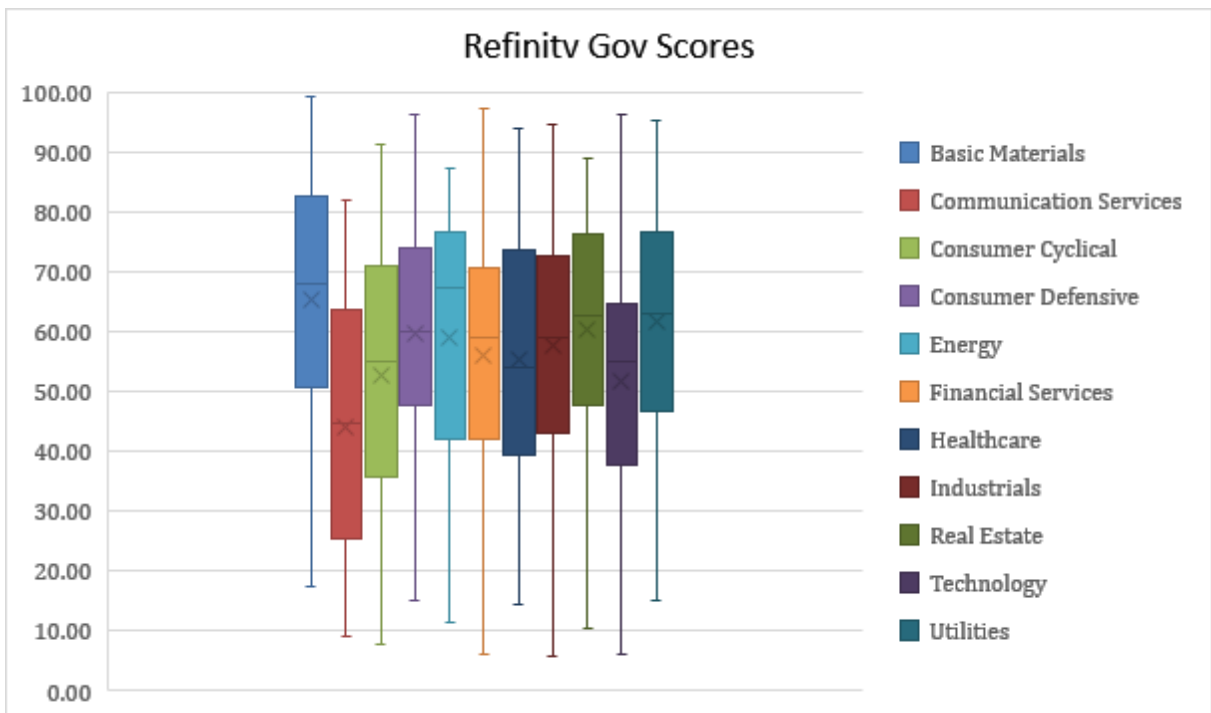
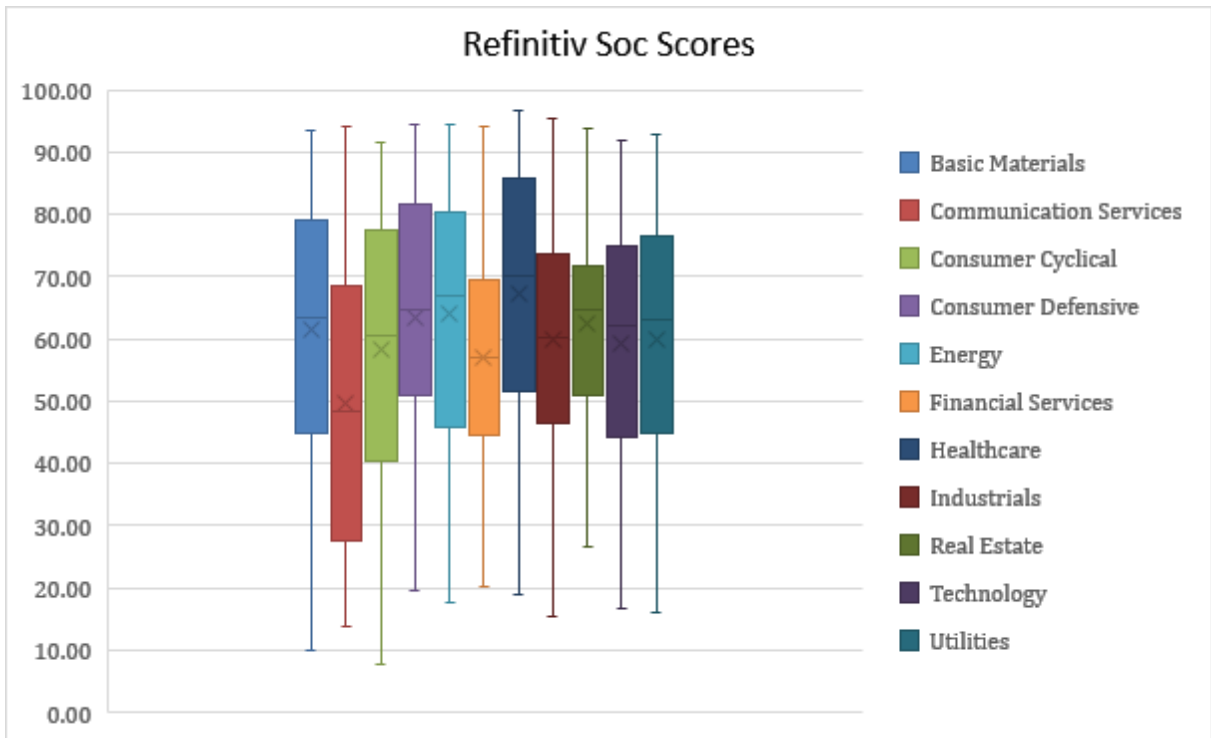
Source: Author

Appendix J – Scores distribution by sector









Source: Author

	<i>RES</i>	<i>SS</i>	<i>MS</i>	<i>VS</i>	<i>VGS</i>	<i>QS</i>	<i>YS</i>	<i>CR</i>
Mean	81.28	190.74	39.78	33.43	92.23	-0.05	3.31	63.46
Median	81.15	192.81	37.71	31.06	87.56	-0.04	2.84	65.00
Minimum	70.90	-14.83	3.21	19.29	-100.00	-1.75	0.00	15.00
Maximum	97.15	400.00	88.51	73.82	400.00	1.00	22.43	95.00
N	206	206	206	206	206	206	206	206

	<i>RSS</i>	<i>SS</i>	<i>MS</i>	<i>VS</i>	<i>VGS</i>	<i>QS</i>	<i>YS</i>	<i>CR</i>
Mean	84.11	191.94	42.87	34.27	104.16	-0.04	2.81	64.73
Median	82.94	188.40	42.15	31.40	94.21	0.00	2.53	65.00
Minimum	76.65	-7.45	2.17	19.29	-100.00	-1.75	0.00	20.00
Maximum	96.65	400.00	97.22	73.82	400.00	0.35	14.16	95.00
N	206	206	206	206	206	206	206	206

	<i>RGS</i>	<i>SS</i>	<i>MS</i>	<i>VS</i>	<i>VGS</i>	<i>QS</i>	<i>YS</i>	<i>CR</i>
Mean	81.90	163.67	40.14	34.73	102.16	-0.03	2.99	62.41
Median	80.77	160.28	39.55	33.30	94.03	-0.01	2.69	65.00
Minimum	72.63	-14.83	2.17	19.29	-100.00	-1.27	0.00	20.00
Maximum	99.11	400.00	97.22	60.90	400.00	0.43	14.30	100.00
N	206	206	206	206	206	206	206	206

Source: Author

	<i>RES</i>	<i>SS</i>	<i>MS</i>	<i>VS</i>	<i>VGS</i>	<i>QS</i>	<i>YS</i>	<i>CR</i>
Mean	9.88	114.62	36.79	42.65	169.65	0.08	1.84	61.78
Median	9.45	112.10	34.20	38.84	165.74	0.13	0.00	65.00
Minimum	0.00	-15.63	0.36	24.01	-100.00	-1.50	0.00	20.00
Maximum	24.07	400.00	97.34	103.72	400.00	0.78	23.00	100.00
N	206	206	206	206	206	206	206	206

	<i>RSS</i>	<i>SS</i>	<i>MS</i>	<i>VS</i>	<i>VGS</i>	<i>QS</i>	<i>YS</i>	<i>CR</i>
Mean	34.24	110.94	33.11	40.81	152.08	0.04	2.09	59.73
Median	35.61	110.99	29.91	36.98	143.78	0.07	0.65	60.00
Minimum	7.86	-27.75	0.36	20.88	-100.00	-1.11	0.00	20.00
Maximum	46.16	400.00	97.34	103.72	400.00	0.44	23.00	100.00
N	206	206	206	206	206	206	206	206

	<i>RGS</i>	<i>SS</i>	<i>MS</i>	<i>VS</i>	<i>VGS</i>	<i>QS</i>	<i>YS</i>	<i>CR</i>
Mean	28.13	133.11	38.19	40.63	159.01	0.00	2.16	59.46
Median	29.44	125.79	36.74	37.79	159.52	0.03	0.82	60.00
Minimum	5.72	-27.75	0.85	22.11	-100.00	-1.60	0.00	20.00
Maximum	41.75	400.00	97.55	91.32	400.00	0.45	23.00	95.00
N	206	206	206	206	206	206	206	206

Source: Author

Appendix M – Summary statistics of companies whose credit rating is investment grade

	<i>SESGS</i>	<i>SES</i>	<i>SSS</i>	<i>SGS</i>	<i>RESGS</i>	<i>RES</i>	<i>RSS</i>	<i>RGS</i>
Mean	23.21	6.31	9.75	7.34	58.08	48.77	62.16	58.25
Median	22.42	4.53	9.63	6.70	59.28	50.97	64.26	60.02
Minimum	6.99	1.02	1.25	1.75	8.06	0.00	8.42	5.91
Maximum	48.81	25.46	26.01	16.61	94.48	97.15	96.65	99.11
N	528	528	528	528	528	528	528	528

Source: Author

Appendix N – Summary statistics of companies whose credit rating is high yield

	<i>SESGS</i>	<i>SES</i>	<i>SSS</i>	<i>SGS</i>	<i>RESGS</i>	<i>RES</i>	<i>RSS</i>	<i>RGS</i>
Mean	23.61	7.13	9.84	6.76	52.23	46.63	55.09	52.46
Median	23.06	5.50	10.54	6.13	53.73	50.22	54.91	50.77
Minimum	10.44	1.13	1.21	3.41	11.38	0.00	13.80	7.62
Maximum	46.78	24.61	20.66	16.95	87.75	95.96	93.59	95.34
N	143	143	143	143	143	143	143	143

Source: Author

Appendix O – Outputs of the regressions

Table O1 – Regression for SESGS

Dependent variable: Sustainalytics ESG rating						
Variable	Correlation sign	Coefficient	Correlation sign	Coefficient	Correlation sign	Coefficient
Constant		18.044 (-2.015)		13.923 (-1.096)		35.18 -2.249
SS	-	0 (-0.003)	-	-0.003 (-0.003)	-	-0.006* (-0.004)
MS	-	0.004 (-0.013)	+	0.003 (-0.006)	+	0.043** (-0.016)
VS	+	0.119*** (-0.026)	+	0.002 (-0.014)	+	-0.004 (-0.03)
VGS	-	-0.011*** (-0.002)	+	0 (-0.001)	-	-0.005 (-0.003)
QS	-	-0.676 (-0.947)	-	-0.745 (-0.782)	+	1.275 (-1.106)
YS	+	-0.059 (-0.091)	+	0.031 (-0.043)	-	-0.185** (-0.083)
CR	-	0.037* (-0.021)	-	0.009 (-0.012)	-	-0.02 (-0.023)
Observations		825		206		206
Period		2021		2021		2021
R-squared		0.044		0.015		0.069
Ajusted R-squared		0.036		-0.019		0.036
Prob(F-statistic)		0		0.876		0.043

*** p-value < 0.01

**p-value < 0.05

*p-value < 0.1

Table O2 – Regression for SES

Dependent variable: Sustainalytics Environmental rating						
Variable	Correlation sign	Coefficient	Correlation sign	Coefficient	Correlation sign	Coefficient
Constant		8.027 (-1.431)		1.943 (-0.185)		15.971 (-2.319)
SS	-	-0.003 (-1.431)	-	-7.25 0	-	-0.006 (-0.004)
MS	+	0.022** (-0.009)	+	0.001 (-0.001)	+	0.044*** (-0.014)
VS	+	0.008 (-0.019)	-	-0.003* (-0.001)	+	0.009 (-0.023)
VGS	-	-0.009*** (-0.001)	-	0 0	-	-0.009*** (-0.002)
QS	-	-1.148 (-0.773)	+	0.122* (-0.074)	+	2.876*** (-0.977)
YS	+	-0.095 (-0.061)	+	0 (-0.006)	-	-0.09 (-0.064)
CR	-	-0.011 (-0.015)	-	-0.004** (-0.001)	-	-0.026 (-0.026)
Observations		825		206		206
Period		2021		2021		2021
R-squared		0.055		0.076		0.145
Ajusted R-squared		0.047		0.043		0.114
Prob(F-statistic)		0		0.025		0

*** p-value < 0.01

**p-value < 0.05

*p-value < 0.1

Table O3 - Regression for SSS

Dependent variable: Sustainalytics Social rating						
Variable	Correlation sign	Coefficient	Correlation sign	Coefficient	Correlation sign	Coefficient
Constant		4.517 (-1.061)		2.549 (-0.913)		13.988 (-1.195)
SS	+	0.003 (-0.002)	-	-8.86E-06 (-0.001)	-	-0.002 (-0.002)
MS	-	-0.021*** (-0.006)	+	0.004 (-0.004)	+	0.006 (-0.008)
VS	+	0.083*** (0.013)	+	0.034** (-0.013)	+	0.012 (-0.02)
VGS	+	0 (-0.001)	+	0 (-0.001)	-	-0.001 (-0.001)
QS	-	-1.057* (-0.498)	+	-0.154 (-0.4)	+	0.261 (-0.418)
YS	-	-0.039 (-0.047)	-	0.035 (-0.047)	+	0.024 (-0.041)
CR	+	0.043*** (-0.011)	+	0.008 (-0.009)	+	0.009 (-0.011)
Observations		825		206		206
Period		2021		2021		2021
R-squared		0.06		0.059		0.021
Ajusted R-squared		0.052		0.026		-0.013
Prob(F-statistic)		0		0.092		0.747

*** p-value < 0.01

**p-value < 0.05

*p-value < 0.1

Table O4 - Regression for SGS

Dependent variable: Sustainalytics Governance rating						
Variable	Correlation sign	Coefficient	Correlation sign	Coefficient	Correlation sign	Coefficient
Constant		5.765 (-0.573)		4.705 (-0.473)		12.563 (-1.256)
SS	-	0 (-0.001)	-	-0.001 0	-	-0.004** (-0.001)
MS	+	0.001 (-0.004)	-	-0.002 (-0.002)	+	0.005 (-0.006)
VS	+	0.025*** (-0.007)	+	0.003 (-0.005)	-	0.029** (-0.012)
VGS	-	0 0	+	3.89E-05 0	-	0 (-0.001)
QS	+	1.858*** (-0.321)	-	-0.085 (-0.131)	+	0.845 (-0.576)
YS	+	0.067* (-0.035)	-	-0.03 (-0.021)	+	0.05 (-0.042)
CR	+	0.007 (-0.006)	-	0.002 (-0.004)	+	-0.004 (-0.014)
Observations		825		206		206
Period		2021		2021		2021
R-squared		0.059		0.038		0.083
Ajusted R- squared		0.051		0.004		0.051
Prob(F- statistic)		0		0.345		0.014

*** p-value < 0.01

**p-value < 0.05

*p-value < 0.1

Table O5 - Regression for RESGS

Method: Least Squares		Full sample		Best 25% companies rated by RESGS		Worst 25% companies rated by RESGS
Variable	Correlation sign	Coefficient	Correlation sign	Coefficient	Correlation sign	Coefficient
Dependent variable: Refinitiv ESG rating						
Constant		53.951 (-3.991)		64.275 (-3.472)		37.167 (-3.74)
SS	+	0.099*** (-0.007)	+	0.015*** (-0.004)	+	0.015 (-0.01)
MS	+	0.003 (-0.027)	-	-0.024 (-0.024)	+	0.02 (-0.023)
VS	-	-0.190*** (-0.049)	+	0.122*** (-0.0459)	-	-0.101** (-0.046)
VGS	-	-0.032*** (-0.005)	-	-0.006 (-0.004)	-	-0.006 (-0.006)
QS	-	-4.534** (-1.935)	-	-3.953** (-1.556)	+	3.019 (-2.575)
YS	+	0.148 (-0.221)	+	-0.021 (-0.145)	+	-0.171 (-0.277)
CR	+	-0.025 (-0.048)	+	0.115** (-0.044)	+	-0.026 (-0.045)
Observations		825		206		206
Period		2021		2021		2021
R-squared		0.278		0.107		0.067
Ajusted R-squared		0.272		0.076		0.034
Prob(F-statistic)		0		0.001		0.052

*** p-value < 0.01

**p-value < 0.05

*p-value < 0.1

Table O6 - Regression for RES

Method: Least Squares		Full sample		Best 25% companies rated by RES		Worst 25% companies rated by RES
Dependent variable: Refinitiv Environmental rating						
Variable	Correlation sign	Coefficient	Correlation sign	Coefficient	Correlation sign	Coefficient
Constant		54.143 (-6.443)		76.32 (-4.153)		15.313 (-4.601)
SS	+	0.158*** (-0.011)	+	0.013* (-0.006)	+	0.027** (-0.01)
MS	+	-0.005 (-0.043)	-	-0.026 (-0.025)	+	0.013 (-0.023)
VS	-	-0.364*** (-0.076)	-	-0.001 (-0.057)	-	-0.08 (-0.053)
VGS	-	-0.045*** (-0.007)	-	9.65E-05 (-0.004)	-	-0.010* (-0.005)
QS	-	-12.938*** (-3.59)	-	-4.700*** (-1.575)	-	1.045 (-2.543)
YS	+	0.375 (-0.354)	+	0.257 (-0.236)	+	-0.064 (-0.213)
CR	+	-0.176** (-0.078)	+	0.036 (-0.037)	+	-0.061 (-0.048)
Observations		825		206		206
Period		2021		2021		2021
R-squared		0.296		0.073		0.076
Ajusted R-squared		0.29		0.04		0.044
Prob(F-statistic)		0		0.031		0.005

*** p-value < 0.01

**p-value < 0.05

*p-value < 0.1

Table O7 – Regression for RSS

Method: Least Squares		Full sample		Best 25% companies rated by RSS		Worst 25% companies rated by RSS
Dependent variable: Refinitiv Social rating						
Variable	Correlation sign	Coefficient	Correlation sign	Coefficient	Correlation sign	Coefficient
Constant		52.46 (-4.371)		83.189 (-2.901)		35.376 (-3.897)
SS	+	0.108*** (-0.008)	+	0.016*** (-0.004)	+	0.024** (-0.009)
MS	+	0.053* (-0.029)	-	-0.012 (-0.016)	+	-0.002 (-0.028)
VS	-	-0.112** (-0.056)	-	-0.04 (-0.042)	-	-0.025 (-0.045)
VGS	-	-0.028*** (-0.006)	+	-0.001 (-0.004)	-	-0.006 (-0.005)
QS	-	-4.582** (-2.186)	-	-1.037 (-1.081)	+	0.969 (-2.979)
YS	+	-0.005 (-0.223)	-	-0.151 (-0.14)	+	0.033 (-0.293)
CR	+	-0.037 (-0.057)	+	0.002 (-0.03)	+	-0.029 (-0.044)
Observations		825		206		206
Period		2021		2021		2021
R-squared		0.231		0.076		0.031
Ajusted R- squared		0.224		0.043		-0.002
Prob(F- statistic)		0		0.026		0.485

*** p-value < 0.01

**p-value < 0.05

*p-value < 0.1

Table O8 – Regression for RGS

Method: Least Squares		Full sample		Best 25% companies rated by RGS		Worst 25% companies rated by RGS
Variable	Correlation sign	Coefficient	Correlation sign	Coefficient	Correlation sign	Coefficient
Dependent variable: Refinitiv Governance rating						
Constant		59.065 (-5.84)		80.092 (-3.219)		28.923 (-5.552)
SS	+	0.036*** (-0.012)	+	0.014** (-0.006)	+	0.015* (-0.008)
MS	+	-0.017 (-0.033)	+	0.008 (-0.023)	-	-0.032 (-0.033)
VS	-	-0.217*** (-0.074)	+	0.034 (-0.045)	-	-0.049 (-0.064)
VGS	-	-0.030*** (-0.007)	-	-0.004 (-0.006)	-	-0.006 (-0.005)
QS	-	-1.201 (-2.666)	-	-1.305 (-1.698)	+	3.62 (-2.643)
YS	+	0.013 (-0.267)	-	-0.091 (-0.216)	+	-0.1 (-0.198)
CR	+	0.071 (-0.065)	-	-0.023 (-0.04)	+	0.03 (-0.066)
Observations		825		206		206
Period		2021		2021		2021
R-squared		0.085		0.036		0.052
Ajusted R-squared		0.078		0.002		0.018
Prob(F-statistic)		0		0.375		0.147

*** p-value < 0.01

**p-value < 0.05

*p-value < 0.1

Source: Author

Appendix P – Summary of the results

Table P1 – Dependent variable is SESGS

Full sample		Sample of 25% best rated companies		Sample of 25% worst rated companies	
Significant variables	Relationship	Significant variables	Relationship	Significant variables	Relationship
Volatility	+			Size	-
Value/Growth	-			Momentum	+
Credit rating	+			Yield	-

Table P2 – Dependent variable is SES

Full sample		Sample of 25% best rated companies		Sample of 25% worst rated companies	
Significant variables	Relationship	Significant variables	Relationship	Significant variables	Relationship
Momentum	+	Volatility	-	Momentum	+
Value/Growth	-	Quality	+	Value/Growth	-
		Credit rating	-		

Table P3 – Dependent variable is SSS

Full sample		Sample of 25% best rated companies		Sample of 25% worst rated companies	
Significant variables	Relationship	Significant variables	Relationship	Significant variables	Relationship
Momentum	+	Volatility	+		
Volatility	+				
Quality	-				
Credit rating	+				

Table P4 – Dependent variable is SGS

Full sample		Sample of 25% best rated companies		Sample of 25% worst rated companies	
Significant variables	Relationship	Significant variables	Relationship	Significant variables	Relationship
Volatility	+			Size	-
Quality	+			Volatility	+
Yield	+				

Table P5 – Dependent variable is RESGS

Full sample		Sample of 25% best rated companies		Sample of 25% worst rated companies	
Significant variables	Relationship	Significant variables	Relationship	Significant variables	Relationship
Size	+	Size	+	Volatility	-
Volatility	-	Volatility	+		
Value/Growth	-	Quality	-		
Quality	-	Credit rating	+		

Table P6 – Dependent variable is RES

Full sample		Sample of 25% best rated companies		Sample of 25% worst rated companies	
Significant variables	Relationship	Significant variables	Relationship	Significant variables	Relationship
Size	+	Size	+	Size	+
Volatility	-	Quality	-	Value/Growth	-
Value/Growth	-				
Quality	-				
Credit rating	-				

Table P7 – Dependent variable is RSS

Full sample		Sample of 25% best rated companies		Sample of 25% worst rated companies	
Significant variables	Relationship	Significant variables	Relationship	Significant variables	Relationship
Size	+	Size	+	Size	+
Momentum	+				
Volatility	-				
Quality	-				

Table P8 – Dependent variable is RGS

Full sample		Sample of 25% best rated companies		Sample of 25% worst rated companies	
Significant variables	Relationship	Significant variables	Relationship	Significant variables	Relationship
Size	+	Size	+	Size	+
Volatility	-				
Value/Growth	-				

Source: Author