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“The impact of ESG Score on financial performance and risk: an Italian scenario”

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Firma (Signature).....

*Alla mia famiglia e
ai miei amici più cari.*

ABSTRACT

Sustainability is one of the hottest topics in recent years, affecting various sectors of the economy and of our life. The theme of sustainability has radically changed our world in a very few years, having a radical impact on our lives, becoming so fundamental that it is changing our day-to-day habits and routines, being applied to almost everything around us.

For this reason, many companies have begun to give importance and attention to this trend. There are many reasons why companies are concerned about sustainability, starting from a necessity imposed by the environment to all the people on our planet, requiring us to implement a more sustainable lifestyle, to a more reliable and transparent behaviour towards all the stakeholders and the market.

The interesting challenge that arises from this topic is to understand whether being sustainable for a company can also be beneficial from a financial as well as a reputational perspective. Answering this question would incentivize companies, still reluctant to CSR practices, to embrace more sustainable business. In particular, the research will focus on major companies in the Italian market.

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CHAPTER I

CORPORATE SUSTAINABILITY

1.1 – INTRODUCTION

Achieving sustainable economic growth is the eighth goal of the Sustainable Development Goals (United Nations, 2015). To reduce climate change and global warming, these goals must be achieved. This has increased the importance of environmental, sociological and governance (ESG) performance. By improving their ESG performance, companies should contribute to the achievement of these goals. This not only benefits society but can also help businesses grow.

Looking at recent history, for more than 50 years, business organizations have been under increasing pressure to reconcile social and environmental concerns with economic development. As a result, concepts such as corporate sustainability (CS), business ethics, corporate citizenship, and stakeholder management have developed along with CSR-corporate social responsibility (CS) (Sarvaiya & Wu, 2014). The concept of CSR has served as a starting point, foundation, or point of departure for various related concepts and topics, many of which have embraced CSR thinking and been quite compatible with it, as Carroll (1999) pointed out. Although all these frameworks have a similar goal, it is increasingly difficult to understand each idea, its meaning, and its relationship to the others (Schwartz & Carroll, 2008).

According to Sarvaiya & Wu, 2014, over the past 10 years, companies have improved corporate sustainability by focusing on social, environmental, governance and financial goals in a forward-looking manner (United Nations Global Compact, 2013). Corporate sustainability has become a hot research topic from management and financial perspectives. The benefits of environmental, social, and governance practices (ESG criteria) on corporate value and financial performance are highlighted in several studies from the management research strand (Fatemi et al., 2018; Harrison & Wicks, 2013; Lins & Servaes, 2017; Friede, Busch, & Bassen, 2015). Despite the growing interest in this topic and the findings from all the studies just mentioned, it is still unclear how ESG factors can economically affect the firm as a whole, particularly from a risk perspective, when debt financing is considered (Albuquerque, Durnev, & Koskinen, 2014; Lee & Faff, 2009). According to academics and practitioners, credit score assessments and lending policies made by financial intermediaries must incorporate ESG objectives (Attig, El Ghouli, & Guedhami, 2013; Birindelli, Ferretti, Intonti, & Iannuzzi, 2015; Zeidan, Boechat, & Fleury, 2015). Even though financial markets and institutions have shown a growing interest in using ESG criteria in the decision-making process for investments, ESG objectives are not yet fully incorporated into the creditworthiness evaluation of credit lending techniques used by

banks (Zeidan et al., 2015; Friede et. al., 2015). To put it another way, banks and other financial institutions solely rely on risk sensitivity parameters and continue to establish lending strategies by calculating risk against borrower default (Zeidan et al., 2015).

In addition to this international picture, the issue in Italy is also becoming more important than ever. In fact, after the recent tragic pandemic, which heavily affected the country from many sides, the country's economy in particular has been damaged as never before, causing a drop in GDP of 8.9 percent in 2020 (Bank of Italy).

However, this catastrophic situation started a process of economic recovery of all European countries with the so-called "NextGenerationEU," a massive aid package provided by the European Union, which, after the recent pandemic disaster, seized the opportunity to start a process of recovery, renewal and reform in all countries.

In this scenario, Italy is one of the countries that will receive the largest share of the funds made available, with about 190 billion euros.

One of the most important areas of development that will be crucial to the success of the recovery plan is the ecological and green transition. In fact, as can be guessed from the allocation of funds, sustainability is one of the guiding principles of the recovery plan. That is why 37 percent of the funds will be dedicated to the green revolution and ecological transition (Luca Greco, Cribis, 2022).

In this context, it is evident how corporate sustainability is not simply seen as a futile virtue or boast, but is considered an integral part of companies, imposing itself as a necessary condition, a pre-requisite, for business management.

However, despite the growing importance of sustainability in the financial sector and given the positive effects these kinds of practices have on our planet, there is still an essential question that is being asked and struggling to be answered: "Is it worth it for a company's financial structure to be sustainable?".

The pursuit of sustainable goals can certainly help companies improve their reputation and standing through the dissemination of the sustainable performance achieved, which can influence people's commitment and public perception and, consequently, that of investors, banks, rating agencies, and all stakeholders involved. Although it is not yet clear whether the pursuit of a more sustainable way of running the business will have a positive effect on some financial indicators.

This seems to be one of the main problems that needs to be solved nowadays in order to convince all companies to follow a more respectful model for their business, because despite all the giant strides that have been made in the economy of different sectors, it is clearly

observable that many companies around the world, and even in Italy, are still reluctant to embrace a more sustainable model for conducting their business.

In fact, according to the "GreenItaly 2019" report, one third of Italian companies have taken the path of sustainability. Although this can be considered a good result, given also the real effects that this transformation has brought about, such as a strong reduction in CO₂ emissions and the creation of many new jobs, it is clear that 2/3 of Italian companies are still ambivalent regarding these issues (Ermete Realacci, Symbola, GreenItaly 2019).

From this context, several questions may emerge that need to be addressed and answered. What is the reason why some companies seek to improve their corporate sustainability impact more than others? What are the main drivers of these choices? Is it worthwhile for a company to be financially sustainable?

To provide an answer to these kinds of questions, the main objective of this research is to assess how pursuing the objectives of ESG criteria can concretely help a company achieve a better financial point of view, all this based on different perspectives, starting from financial efficiency, which can be tracked by considering a company's financial performance, to the risk in which the company has to operate.

Understanding how following ESG guidelines can be beneficial from an economic point of view by improving the financial situation of companies, would enable all companies that have yet to embark on a sustainable path, to engage with more environmental and social behaviors. Analyzing the research used for this thesis, which focuses on investigating a meaningful connection between ESG practices and corporate financial performance, the questions posed for the completion of this work are quite ambitious, since, as can be seen from the various articles in the bibliography, finding work that seeks to assess the impact of ESG criteria on different aspects of a company's financial structure is not at all common. However, partly because of this ambitious challenge, this research has the potential to be interesting and informative. In addition, some features that can make this work truly particular will be introduced. In fact, the analysis will be conducted on a sample of Italian companies. This is unique, since there is not much literature on the Italian corporate environment. On this wise, it will be possible to understand the impact of Corporate Social Responsibility practices in the Italian business environment, providing the possibility to compare the Italian evidence with a European benchmark, made available by all the different cases already examined in other works, in which other countries were considered. Furthermore, as far as the empirical part of the work is concerned, in addition to a standard linear regression, an analysis performed with a machine learning model called Random Forest, will also be introduced. The approach pursued using a machine learning model is certainly a distinctive and innovative technique, which can

be extremely useful in identifying possible connections of outcome variables with ESG indicators, particularly given the nuanced results obtained so far by researchers.

1.2 – REVIEW OF THEORETICAL CONCEPTS

Although the growing importance of implementing sustainability procedures in business operations has been made clear, there is still some confusion about various concepts that gravitate around the main theme of sustainability.

Indeed, in recent years, sustainability has been expressed in different ways and through different channels, becoming one of the most important trends in financial markets.

However, as explained in the work of Sarvaiya & Wu, 2014, there is still a lack of familiarity with these corporate sustainability issues, making them somewhat confusing among general knowledge.

Therefore, in the next section we will look at the different definitions of CSR, CS, ESG concepts and try to clarify the confusion among them.

1.2.1 – CORPORATE SOCIAL RESPONSIBILITY

The first idea of Social Responsibility was introduced from Frank Abrams in 1951 for the Harvard Business Review (Abrams, 1951), while the first one who presented the concept of Corporate Social Responsibility was Howard Bowen, who referred to CSR as “The responsibility of businessmen”; with this line he talked about the responsibility of business people to pursue policies, decisions, actions which are beneficial in terms of objectives and values for the society (Bowen, 1953, p. 6).

After several years, some nuances of this idea have been modified by many scholars, researchers, and institutions, especially by extending the idea of accountability not only to the business owner, but to all practices and operations that make up the entire business organization. Despite the expansion of the concept, the main goal has remained the same: positively meet social needs and public satisfaction.

One of the most recognized definitions of CSR is the one developed by Carroll (1979), according to which “the social responsibility of business encompasses the economic, legal, ethical, and discretionary expectations that society has of organizations at a given point in time”.

Afterwards, following many contributes of scholars during 1980s and 1990s, among which we can mention Carroll, Tuzzolino and Armandi, Jones, Freeman, Hopkins, the notion of CSR has been connected to business ethics, corporate social performance, and stakeholder theory. For example, Jones (1980) suggested to consider the social cost of these decisions rather than just philanthropy and aligning social consequences with corporate decisions. He stated that environmental concerns had to be integrated into CSR practices. Moreover, according to Tuzzolino and Armandi (1981), CSR needs to be linked to the company life cycle dynamic; so, as results of this, CSR and stakeholder theory were integrated. The main contribution has been provided by Hopkins (1998), who asserted that “CSR is concerned with treating the stakeholders of the firm ethically and in a socially responsible manner. Stakeholders exist both within a firm and outside. Consequently, behaving socially responsible will increase the human development of stakeholders both within and outside the corporation”.

1.2.2 – TRIPLE BOTTOM LINE

CSR has recently developed into a three-dimensional approach. The environment has historically received little attention in CSR literature (Dewangga et al., 2008). However, in the 2000s, environmental concerns became a significant component of CSR. The triple bottom line (profit, people, and planet) and sustainable development have been linked to CSR in this way (Elkington, 1999; Moon, 2007). CSR, for instance, was more specifically defined by the World Business Council for Sustainable Development (WBCSD) in 2000 as "the commitment of businesses to contribute to sustainable economic development, working with employees, their families, the local community, and society at large to improve their quality of life" (p.5).

Additionally, as stated from the Commission of the European Communities (2001), CSR is "a concept whereby corporations integrate social and environmental issues in their business operations and in their contacts with their stakeholders on a voluntary basis". According to the currently prevalent definition of CSR, businesses deliberately integrate social and environmental issues into their business operations (Branco & Rodrigues, 2006). In fact, as it is demonstrated in literature, while in the short term the success of a business can be achieved just focusing on the economic sustainability, in the long run all three components of the approach are fundamental (Dyllick & Hockerts, 2002), because, according to Elkington (2004), the three dimensions of sustainability are interconnected and have a range of influences between each other. The economic sustainability of a corporation is thus intrinsically related to its social and environmental sustainability. In short, CSR can be defined as the process of integrating economic, social, and environmental issues of corporate firms with the purpose of achieving balanced growth in societies.

1.2.3 – CORPORATE SUSTAINABILITY

The concept of Corporate Sustainability (CS) was derived from the notion of Sustainable Development (SD) initially developed in the 18th century, which has become popular after a report of the World Commission on Environment and Development (WCED), entitled 'Our Common Future' (better known as Brundtland Report), had been published in 1987 and Sustainable Development was defined as "development which meets the needs of the present without compromising the ability of future generations to meet their own needs". The paper is widely considered to be the primary source for explanation of the origins and the evolution of sustainability. Following this concept, a broad of definitions have been developed. A couple of relevant ones will be cited. For example, according to Goldsmith and Samson (2005, p. 5) sustainability practices are a way to "manage technology and social organization to make balanced and equitable progress on economic, environmental and social needs so that meeting these needs in the present does not compromise the ability of future generations to meet their own needs".

Similarly, (Benn & Dunphy, 2009, pp. 276–277) defined sustainability as "the ability to ensure economic development is accompanied by progress towards social inclusion and does not take place at the expense of the natural environment". When SD first came out, it introduced the implications of global and ecological problems (Moon, 2007). It was regarded as an example of how society should operate. Corporate sustainability, or CS, is the term used to describe the implementation of SD in a business context (Dentchev, 2009; Steurer et al., 2005). So, at a corporate level, corporate sustainability is defined as "meeting the needs of the firm's direct and indirect stakeholders (such as shareholders, employees, clients, pressure groups, communities etc.) without comprising its ability to meet the needs of future stakeholders as well" (Dyllick & Hockerts, 2002, p. 131). Following this line, a wide range of ecological and social company activities are described by the terms "corporate sustainability" or "sustainable development" in a growing number of contexts. In particular, the concept of "corporate sustainability" typically alludes to the triple bottom line idea, which considers social, environmental, and economic factors (Elkington, 1999). To sum up, Corporate Sustainability was first perceived as an ecological concept with a narrow focus on environmental preservation. Then, research in corporate sustainability has typically focused on how to preserve the environment while formulating and developing business activity and all the operations related to the firm's business, progressively adding the social side into Corporate Sustainability issues as well. Agenda 21 can be seen as a milestone to identify when non-environmental issues became a dimension of CS (Steurer et al., 2005). The social aspect was incorporated into CS along with the environmental aspect; however, this approach has not been widely accepted until

Elkington (1999) proposed the idea of the triple bottom line of sustainability, in which, as already mentioned, three principles are pursued: economic integrity, social equity and environmental integrity (Bansal, 2005). However, the inclusion of social consideration in sustainability creates a connection between CS and CSR which can be confusing and that is the reason why it will be explained in the next paragraph, in which the differences and similarities and in general the relationship between the two concepts, will be clarified.

1.2.4 - RELATIONSHIP BETWEEN CSR AND CS

The debate on Corporate Social Responsibility and Corporate Sustainability has been widely discussed among academics in recent years, particularly because of a confusing relationship between the two concepts. In particular, the two of them can be ambiguous, interchangeable and debatable (Moon, 2007). It is possible to identify two main lines of thought on the topic. Indeed, some researchers see corporate sustainability as an important part of a broader agenda such as corporate social responsibility, in which the company is responsible for the social and environmental dimensions. However, it seems that most scholars, who see Corporate Sustainability as a natural outgrowth of Sustainable Development, suggest CSR can be seen as a contribution to CS and as a pillar of the theory. Particularly in a three-dimensional model context, CSR is seen as a pillar focused on social and ethical issues of a broader sustainability framework represented by Corporate Sustainability. Thus, one can consider the issue by placing SD first as a collective and social principle, followed by CS, that addresses the corporate level of the subject, and ending with CSR perceived more as a set of practices and procedures that characterize a managerial approach. Notably, the confusion between the two terms has arisen from the fact that they have often been used for the same purpose and with the same meaning, mainly because of the three dimensions that both concepts involve. Nonetheless, the differences are quite significant, considering that as noted above, CS is more focused on achieving environmental balance than CSR, which is more oriented toward managing social problems, and also because the two concepts have a rather different approach on their purposes, since CS takes into account an interconnectedness of its purposes and a production of synergies and intrinsic value as a product of its activities, while CSR has more disconnected goals.

1.2.5 - ESG

After explaining some basic concepts in the field of corporate sustainability, to conclude this introductory section of the literature framework, the meaning and purpose of ESG measures, how they work, and how they are related to sustainability, will be clarified.

ESG is an acronym that stands for Environmental, Social, and Governance (Table 1.1). In a word, it is a set of measures for assessing a company's sustainability performance. Thus, ESG criteria focus on quantitative results that help investors make better decisions about the risks and ethics of companies. ESG reporting also helps consumers decide which companies to support and which not to support by providing them with an indication of company practices and actions aligned with their values.

A natural question that might materialize from this first part of the introduction, concerns the actual differences between ESG measures and CSR. Of all the definitions of these two concepts, the main difference lays on the tangibility and wholeness of the concept itself. First, as stated by Stuart L. et al, 2021, the concept of ESG specifically includes three dimensions among its purposes, whereas CSR does not appear to be a clear and well-defined concept. So, it turns out to be a broader term because, in addition to environmental and social aspects, ESG measures clearly incorporate governance components, and for each of these three aspects it provides some defined goals to be achieved and aspects to be considered in order to be sustainable and measurable.

In effect, ESG is used to describe how companies and investors incorporate environmental, social and governance issues into their business models; instead, CSR historically refers to a company's efforts to be a better and more socially responsible corporate citizen. Moreover, as Simrin Jhangiani writes in an article for "MetricSteam," although corporate social responsibility aims to hold companies accountable for their broader social obligations, the activities and effects are not clearly quantifiable; moreover, there are fewer governance practices that address CSR. Customers, employees, investors, and shareholders agree that the world today faces unprecedented challenges and requires focused action to stimulate positive change. ESG criteria advances the CSR agenda by adding a robust governance framework and integrating environmental and social responsibility into the heart of corporate strategy. It involves measurable impact assessments and quantifiable targets. The author just quoted also adds a very direct example: "For example, a car company's CSR initiative might involve its employees cleaning trash off city streets or engaging in reforestation in their community. But their ESG policy would require a firm commitment to plant one million trees by 2030 or to ensure a 25 percent increase in the use of recycled material in their manufacturing process." In addition, ESG principles can also be easily used from the perspective of investors. As reported by Ting-

Ting Li et al. 2021, investors typically use ESG as a benchmark and technique to evaluate corporate behavior and potential future profitability. The three core elements of ESG are the most important factors to consider during analysis and investment decision making because they are concepts for evaluating the sustainable development of companies. In addition, environmental, social and governance (ESG) aspects of business activities help to measure their sustainability and social impact. As the European Banking Authority (EBA) states, ESG factors are "environmental, social or governance issues that can have a positive or negative impact on the financial performance or solvency of an entity, sovereign or individual." Therefore, ESG is an investment philosophy that aims at long-term value growth and is a comprehensive, practical and governance method. It is a value of greener and integrated innovation that takes into account economic, environmental, social and governance benefits.

1.2.5.1 - ESG MEASURES AND CSR ACCOUNTABILITY

Many independent reporting and rating providers examine and rate most domestic and foreign public (and many private) companies on their environmental, social, and governance (ESG) performance. The use of these reports and ratings by institutional investors, asset managers, financial institutions, and other stakeholders to assess and analyze a company's ESG performance over time is increasing. Investor engagement with companies on ESG issues often begins with this assessment and measurement, and the process is centered on shareholder proposals. However, the approach, breadth, and coverage of reports and ratings differ widely among providers. Many rating companies promote feedback and interaction with target companies to improve or occasionally modify the data.

As detailed by Huber and Comstock (2017), there are numerous actors and scoring options in the CSR field. Sustainalytics, Thomson Reuters, and Morningstar, for example, all offer comparable ESG scores. These three sources provide ESG scores and other CSR-relevant data on specific companies, while Morningstar works with Sustainalytics to provide an ESG score on mutual funds. Other players include Bloomberg, whose score is a disclosure score, and MSCI, a provider of Socially Responsible Investments (SRI) indexes. There is a distinction between disclosure and performance: disclosure refers to how companies report on sustainability, while performance indicates their performance in environmental or social terms, such as the amount of carbon emissions produced. Another group working to standardize the ESG reporting process is the Global Reporting Initiative (GRI). According to the Principles of Responsible Investing (PRI), ESG is a term that helps investors manage risk and generate long-

term sustainable returns. Investors use ESG scores combined with other analytical tools to predict how sustainable a company is and to forecast future financial performance.

ESG stands for environmental, social and governance, as already mentioned: the environmental factor consists in how a company manages, for example, pollution, waste, deforestation, carbon emissions and climate change; the social factor includes how a company treats people and the community. Here, employee relations, working conditions, local community, diversity, conflict management, health and safety gain importance. The governance factor, on the other hand, considers how a company is led. The factor includes different policies, fiscal strategies, donations, lobbying, bribery and corruption (PRI 2018).

The emphasis on measuring sustainability raises the question of whether such metrics can be applied to improve financial performance. Some studies, but perhaps especially financial sector marketing, argue that sustainable portfolios offer higher returns and outperform the index (Thompson 2018). MSCI's Socially Responsible Investment (SRI) World Index, an equity and fixed income index provider, is an example of an ESG portfolio that has actually performed well. Since 2007, it has slightly outperformed the corresponding general world index (MSCI 2018). ESG data is used to select stocks, but can sustainability really affect performance?

As mentioned in the previous section, asset managers, individual investors, and smaller institutions now rely on external analysis for ESG scoring. If there is a link, the lack of transparency in the ESG scoring process makes it difficult to determine where the returns actually come from. If investors knew how to choose the best ESG-rated companies, perhaps their financial performance would improve. It is difficult to determine the factors that actually influence performance because there are different ESG scores, there is little transparency, and the scale for measuring sustainability is not clearly defined. Therefore, the purpose of this thesis is to examine the relationship between the ESG score and two of the main indicators of the financial structure of selected companies using a broader perspective than most previous research, focusing on multiple aspects of the financial structure rather than just one specific component of the companies' financial organization. Due to the ambiguity surrounding the potential link between ESG and financial benefit for the firm, the main purpose of this work, is to investigate accounting-based performance that relates to the stock market, to firstly account based performance which relates to profitability and then to understand how ESG performance are linked to financial risk of a company, to explain if the credit worthiness is affected from ESG performance and in general clarify if sustainability can be helpful from a financial point of view. With these kinds of measures, the main goal of the research is to add to the knowledge of why there might be a relationship between these variables and investigate which part of the ESG score is the most connected to financial performance.

Table 1.1 - ESG Score composition

Dimension	Factors	Definition
Environmental (E)	<ul style="list-style-type: none"> • GHG Emission • Energy consumption and efficiency • Air pollutants • Water usage and recycling • Waste production and management (water, solid, hazardous) • Impact and dependence on biodiversity • Impact and dependence on ecosystems • Innovation in environmentally friendly products and services 	Environmental matters that may have a positive or negative impact on the financial performance or solvency of an entity, sovereign, or individual.
Social (S)	<ul style="list-style-type: none"> • Workforce freedom of association • Child labor • Forced and compulsory labor • Workplace health and safety • Customer health and safety • Discrimination, diversity, and equal • Opportunity • Poverty and community impact • Supply chain management • Training and education • Customer privacy • Community impacts 	Social matters that may have a positive or negative impact on the financial performance or solvency of an entity, sovereign, or individual.
Governance (G)	<ul style="list-style-type: none"> • Codes of conduct and business principles • Accountability • Transparency and disclosure • Executive pay • Board diversity and structure • Bribery and corruption • Stakeholder engagement • Shareholder rights 	Governance matters that may have a positive or negative impact on the financial performance or solvency of an entity, sovereign, or individual.

1.3 – ORGANIZATION OF THE RESEARCH

In the next chapter, Chapter 2, some literature review about the already mentioned topics which will be investigated in this work, will be introduced, so the connection between ESG Score and Financial performance and Financial Risk of companies. The chapter will mainly treat the state of art in these fields of research. Each presented work will have a focus in a particular segment of the main argument, presenting each of them something unique, from the selected sample, or the considered geographic area, to the econometric model applied and the main hypothesis developed. Of course, all of them investigate a possible link between the variables just mentioned. As it will be shown, the state of art is not so advanced, mainly because of the uncertainty around the obtained results, therefore there is still a considerable opportunity to carry on new studies about these topics.

In Chapter 3 the research part of the study will be presented, alongside a brief introduction about the models and the framework which are going to be applied and the database used to perform the analysis and the description of the data. Additionally, there will be a focus on sample selection and methodology will be applied. The most relevant part of the chapter will focus on a deep examination of the variables and hypothesis put in place, which will be the drivers of the analysis.

Then, with Chapter 4, a focus on the empirical results obtained from the regression analysis is going to be presented. In particular, it will start with a deep explanation of the applied regression models in the Panel Data Analysis conducted. At the end of the chapter an interpretation of the obtained results and of the performed test will be presented.

At last, Chapter 5, in which there will be a deep analysis of the obtained results, along with connected conclusions and economic interpretation of the outcomes. In this last part, the main concept of the research is going to be reintroduced, but this time with the possibility to make some statements on obtained evidence based on the results. In this way there will be the chance to answer to the main questions raised for the purpose of this study.

CHAPTER II

LITERATURE REVIEW

2.1 - INTRODUCTION

Over the past few decades, a significant trend in corporate sustainability has started to emerge, moving from voluntary participation in sustainable operations until to actual regulations as a result of social expectations and governmental pressure (Brockett & Rezaee, 2012). In particular, since 1987, moment in which the concept of sustainable development has been introduced by the report from the World Commission of Environment and Development, more companies have become aware of their responsibility in this matter (Peeters 2003). For this reason, businesses are increasingly using sustainability strategies and disclosing environmental, social, and governance (ESG) data, which has led to significant changes in business models and management theory. However, while traditional shareholder-oriented management seeks to improve financial performance and maximize shareholder advantages (Friedman, 1970), sustainable business encourages stakeholder-oriented management (Freeman & McVea, 2001), which focuses on minimizing externalities and maximizing social value about ESG issues while taking into account all stakeholders, including shareholders, consumers, customers, communities, and other related groups.

Hence, despite several studies empirically examined the relationship between corporate social responsibility and financial performance in terms of quantitative returns, it has emerged relatively little agreement in the relevant literature regarding the direction of the effects of Sustainability on business performance. Therefore, there has been significant discussion on how ESG criteria impact a company's financial performance and, ultimately, its value.

In the early stages of the discussions around these topics, rooted in neoclassical theory, it was assumed that the relationship between ESG and financial success was universally negative (e.g., see Vance, 1975; Wright & Ferris, 1997). This argument is best summarized by Friedman (1970), who claims that the firm's main social responsibility is to maximize its owners' profits. The basic assumption is that ESG activities' payoffs do not offset their costs.

However, many researchers have more recently found that socially responsible behaviour may have a net positive influence on performance and business value (Fatemi et al., 2015; Malik, 2015). It can be argued that socially responsible behaviour better satisfies the interests of nonowner stakeholders (e.g., debtors, employees, customers, and regulators) within the framework of stakeholder theory (Freeman, 1984), allowing for more efficient contracting (Jones, 1995) and opening new paths to further growth and risk reduction (Fatemi & Fooladi, 2013). In a similar fashion, Porter and Kramer (2006, p. 2) suggest that CSR may be much more

than a cost, a constraint, or a charitable activity; in fact, it can be a source of opportunity, development, and competitive advantage.

According to Kim and Lyon (2015), also some recent papers (Fisher-Vanden & Thorburn, 2011; Jacobs, Singhal, & Subramanian, 2010; Lyon, Lu, Shi, & Yin, 2013) continue to find that firms reporting participation in environmentally friendly activities, or receiving green awards, tend to experience negative abnormal returns. According to these findings, investors punish the firm for what they consider to be costly investments.

Despite of these findings, Clark, Gordon L., Andreas Feiner, and Michael Viehs in their report, in which they investigate over 200 of the highest quality academic studies and sources on sustainability and economic performance, have found out that generally companies with strong sustainability scores show an improvement of operational and financial performance, a reduction in the riskiness of the business as well as an enhancement in the value of the firm, creating actual value. In fact, based on their findings, they believe that including sustainability factors into decision making processes is in the best economic interest of business executives and investors. They conclude the paper by arguing that it is in the long run self-interest of the general public, as beneficiaries of institutional investors (such as pension funds and insurance companies), to persuade corporations to produce goods and services responsibly. They not only improve the returns on their savings and pensions, but they also contribute to the preservation of the world they live in for themselves and future generations.

After this brief introduction to the literature about the topic, throughout this chapter we will present the main findings of the studies which have been analysed and take into consideration for driving and writing this research. In particular, as mentioned before, the main two fields in which will be placed the focus are the connection between ESG Scores and Financial Performances of the companies and at the same time it will be tested the impact of the sustainability on the riskiness of the company, in particular the focus will be place on credit risk, choosing the credit rating as main indicator.

It may be interesting to begin from the paper written by Ali Fatemi, Martin Glaum, Stefanie Kaiser, in which they study the effect of environmental, social, and governance (ESG) activities and their disclosure on firm value, finding that disclosure plays a crucial role in the effect of ESG factors, by mitigating negative effects of weakness connected to lack of attention to sustainability issues and by limiting the positive effects of strength given by high level of effort on sustainability behaviour. Beginning the review of the literature with this paper may be important just to understand how much this field is uncertain and not so clear.

According to their work, ESG strengths raise firm value whereas ESG issues diminish it. When ESG disclosure is isolated, publishing information about ESG practices without pointing out strong and weak aspects, it is observed to reduce corporate value. When disclosure is instead combined with a proper explanation of ESG strengths and weaknesses, more complete evidence has emerged. However, it results that high ESG disclosure reduces the beneficial valuation effect of ESG strengths when they exist. This conclusion could be explained by the markets interpreting increased disclosure as the firm's attempt to defend an excess of investment in ESG activities.

Disclosure also mitigates the negative valuation effects of ESG issues, possibly because it helps firms legitimize their behavior by explaining to investors the rightness of their operations and ESG policies, or because it convinces investors that firms have made credible commitments to modify their operational processes and thus overcome ESG weaknesses.

The models are then estimated for each of the three components that comprise the firm's ESG score: the environmental score, the social score, and the governance score. These findings suggest that environmental strengths boost business valuation while environmental deficits decrease it; in both cases, disclosure has a moderating effect.

For social and governance aspects, the outcome is slightly different: while shortcomings in both areas tend to diminish valuation, neither social nor governance strengths raise it.

The valuation reductions associated with social and governance flaws are again addressed by the corresponding disclosures.

Finally, an analysis at the individual component level demonstrate that investors differentiate considerably among the various dimensions of the ESG scores. Governance problems result in substantially larger valuation discounts than social or environmental concerns (in that order). Simultaneously, the moderating impacts of governance-related disclosure are far greater than those of social or environmental concerns. These effects can be explained in terms of opacity differences. In fact, Security and Exchange Commission frequently mandates and regulates governance-related disclosures, and investors can judge their authenticity with considerable ease and confidence. Social and environmental disclosures, on the other hand, are generally voluntary, making them opaquer and more difficult to verify.

After having understood the importance of the disclosure, as an example on how many factors can alter the perception and the relationship between companies and stakeholders and the market in general, introduced from this introduction paper, the review will go through several papers in which it is possible to find fundamental studies for the purpose of this thesis and which can be considered a basis for this work.

2.2 - ESG INDICATORS AND FINANCIAL PERFORMANCE

Corporate social performance (CSP) is becoming more and more significant, but there is no agreement on how it affects market value and its financial performance. While some academics contend that reducing costs and idiosyncratic risk through excellent social performance increases corporate value (Oikonomou et al. 2012; McWilliams and Siegel 2001), others see CSR initiatives as a waste of resources and a managerial technique for obtaining private advantages from shareholders (Friedman 2002; Barnea and Rubin 2010; Groening and Kanuri 2013). The relationship between sustainability and financial performance is probably one of the most investigated one in this field of study. However, just few studies which have been analysed for this work clearly show a consistent relationship between the two variables. In fact, starting from the research of Weston, Piers, and Matthias Nnadi (2021), it's possible to understand many information about the sustainability business environment. In terms of how companies should respond to climate change, public outcry about the role that companies play in contributing to environmental problems is increasing, and the impact and importance of corporate social responsibility in recent decades does not seem to be slowing down. This can be explained by the significant shift in investor needs and preferences regarding the sustainability of their investments that financial institutions have observed, which has resulted in a fast rise in the number of socially responsible investment funds (Munoz-Torres et al. 2004), in fact an increased investor awareness of CSR, the abundance of financial products at their disposal (O'Rourke 2003), and increasing regulation on the subject (Albareda, Lozano, and Ysa 2007) have all contributed to this growth. Additionally, a growing body of academic research has shown that SRI/ethical investing generally yields returns that are similar to those of more traditional investments (Guerard 1997; Hutton, D'Antion, and Johnsen 1998; Bellow 2012; Statman 2000). When combined with the statistic that approximately 90% of Fortune 500 corporations use ethical procedures, we can see that there is a turning point in the degree to which businesses are tolerant of such methods. Thus, this brings up the question of how businesses could participate in such practices, as it is actually considered the norm to engage with, trying to understand if these practices can also be helpful in financial terms.

So, considering the empirical analysis conducted by authors, which accounted for overall financial performance of sustainable firms against those who are not, it possible to notice that the results were similar for both regressions which is in line with the current academic work on voluntary sustainable guidelines affecting performance. The authors, for this regression, have chosen Total Return as dependent variable, since it is considered as a main driver of profitability whereas P/E ratio, ROE, MV and the Beta were used as the independent variables to test the

relationship with the dependent variable and how much they influence it. Overall, the results of the performed regressions showed that there is no inherent financial benefit to being sustainable, however it is important to state that there are numerous non-financial benefits to acting in a sustainable manner such as increased reputation, feel-good factor of being eco-aware, increased access to debt and equity financing and perhaps better credit ratings and overall contribution to a better environment. Hence, to find an answer at the question that the researches has raised at the beginning of the paper, it can be seen that pursue a sustainability development can be positive for a company in terms of financial benefits, as an enhancement in raising capital for example, even if no connections with the financial performance have been found.

Although, reviewing other studies about the topic, different evidence has also been provided. In fact, analyzing the research performed by Sang Kim and Zhichuan (Frank) Li, “Understanding the Impact of ESG Practices in Corporate Finance”, other findings come to the light. Their analysis takes into consideration the impact of ESG indicators in both financial performance and financial risk of the companies. In particular they performed four equations for each area of interest. Each of the regression has the purpose to analyze the single impact of one channel of the ESG score, and the last regression take into consideration the overall impact of the score on the outcome variable. In particular, they used ROA as indicator of financial performance and Credit Ratings as indicator of financial risk. The results which came from their research show how ESG performance actually matters on the impact on financial performance and risk. Their findings show how certain component and aggregate ESG variables positively impact the selected performance indicators, even though it is challenging to generalize the positive impact of ESG factors on corporate finance performance. In particular there are clear evidences that overall ESG score has a positive impact on corporate profitability. Additionally, the split regression analysis demonstrates the beneficial effects of ESG characteristics on corporate profitability for businesses with high total asset values; among them, corporate governance is the ESG component with the biggest effect on business profitability. With respect to corporate risk instead, the obtained results show how all four ESG criteria significantly affect credit rating. While the Social, Governance, and overall ESG scores have a favorable effect on credit ratings, the Environmental score has an unexpectedly negative impact. Among them the Social component has the biggest influence.

Lastly, taking into consideration the paper produced by Piers Weston & Matthias Nnadi, 2021, there are other evidences from which it's possible to understand the difficult to find any connection between ESG practices and corporate performance. Given the rise of the importance of corporate social responsibility and, as consequence, the increase of literature in the academic field about the topic, the authors were interested in understanding how the companies could imply sustainable practices in the management of the company trying to find connections between corporate social sustainability and corporate performances. In particular, they compared a bunch of companies which are following the Principles for Responsible Investing with another group of companies which do not adhere to these guidelines. The sample was composed by data of these firms for the period 2009-2019, using monthly returns as outcome variable. Overall, the regressions showed that acting sustainably does not have any inherent financial benefits; however, it is important to note that doing so has many non-financial advantages, including improved reputation, the feel-good factor of being environmentally conscious, increased access to debt and equity financing, possibly better credit ratings, and overall improvement to the environment. Nonetheless, they understood that the mentioned frameworks, should help you grasp the firm's current situation, its capabilities, what it has to do to become more sustainable, as well as the advantages that come with it, in order to better investigate the mentioned relationship.

With these three examples, it's possible to figure out how much is grey this field and how much is challenging to proof an actual relationship between the analyzed variables, as already discussed and this is one of the main reasons why this topic is so hot in the last years.

2.3 - ESG INDICATORS AND FINANCIAL RISK

As mentioned before, the main part of the literature about the relationship between corporate sustainability and corporate financial performance is developed considering the financial performance of the companies. However, as it is understandable, there are many aspects of the financial situation of a firm which can be affected by a certain level of sustainability practices. In fact, as it has been underlined above, and taking into consideration many studies, in this case considering the one from Sassen et al., 2016 and Bauer et al., 2010, these kinds of practices have many effects even among the stakeholder interests. So, one attempt to be capable to capture this impact among firm's business is testing the relationship between ESG measures and the financial risk. In fact, financial risk can actually be affected from many factors, as an enhance in the reputation of the company, specific policies put in place by the governance of a firm, so by its shareholders, from a more general attention to social and environmental topics, which can allow a business to be more reliable and accepted by the society, allowing it to be more sustainable from a long term perspective, being in line with what the different stakeholders required from a business nowadays, avoiding for example the risk of future scandals or possible turnarounds in the business and in the projects of a company due to misalignment with sustainable guidelines. In fact, according to Bauer et al. conceptual framework, environmental practices affect borrowing firms' solvency by determining their exposure to legal, reputational, and regulatory risks. Environmentally negligent businesses may face expensive fines and face harsh criticism from both financial and non-financial stakeholders, both of which increase their default risk and reduce the value of their fixed income assets.

Before deciding to lend, bond investors who want to protect themselves from losses caused by environmental performance-related factors need to have a better grasp of how the various corporate environmental initiatives relate to credit risk.

Below there will be presented other few evidences from literature developed until now on this topic, which will be useful in order to understand the advancement of the studies in this field and the academic point of view about the theme.

First of all, there will be presented the work developed by Attig et al., 2013. They start the paper with some evidence in which they make some statement about the current academic research around the connection between corporate financial performance and sustainability. In fact, growing corporate and media interest is being paid to the significance of corporate social responsibility (CSR). For instance, according to a 2008 KPMG poll, 80% of Fortune Global 250 companies provide corporate responsibility data in separate reports or as part of annual

financial reports. In a similar vein, the Ethical Corporation magazine's 2010 survey found that 67% of the 116 firms surveyed measured the social and/or economic impact of their businesses on the communities in which they operate, and both the Wall Street Journal and the Financial Times included CSR—along with finance, marketing, accounting, and operations—in their assessments of top business schools. Equally relevant, according to the Social Investing Forum, as of the end of 2009, the US social investing market was worth \$3.07 trillion out of the \$25.1 trillion in assets managed.

The question of whether CSR enhances corporate financial performance (CFP) is still largely unsolved in the context of rising business involvement in social activities. Although Orlitzky et al. meta-analytic's findings from 2003 imply a favorable correlation between CSR and financial performance, the current empirical research, using accounting profitability as a measure of financial performance, reveals conflicting data on this subject. For example, Margolis and Walsh (2003) indicate that 54 of the 109 studies that were analyzed document a positive link between CSR and financial success, as opposed to 48 of them that do not. As a result, managers don't receive clear instructions on whether investing in CSR is desirable (McWilliams and Siegel 2001), which has led to more investigation into how financial markets see socially responsible companies.

These issues are being addressed by a growing body of research that looks at how CSR affects a firm's financing costs. According to El Ghoul et al. (2011), CSR is linked to a lower cost of equity capital. In Europe, Menz (2010) finds a marginally positive correlation between CSR and bond spreads. Goss and Roberts (2011) find that companies with below-average environmental and social performance are associated with a higher—yet modest—premium on their cost of private bank debt. Chava (2011) demonstrates that businesses with environmental concerns pay a higher interest rate on their bank loans. In contrast, Sharfman and Fernando (2008) discover that companies with strong environmental performance have higher bond yields (and have higher leverage). Starting from this academic background, the authors have extended the above line of research by investigating the effects of CSR on firms' credit ratings, used as index of firms' risk. Their key driving impulse is the assumption that earlier research' reliance of short-term accounting profitability to evaluate financial advantages may be partially responsible for the lack of conclusive data regarding the financial benefits of CSR. They contend that the advantages of CSR primarily manifest as intangible assets, such as reputation and stakeholder connections, which are unlikely to have an immediate impact on short-term accounting profitability. Additionally, companies that participate in CSR pay expenses that may erode the connection between CSR and accounting profitability.

From an analytic point of view, they empirically analyze the effect of CSR on credit ratings, using an ordered probit model instead of a standard linear regression model (OLS), because of the ordinal nature of the dependent variable. They show that CSR has a considerable beneficial effect on company credit ratings, both in terms of the overall CSR score and the scores for each of the separate CSR components. These findings imply that investing in CSR initiatives is likely to lower a firm's financing costs by raising its credit rating, which, all else being equal, should increase the firm's value and subsequently the value of its shareholders. However, not all of the particular CSR components are important to the credit ratings of businesses. We find that while the human rights component does not significantly affect business credit ratings, other factors, such as employee relations, diversity issues, product issues, community relations, and environmental concerns, favorably affect firms' credit ratings. These findings imply that socially desirable CSR initiatives that have a direct impact on a company's key stakeholders are those that have the greatest impact on the credit ratings of enterprises. Overall, the authors' findings support the notion that RSI, particularly those dimensions that reflect the company's discretionary responsibilities and are directly related to stakeholder interest management, is significant in determining the creditworthiness of businesses. These data can help investors make better selections by enabling them to comprehend how CSR performance influences firms' financing costs because ratings indicate the quality of information disclosure by firms and hence play a significant function in the financing and investment decisions of firms. The findings also imply that managers might increase shareholder value by encouraging CSR initiatives that are socially desirable and that are closely related to a company's main stakeholders.

Next, it has been analyzed the paper “ESG as a Measure of Credit Ratings” (Chodnicka-Jaworska, 2021). The author started with her assumption taking into account the economic consequences produced by the recent tragic pandemic, which has affected the entire world in a way in which has never been seen, in particular from an economic perspective.

With regard to these two last years, the COVID-19 pandemic directed attention toward ESG (environmental, social, and governance) measures. In April 2021, the European Commission published a draft directive on non-financial reporting. The CSRD (Corporate Sustainable Reporting Directive) will replace the existing NFRD (Non-Financial Reporting Directive), and it will impose not only more reporting obligations but also expand the list of entities and areas covered by that reporting. A significant change will be the obligation for all large companies that meet certain financial and employment criteria—not only listed companies. The new directive, after its adoption by the Member States and its implementation into national

legislation, will come into force in 2024 and will apply to data reporting for 2023. The COVID-19 pandemic shows that a company's creditworthiness is not only strictly connected to its financial condition but also non-financial measures. This serious issue is also linked to the extent of environmental contamination, particularly that caused by coal and green energy, dry weather, rising temperatures, glacier melting, etc. As a result, the regulatory risk associated with the changes in standards and the decrease in pollution is significant. In essence, a contaminated environment poses a huge danger, particularly in industries like the oil and energy sectors. Credit rating agencies are beginning to recognize these hazards when they analyze the default risk. The most serious ESG risks for specific industries were presented by S&P in 2021. Because of this, the building materials industry in the EMEA region faces the greatest danger from CO2 emissions. For the metals and mining or oil and gas sectors, the ESG factors and laws related to the rapid energy transitions are extremely crucial. The transportation situation may be significantly impacted by the likelihood of emission inspection. Due to the established association, it was necessary to examine how ESG elements affected financial intermediaries' default risk and creditworthiness. Due to industry risk, borrower cash flow, and company default risk, ESG metrics have a substantial impact on credit ratings. Positive ESG initiatives should therefore raise organizations' credit ratings.

For these reasons the author decided to analyze the impact of the ESG measures on the credit ratings by taking into account the type of the sector; performing an analysis for a specific industry in order to confirm the need to assess the value of ESG metrics for credit rating projections. Particularly, various responses to the following elements can be seen in different sectors. Some of them, like the energy sector, are more susceptible to CO2 emission laws, while others are more sensitive to pollution reduction, water conservation, for example.

Hence, the presented article has also filled a research gap on the influence of ESG factors on credit rating estimation. There are still just a few studies that have looked at how ESG-CSR policies affect default risk. Credit ratings provided by independent credit rating companies might be used to evaluate the occurrence. Credit ratings are used by financial institutions to calculate default and credit risks as well as by investors when making investment decisions, therefore understanding how ESG factors affect credit ratings is crucial.

In particular the dataset used for this work is composed by data of the companies in a 30-years period, from 1990 to 2020, even if at the end just the last 10 years have been used, due to the lack of ESG data in the earlier years. Regarding the econometric model, it has been used an ordered logit panel model, using credit rating scores as dependent variable, as explained above. The findings support the assumption that ESG variables have a considerable impact on credit ratings. For specific credit rating agencies, the influence varies in intensity, since of course

each credit rating organization uses a different approach. The environmental measure is the most crucial element. Social responsibility becomes less important. The effect of information released by businesses themselves as well as adverse events on credit rating assessment is not without relevance. The results collected are consistent with several research' conclusions that companies might use ESG practices to raise their reputational risk and boost their standing with the public (Goss and Roberts 2011; Jang et al. 2020). The impact of the ESG indicators on the calculation of default risk is further supported by the obtained results.

What's make this study particularly interesting is the pursuit of an analysis in which there is a distinction between different sectors. In this way the author has been able to understand the different impact of corporate sustainability among the different economics sectors and this is kind of unique approach in literature.

In fact, sectors respond to ESG scores differently. Energy, industrial (on social responsibility), material, and utility industries are the most susceptible. This has a direct connection to laws governing pollution reduction, energy efficiency, and water conservation. The decision made by the major investment funds to reduce or even stop investing in securities of companies with high carbon emission policies is also related to the significance of ESG factors in the estimate of credit ratings. ESG measures are combined with financial considerations. It demonstrates how the importance of ESG metrics has evolved over time. Company notes are sensitive to bad things happening in relation to the pillars of governance, social, and the environment. Similar to prior studies, the most important variables have to do with leverage ratios and earnings potential.

The obtained evidence can actually be interesting for many categories. For example, due to the new perspectives they offer on how ESG factors affect credit and default risk, the received findings can be helpful to financial institutions, as long as regulators and supervisors. Many financial institutions are currently working to rebuild their methods for assessing credit risk and default risk. The findings that are presented can help categorize important factors and highlight their significance in determining whether the risks that are mentioned are present or not. In addition, they can be even used to categorize the significance of the mentioned phenomenon in particular sectors and assess the risk of rebuilding portfolios by investors.

The last research will be presented in this section is the one developed by Devalle et al., 2017, in which they analyzed the effect of environmental, social, and governance (ESG) performance on credit ratings. Beyond the motivation already cited in the other paragraphs, as the increase in the importance of sustainability in the recent years and all the question related to that, the main reason which incentivized the realization of the paper is that, despite the fact that financial

markets and institutions have shown a growing interest in using ESG criteria in investment decision-making processes, ESG objectives are not yet clearly incorporated into the creditworthiness evaluation of credit lending practices used by banks (Zeidan et al., 2015). In other words, banks and financial institutions still adopt lending practices by estimating risk against the default of borrowers and solely relying on risk sensitivity parameters (Zeidan et al., 2015). So, from a financial standpoint, academics and practitioners encourage financial intermediaries to incorporate ESG objectives into their evaluations of credit scoring and lending policies.

To perform the analysis, authors performed an ordered logistic regression among a sample of 56 Spanish and Italian public companies, using as dependent variable the credit ratings and as control variables, many ESG and CSR indicators, including three measures for each of the category of ESG Score.

The results shows that improved credit ratings are positively correlated with improved ESG performance. Credit ratings are strongly and favorably correlated with shareholder and community scores, respectively. Results reveal a weak relationship between credit ratings and CSR Strategy Score. Further study is required to strengthen this relationship because we do not obtain significant and meaningful results regarding the environmental metrics (Environmental Innovation Score, Emission Score, and Resource Use Score). The study investigates the relationship between ESG performance and credit ratings by offering both theoretical and practical implications. First off, the research shows that there are no unambiguous limits to the relationship between default probability and ESG criteria. Therefore, it is necessary to unravel this tie. Increasing sustainable practices results in a decrease in the default probability if this relationship is empirically significant. Second, this unfavorable relationship may subsequently have important practical ramifications. Enhancing ESG commitments serves as a risk mitigation strategy that indirectly lowers businesses' overall risk, which has a direct impact on credit ratings and default risk. ESG commitments may therefore be incorporated into credit lending policies, advancing the analysis of sustainable credit lending practices. ESG criteria, specifically the default probability, may be used to estimate a company's risk sensitivity.

However, there are 2 main issues related to this article, firstly a small sample may not allow to obtain precise information about the research, as long as the second problem, that is the choice to use just one year of observation for the analysis.

With the review of these last articles, focused mainly to find information about the relationship between corporate sustainability and financial risk, it's still possible to notice some complexity about obtain reliable and clear results about the question raised. However, it's possible to see

how every author has tried to give emphasis in a particular aspect of the research, as dividing the sample in each sector, or as in the case of by Devalle et al., 2017, in which they used many ESG indicators as regressor. This aspect it is surely interesting because of course they have tried to cover a larger range of questions, which may be important for more involved categories of people. Nevertheless, this heterogeneity may be one of the reasons why it's so hard to obtain consistent results, which can be considered reliable from the economic community.

CHAPTER III

RESEARCH METHOD

3.1 - INTRODUCTION

This chapter will explain the sample selection process, going through the choice of dataset, the financial service provider where the data were taken, the analysis and processing of the data, and finally the description of the variables used. Next, the various hypotheses underlying the questions posed for the development of this thesis will be listed and expressed. The main goal is to provide a thorough understanding of the decisions made, ensuring the openness and reliability of the research. Initially, it will be introduced the models used in the literature and taken as a reference to conduct this research, followed by a brief introduction of the data providers used and the reference databases, with a detailed analysis of the sample selection process that produced the final dataset used. In particular, the rationale behind the decisions taken in terms of data selection and data cleansing will be explained.

All of the above-mentioned papers were a source of interest in the realization of this paper, in particular the work of Sang Kim and Zhichuan (Frank) Li, “Understanding the Impact of ESG Practices in Corporate Finance”, referred to as the principal source used to implement the analysis since the two research have similar goals of interest.

After considering multiple econometric methods that could have been applied for this specific study, the panel analysis of the date has been considered the most appropriate one. As will be later made explicit, three different panel data analysis models were applied, sequentially Pooled OLS model, Fixed Effects Model and Random Effects Model.

These multiple model variants were applied to achieve a broader perspective of the data analysed, ultimately to obtain meaningful results and capture the different facets of the survey conducted. Statistically, what makes this thesis unique and different from all other works analyzed are the application of diverse econometric methods and the dataset used, particularly in terms of its geographic focus.

In fact, most of the studies that analyze the effects of corporate sustainability concern European or American samples, except for a few studies focused on the Chinese and Middle Eastern markets. Beyond isolated cases, there is scarce research targeting the Italian market. Given this lack of research, it was decided to focus the study in this particular area, thus taking the

opportunity to provide a study on domestic companies, with the possibility to compare the results obtained with other studies, studies and possibly highlight eventual differences or similarities between the Italian market and other geographical areas.

3.2 – SAMPLE SELECTION

As mentioned before, the sample is represented form a cluster of Italian listed companies. Obviously, the fact that the companies were listed is of paramount importance since it is necessary to have consistent historical annual data regarding the financial statements and the ESG information published.

For this very reason, it was decided to take the FTSE MIB as the benchmark. FTSE MIB is the main index of Italian stock markets, stock market, which is composed of leading, high-liquid companies in various ICB sectors in Italy (Borsa Italiana Spa) and which captures about 80 per cent of the domestic market capitalization.

The FTSE MIB Index measures the performance of 40 Italian stocks and is intended to replicate the weightings of the broadened sector of the Italian stock market. The Index is derived from the trading universe of stocks on the main stock market of Borsa Italiana. Each security is analyzed by size and liquidity, and the Index overall provides a fair representation by sector. The FTSE MIB Index is weighted by market capitalization after adjusting the components for free float (Borsa Italiana Spa).

Since it represents 80 percent of the entire domestic market capitalization, the rationale behind the choice of this index is its representativeness of the Italian equity market. The financial services provider used is Thomson Reuters, the world's leading provider of news and information tools for professionals (Thomson Reuters Holdings Inc.).

Specifically, with its service named Eikon, it enables economic research and strategy development by accessing accounting and stock data of global companies and stock indices.

Eikon is a financial information service that includes company data, market data, news, economic and country data, analysis, and trading tools. It is used to find information on markets, stocks and stock indices, historical financial data, corporate and economic information, and more. In particular, the service offered by Thomson Reuters, namely called Refinitiv Eikon, made it possible to collect all the data available for each of the firm which are part of the FTSE MIB index.

The data have been collected from several financial documents, namely the Balance Sheet, Income Statement, Key Ratios Metrics and historical Credit Rating. To collect ESG data it has been used ASSET4, the leading source of environmental, social and corporate governance data. ASSET4's ESG framework allows companies to evaluate and compare over 700 distinct data

points from sources such as stock market documents, CSRs, annual reports, nongovernmental organization websites, and news sources. This data are then combined into over 400 key performance indicators (KPIs). The scores for these KPIs are compiled into a framework of 10 categories (Resource Use, Emissions, Innovation, Workforce, Human Rights, Community, Product Responsibility, Management, Shareholders, and CSR Strategy), each of which has three dimensions (Environmental, Social, and Governance). The partial scores are then summed to produce a single overall score. All the underlying data received the same weighting and z score to calculate the indicators, categories, pillars, and overall score. These scores are then compared with those of all companies in the ASSET4 universe. To distinguish more clearly the different values and place the score between 0 and 100 percent, the resulting percentage is then a z-scored and normalized relative measure of performance (Asset4, 2011).

Our sample is based on yearly data of the largest Italian listed companies over a 7-year period from 2015 to 2021. The selected time frame is compliant with the Non-Financial Reporting Directive (NFDR) (Directive 2014/95/EU), which requires large, listed companies, banks, and insurance companies with more than 500 employees to publish reports on the implementation of policies on environmental protection, social responsibility and treatment of employees, respect for human rights, anti-corruption and bribery, and diversity on company boards. In addition, following the guidelines provided by the analyzed papers, a 7-year period looks in line with a reliable study.

As a result, the study can rely on more accurate data because all the information needed for the research is readily available.

Analyzing more deeply the sample of selected companies, it is important to understand how they were chosen.

Although the FTSE MIB was taken as the reference point, not all the companies that make up the index were ultimately selected to compose the sample. First, consistently with almost all the studies presented in the Literature Review, it was decided to remove all financial, banking or insurance companies.

This was a crucial and fundamental step in the construction of the dataset, and the rationale behind this choice is because of the characteristic financial structure of these categories.

Banks, insurance companies, and generally all companies in the financial sector are characterized by a high level of financial leverage and they also present an increased sensitivity to financial risk (Foerster & Sapp, 2005). These aspects, which make these firms too different from the structure of all the other companies, would have diminished the quality of our analysis, yielding results that were not significant and uninformative, given also the large number of

companies that make up these sectors. By removing the categories mentioned, of the 40 companies that compose the index, only 29 remained available for research. In addition to this group of excluded companies, another one was removed, that is Iveco, because it did not have enough data available for a reliable data analysis.

Hence, at the end, the sample selected for this research consisted of 28 Italian listed companies, operating in different market sectors (Table 3.1).

Table 3.1 - List of Companies

COMPANY	TICKET	SECTOR
A2A	A2A.MI	Electricity
Amplifon	AMP.MI	Health Care
Atlantia	ATL.MI	Industrial Transportation
Azimut	AZM.MI	Financial Services
Campari	CPR.MI	Beverages
CNH Industrials N.V.	CNHI.MI	Industrial Goods and Services
Diasorin	DIA.MI	Health Care
Enel	ENEL.MI	Electricity
Eni	ENI.MI	Oil & Gas Producers
Ferrari	RACE.MI	Automobiles & Parts
Hera	HER.MI	Utilities
Interpump Group	IP.MI	Industrials
INWIT	INW.MI	Communication Services
Italgas	IG.MI	Utilities
Leonardo	LDO.MI	Aerospace & Defense
Moncler	MONC.MI	Personal Goods
Nexi	NEXI.MI	Technology
Pirelli	PIRC.MI	Automobiles & Parts
Poste italiane	PST.MI	Nonlife Insurance
Prysmian	PRY.MI	Electronic & Electrical Equipment
Recordati	REC.MI	Pharmaceuticals & Biotechnology
Saipem	SPM.MI	Oil Equipment Services & Distribution
Snam	SRG.MI	Gas Water & Multiutilities
Stellantis	STLA.MI	Automobiles & Parts
STMicroelectronics	STM.MI	Technology Hardware & Equipment

Telecom Italia	TIT.MI	Telecommunications
Tenaris	TEN.MI	Industrial Metals & Mining
Terna	TRN.MI	Electricity

3.3 – VARIABLES AND DESCRIPTIVE STATISTICS

In terms of selected variables, the data for each company have been collected from four main sources: Balance Sheet, Income Statement, Key Ratios Metric and Credit Ratings. Once all these documents have been collected, it has been applied a manual selection of several variables, based on findings provided from the considered literature.

After investigating about the relationship between the various measurement variables, a dataset was manually created with all the variables of interest chosen to conduct the analysis.

The variables chosen will be indicated below (Table 3.2):

- Independent Variables: Credit Rating and ROA (Used as independent variable for Financial Performance regression and as dependent variable for financial risk regression)
- Dependent Variables: ESG Total Score, Environmental Score, Social Score, Governance Score
- Control Variables: Ln (Total Asset), Total Equity, Total Revenue, Debt/Equity Ratio, Quick Ratio

A summary of the chosen variables can be found in Table 3.2. The following will explain a little more in depth where the various variables were found and what they measure.

The two dependent variables used in this study are Return on Assets (ROA) and Credit Rating since they are widely used in the academic literature and represent different aspects of a firm's financial structure.

Credit Rating is a metric used as index to represent business risk, as it was done in much of the research mentioned above in the Literature Review. The selected Credit Rating is an implied rating calculated directly by Refinitiv Eikon, which represents an average across several ratings from major rating companies, such as Standard & Poor's, Moody's, and Fitch.

The rating proposed by Refinitiv Eikon follows well or poorly the credit ratings proposed by the various agencies, with a ranking represented by letters, ranging from AAA to D.

One of the critical problems addressed in the data collection process was that more than a few companies did not have ratings available for the time frame considered.

Table 3.2 – List of Variables

VARIABLE	MEASURE	REFERENCE
Credit Rating	Credit Rating is used as index for company risk	Composed Credit Rating
Return on Assets - ROA	ROA is used as index for company financial performance	Key Ratios Metrics
ESG Score	ESG Score is the composite value assigned from Refinitiv Eikon for the company sustainability performance	Asset 4 Database
Environmental Score - E	Environmental Score takes into account how well a company manages the natural environment	Asset 4 Database
Social Score - S	Environmental Score measure how investors and consumers feel about a given company, sector, index, or stock as expressed in social media	Asset 4 Database
Governance Score - G	Governance Score includes everything from the allocation of rights and obligations among various organizational stakeholders	Asset 4 Database
Ln (Total Asset)	The natural logarithm of Total Asset is a measure used as index for the company size	Balance Sheet
Total Equity	Equity is the value owed by the company to its owners or shareholders.	Balance Sheet
Total Revenue	It is the total revenue generated by the sale of goods and services by the business.	Income Statement
Debt/Equity Ratio	The debt-to-equity ratio evaluates your company's overall debt in relation to the capital the owners initially invested and the profits that have been held over time.	Key Ratios Metrics
Quick Ratio	Quick Ratio is a particular liquidity ratio which indicate how company use its liquidity	Key Ratios Metrics

The lack of data is most likely attributable to the fact that the companies were not listed in the year in which the rating is missing, such that almost all of the missing data is recorded in 2015, the first year taken into consideration. To address this problem, it was decided to make up for the missing data by averaging the following two years, in order to obtain a result that could be fairly in line with the company's performance.

In case the missing data occurred in between two data instead, it was decided to average the two ratings around the missing information.

In the only case where the missing items were more than two, it was simply decided to disregard the company because the calculation of the missing information was not considered reliable, as has been done with Iveco.

Next, further manipulations were made in order to use the Credit Ratings in the analysis. In fact, it was necessary to convert all Credit Ratings to an equivalent numeric value, but without changing the rating scale.

For this purpose, conversion of S&P's alphanumeric ratings to numeric values were used (Ferri & Majnoni, 2000).

The conversion is done on a scale ranging from 5, which corresponds to the lowest value rating (D), to 100, which corresponds to the highest-ranking value (AAA) (Table 3.3).

The other measure used as dependent variable, is ROA – Return on Assets, calculated as the ratio between Net Income and Total Assets.

Since it provides information about a company's performance, ROA is a frequently used as measure of profitability in financial research, as evidenced by the various research studies listed in the previous chapters (Kim & Li, 2021). It evaluates a company's operating effectiveness separately from its financial performance. It shows how an organization's profits respond to various management strategies and the effectiveness with which the organization manages its assets (Selling & Stickney, 1989; Xie et al., 2019).

In this case, all the data were available and so there was no need for further manipulation of data.

Table 3.3 - Credit Rating Numeric Conversion

S&P Credit Rating	Numeric Equivalent
AAA	100
AA +	95
AA	90
AA -	85
A +	80
A	75
A -	70
BBB +	65
BBB	60
BBB -	55
BB +	50
BB	45
BB -	40
B +	25
B	30
B -	25
From CCC + to CCC -	20
CC	15
C	10
D	5

As concerns the independent variables of the analysis, the selected target variables will be introduced, in particular the variables related to corporate sustainability. The first target variable is the ESG score.

This measure has already been extensively explained in the dedicated section, so we will not dwell too much on the explanation of the score itself.

However, it is certainly interesting to understand Refinitiv's approach to calculating and ranking this type of data by taking a closer look at the framework around this type of measurement.

Refinitiv's ESG scores are intended to transparently and objectively measure a company's relative ESG performance, commitment, and effectiveness across ten major themes (emissions, environmental product innovation, human rights, shareholders, and so on) using publicly available data.

Based on verifiable reported data, the Refinitiv ESG score assesses a company's ESG performance; over 630 company-level ESG measures are captured and calculated.

The underlying measures are based on factors such as comparability, impact, data availability, and industry relevance, which vary by industry group.

These are divided into ten categories that comprise the three pillar scores and the final ESG score, which reflects the company's overall performance.

The scores from each category are combined to form three pillar scores: environmental, social, and corporate governance. The ESG pillar score is a relative sum of the category weights for the 'Environmental' and 'Social' categories, which vary by industry. The weights for 'Governance' are the same across all industries (Refinitiv). A summary of the resulted scores can be found in the following table (Table 3.4):

Table 3.4 - ESG Score Ranges (Refinitiv)

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

The overall ESG Score merges the partial performance of the company in each of the previously mentioned three channels through which corporate sustainability is pursued. The three partial scores are addressed as: Environmental Score (E-Score), Social Score (S-Score) and Governance Score (G-Score).

Environmental score represents, among other marginal things, emissions and resources, while social performance includes human rights and workforce, and governance performance takes into consideration management, stakeholders, and CSR strategy.

Following the methodology applied in many other studies (e.g. see Aslan et al., 2021; Kabir Hassan et al., 2021), a lag of 1-year period has been applied to ESG rating scores and also to the three channels through which the ESG objectives are pursued, namely E-Score, S-score and G-Score

This adjustment has been put in place for two main reasons: first, because it is more probable that the effects of these lagged variables are going to influence the dependent variables after a certain period, so the chosen lag period may be a good compromise, even because it is assumed that credit rating agencies do not obtain the contemporary scores prior to their credit evaluation.

Secondly, this data manipulation is also going to mitigate the issues caused by endogeneity and simultaneity bias.

Regarding instead to the independent control variables, the different variables were chosen mainly following the papers in the Literature Review, considering also the availability of data that the utilized financial provider Thomson Reuters was providing.

The selected variables, at the end, were six plus Return on Asset, used also as control independent variable in the regression for Financial Risk. It was decided to include six variables, in line with other works, in order to specify the different equations as much as possible, but without risking falling into the problem of overfitting, in order to get more precise and more reliable effects for our reference variables in which we are interested.

It is particularly relevant to observe to see the effects that these independent control variables have on the dependent variables, and to understand what the combined effect of the dependent variables may be, to see if there may be an interaction between them and a connection between the effects of firm sustainability and the characteristics of different firms.

Here below there will be a small introduction and explanation for all the variables in order to make easy to understand the reason why they have been chosen (Aslan et al., 2021; Bauer et al.; Drago et al., 2019; Kabir Hassan et al., 2021; Sassen et al., 2016a).

The first 2 variables, Debt to Equity ratio and Quick Ratio, measure two important features for all the businesses under analysis. Debt to Equity ratio is computed by dividing a company's total liabilities by shareholder equity. This ratio is considered an essential measure in corporate finance, since it is a measure of how much a firm uses debt to fund its operations rather than its own resources, so it may provide information about how much a firm rely on debt.

The second selected variable is the Quick Ratio, computed as the liquid part of Assets (Cash + marketable securities + accounts receivable) divided by Current Liabilities.

The Quick Ratio, also called Acid-test, is a Liquidity Ratio which measures the ability of a business to pay its short-term liabilities with its most liquid assets, so it is and indicator of a

company's short-term liquidity position and measures a company's ability to meet its short-term obligations with its most liquid assets. These assets are called "quick" assets because they can quickly be converted into cash.

The other three variables are Total Revenue, Total Size and Total Equity.

These are more immediate indicators, in fact Total Revenue is the total amount of income or simply the total amount of cash that a company earn from selling products or services.

Total Size of the company is computed as natural logarithm of total asset, and it accounts for the effects of scale economies and competitive position associated with a firm's size.

Larger enterprises, in general, dominate smaller organizations due to economies of scale, as large firms achieve more operational efficiency, such as greater purchasing power and cheaper expenses. A larger corporation has a greater share of people and financial resources. These capabilities, which are clearly superior in contrast to smaller firms, might be exploited for CSR activities, according to Mohammed & Rivas Vazquez in which they consider also the work of McWilliams and Siegel (2001).

Lastly, Total Equity is the book value of shareholders' investment in the company. Total equity is one of the two main sources of long-term capital for a company, the other is clearly long-term debt.

In Table 3.5, a descriptive statistic for the selected variables is presented.

As we can see in the table, there are some different metrics among the variables: for example, Return on Assets, Debt/Equity Ratio and Quick Ratio are expressed as percentage, while Total Return and Total Equity are expressed in million. Firm Size, as already discussed, is expressed as natural logarithm of Total Assets, instead all the scores and ratings are expressed in a scale from 0 to 100.

For this reason, it has been necessary to standardize data before implementing the regressions, in order to re-scale all the data without the risk that this issue could affect our regressions.

Data pre-processing is an important part of every project base on a data frame, in particular standardization of data is a crucial transformation of data, since it gives each feature a zero mean and a unit variance.

Standardization is the most used scaling technique since it is straightforward and allows the statistics of the characteristics to be compared. Keeping the variance at one and the mean at zero gives every feature an order of magnitude of one, which is critical for models that suffer from the gradient vanishing problem. The reason to perform standardization to reduce all features to a single scale without distorting the differences in the range of values (IEEE Staff, 2014).

Table 3.5 - Descriptive Statistics for all the Variables

<i>Variables</i>	<i>Count</i>	<i>Mean</i>	<i>Std</i>	<i>Min</i>	<i>25%</i>	<i>50%</i>	<i>75%</i>	<i>Max</i>
<i>Credit Rating</i>	196	64.57	15.025	30	55	65	75	100
<i>ROA (% Assets)</i>	196	0.059	0.0690	-0.21	0.0189	0.046	0.0793	0.278
<i>ESG Score</i>	196	67.70	18.762	12.05	56.003	71.66	83.16	94.04
<i>E - Score</i>	196	67.19	24.612	3.57	52.088	72.92	87.333	99.05
<i>S - Score</i>	196	72.77	19.691	14.29	61.283	77.115	89.27	97.77
<i>G - Score</i>	196	60.44	22.021	13.24	43.668	64.705	79.575	97.38
<i>Debt/Equity</i>	196	1.676	1.7977	0.001	0.6275	1.175	2.025	12.07
<i>Quick Ratio</i>	196	1.234	1.1709	0.004	0.6975	1.01	1.4075	9.90851
<i>Tot. Revenue</i>	196	15513	25957	239.2	1649.5	6260.5	13410	149419
<i>Tot. Equity</i>	196	7815	11170	-25.1	1513	4235	7389.2	55907
<i>Firm Size</i>	196	9.571	1.4283	6.562	8.6476	9.4194	10.3	12.559

3.4 – HYPOTHESIS AND MODELS

After reviewing the literature in the previous sections and analyzing and understanding how the data selection and data set formation took place, the research hypotheses will be formulated, with the aim of giving a clear direction to the study.

Hypothesis 1: The ESG Score and its components have a positive effect on the Credit Rating of companies, and thus on the risk of corporate business.

Hypothesis 2: ESG Score and its components have a positive effect on Return on Assets, and thus on the financial performance of the corporate business

These are the two main questions raised by this research.

Given the various studies conducted on these fields, it is expected a slight positive effect of the variables of interest on these financial aspects of firms. However, there is a high likelihood that the effects will be small or insignificant, as masses of the research analyzed have shown (e.g see Aslan et al., 2021; Sassen et al., 2016b).

Besides these two hypotheses, the analysis that will be performed will also give room for later investigation: in fact, in addition to check for any effect of ESG Score on Dependent Variables, there will also be the opportunity to reason about the three components of ESG Score. In fact,

it will be interesting to analyze the different effect of the single measures on risk and performance, in order to understand which of the three channels is the more effective. It will also be possible to reason about the control variables and the effect they have on the target variables, ROA and Credit Ratings.

In addition, since our sample is based on the FTSE MIB and includes Italian companies, the model will give the opportunity to compare the results obtained with those of the papers analyzed, which focused more on foreign companies. Ultimately, by comparing the different international context, it will be eventually possible to extract insights about the level of development of corporate sustainability recognition in different countries, even though additional studies would be needed to do a more in-depth study on the topic.

3.5 – ECONOMETRIC MODELS

As explained above, this study involves a Panel Analysis of the data.

The choice of this approach is determined mainly based on the available database.

In fact, panel data (also known as longitudinal or cross-sectional time-series data) is a dataset in which the behaviour of entities is observed across time.

There are numerous reasons to use Panel data. In the first instance, it has generally been favored by academics over cross-sectional data due to various advantages of the former. The advantages of employing panel data in empirical analysis have been eloquently explained by Hsiao (1985), Baltagi (2008), and Wooldridge (2010). In general, panel data can provide more precise model parameter inferences, a larger capacity to reflect the complexity of human behavior, and more streamlined computing and statistical inference. However, it should be noted that panel data has drawbacks as well. Panel datasets frequently suffer from intertemporal dependencies, autocorrelation, endogeneity, and other statistical issues that may not be present in cross-sectional data.

Furthermore, panel data collection is resource-intensive, requiring a significant amount of time, labor, and monetary commitments; thus, many researchers select cross-sectional data to fulfill resource restrictions. However, given the rapid development of econometric approaches to overcome panel data concerns and the availability of secondary sources, panel data is preferred over cross-sectional data.

Following much of the work in the literature, it can be noticed that the most used models are Pooled OLS, Random Effects and Fixed Effects, probably due to the features of data, since they describe different aspects of several entities (companies) along many years or during a period of time.

However, these models are not alternatives to each other; in fact, each is intended for certain characteristics of the data in question.

Pooled OLS, according to Wooldridge (2010), is employed when a different sample is chosen for each year/month/period of the data panel. When it is intended to monitor the same data sample for multiple time periods, fixed effects or random effects are used.

The equation for Pooled OLS is the following:

$$Y_{it} = \alpha + \beta_k X_{k,it} + u_{it} \quad [eq. 1]$$

Where:

- Y_{it} is the dependent variable (DV) where i = entity and t = time.
- $X_{k,it}$ represents one independent variable (IV)
- u_{it} is the error term
- α is the unknown intercept
- β_k is the coefficient k ($k = 1 \dots n$) for the IVs

Following Torres-Reyna, 2007, a brief explanation of the models will be presented.

When analyzing the usage of a Fixed Effect (FE) estimation instead, it is clear that this approach is employed when one just wants to study the impact of elements that fluctuate over time.

FE investigates the relationship between predictor and outcome factors inside an entity (country, per-son, firm, etc.). Each entity has distinct characteristics that may or may not influence the predictor variables (for example, being a man or a woman may influence opinion on a particular issue; a specific country's political system may influence trade or GDP; or a company's business practices may influence its stock price).

When FE is applied, anything within the individual can influence or skew the outcomes.

The equation for the fixed effects model is:

$$Y_{it} = \beta_k X_{k,it} + \alpha_i + u_{it} \quad [eq. 2]$$

Where:

- α_i ($i = 1 \dots n$) is the unknown intercept for each entity (n entity-specific intercepts).
- Y_{it} is the dependent variable (DV) where i = entity and t = time.
- $X_{k,it}$ represents one independent variable (IV)
- β_k is the coefficient k ($k = 1 \dots n$) for the IVs

- u_{it} is the error term

Another way to see the fixed effects model is by using binary variables. So, the equation for the fixed effects model becomes:

$$Y_{it} = \beta_0 + \beta_1 X_{1,it} + \dots + \beta_k X_{k,it} + \gamma_2 E_2 + \dots + \gamma_n E_n + u_{it} \quad [eq. 3]$$

Where:

- Y_{it} is the dependent variable (DV) where i = entity and t = time
- Xk_{it} represents independent variables (IV)
- β_k is the coefficient k (k = 1 ... n) for the IVs
- u_{it} is the error term
- E_n is the entity n. Since they are binary (dummies) you have n-1 entities included in the model
- γ_2 Is the coefficient for the binary repressors (entities)

You could add time effects to the entity effects model to have a time and entity fixed effects regression model:

$$Y_{it} = \beta_0 + \beta_1 X_{1,it} + \dots + \beta_k X_{k,it} + \gamma_2 E_2 + \dots + \gamma_n E_n + \delta_2 T_2 + \delta_t T_t + u_{it} \quad [eq. 4]$$

Where:

- Y_{it} is the dependent variable (DV) where i = entity and t = time
- Xk_{it} represents independent variables (IV)
- β_k is the coefficient k (k = 1 ... n) for the IVs
- u_{it} is the error term
- E_n is the entity n. Since they are binary (dummies) you have n-1 entities included in the model
- γ_2 Is the coefficient for the binary repressors (entities)
- T_t is time as binary variable (dummy), so we have t-1 time periods.
- δ_t is the coefficient for the binary time regressors

When unexpected variation or unusual events may alter the outcome variable, it is required to include the control for time effects.

The downside of fixed-effects models is that they cannot study time-invariant sources of dependent variables. The time-invariant properties of individuals are perfectly collinear with the entity dummies. The purpose of fixed-effects models is to study the causes of changes inside an entity (Ulrich Kohler and Frauke Kreuter, 2009).

Instead, the rationale behind the Random Effects model is that, unlike the Fixed Effects model, the variation between entities is believed to be random and uncorrelated with the predictor or independent variables included in the model.

Because random effects presume that the entity's error term is uncorrelated with the predictors, time-invariant variables can serve as explanatory variables. Individual qualities that may or may not influence the predictor variables must be specified in random effects. The issue here is that some variables may not be available, resulting in omitted variable bias in the model. RE enables generalization of inferences beyond the sample utilized in the model.

If there is a suspect that variations between entities have an impact on your dependent variable, you should employ random effects. Random effects have the advantage of allowing you to include time invariant variables. These variables are absorbed by the intercept in the fixed effects model (Torres-Reyna, 2007).

The random effects model is:

$$Y_{it} = \beta_k X_{it} + \alpha + u_i + \varepsilon_{it} \quad [Eq. 5]$$

- Y_{it} is the value of the dependent variable of unit (company) i at time period (year) t .
- X_{it} represents independent variables (IV)
- β_k is the coefficient k ($k = 1 \dots 13$) for the IVs
- α is the common bias (the mean of all unit-specific effects). It forms the intercept of the linear regression model.
- u_{it} is the variance introduced by the unit-specific effect for unit i . Notice that it lacks the time subscript t as it is assumed to be constant across all time periods in the data panel (a.k.a. time invariant).
- ε_{it} is the balance amount of error from all other sources introduced for unit i at time period t .

Based on this brief explanation of the models, it is clear how they are not interchangeable.

In fact, for our dataset, applying a Pooled OLS model seems to be incorrect, since we have 28 different benchmark companies, evaluated over a 7-year time span, when Pooled OLS should be used in a situation in which there is an investigation of one entity over several years.

Between Fixed Effects and Random Effects, the former would seem to be the more ideal model, given that one can include controls for differences between different reference entities and for different years. Since there is no constant variable over time, e.g., time - invariant, the use of random effects does not seem to be more useful.

In any case, to decide which of the three models to use, it would be sufficient to rely on simple statistical tests, such as Hausman test to decide between Fixed and Random Effects and Breusch Pagan to decide whether we can use Pooled OLS. These tests will be better explained and performed in the next chapter.

From this point of view, it might seem trivial to use all three models. However, according to our review of the literature, it can be seen that all three models are used for very similar studies. For example, probably for convenience, the Pooled OLS model is often used in this type of analysis.

For example, Kabir Hassan et al., 2021, performed this type of analysis using the Pooled OLS with the addition of dummies to control for fixed effects. A similar method was used by Kim & Li, 2021; Weston & Nnadi, 2021.

Another, more rigorous approach was applied by Sassen et al., 2016, who instead performed a Breusch and Pagan Test and a Hausman Test to identify which panel model was best for their data.

These are just a few of many examples showing that these techniques are often used for the same purpose, often without testing the most effective one.

For this reason, it would seem interesting to run all three models, and then analyze the results obtained and see which of the three models seems to most reliably explain the effects being investigated.

3.6 – INSTRUMENTAL FRAMEWORK AND DATA PRE-PROCESSING

To conclude this chapter, the computer tools used to conduct the analysis and the steps taken in processing the data will be explored.

All data were downloaded, as mentioned earlier, from Refinitiv Eikon.

For each of the 28 companies under investigation, 5 documents were downloaded: Balance Sheet, Income Statement, Credit Rating History, Key Metrics Ratios, ESG Score History.

These were transported into Excel, and with Excel for each company a single dataset was created with all the data of interest taken from the above 5 documents.

For each dataset, the data needed to be edited, since downloading them from Refinitiv, they had different formats and were not compatible with each other.

In addition, it has been necessary to fill in the data when not available, as explained in the previous paragraphs, mainly by averaging the observations around the missing data. Once the dataset for each company was created and arranged, the data analysis has been conducted through Python applications. To do this, the following packages were used: pandas, numpy, linearmodels, matplotlib, scipy, sklearn, and statsmodel. The pre-processing of the data began by merging all the datasets creating a single dataframe. This was joined so as to be compatible with a panel analysis of the data, then the sequence was to arrange, for each variable, the data in chronological order for each company, then 13 group of variables one after the other chronologically for each column. Once the data frame was arranged, the columns for years and company name were removed, and all the data were standardized, using the Standard Scaler from sklearn's "preprocessing" package. Once the data were preprocessed and ready to be used, the benchmark regressions that were listed earlier, namely Pooled OLS Estimation, Fixed Effects Estimation and Random Effects Estimation, were applied using the "linearmodels" package.

For each estimation, 4 regressions were performed, two to analyze the effect of the variables on the company's financial risk and two to analyze that on financial performance, one using the overall ESG Score and one using the E, S and G Scores as regressors instead.

All the tests have been performed using "scipy" package.

CHAPTER IV

EMPIRICAL ANALYSIS

4.1 – INTRODUCTION

After having explained in detail how the data were collected and how they were processed, in order to make them usable for analysis, and after it has been introduced in a theoretical way the econometric models that were used, this chapter will look in more detail at the models applied to the data set created. Then it will be presented the results obtained with the different methodologies.

At the beginning of the chapter, the equations for each regression will be formulated, explaining in detail how the various models were set up.

Then, once the results have been presented, an in-depth section will be devoted to explaining and interpreting the evidence obtained. This will be done with the help of several tables in which the results of the regressions will be presented and in which it will be possible to make a comparison between the different estimations.

Specifically, four tables will be presented comparing the various models run containing the results of the regressions. For each table, then, the regressions performed with Pooled OLS, Random Effects and Fixed Effect Estimation will be compared.

The complete output obtained with the models can be found in the Appendix.

In addition to the interpretation of the results per se, a comparison will also be made with various results obtained from the other papers in the literature, to understand if the findings obtained in this research are in line with the literature, or if they somehow deviate in some characteristic.

Then will be briefly made some considerations about diagnostic, conducting tests on the outcomes, in particular considering the obtained residuals and coefficients, in order to understand which of the three estimations is the most reliable and the one that should be looked at with the most interest.

4.2 – REGRESSION EQUATIONS

As has already been mentioned, the empirical analysis is based on the construction of three econometric models, and four regressions were performed with each of them, two to assess the effect of the overall ESG Score on financial performance and financial risk, and two regressions to assess instead the impact of individual ESG factors (E-Score, S-Score, and G-Score) on the same targets of interest.

The equations that made up the various models will be presented below:

POOLED OLS:

Credit Rating_{it}

$$\begin{aligned} &= \beta_0 + \beta_1 \mathbf{ESG - Score}_{it} + \beta_2 \mathbf{ROA}_{it} + \beta_3 \mathbf{Quick Ratio}_{it} \\ &+ \beta_4 \mathbf{Debt Ratio}_{it} + \beta_5 \mathbf{Tot. Equity}_{it} + \beta_6 \mathbf{Size}_{it} \\ &+ \beta_7 \mathbf{Tot. Revenue}_{it} + \beta_i \mathbf{Year}_i + u_{it} \quad [\text{eq. 6}] \end{aligned}$$

Credit Rating_{it}

$$\begin{aligned} &= \beta_0 + \beta_1 \mathbf{E - Score}_{it} + \beta_2 \mathbf{S - Score}_{it} + \beta_3 \mathbf{G - Score}_{it} \\ &+ \beta_4 \mathbf{ROA}_{it} + \beta_5 \mathbf{Quick Ratio}_{it} + \beta_6 \mathbf{Debt Ratio}_{it} \\ &+ \beta_7 \mathbf{Tot. Equity}_{it} + \beta_8 \mathbf{Size}_{it} + \beta_9 \mathbf{Tot. Revenue}_{it} + \beta_i \mathbf{Year}_i \\ &+ u_{it} \quad [\text{eq. 7}] \end{aligned}$$

$$\begin{aligned} \mathbf{ROA}_{it} &= \beta_0 + \beta_1 \mathbf{ESG - Score}_{it} + \beta_2 \mathbf{Quick Ratio}_{it} + \beta_3 \mathbf{Debt Ratio}_{it} \\ &+ \beta_4 \mathbf{Tot. Equity}_{it} + \beta_5 \mathbf{Size}_{it} + \beta_6 \mathbf{Tot. Revenue}_{it} + \beta_i \mathbf{Year}_i \\ &+ u_{it} \quad [\text{eq. 8}] \end{aligned}$$

$$\begin{aligned} \mathbf{ROA}_{it} &= \beta_0 + \beta_0 + \beta_1 \mathbf{E - Score}_{it} + \beta_2 \mathbf{S - Score}_{it} + \beta_3 \mathbf{G - Score}_{it} \\ &+ \beta_4 \mathbf{Quick Ratio}_{it} + \beta_5 \mathbf{Debt Ratio}_{it} + \beta_6 \mathbf{Tot. Equity}_{it} \\ &+ \beta_7 \mathbf{Size}_{it} + \beta_8 \mathbf{Tot. Revenue}_{it} + \beta_i \mathbf{Year}_i + u_{it} \quad [\text{eq. 9}] \end{aligned}$$

Where:

- β_0 is the constant term
- $\beta_1 \dots \beta_k$ ($k = 1 \dots 6/7/8/9$) are the coefficients of the Independent Variables
- $Year_i$ is the dummy variable for Year i
- β_i is the coefficient for the dummy variable for Year i
- $i = 1, \dots, 28$
- $t = 2015, \dots, 2021$
- u_{it} is the error term

RANDOM EFFECTS MODEL:

Credit Rating_{it}

$$= \beta_0 + \beta_1 \mathbf{ESG - Score}_{it} + \beta_2 \mathbf{ROA}_{it} + \beta_3 \mathbf{Quick Ratio}_{it} \\ + \beta_4 \mathbf{Debt Ratio}_{it} + \beta_5 \mathbf{Tot. Equity}_{it} + \beta_6 \mathbf{Size}_{it} \\ + \beta_7 \mathbf{Tot. Revenue}_{it} + \beta_i \mathbf{Year}_i + u_i + \varepsilon_{it} \quad [\text{eq. 10}]$$

Credit Rating_{it}

$$= \beta_0 + \beta_1 \mathbf{E - Score}_{it} + \beta_2 \mathbf{S - Score}_{it} + \beta_3 \mathbf{G - Score}_{it} \\ + \beta_4 \mathbf{ROA}_{it} + \beta_5 \mathbf{Quick Ratio}_{it} + \beta_6 \mathbf{Debt Ratio}_{it} \\ + \beta_7 \mathbf{Tot. Equity}_{it} + \beta_8 \mathbf{Size}_{it} + \beta_9 \mathbf{Tot. Revenue}_{it} + \beta_i \mathbf{Year}_i \\ + u_i + \varepsilon_{it} \quad [\text{eq. 11}]$$

$$\mathbf{ROA}_{it} = \beta_0 + \beta_1 \mathbf{ESG - Score}_{it} + \beta_2 \mathbf{Quick Ratio}_{it} + \beta_3 \mathbf{Debt Ratio}_{it} \\ + \beta_4 \mathbf{Tot. Equity}_{it} + \beta_5 \mathbf{Size}_{it} + \beta_6 \mathbf{Tot. Revenue}_{it} + \beta_i \mathbf{Year}_i \\ + u_i + \varepsilon_{it} \quad [\text{eq. 12}]$$

$$\mathbf{ROA}_{it} = \beta_0 + \beta_1 \mathbf{E - Score}_{it} + \beta_2 \mathbf{S - Score}_{it} + \beta_3 \mathbf{G - Score}_{it} \\ + \beta_4 \mathbf{Quick Ratio}_{it} + \beta_5 \mathbf{Debt Ratio}_{it} + \beta_6 \mathbf{Tot. Equity}_{it} \\ + \beta_7 \mathbf{Size}_{it} + \beta_8 \mathbf{Tot. Revenue}_{it} + \beta_i \mathbf{Year}_i + u_i + \varepsilon_{it} \quad [\text{eq. 13}]$$

Where:

- β_0 is the constant term
- $\beta_1 \dots \beta_k$ ($k = 1 \dots 6/7/8/9$) are the coefficients of the Independent Variables
- $Year_i$ is the dummy variable for Year i
- β_i is the coefficient for the dummy variable for Year i
- $i = 1, \dots 28$
- $t = 2015, \dots 2021$
- ε_{it} is the balance amount of error from all other sources introduced for unit i at time period t .
- u_i is the variance introduced by the unit-specific effect for unit i . Notice that it lacks the time subscript t as it is assumed to be constant across all time periods in the data panel (a.k.a. time invariant)

FIXED EFFECTS MODEL:

Credit Rating_{it}

$$= \beta_1 \mathbf{ESG - Score}_{it} + \beta_2 \mathbf{ROA}_{it} + \beta_3 \mathbf{Quick Ratio}_{it} + \beta_4 \mathbf{Debt Ratio}_{it} + \beta_5 \mathbf{Tot. Equity}_{it} + \beta_6 \mathbf{Size}_{it} + \beta_7 \mathbf{Tot. Revenue}_{it} + \beta_i \mathbf{Year}_i + \alpha_i + u_{it} \quad [\text{eq. 14}]$$

Credit Rating_{it}

$$= \beta_1 \mathbf{E - Score}_{it} + \beta_2 \mathbf{S - Score}_{it} + \beta_3 \mathbf{G - Score}_{it} + \beta_4 \mathbf{ROA}_{it} + \beta_5 \mathbf{Quick Ratio}_{it} + \beta_6 \mathbf{Debt Ratio}_{it} + \beta_7 \mathbf{Tot. Equity}_{it} + \beta_8 \mathbf{Size}_{it} + \beta_9 \mathbf{Tot. Revenue}_{it} + \beta_i \mathbf{Year}_i + \alpha_i + u_{it} \quad [\text{eq. 15}]$$

$$\mathbf{ROA}_{it} = \beta_1 \mathbf{ESG - Score}_{it} + \beta_2 \mathbf{Quick Ratio}_{it} + \beta_3 \mathbf{Debt Ratio}_{it} + \beta_4 \mathbf{Tot. Equity}_{it} + \beta_5 \mathbf{Size}_{it} + \beta_6 \mathbf{Tot. Revenue}_{it} + \beta_i \mathbf{Year}_i + \alpha_i + u_{it} \quad [\text{eq. 16}]$$

$$\begin{aligned}
ROA_{it} = & \beta_1 E - Score_{it} + \beta_2 S - Score_{it} + \beta_3 G - Score_{it} \\
& + \beta_4 Quick Ratio_{it} + \beta_5 Debt Ratio_{it} + \beta_6 Tot. Equity_{it} \\
& + \beta_7 Size_{it} + \beta_8 Tot. Revenue_{it} + \alpha_i + u_{it} \quad [eq. 17]
\end{aligned}$$

Where:

- $\beta_1 \dots \beta_k$ ($k = 1 \dots 6/7/8/9$) are the coefficients of the Independent Variables
- $Year_i$ is the dummy variable for Year i
- β_i is the coefficient for the dummy variable for Year i
- $i = 1, \dots 28$
- $t = 2015, \dots 2021$
- α_i is the unknown intercept for each entity
- u_{it} is the error term

A combination of dependent and independent variables can be found in the Table 4.1:

Table 4.1 - Summary Independent/Dependent Variables

COMBINATION OF DEPENDENT AND INDEPENDENT VARIABLES:
Models: <i>Pooled OLS, Random Effects, Fixed Effects</i>
Credit Rating ~ ESG Score + Control Variables*
Credit Rating ~ E-Score + S-Score + G-Score + Control Variables*
ROA ~ ESG Score + Control Variables*
ROA ~ E-Score + S-Score + G-Score + Control Variables*
Total Number of Regressions: 12
<i>*Control Variables:</i> <i>ROA + Quick Ratio + Debt/Equity Ratio + Tot. Equity + Tot. Revenue + Size</i>

Looking at the equations above, it can be seen that they are very similar to each other.

In all equations, the reference independent variables are regarding ESG scores, while all variables are the variables explained in Chapter 3. The only difference in the control variables is that the regression to assess the effect of corporate sustainability on financial performance has one less variable, using Return on Asset as dependent variable.

Another difference to note is the control for the time effect.

In fact, in all the equations used in the Pooled OLS and Random effects models, dummies were introduced to control for time effects, thus one dummy for each year.

In contrast, in the fixed effects model equations, these variables were not introduced directly into the equation because the applied model included default controls for time effects and did not require manual introduction of dummies into the equation.

In general, the major differences between the three approaches can be seen on how the different model equations are implemented: in fact, it can be seen that Random Effects Model and Pooled OLS Model present a single, constant intercept, while in the Fixed Effects Model there is no real intercept, but rather an unknown intercept for each entity, represented by α_i .

In addition, one can also see a difference in the way the three models account for the error term. While for the Pooled OLS Model and the Fixed Effects Model there is only one term that accounts for the error, in the Random Effects Model, besides to ε_{it} , the balance amount of error from all other sources introduced for unit i at time period t , there is u_i , which represents the variance introduced by the unit-specific effect for unit i .

A more practical comparison between Fixed Effects and Random Effects models will be given on Paragraph 4.4, during the explanation of diagnostic.

4.3 – EMPIRICAL RESULTS

Beginning with the Financial Risk regressions, the outcomes of the performed regressions will be presented below. The results of the models that used the overall ESG Score and then those in which the three separate E, S and G factors were used, will be presented first (Table 4.2 and Table 4.3).

This will be followed by a commentary on the outcomes, then making a comparison between the various models.

Table 4.2 - Financial Risk Regression (ESG Score)

Variables	Dependent Variable: Credit Rating		
	Pooled OLS	Random Effects	Fixed Effects
<i>Constant</i>	0.0684 (0.1393)	0.0289 (0.1616)	-0.0296 (0.0984)
<i>ESG – Score</i>	0.1115 (0.0701)	0.0618 (0.0868)	0.0677 (0.0979)
<i>ROA</i>	0.4133 *** (0.0698)	0.1723 ** (0.0858)	0.1134 ** (0.0549)
<i>Debt/Eq. Ratio</i>	-0.0385 (0.0678)	-0.0057 ** (0.0028)	-0.0244 ** (0.0122)
<i>Quick Ratio</i>	0.2582 *** (0.0572)	0.6932 (0.8107)	0.0272 (0.0277)
<i>Tot. Revenue</i>	-0.2284 (0.0947)	0.0816 (0.1718)	0.0914 (0.2611)
<i>Tot. Assets</i>	-0.3157 *** (0.1180)	-0.7731 *** (0.1641)	-1.1664 *** (0.2370)
<i>Tot. Equity</i>	0.3281 *** (0.1026)	0.3646 *** (0.1428)	0.3783 *** (0.1680)

***, ** and * denote statistical significance at the 1, 5, and 10 % levels, respectively

Analyzing the results obtained, we can see that for all the different estimations, the variable of interest, ESG Score, despite having a positive coefficient, is not significant.

Looking instead at the control variables, we will focus only on those with a significant effect. It can be seen that Return on Assets and Total Equity have a positive and highly significant

effect on Credit Rating, and thus a positive effect in the financial risk of companies, lowering this risk. On the other hand, the opposite can be said for the size of companies, which is found to have a negative and significant effect on Rating.

Checking the remaining significant parameters, it appears that Debt/Equity ratio, as can be expected, seems to have a negative effect on credit risk, following Fixed and Random Effects Model. Finally, it can also be seen that Quick Ratio appears to have a positive effect on risk, as we can expect since it's a liquidity ratio; however, the effect that is significant only with the Pooled OLS Model.

Table 4.3 - Financial Risk Regression (E, S and G Scores)

Variables	Dependent variable: Credit Rating		
	Pooled OLS	Random Effects	Fixed Effects
<i>Constant</i>	0.1027 (0.1399)	0.0427 (0.1655)	-0.0159 (0.0991)
<i>E – Score</i>	-0.2042 ** (0.0949)	-0.0915 (0.1158)	-0.1158 (0.1330)
<i>S – Score</i>	0.1222 (0.0954)	0.1273 ** (0.0637)	0.1198 (0.0908)
<i>G – Score</i>	-0.0879 (0.0627)	0.0001 (0.0476)	0.0386 (0.0627)
<i>ROA</i>	0.4324 *** (0.0703)	0.1721 ** (0.0861)	0.3141 *** (0.0510)
<i>Debt/Eq. Ratio</i>	-0.0529 * (0.0679)	0.0025 (0.0590)	-0.0247 *** (0.0053)
<i>Quick Ratio</i>	-0.2611 (0.0569)	-0.0494 (0.0541)	-0.0194 (0.0572)
<i>Tot. Revenue</i>	-0.2321 (0.0948)	-0.0878 (0.1749)	-0.1047 (0.2618)
<i>Tot. Assets</i>	-0.23430 * (0.1244)	-0.7368 *** (0.1721)	-1.1477 *** (0.2488)
<i>Tot. Equity</i>	0.2782 *** (0.1077)	0.3537 *** (0.1443)	0.3741 ** (0.1683)

***, ** and * denote statistical significance at the 1, 5, and 10 % levels, respectively

Considering instead the models applied with the three factors E, S and G isolated, we can see differences.

First, it is important to point out that indeed one of the score factors, the Social Score, appears to have a positive effect on business risk, and this is estimated significantly by Random Effects Model. Same effect is estimated also by the other models, however not significant enough to be considered.

For the rest of the control variables, on the other hand, the estimated effects are very similar to those previously presented for the overall score, with a positive and significant effect of Total Equity and ROA, balanced by the size of the companies, which again shows a negative effect, going to raise the financial risk of the companies.

Debt/Equity Ratio seems to have still a negative effect on risk, except for the estimation produced by Random Effects Model.

Summarizing these initial results obtained, there are some points to point out.

Talking about the main variables under analysis, we learn how, according to our study, there is no evidence to say that the overall ESG Score has a significant impact in the Credit Ratings and therefore in the risk of the Italian companies taken into consideration. This is slightly in opposition to the papers analyzed in the literature, as many of them have shown that ESG Score instead has a positive effect on corporate risk.

However, moving to the individual score factors, we get results that instead seem to be quite in line with the work developed in the research field, as we can see a significant impact of the Social Score, while a very uncertain effect of both the Environmental and Governance Score (Devalle et al., 2017).

The effect of the control variables instead, seems to be in line with the expectations, in fact Debt/Equity and Total Equity affect the risk of business in an opposite way, as we can expect. Also Return on Assets has a straightforward effect, since increasing the profitability of the company seems quite logical to expect a decrease in the risk of the business.

After having introduced the effects on business risk, we will shift the focus to Financial Performance regressions.

The results will be presented and commented on in the same way (Table 4.4 and Table 4.5).

Table 4.4 - Financial Performance Regression (ESG Score)

Dependent variable: Return on Assets (ROA)			
Variables	Pooled OLS	Random Effects	Fixed Effects
<i>Constant</i>	-0.1713 (0.1469)	-0.2242 (0.1725)	-0.2192 *** (0.0788)
<i>ESG - Score</i>	0.1237 ** (0.0624)	0.0024 *** (0.0008)	0.0018 *** (0.0003)
<i>Debt/Eq. Ratio</i>	-0.0089 (0.0054)	-0.2664 *** (0.0454)	-0.2834 *** (0.0386)
<i>Quick Ratio</i>	0.0563 (0.0604)	-0.0422 (0.0449)	-0.0484 (0.0464)
<i>Tot. Revenue</i>	0.2426 (0.0987)	0.4437 *** (0.1593)	0.6826 *** (0.2070)
<i>Tot. Assets</i>	-0.9012 *** (0.1056)	-0.8539 *** (0.1382)	-0.8195 *** (0.1830)
<i>Tot. Equity</i>	0.1386 *** (0.1081)	0.1650 (0.1245)	0.1503 (0.1372)

***, ** and * denote statistical significance at the 1, 5, and 10 % levels, respectively

Analyzing this new group of results, we start immediately by saying that it is possible to see a positive and strongly significant effect of ESG Score on business performance.

In particular with Pooled OLS Model the figure seems less significant, while with the other two models the result proves more reliable.

In general, Random and Fixed Effects show very similar results, presenting a negative effect of Debt/Equity Ratio and Total Assets on ROA. Also in this case, a significantly positive effect of Total Income on corporate profitability can be seen.

Table 4.5 - Financial Performance Regression (E, S and G Scores)

Dependent Variable: Return on Assets (ROA)			
Variables	Pooled OLS	Random Effects	Fixed Effects
<i>Constant</i>	-0.1988 (0.1471)	-0.2220 (0.1784)	-0.2157 *** (0.0798)
<i>E – Score</i>	0.1291 * (0.0720)	0.0086 (0.1003)	0.1291 (0.0999)
<i>S – Score</i>	-0.1269 (0.1004)	-0.0221 * (0.0131)	-0.0130 * (0.0078)
<i>G – Score</i>	0.1619 *** (0.0651)	0.0196 ** (0.0098)	0.1619 *** (0.0066)
<i>Debt/Eq. Ratio</i>	-0.0085 * (0.0044)	-0.2655 *** (0.0456)	-0.2821 *** (0.0471)
<i>Quick Ratio</i>	0.0560 (0.0600)	-0.0427 (0.0452)	-0.0485 (0.0469)
<i>Tot. Revenue</i>	0.2573 *** (0.0984)	0.4577 *** (0.1621)	0.6850 *** (0.2086)
<i>Tot. Assets</i>	-0.9180 *** (0.1124)	-0.8736 *** (0.1457)	-0.8307 *** (0.1938)
<i>Tot. Equity</i>	0.1477 (0.1133)	0.1648 (0.1256)	0.1509 (0.1381)

***, ** and * denote statistical significance at the 1, 5, and 10 % levels, respectively

Taking a look at Table 4.5 instead, it is possible to point out how the models give quite different results on the variables soot analysis.

In fact, in the estimations produced by the Pooled OLS model we see how the Governance Score and the Environmental Score have a positive effect on financial performance, effects that are only partially registered by the other two models, which instead show only a positive effect of the Governance Score, and unlike the Pooled OLS present a positive and significant effect of the Social Score. Instead, controlling for control variables, there continues to be a positive and significant effect of Total Revenue, and a detrimental effect on performance by the size of the company and its Debt/Equity Ratio.

4.4 – TESTS AND DIAGNOSTIC

After the presentation of the various outcomes obtained, we will focus on the diagnostics of the applied models. In fact, among the three methods used in the thesis, only one will emerge and will be taken as a reference model for the final considerations. This is because, understanding also the differences explained at the beginning of this chapter and of Chapter 4, these three methods are in some ways alternative to each other, or if not alternative, there will be in each case one model more reliable or more correct than the other.

The diagnostic analysis is done performing some tests, which will focus mainly on the residuals and coefficients produced by the various regressions.

In particular, in this case, two tests were applied: the Breusch-Pagan Test and the Hausman Test, with the accompaniment of some figures to the Breusch Pagan, which will provide a graphical demonstration of the test evidence.

These two tests are considered to be the main and necessary checks to be performed in a Panel Data Analysis (Torres-Reyna, 2007).

4.4.1 – BREUSCH-PAGAN TEST

To briefly explain the two measurements, let us start by considering the Breusch-Pagan Test.

The Breusch-Pagan test, also called the Breusch-Pagan Lagrange Multiplier, is a control measure proposed by Trevor Breusch and Adrian Pagan in 1979, derived mainly from the original Lagrange Multiplier model.

It is a test considered crucial in Panel Data Analysis, particularly for the Random Effects Model, as it goes to test whether it is possible to use the OLS model to estimate the coefficients of interest, and thus in our case to use the Pooled OLS Model.

The diagnostic model is based on the residuals derived from the OLS model and it test the null hypothesis that the variance of the individual effects, thus the entity-specific component of the composite error term is zero.

The Breusch-Pagan is a Chi-Square test, meaning that the t-test derived from the model follows a Chi-Square distribution with k degrees of freedom.

Once the test is performed, we are going to evaluate the p-value obtained; if the p-value is less than 0.05, then we are going to reject the null hypothesis of homoscedasticity, and thus it means it is assumed that our data exhibit heteroskedasticity, and therefore the variance of the errors is dependent on the independent variables.

If the null hypothesis is rejected, and thus heteroskedasticity is shown in the data, the OLS model cannot be applied, since by definition it assumes no dependence of the regression residuals on the independent variables.

The results are showed in Table 4.6.

Table 4.6 - Breusch Pagan Test

BREUSCH PAGAN LAGRANGE MULTIPLIER TESTS		
Regression	Value	P - Value
Risk Regression (ESG Score)	10.764	0.009
Risk Regression (E, S and G Scores)	18.543	0.009
Performance Regression (ESG Score)	55.860	< 0.001
Performance Regression (E, S and G Scores)	56.604	< 0.001

As we can see from Table 4.6, the test results seem to be quite clear. In fact, for all four equations, performed with a normal OLS Model in the test case, it can be seen that the p-value obtained is below the threshold of 0.05. Based on this, we therefore assume that data exhibit heteroskedasticity. Particularly in the financial performance regressions we note a p-value tending toward zero, which shows large heteroskedasticity among the data.

Concurring with this, the conclusion is that the Pooled OLS cannot be used as we would violate the constraints imposed by the model itself, and so we will then have to opt for Random Effects or Fixed Effects.

Homoskedasticity Test - Risk Pooled (ESG)

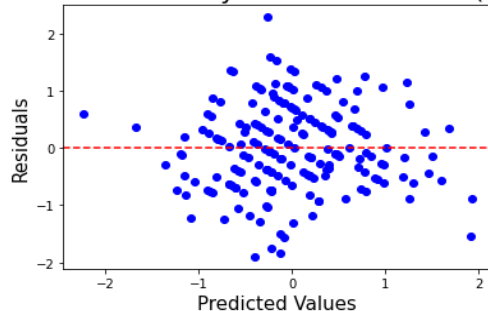


Figure 4.1

Homoskedasticity Test - Performance Pooled (ESG)

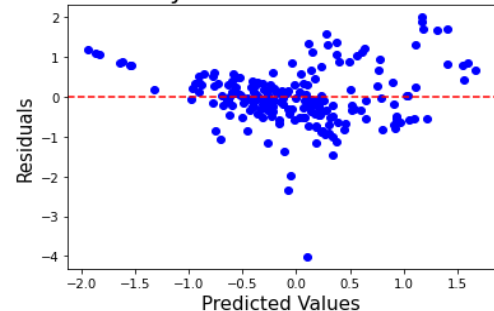


Figure 4.2

Two figures are also proposed above, showing the residue pattern of the Pooled OLS used.

It should be noted that the residuals obtained from the Pooled OLS are different from those used by the Breusch Pagan Test, since a simple OLS model was used for the test, which served only to do the checking.

From these figures, even though they may not have the same reliability as the test, it is notable that the data indeed exhibit heteroskedasticity. In particular, this is very clear in Figure 2, where the residuals follow a clear pattern, a symptom of heteroskedasticity.

All other figures, which show the graphical representation of the residuals of all the models used, will be proposed in the Appendix. It was chosen to show only these two in this section, as it is believed to be the most meaningful to analyze, since the other models, Random Effects and Fixed Effects, have no limitations in the case of heteroskedasticity and can therefore be used.

4.4.2 – HAUSMAN SPECIFICATION TEST

After analyzing the Breusch-Pagan Tests and pointing out the impossibility of using the Pooled OLS, there is another issue to be addressed.

Indeed, once the heteroskedasticity of the data used is established, it follows that there is a need to use models that do not impose homoskedasticity on the data, such as the other two models used in this study, Random Effects and Fixed Effects.

Here, however, arises the problem of checking which of the two methods is the best and most correct to use for our study.

In fact, the main difference between the two estimations, is that, although they may lead to similar results, Fixed Effects normally leads to more accurate results than Random Effects, but it has more variance in the estimated parameters, making it less efficient. On the other hand, on the other hand, Random Effects is more efficient but may estimate more biased coefficients.

This is precisely why we use the Hausman Test to decide which of the two models is the most suitable for this analysis.

In fact, the Durbin-Wu-Hausman Test, more simply called the Hausman Specification Test, or Hausman Test, basically test the consistency of the estimators of one model by comparing them with those obtained from another model that is considered less efficient but is nevertheless recognized as consistent.

The assumption under the null hypothesis will be $H_0: \beta_{RE} = \beta_{FE}$, instead under alternative hypothesis, the assumption will be $H_1: \beta_{RE} \neq \beta_{FE}$.

Thus, if the p-value of the result will be lower than the threshold of 0.05, the null hypothesis will be rejected and the Fixed Effect estimator will be used, as the Random Effects one will be considered as inconsistent. However, at the contrary, if H_0 will be accepted, the Random Effects model will be the one preferred, as it is the more efficient one.

The results are showed in Table 4.7.

Table 4.7 - Hausman Specification Test

HAUSMAN TESTS			
Regression	Chi-Square	Degree of Freedom	P - Value
Risk Regression (ESG Score)	10.764	13	0.6305
Risk Regression (E, S and G Scores)	6.756	12	0.8732
Performance Regression (ESG Score)	10.121	15	0.8120
Performance Regression (E, S and G Scores)	6.129	14	0.9631

As can be clearly seen from the results obtained in the table, all the p-values obtained are above the threshold of 0.05, and thus this leads us to accept the null hypothesis. This means that both the methods can be used, but we should rely on Random Effects Model, as it is assumed to be more efficient than the other.

4.5 – FINAL CONSIDERATIONS AND PROBLEMS

Taking into account the results obtained from the tests in the previous paragraph, the most suitable model for the application of the dataset in this research is the Random Effects Model. Given this, a small summary of the outcomes of the regressions will be made, this time considering only the chosen model.

4.5.1 – OVERALL ESG SCORE

One of the main objectives of the research, was to understand what impact the overall ESG Rating had on the performance and financial risk of the selected companies, using the Return on Assets and Credit Ratings of the different companies as independent variables and as an index for performance and risk.

Looking then at the estimates performed with the Random Effects Model, it can be noticed that the ESG Score has a clear and significant impact on company performance, although the effect shown is still relatively small.

No conclusions can be drawn about the other case, on the other hand, since no significant effect on business risk is detected.

Although no conclusions can be drawn from the empirical analysis on this last case, it can still be thought that corporate sustainability has some slightly positive effect on corporate risk as well, this is also by looking at the other studies on the subject analyzed (e.g. see Devalle et al., 2017; H. Li et al., 2022b; Sassen et al., 2016b)

The evidence obtained studying the impact of corporate sustainability on corporate performance, on the other hand, seems quite in line with the evidence found in the literature, going on to manifest a slightly positive effect of scores on profitability (e.g. see Aouadi & Marsat, 2018; Xie et al., 2019)

4.5.2 –E, S AND G COMPONENT SCORES

Referring to the same questions as for the overall ESG Score, an in-depth study was also made of the impact that individual components of the score have on the dependent variables of interest, and this is where the most interesting results were obtained.

In fact, analyzing the outcomes, Social Score is the only factor to have a clearly positive effect on Credit Ratings, distancing itself from the weak results obtained from the ESG Score on Credit Ratings and from the non-significative results obtained from the others two components, E and G. However, even though the effects of E and G Score are not significative, it's possible to notice a positive impact of Governance Score and a negative impact of Environmental Score on Credit Ratings, which is confirmed by all the models and that appear to be significative with Pooled OLS, but as we stated before, we cannot make any conclusion about OLS as it cannot be used in this analysis. The negative impact of Environmental component may be explained by substitute effect, which states that firms with high credit rating may neglect to invest in environmental issues. Anyway, these findings seem to be totally in line with the evidence recorded in the Literature, which draws the S-Score as the main factor to influence Credit Ratings along with a slightly negative impact of Environmental Score. (e.g. see Kim & Li, 2021; Ziegler et al., 2007).

In terms of the impact on financial performance, however, we surprisingly note a negative and significant effect of the Social Score on Return on Assets, followed instead by a significant positive effect of the Governance Score. The Environmental Score, on the other hand, turns out to be non-significant and therefore will not be commented.

This evidence seems to be in line with much research, which report the Governance Score as the main driver on an enhancement of financial performance among the three components (Kim & Li, 2021; T. T. Li et al., 2021).

We found also some confirmation about the negative impact of Social Score on corporate performance, in particular it seems there is a negative impact when the social performance is particularly high, probably because it is seen as unnecessary cost. (Ziegler et al., 2007).

4.5.3 – PROBLEMS AND CRITICAL REVIEW

Although all the steps that were conducted to develop the analysis in this thesis have been explained in detail, trying to maximize the reliability of the study through maximum transparency and specification of all manipulations implemented on the data, this study still has several limitations.

Starting with the data set, importing the data from Refinitiv Eikon into Excel, was a bit complex since each data type had different formats, hence for most of the surveys it was necessary to rewrite the data by hand and this may have been a reason for inaccuracy on some data.

In addition, the data set turned out to be a bit small comparing it with those collected from the analyzed literature, and this can lead to biased estimation. In particular, since the analysis was done with annual data over a seven-year period, for each variable only seven observations were available for each company. Moreover, the number of firms is also particularly limited, given the adjustments made at the beginning of the analysis, in which firms operating in the financial sector were cut out.

In addition, another main problem that may have had a large effect in the results obtained is the presence of outliers in the dataset, which could have been removed with the aim of obtaining more stable and mutually consistent data.

Considering control variables instead, it can be noticed they had different scales, which theoretically should not be a problem performing a regression, especially when data have been standardized, however it still turns out to be a problem that had to be manually addressed.

Taking individual variables into consideration, it is reported that the Quick Ratio was highly manipulated, as there was a lack of data for many companies. As was explained earlier, action was taken in the missing data by applying the average of the following data or those around the missing number. For some companies the calculation was done manually as there were no observations available for this measure.

This may have affected the final results in a considerable way. In fact, as can be seen from the outcomes tables, this measure is almost never significant, and this may have affected the overall result, since the Quick Ratio is considered an important measure of liquidity.

Even ESG Score had to be manually intervened for a few companies, as there were missing data. Again, the choice was made to average the following observations or those around the missing number. Since ESG Score was our main independent variable, these manipulations may have vitiated the outcomes obtained.

Another possible problem to point out is that related to the use of models. In fact, in several papers analyzed (e.g. see Aslan et al. 2021), since Credit Ratings and ESG Ratings are ordinal data, it was chosen to use a Ordered Logistic regression or Ordinary Least Square, which, according to the authors, seems to be the ideal model to deal with data which present this feature.

A final clarification to be made about the methodology used is the lack of a control for a firm fixed effect with Pooled OLS and Random Effects models, while these controls have been introduced for Fixed Effects Estimation.

In particular, it would seem more appropriate to apply a control for industry fixed effect for all 3 models.

The last problem to mention is that of heteroskedasticity. In fact, as it can be understood from the Breusch Pagan Test, the data analyzed had considerable heteroskedasticity, and this can still be considered a problem because this may mean that the regressions did not capture all possible relevant information to explain the dependent variable, even though in this study, models resistant to this characteristic were then chosen.

At the end, in addition to these technical problems, we would also like to point out that the time period considered for this thesis, has been highly affected by the pandemic that has hit the world in these recent years.

Although limited to only the last two or three years of the selected time period, this may have caused a lot of noise in the observations, particularly distancing the link between the growth of corporate sustainability in recent years and the profitability and risk measures of the companies, which were instead put to test during the pandemic.

CHAPTER V

CONCLUSION

5.1 – CONCLUSIVE DISCUSSION

In this paper, the main Italian companies, which are part of the FTSE MIB index, were analyzed, studying their account-based data for the past 7 years.

A Panel Data Analysis was conducted to determine whether corporate sustainability really has an impact on risk and financial performance from an accounting perspective.

To answer the research questions posed for this thesis, we can say that the evidence shows a positive impact of ESG practices on corporate profitability, in particular the Governance and Environmental components seem to be the main drivers of the profitability, while some doubts are detected about the Social component, particularly when it gets a high score, such that, in our analysis, it turns out to have a negative effect on ROA.

About the financial risk of the business, based on the evidence obtained from our study, there is no evidence of significant effects of ESG practices on the Credit Ratings of various companies. However, checking the different components of the score, there is a significant impact of Social Score in lowering corporate financial risk.

Focusing instead on another question raised at the beginning of the paper, that is whether there were any particular differences between Italian companies and those analyzed in the rest of the world, through this research it is really difficult to be able to express any opinion about it. However, it can be said that, unlike many other research studies, the evidence shows the absence of a significant impact of corporate sustainability on business risk, when in research involving companies in foreign countries, this effect is primarily reported.

However, the data and the analysis conducted do not give any other insight to comment on this issue.

5.2 – RECCOMANDATIONS AND FUTURE RESEARCH

This work, though mostly tracing other research done in this field, nonetheless finds definite utility, as there is a noticeable lack of such research on Italian companies. Moreover, the thesis tries to provide a comprehensive point of view by providing a fairly complete Panel Data Analysis, which includes three different models and compares them, obtaining results that can be compared with each other.

Also of interest may be the work done in building the database, mostly done manually making use of different company documents found on Refinitiv Eikon, which thus makes the data set used unique.

For future research in this field, we recommend expanding the dataset, trying to include more companies and extending the time period, so that more reliable results can be obtained.

In addition, an actual comparison between two datasets composed of companies from different countries, in this case for example Italy and another European country, which may have similar characteristics, may be interesting, with the aim of going to answer one of the curiosities posed above, so as to understand the status of development of corporate sustainability among companies from different countries and with the possibility of understanding how much sustainability is recognized and rewarded by bodies outside the company, such as the market, banking institutions, investors and the state, so as to understand how much the value given to these topics is advanced or not in a country.

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APPENDIX

1) POOLED OLS ESTIMATION – FINANCIAL RISK REGRESSIONS

Credit Rating ~ ESG Overall Score				
Variables	Parameter	St. Error	T - Stats	P - Value
Constant	0.0684	0.1393	0.4908	0.6241
ESG – Score	0.1115	0.0701	1.3896	0.1135
ROA	0.4133	0.0698	5.9188 ***	0.0001 ***
Debt/Eq. Ratio	-0.0385	0.0678	-0.5677	0.5709 ***
Quick Ratio	0.2582	0.0572	3.0007 ***	0.0030 ***
Tot. Revenue	-0.2284	0.0947	0.7116	0.4776
Size	-0.3157	0.1180	-2.6756 ***	0.0081 ***
Tot. Equity	0.3281	0.1026	3.1971 ***	0.0016 ***

Credit Rating ~ E, S and G Scores				
Variables	Parameter	St. Error	T - Stats	P - Value
Constant	0.1027	0.1399	0.7339	0.4639
E – Score	-0.2042	0.0949	-2.0515 **	0.0327 **
S – Score	0.1222	0.0954	1.2802	0.2020
G – Score	-0.0879	0.0627	-1.4023	0.1624
ROA	0.4324	0.0703	6.1477 ***	< 0.0001 ***
Debt/Eq. Ratio	-0.0529	0.0679	-1.7785 *	0.0769 *
Quick Ratio	-0.2611	0.0569	-0.9880	0.3244
Tot. Revenue	-0.2321	0.0948	-1.2474	0.1494
Size	-0.23430	0.1244	-1.8839 *	0.0611 *
Tot. Equity	0.2782	0.1077	2.5827 ***	0.0105 ***

2) POOLED OLS ESTIMATION – FINANCIAL PERFORMANCE REGRESSIONS

ROA ~ ESG Overall Score				
Variables	Parameter	St. Error	T - Stats	P - Value
Constant	-0.1713	0.1469	-1.1658	0.2451
ESG – Score	0.1237	0.0624	1.9799 **	0.0491 **
Debt/Eq. Ratio	-0.0089	0.0054	-1.6238	0.1060
Quick Ratio	0.0563	0.0604	0.9313	0.3528
Tot. Revenue	0.2426	0.0987	2.4591 ***	0.0148 ***
Size	-0.9012	0.1056	-8.5314 ***	< 0.0001 ***
Tot. Equity	0.1386	0.1081	1.2817	0.2015

ROA ~ E, S and G Scores				
Variables	Parameter	St. Error	T - Stats	P - Value
Constant	-0.1988	0.1471	-1.3512	0.1782
E – Score	0.1291	0.0720	1.7930 *	0.0745
S – Score	-0.1269	0.1004	-1.2635	0.2079
G – Score	0.1619	0.0651	2.4858 ***	0.0138
Debt/Eq. Ratio	-0.0085	0.0044	-1.9180 *	0.0566
Quick Ratio	0.0560	0.0600	0.9335	0.3517
Tot. Revenue	0.2573	0.0984	2.6151 ***	0.0096
Size	-0.9180	0.1124	-8.1706 ***	< 0.0001
Tot. Equity	0.1477	0.1133	1.3033	0.1940

3) RANDOM EFFECTS. ESTIMATION – FINANCIAL RISK REGRESSIONS

Credit Rating ~ ESG Overall Score				
Variables	Parameter	St. Error	T - Stats	P - Value
Constant	0.0289	0.1616	0.1786	0.8584
ESG – Score	0.0618	0.0868	0.7127	0.4769
ROA	0.1723	0.0858	2.0084 **	0.0460 **
Debt/Eq. Ratio	-0.0057	0.0028	-1.9761 **	0.0495 **
Quick Ratio	0.6932	0.8107	0.8550	0.0048
Tot. Revenue	0.0816	0.1718	0.4750	0.6353
Size	-0.7731	0.1641	-4.7120 ***	< 0.0001 ***
Tot. Equity	0.3646	0.1428	2.5529 ***	0.0114 ***

Credit Rating ~ E, S and G Scores				
Variables	Parameter	St. Error	T - Stats	P - Value
Constant	0.0427	0.1655	0.2580	0.7967
E – Score	-0.0915	0.1158	-0.7902	0.4304
S – Score	0.1273	0.0637	1.9959	0.0473 **
G – Score	0.0001	0.0476	0.0021	0.9983
ROA	0.1721	0.0861	1.9975 **	0.0472 **
Debt/Eq. Ratio	0.0025	0.0590	0.0428	0.9659
Quick Ratio	-0.0494	0.0541	-0.9140	0.3618
Tot. Revenue	-0.0878	0.1749	-0.5022	0.6161
Size	-0.7368	0.1721	-4.2821 ***	< 0.0001 ***
Tot. Equity	0.3537	0.1443	2.4515 ***	0.0151 ***

4) RANDOM EFFECTS ESTIMATION – FINANCIAL PERFORMANCE REGRESSIONS

ROA ~ ESG Overall Score				
Variables	Parameter	St. Error	T - Stats	P - Value
Constant	-0.2242	0.1725	-1.2997	0.1952
ESG – Score	0.0024	0.0008	2.8055 ***	0.0055 ***
Debt/Eq. Ratio	-0.2664	0.0454	-5.8686 ***	< 0.0001 ***
Quick Ratio	-0.0422	0.0449	-0.9387	0.3490
Tot. Revenue	0.4437	0.1593	2.7846 ***	0.0059 ***
Size	-0.8539	0.1382	-6.1783 ***	< 0.0001 ***
Tot. Equity	0.1650	0.1245	1.3251	0.1867

ROA ~ E, S and G Scores				
Variables	Parameter	St. Error	T - Stats	P - Value
Constant	-0.2220	0.1784	-1.2447	0.2147
E – Score	0.0086	0.1003	0.0860	0.9316
S – Score	-0.0221	0.0131	-1.6761 *	0.0953 *
G – Score	0.0196	0.0098	1.9889 **	0.0481 **
Debt/Eq. Ratio	-0.2655	0.0456	-5.8220 ***	< 0.0001
Quick Ratio	-0.0427	0.0452	-0.9454	0.3456
Tot. Revenue	0.4577	0.1621	2.8232 ***	0.0052
Size	-0.8736	0.1457	-5.9942 ***	< 0.0001
Tot. Equity	0.1648	0.1256	1.3120	0.1911

5) FIXED EFFECTS ESTIMATION – FINANCIAL RISK REGRESSIONS

Credit Rating ~ ESG Overall Score				
Variables	Parameter	St. Error	T - Stats	P - Value
Constant	-0.0296	0.0984	-0.3002	0.7643
ESG – Score	0.0677	0.0979	0.6920	0.4898
ROA	0.1134	0.0549	2.0619 **	0.0405 **
Debt/Eq. Ratio	-0.0244	0.0122	-1.9845 **	0.0486 **
Quick Ratio	0.0272	0.0277	0.9790	0.3288
Tot. Revenue	0.0914	0.2611	0.3499	0.7268
Size	-1.1664	0.2370	-4.9207 ***	< 0.0001 ***
Tot. Equity	0.3783	0.1680	2.2526 ***	0.0254***

Credit Rating ~ E, S and G Scores				
Variables	Parameter	St. Error	T - Stats	P - Value
Constant	-0.0159	0.0991	-0.1605	0.8727
E – Score	-0.1158	0.1330	-0.8706	0.3853
S – Score	0.1198	0.0908	1.3193	0.1886
G – Score	0.0386	0.0627	0.4804	0.6315
ROA	0.3141	0.0510	6.1477 ***	< 0.0001
Debt/Eq. Ratio	-0.0247	0.0053	-4.5880 ***	< 0.0001
Quick Ratio	-0.0194	0.0572	-0.3387	0.7352
Tot. Revenue	-0.1047	0.2618	-0.3999	0.6897
Size	-1.1477	0.2488	-4.6124 ***	< 0.0001
Tot. Equity	0.3741	0.1683	2.2219 **	0.0274

6) FIXED EFFECTS ESTIMATION – FINANCIAL PERFORMANCE REGRESSIONS

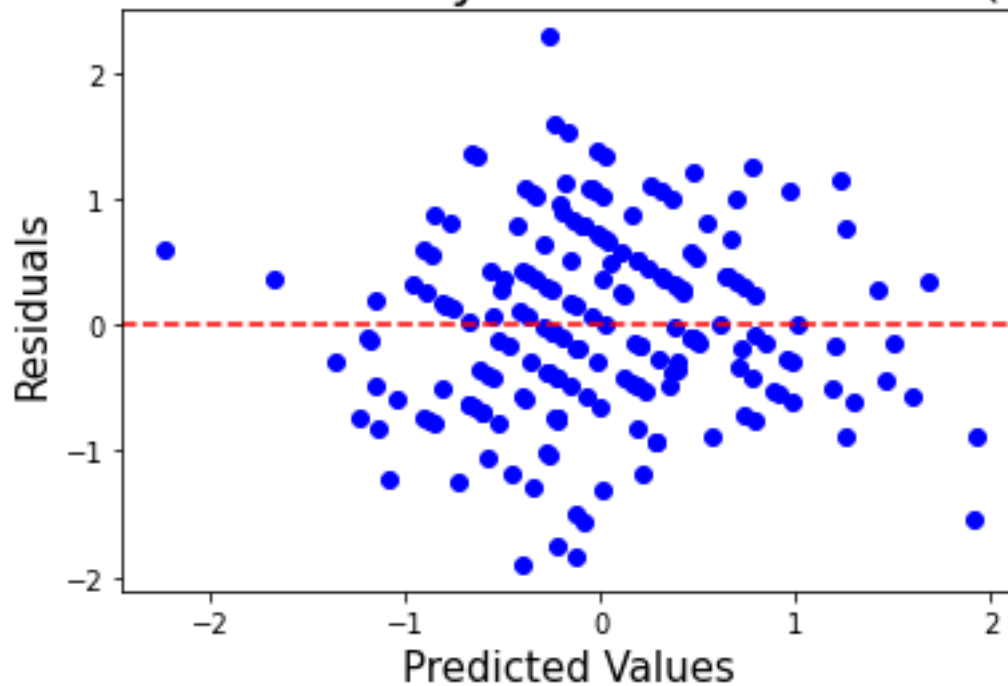
ROA ~ ESG Overall Score				
Variables	Parameter	St. Error	T - Stats	P - Value
Constant	-0.2192	0.0788	-2.7816 ***	0.0059 ***
ESG – Score	0.0018	0.0003	5.8691 ***	< 0.0001 ***
Debt/Eq. Ratio	-0.2834	0.0386	-6.0591 ***	< 0.0001 ***
Quick Ratio	-0.0484	0.0464	-1.0430	0.2982
Tot. Revenue	0.6826	0.2070	3.2971 ***	0.0012 ***
Size	-0.8195	0.1830	-4.4783 ***	< 0.0001 ***
Tot. Equity	0.1503	0.1372	1.0951	0.2748

ROA ~ E, S and G Scores				
Variables	Parameter	St. Error	T - Stats	P - Value
Constant	-0.2157	0.0798	-2.7017 ***	0.0075
E – Score	0.1291	0.0999	1.2930	0.1975
S – Score	-0.0130	0.0078	-1.6635 *	0.0978 *
G – Score	0.1619	0.0066	2.4243 ***	0.0162 ***
Debt/Eq. Ratio	-0.2821	0.0471	-5.9784 ***	< 0.0001 ***
Quick Ratio	-0.0485	0.0469	-1.0333	0.3029
Tot. Revenue	0.6850	0.2086	3.2827 ***	0.0012***
Size	-0.8307	0.1938	-4.2859 ***	< 0.0001 ***
Tot. Equity	0.1509	0.1381	1.0922	0.2761

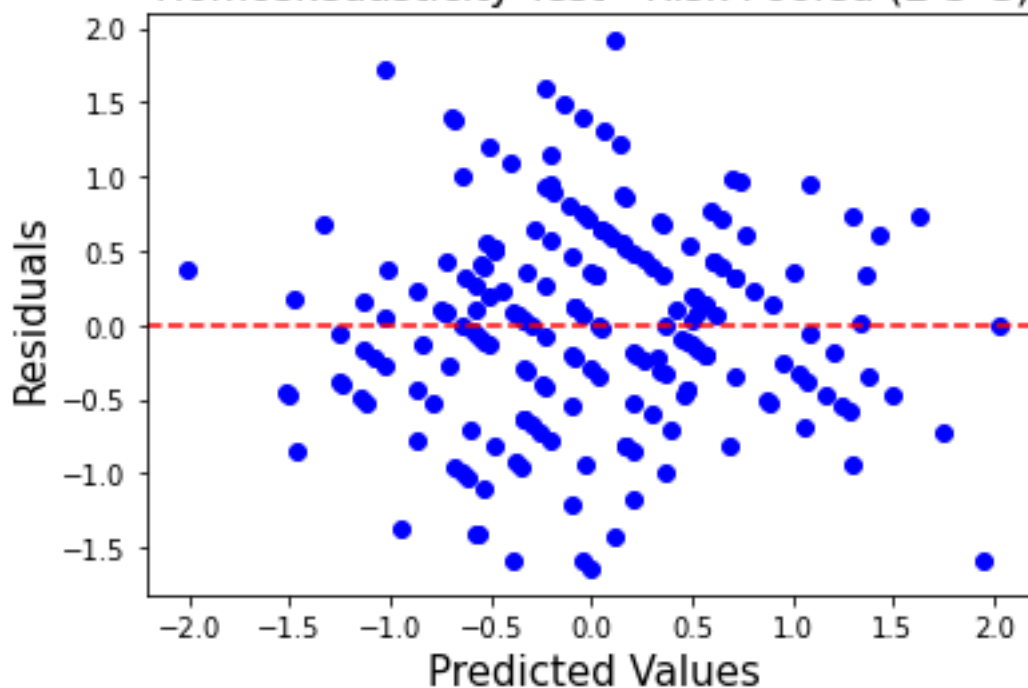
HOMOSKEDASTICITY SCATTER PLOTS

1) POOLED OLS ESTIMATION – FINANCIAL RISK REGRESSIONS

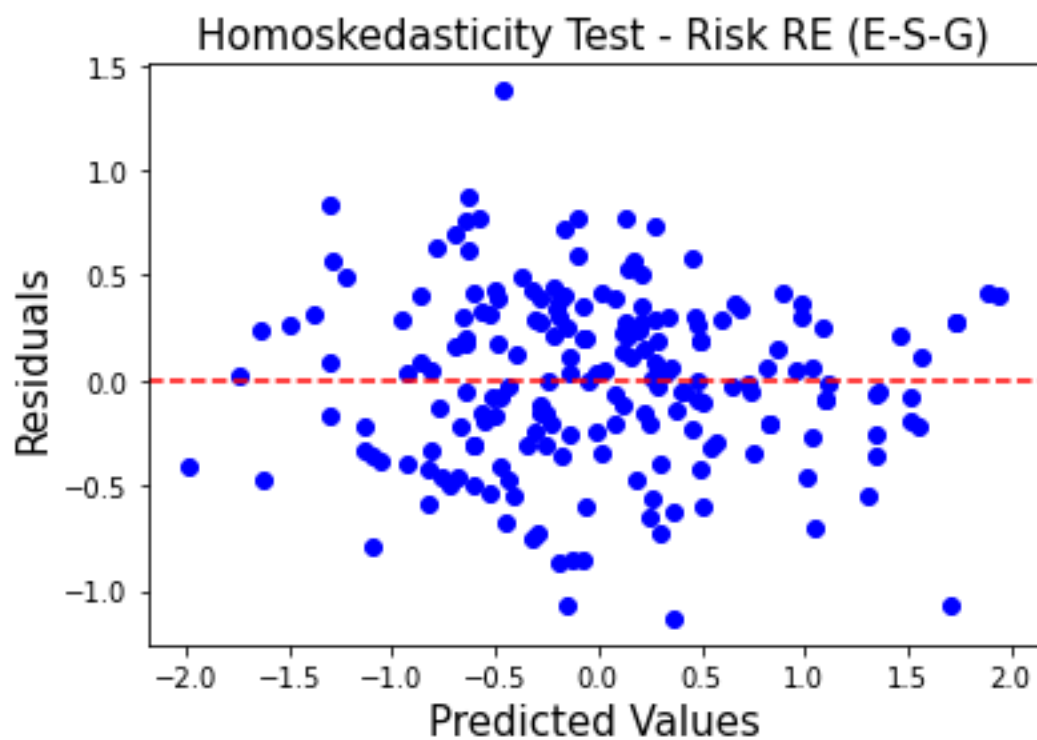
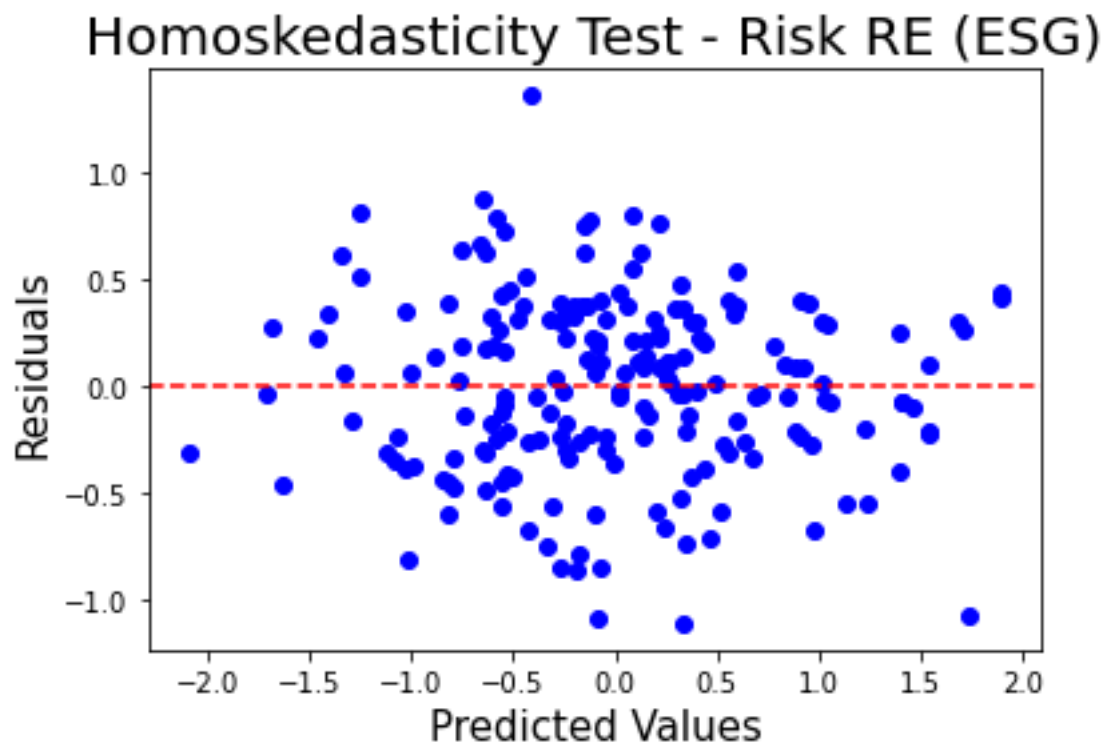
Homoskedasticity Test - Risk Pooled (ESG)



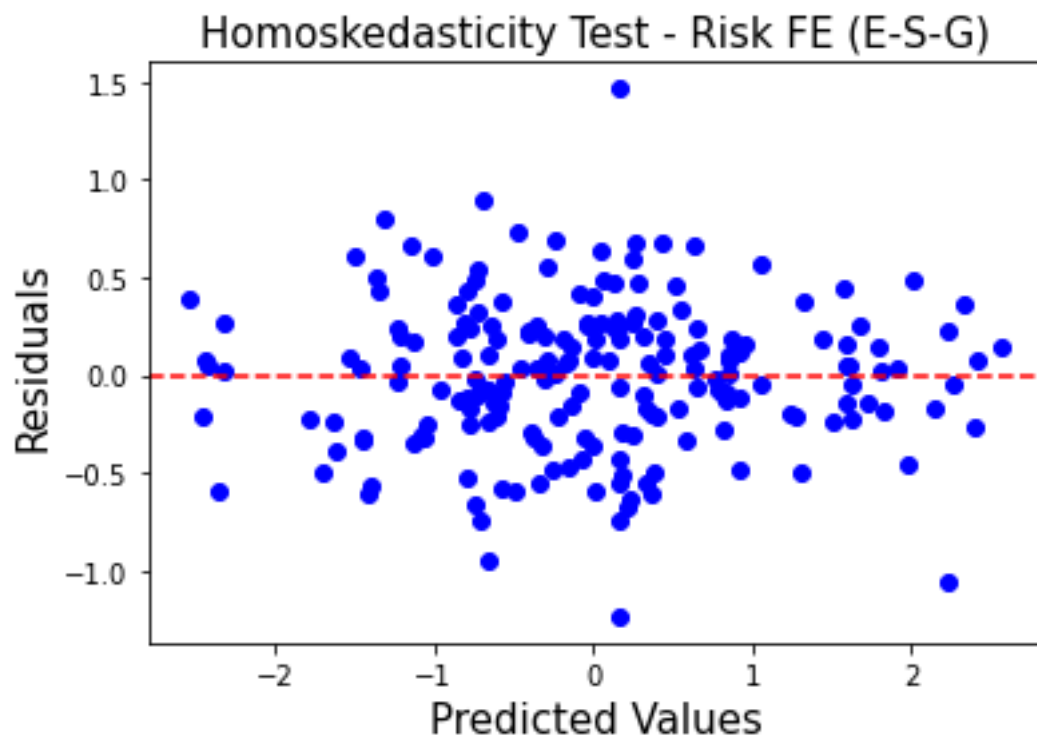
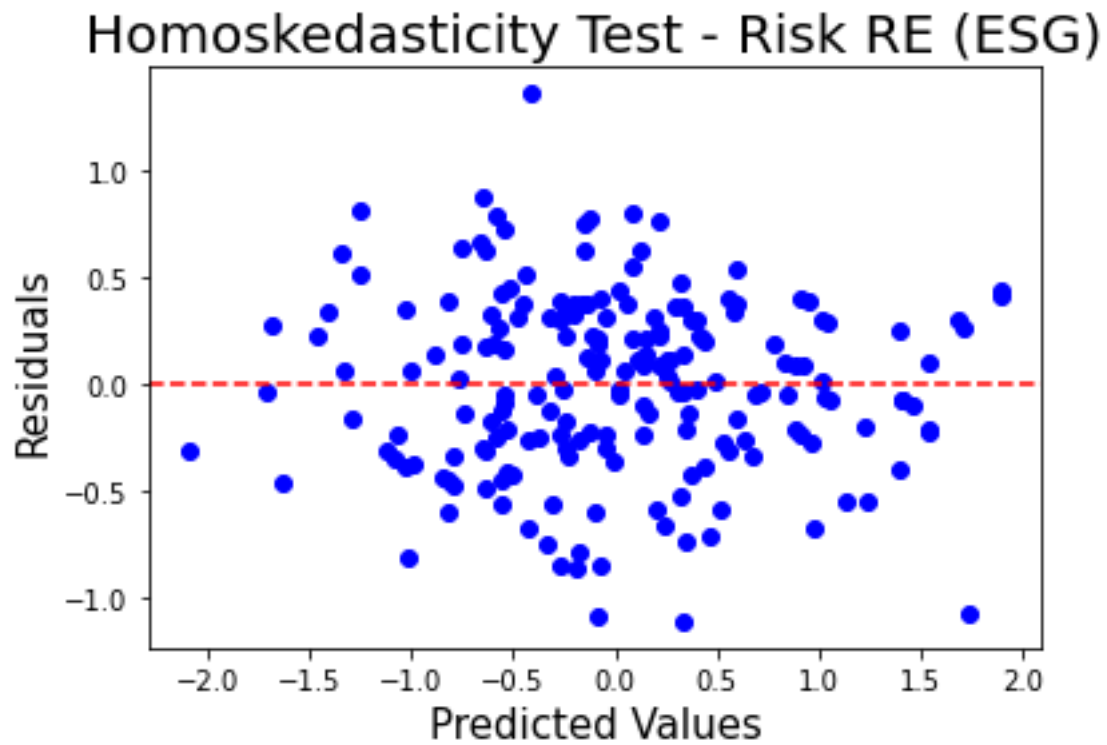
Homoskedasticity Test - Risk Pooled (E-S-G)



2) RANDOM EFFECTS ESTIMATION – FINANCIAL RISK REGRESSIONS

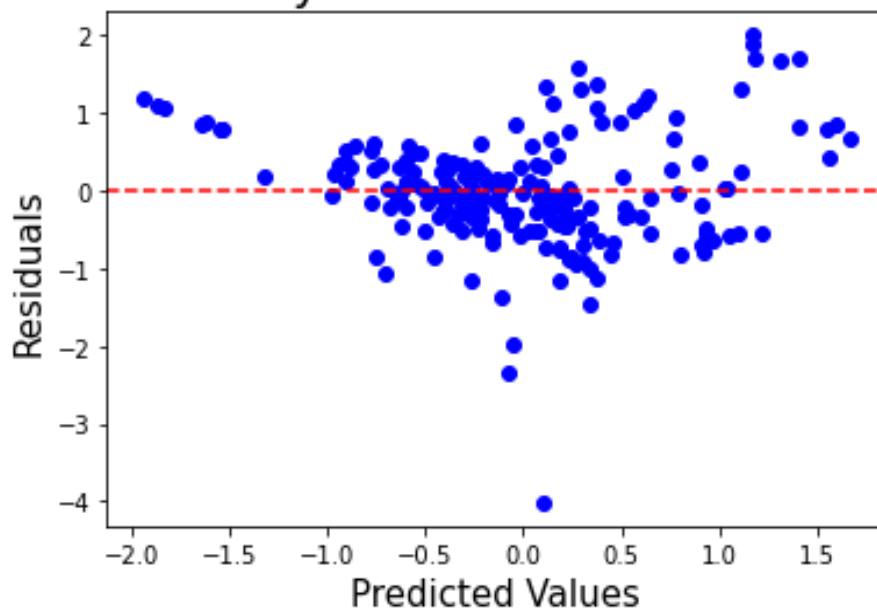


3) FIXED EFFECTS ESTIMATION – FINANCIAL RISK REGRESSIONS

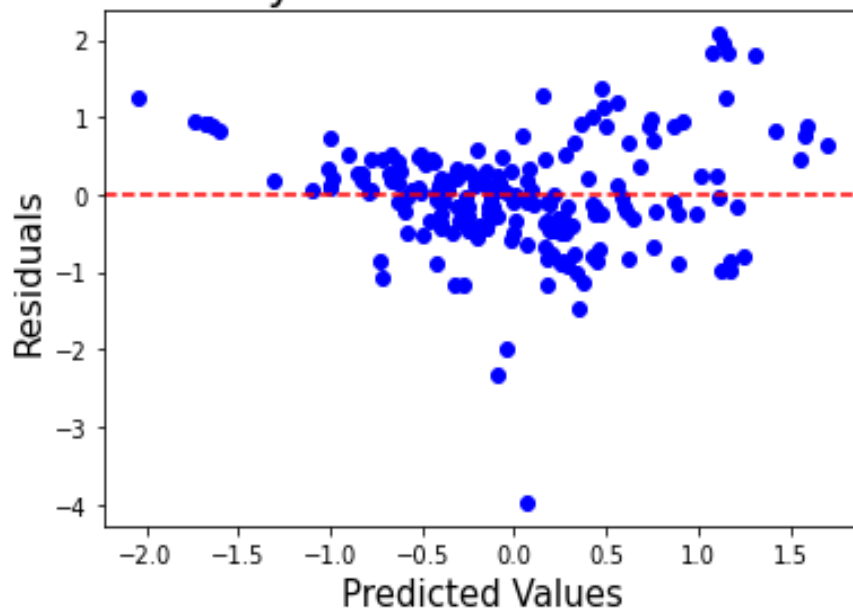


4) POOLED OLS ESTIMATION – FINANCIAL PERFORMANCE REGRESSIONS

Homoskedasticity Test - Performance Pooled (ESG)

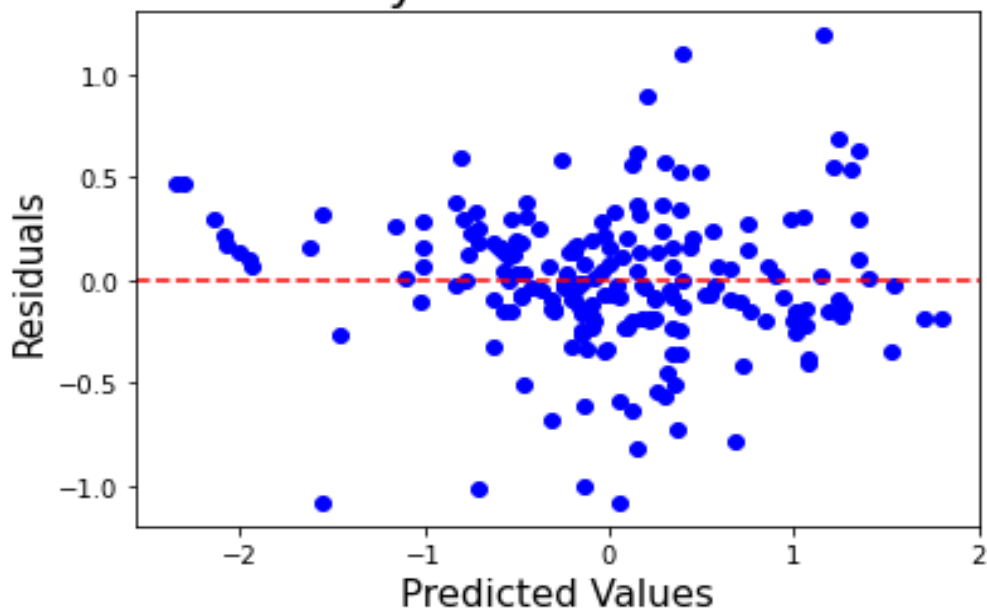


Homoskedasticity Test - Performance Pooled (E-S-G)

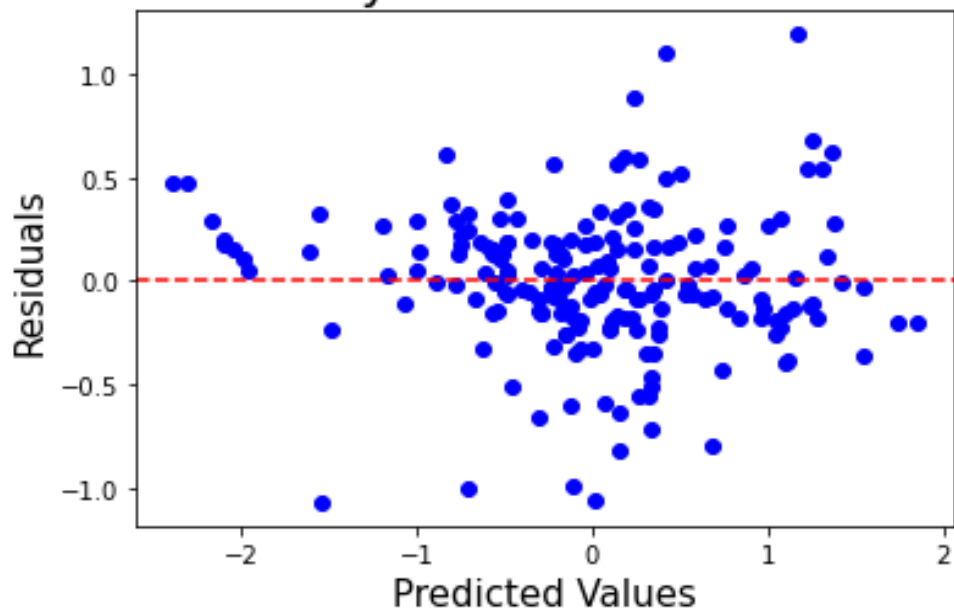


5) RANDOM EFFECTS ESTIMATION – FINANCIAL PERFORMANCE REGRESSIONS

Homoskedasticity Test - Performance RE (ESG)

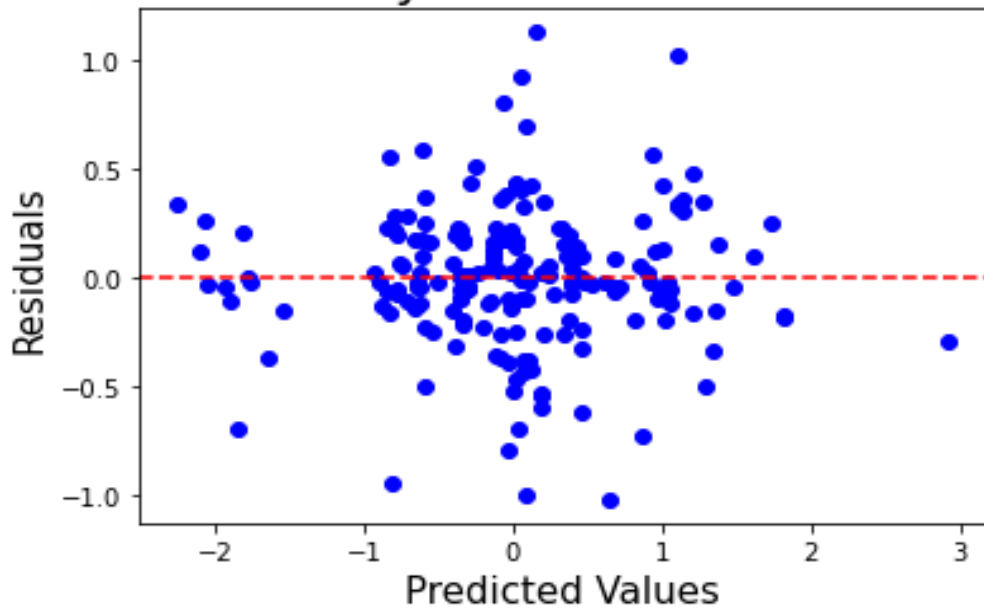


Homoskedasticity Test - Performance RE (E-S-G)



**6) FIXED EFFECTS ESTIMATION –
FINANCIAL PERFORMANCE REGRESSIONS**

Homoskedasticity Test - Performance FE (ESG)



Homoskedasticity Test - Performance FE (E-S-G)

