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The Impact of ESG Ratings on Default Probability
An Empirical Analysis on European Firms

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ABSTRACT

The purpose of this dissertation is to assess the impact of ESG Ratings on the default probability of European firms. In particular, the panel data analysis performed takes into consideration the relation between the CDS spreads of a sample of 181 European firms belonging to different sectors and the ESG Ratings assigned by one of the main international rating agencies (i.e. Refinitiv Eikon) to these companies.

The research is based on the ratings assigned by Refinitiv to the three ESG pillars (Environmental – Social – Governance) of a company and, more specifically, to their components (Emissions Score, Human Rights Score, Management Score etc.). Moreover, it has been studied the impact that the subscription of the "Paris Agreement on Climate Change" in 2015 had on ESG and CDS data and on the perception of investors towards ESG themes and sustainable finance. In fact, in the last decades, the increase of environmental and social concerns, caused by the continuously worsening situation of climate change, have pervaded also the financial and economic systems threatened by further risks. Hence, more and more frequently, companies are evaluated considering environmental, social and governance (ESG) factors rather than looking only at their financial metrics. By doing so, investors are willing to finance long term investments in sustainable economic activities and projects conducted by companies aiming to create a positive impact.

The analysis performed suggests that increasing ESG Ratings have a negative impact on the probability of default of European firms, which should focus in particular on the social and environmental aspects, while the governance performance does not seem to play a clear role in the dispute.

TABLE OF CONTENTS

INTRODUCTION

In recent years, the importance of sustainable aspects of investments has gained increased importance in financial markets, impacting decisively the creditworthiness of companies. But do markets really incorporate firms' ESG choices and characteristics? If so, which of them have the greater weight? The scope of this dissertation is to try to answer to these questions using Credit Default Swaps (CDS) spreads, which are considered a strong indicator of default probability and credit risk, analysing whether European credit market reflects the firm's choices in terms of environmental, social and governance sustainability.

In the first chapter the main concepts at the core of sustainable finance are presented, with the aim to clarify the main differences between the various definitions and sustainable investment styles. Moreover, in the introductory chapter, the financial and non-financial reasons - that should encourage investors to apply sustainable investment strategies - are discussed. Assuming a purely financial perspective, investors should consider that extensive academic research demonstrates that strong corporate performance on ESG factors is positively correlated with superior financial performance and better financing conditions. On the other hand, an increasing number of institutional investors is considering the environmental performance of a corporation as a core factor of the investment decision, combining the pure financial metrics with the non-financial performance. The importance of ESG themes in the current economic framework will be discussed also from the political perspective presenting how European authorities, leaded by the European Commission, are facing them and which measures are putting in place.

The second chapter is focused on the key player of the dissertation, the ESG ratings provided by the main ESG rating agencies (i.e. Refinitiv Eikon, RobecoSAM, MSCI ESG Research Unit). Moreover, it explores the rating framework and the impact that these judgements could have on the investors. This introduction to the ESG rating context is followed by the discussion of the main criticalities, starting from the divergence of methodologies for the production of the ESG judgements, up to the rampant diffusion of greenwashing which has become a common practice among companies at worldwide level. As global consumers are increasingly willing to pay for

environmental-friendly products, all the multinational corporations are adopting green marketing strategies to show them how socially responsible their products are, even if, in many cases, reality is far from advertising. This attitude has been adopted also by a number of funds across Europe which rebrand themselves promoting their fictitious positive attitude towards sustainable investments, in order to meet the increased demand for sustainable investments.

The third chapter summarizes part of the existing academic literature on the relationship between the ESG characteristics and firms' credit and firm risks. The main relations reviewed, besides the one at the core of this dissertation between ESG and credit risk, are those between ESG and cost of capital, between the environmental performance and between the cost of debt and corporate governance. In addition, there is a focus on the role that ESG rating agencies have and on the impact of ESG factors on credit rating actions.

Finally, the fourth and last chapter is devoted to the core of the thesis, the empirical analysis on the selected sample of European firms. The panel data analysis is performed on the period between 2010 and 2019, in order to avoid the effects on the credit market of the Great Financial Crisis before 2008 and of the COVID-19 Pandemic after 2019, which could have not been covered also due to a lack of data. The hypothesis tested is whether ESG factors affect the market-implied probability of default of a firm and so its credit risk. In particular, the aim is to understand which specific factors affect the probability of default of a company and the magnitude of their effects compared to other common variables of interest. At the end, in order to understand how these effects have evolved in the last decade, is investigated also the effect produced by the ratification of the "Paris Agreement on Climate Change" on the credit market after its adoption on 12th December 2015.

CHAPTER 1

1. ESG AND RESPONSIBLE INVESTING

In the last decades, the increase of environmental and social concerns, caused by the continuously worsening situation of climate change and by the widespread plague of labour exploitation, has pervaded the financial and economic systems. Several countries and sovereign organizations are putting more and more attention on the importance that a change in how the themes of social and ecological transition are threated and the same is being done by financial and economic institutions willing to satisfy the preferences of the investors towards these types of sustainable investments. For these reasons, during the investment process, more and more frequently companies and countries are evaluated considering environmental, social and governance (ESG) factors rather than looking only at the financial metrics. By doing so, investors are willing to finance long term investments in sustainable economic activities and projects conducted by companies aiming to create a positive impact.

Despite the recent increased interest for sustainable finance issues, this way of investing has deep roots in the past. Since the 18th century, some people in the United States, such as the Christian Methodists, avoided investments in companies producing liquor or tobacco products or promoting gambling. Until the second half of the 19th century, the religious purpose was the first reason when eschewing specific types of investments, but with the first movements fighting for more civil rights or putting more attention on environmental issues such as global warming, socially responsible investing became more popular and widespread in the society. A significant event in this process is represented by the protests in the United States against the Vietnam War in the 1960s, when in particular the students asked university endowment funds to avoid investments in the defence industry. Later on, socially responsible investing played a crucial role also in ending the apartheid regime in South Africa. Between 1970s and 1990s, a lot of international companies avoided investments in the country causing a huge negative flow which forced a group of businesses to draft a charter calling for the end of the of

the apartheid system. Of course, socially responsible investing was not the only cause of the end of this system of racial segregation but has allowed to put a strong pressure on the South African economic system.

In the last years, the market for socially responsible investments has grown both in Europe and in the United States, becoming one of the most popular investment themes among investors. In order to support this type of investments and to favour the transition to a low-carbon and more sustainable economy, the European Union has recently put in place a series of measures aimed at developing a financial system that supports sustainable growth. On 11th December 2019, the European Commission has presented the European Green Deal with the aim of making Europe the first climate-neutral continent by 2050. Moreover, as part of this programme, the Commission has implemented the European green deal investment plan with which at least 1 trillion Euro of sustainable investments over the next decade is expected to be mobilised. A similar responsibility has been assumed by the American government in 2021 by re-joining the Paris Agreement and favouring the development of the green economy with the creation of new jobs and the conversion of the workers employed in non-sustainable sectors. A concrete commitment towards socially responsible investing has been recently remarked also by the largest sovereign wealth fund in the world, the Norwegian Sovereign Pension Fund, whose investment strategy is constrained to companies which do not contribute to unethical acts or omissions, such as violations of human rights, environmental damages or corruption and tax opaqueness.

Despite the huge public commitment, this challenge is far beyond the capacity of the public sector alone, for this reason the financial sector plays a crucial role in order to address the investments towards more sustainable and resource-efficient businesses, provide capital in a sustainable manner over the long-term and take part in the creation of a low-carbon, climate resilient and circular economy.

With regards to the pure investing activity, the consideration of ESG factors is not a recent innovation, in fact these issues have been long considered by investors looking at reputational risks, regulatory developments and to the main megatrends. The fact is that investors do not consider ESG issues for a univocal reason. Some look at them only as a source of economic value, considering only the connected economic risks and opportunities pursuing a value-based ESG approach, meanwhile others see them as a matter of moral values and so are more attached to a values-based approach . The first

may not be interested in the moral aspect of the dispute and only incorporate ESG considerations as a complement to the traditional financial analysis. Amongst the latter, instead, there may be people trying to actively make a positive impact on the society and on the environment, or simply to avoid supporting businesses going in the opposite direction.

1.1 The ESG acronym

The definition of Environmental, Social and Corporate Governance (ESG) is very broad and refers to the three main sustainability and societal impact factors considered when analysing an investment in a company or a business. The availability of nonfinancial information on these three metrics, allows the investors to integrate them in the investment process in stocks or bonds. Even if there is not a strong consensus on the exact list of issues that affect the creation of value by a firm, there is a widespread conviction that well-functioning and well governed social, environmental and economic systems are able to generate long-term sustainable returns. A common global framework identified by the global community to address the most urgent global problems is the UN Sustainable Development Goals (SDGs), considered by world businesses and governments as a *"blueprint to achieve a better and more sustainable future for all".* As a confirmation of the widespread global commitment, MSCI reported that between 2010 and 2019 governments and regulatory authorities all over the world have enacted about 600 ESG-related standards.

Hereafter, the three ESG factors will be described highlighting the main issues connected.

1.1.1 *The "E" – The Environmental factor*

The *"E"* represents the so called first pillar, the *Environmental* factor. It describes the impact that a company or a public entity has on the natural ecosystem throughout greenhouse gas emissions, the efficient use of natural resources in the production process in terms of waste management, water management and energy efficiency and the innovation efforts to eco design its products. In recent times, thanks to the continuous and renewed efforts to tackle climate changes, the reduction of emissions and decarbonization are becoming more and more important when analysing the activities of a company. Considered the increasing frequency of extreme climate events

and the growth of temperatures affecting the natural ecosystem and also daily life, in 2019 the World Economic Forum has identified as the top three risks the "extreme weather events", the "failure of climate-change mitigation and adaptation" and the "natural disasters". Moreover, the Intergovernmental Panel on Climate Change (IPCC) forecasts that continued growth in emissions in line with historical rates could lead, between 2030 and 2052, to a further 1.5°C earth's warming relative to pre-industrial levels (IPCC 2020)[1]. These events do not only represent a danger for the natural ecosystem itself, but pose a significant direct physical threat to properties, lands and infrastructures. These problems have been underlined also by the policymakers, such as in the case of Mark Carney[2], the last governor of the Bank of England, who have expressed concern for the link between climate change and risk in financial market stability. For these reasons, an increasing number of individual and professional investors is screening their investments in terms of their impact on the perceived factors of climate change.

All the discussion about these topics is connected to the broader field of climate finance, in which few studies have been currently made as reported in 2020 by Hong, Karolyi and Scheinkman (2020), who have observed that only few financial economists have done research on topics such as the linkage between national, or transnational, financing and climate change. Between the most influential and recent researches there is the working paper by Bolton and Kacperczyk (2019) who observed that investors are already demanding a compensation for their exposure to carbon emission risk. In particular, they concluded that, among US listed companies, there is a positive and statistically significant effect of CO_2 emissions on firms' stock returns. With regards to institutional investors, Krueger, Sautner and Starks (2020) surveyed the perception of more than 400 large institutional investors on climate related issues and found out that they seem to be in the early stages of incorporating climate risks into their investment processes. This may be due to the fact that most of the times the perception of the price of overvaluations of carbon-related risks is still relatively small.

[1] https://www.ipcc.ch/sr15/chapter/chapter-1/
[2] https://www.imf.org/external/pubs/ft/fandd/2021/09/mark-carney-net-zero-climate-change.htm

1.1.2 *The "S" – The Social factor*

The *"S"* represents the second pillar, the *Social* dimension. It covers the relations that a company entertains with its workforce, costumers and, in general, with the society, and includes the efforts accomplished to maintain a high employment quality, health and safety, to satisfy customers and being a good operator in the communities where it operates. It is a reflection of the company's reputation and the health of its license to operate, which are key factors in determining its ability to generate long-term shareholder value.

In order to give prominence to this aspect of sustainability, the European Commission has recently issued an updated taxonomy for the social factor. This report takes as references the Universal Declaration of Human Rights, the International Declaration on Labour, the Guidelines for Businesses and Human Rights and the OECD Guidelines for Multinational Enterprises. Even more after the COVID-19 pandemics, which has driven about one hundred million people in conditions of extreme poverty, the international organisations and governments should invest and do more in order to reach the objectives shared in the United Nations 2030 Agenda for Sustainable Development. In this perspective, more and more institutional stakeholders are giving higher priority to the social elements which are closely related to the environmental ones.

The effect of social issues is not confined to the reputation of the company and can severely hurt its profitability. So focusing on these topics, a company can increase profits and corporate responsibility both in the short and, most importantly, in the long term. A research[3] made in 2019 has shown that investors who take into consideration social factors are more protected in the long term by the fact that high social standards could reduce the systematic risk of a company. This evidence highlights how these factors have an important role also in risk management, allowing companies with high social standards to react more robustly to adverse contingencies such as inflation or economic weakness. It is also proved that social factors enhance revenue generation through a better understanding of customer's needs, supporting diversity and elevating workforce productivity. This evidence is confirmed by several studies, such as the one by Albuquerque, Koskinen and Zhang (2018) which provide empirical evidence of the fact that a higher corporate social responsibility decreases systematic risk and increase

[3] https://deutschewealth.com/content/dam/deutschewealth/cio-perspectives/cio-special-assets/s-in-esg/CIO%20Special%20-%20The%20S%20in%20ESG.pdf

firm value. In fact, has been observed that the market tends to reward with lower volatility companies that tend to dissociate their name from the sale of controversial products or that do not rely upon materials from geopolitical hot spots.

1.1.3 *The "G" – The Governance factor*

The *"G"* represents the third pillar, the *Governance* dimension. It refers to the set of rules and principles that define the rights, responsibilities and expectations between different stakeholders in a company, including the board of directors, managers and shareholders. A well-defined system of governance can equalize the interests of difference stakeholders and may be an instrument to support the generation of shareholder value in the long-term. A research by S&P Global[4] has found out that governance characteristics below the average lead to mismanagement and put at risk the ability of the company to capitalize on business opportunities over time. Also for this reason, in August 2019 a roundtable of over 180 CEOs of major international corporations agreed upon the fact that companies should provide benefits to customers, employees and communities while creating value for shareholders. Between the most relevant issues in the field, stressed also by institutional shareholders, there are gender diversity and equity, with the requirement of a better representation of women in corporate boards, equal compensations and mobility. This factor is crucial also in the evaluation of the system of government of a country which is as much as important as the governance structure of a private company.

Governance issues are probably the most relevant not only in recent years but in the whole economic history across different companies and sectors and this confirms the importance that they have for the investors. In fact, the first studies on this topic date back to 1776 in *"The Wealth of Nations"* by Adam Smith where, for example, the joint-stock company was criticized with the argument that when the firm's managers are distinct from its owners, they may not have the right incentives to maximize firm value. More recently, Shleifer and Vishny (1997) have observed around the world the effects of agency costs and different corporate governance systems related to the levels of legal protection of investor rights. In their study they have observed that concentrated ownership is a way to help investors "get their money back", but large shareholders may

[4] https://www.spglobal.com/en/research-insights/articles/what-is-the-g-in-esg

also seek to move wealth from small shareholders to themselves. Another influential article by Gompers, Ishii and Metrick (2003) analyses, from an investor point of view, the effects of different corporate governance characteristics of US firms on the value of equity. The authors created a governance index (G-index) based on the number of provisions that restrict shareholders rights and found that for more than one thousand S&P firms those with higher G-index values, so poorer governance, realized lower average returns. Further, they have identified a positive relation between shareholder-friendly governance and Tobin's *q* ratios, so to higher G-index values corresponds a higher firm valuation.

1.1.4 *Impact investing, Socially Responsible Investing or ESG investing?*

Despite the growing popularity gained by Responsible Investing over the last two decades, it is still very difficult to provide a unique and precise definition of this investing style. The inhomogeneity and inconsistency of terminology and nomenclature is one of the main issues in the approach with research covering ESG. A study on this issue has been made by Meuer et al. (2019) who found 33 different definitions of corporate sustainability currently in use. For this reason, the market need for greater transparency and standardization on sustainable investments contrasts with an underlying lack of data and not homogeneous international definitions and regulations. Consequently, it is almost impossible for investors to compare ESG credentials and data according to different reporting standards.

According to Mansley and Bright (2000), a Responsible Investment can be broadly defined as *"An investment where social, ethical or environmental factors are taken into account in the selection, retention and realization of investment and the responsible use of the rights that are attached to such investment"*. In the existing literature, Responsible Investing is often used as a synonym of the three investing categories by which is composed: Impact Investing, Socially Responsible Investing and ESG Investing that, however, differ on their purposes.

Impact investing is the subset of Responsible Investing that has seen the fastest growth in recent periods. By adopting this strategy, the investor wants to have a positive impact both socially and environmentally, without neglecting the financial return of the investment. Several governments encourage this form of investing, helping the investors

in ways that reduce the risk of their investment and maintain an adequate financial return.

The second subset of Responsible Investing is the so called *Socially Responsible Investing*, or SRI. In a paper by Scholtens (2014), Socially Responsible Investing is defined as an equivalent phrase for Responsible Investing. SRI is commonly defined as an investment strategy aiming at integrating non-financial factors into the investment decision-making process or in the construction of portfolios. Investors committing to this investment strategy, which has been defined as a *"mix of money and morality"*, are interested not only in their financial reward, but also want to make a positive impact on the surrounding community and environment. The focus of this investing style is more focused on ethical issues, in fact, generally, socially responsible investors tend to avoid industries such as Tobacco, Alcohol and Gambling due to their negative social reputation. The ultimate purpose of this way of investing is to maximize financial and social well-being for the investor and the underlying corporation with special attention to environmental issues, corporate scandals and humanitarian crises. One of the main authorities in the field of sustainable investments, the Global Sustainable Investment Alliance, affirms that the term "socially responsible investing" may be used interchangeably with "sustainable investing" and "responsible investing".

The third category is *ESG Investing*, which is the focus of this thesis. Although ESG Investing is generally interpreted as the same as Socially Responsible Investing, it is an independent strategy. ESG Investing consists in the integration of the Environmental, Social and Governance factors into the fundamental investment analysis, with the aim of improving the financial performance of a portfolio coherent with the values of the investor. The integration of these factors into the investment analysis is a key step also of Sustainable and Responsible Investing, with the specificity that the aim of ESG Investing is to manage risk and generate sustainable, long-term financial returns.

1.1.5 *Financial reasons for* R*esponsible* I*nvesting*

One of the main financial reasons in support of the ESG investing argument is that extensive academic research shows that strong corporate performance on ESG factors is positively correlated with superior financial performance and better financing conditions. An aggregate analysis of more than 2000 empirical studies over three

decades by Friede et al. (2015) shows a positive correlation between the inclusion of ESG factors in investing and financial performance in 62.6% of the studies and a nonnegative relation between ESG and corporate financial performance in approximately 90% of the studies. Moreover, this meta-analysis found out that the positive empiric results are consistent across various approaches, regions, in particular for North America and Emerging Markets, and asset classes, confirming the evidence in favour of ESG investing. A similar analysis[5] on more than 1000 research papers has been made by the NYU Stern Centre for Sustainable Business which focused on corporate financial performance and investment performance. The research shows a positive relationship between ESG and financial performance for 58% of the studies focused on operational metrics such as ROE, ROA or stock price with 13% showing neutral impact and only 8% showing a negative relationship. When risk-adjusted financial measures are considered, such as the Sharpe ratio or the alpha of a portfolio of stocks, 59% showed similar or better performance compared to conventional investment strategies and only 14% showed negative results.

A further argument is given by the fact that, nowadays, the worth of a company is not represented only by its assets or products, but also by its reputation and other factors closely related to ESG. This exposes companies and investors to collapses of value due to events regarding high-profile problems and imposes to investors to consider sustainability and ESG information into the investment process. This is confirmed in the study by Unruh et al. (2016) which shows that nearly 75 percent of investors consider improved sustainability-related revenues and operational efficiency as strong reasons to invest in a company. Moreover, increasingly investors adopting long-term investment strategies consider ESG factors, allowing companies to develop sustainable development strategies in the long term without having to concentrate on short term results.

The study by Cheema-Fox et al. (2020) concentrated on the initial stock market reaction to the COVID-19 pandemics and found out that companies with higher scores on Human Capital, Supply Chain and Products and Services ESG sentiment were associated with 1.4-2.7% higher stock returns. That would confirm that ESG investing seems to provide downside protection especially during periods of social and

[5]https://www.stern.nyu.edu/sites/default/files/assets/documents/NYU-RAM_ESG-Paper_2021%20Rev_0.pdf

environmental crisis, as observed by Chatterjee (2018) who found out that, in periods of economic downturn, high rated ESG mutual funds outperformed low rated funds based on the Sharpe ratio.

With the increased social relevance of environmental and social issues, more and more public companies feel the pressure by their competitors that have already improved the sustainability of their business strategies. The same is true also for an increasing number of investment funds that, in order to attract customers and stay competitive in the industry, add socially responsible investments to their portfolios. During the last year, in particular following the Paris Agreement on climate change, policymakers have developed regulations to incentivize and facilitate the implementation of sustainable strategies and have influenced also non-governmental organizations, such as CSR Europe or the Global Initiative for Sustainable Ratings, which provide knowledge and capacities for ESG guidance, analysis and reporting. Moreover, the main world governments are incentivizing investments to undertake the transition to a low-carbon world's economy, reducing greenhouse gas levels and reverse the climate change path. The estimates of the European Commission forecast the need of a 2.8% increase of private energy and infrastructure investments to reduce to zero the EU net greenhouse emissions by 2050. The same is valid for the United States, where a research conducted by 13 federal agencies, predicts that climate change effects can hurt the US economy with a contraction of 10% by the end of the century. Investors know that the huge economic efforts of the main world's governments will move great amounts of investments towards companies with sustainable business models or that operate in the field of alternative and renewable sources of energy and may strive to take advantage of this trend.

All that is favoured by the growing desire of investors, in particular belonging to the millennial generation, to align their investments to their ethical values, without compromising the performance aspect. For this reason, corporations and fund managers are focusing more on environmental and socially friendly investment, reducing their exposures to carbon-intensive activities.

1.1.6 *Non-financial reasons for* R*esponsible* I*nvesting*

As already shown, non-financial disclosure is becoming more important both for small and large investors, in particular for what regards environmental, social and governance behavior. A research made by Mackenzie et al. (2013) has identified which factors push investors to have a propensity for sustainable businesses, finding that pressure groups, regulations, the organization's competitive position and the dialogue with stakeholders play an important role in their investment choices.

A survey made by Ernst & Young canvassed the opinion of 163 institutional investors from organizations with assets under management of over $10 billion, including portfolio managers, equity analysts, chief investment officers and managing directors, and found out that the main three non-financial reasons to avoid an investment are the lack of a clear strategy to create value in the short, medium and long term, a company history of poor governance and a risk or history of poor environmental performance. The first motivation has been detected as the most important by the investors, so much that 93.8% of the surveyed ranked the "concentration of a company only on the past performance without a gaze on the future" as the first reason for rejecting a deal. In fact, while looking at past performance can help potential investors to judge risks, it does not give any helpful information about the plans of a company for the future value creation. The second reason takes into consideration the governance structures and process of a company, since an inadequate governance is an important source of risk for an investor, in particular for what regards, for example, executive pay. The 96.3% of the surveyed affirm that they tend to avoid investments in corporations that do not provide evidence of healthy governance practices.

Due to the increasing environmental concerns spreading at all levels of civil society, an increasing number of institutional investors is considering the environmental performance of a corporation as a core factor of the investment decision. In this case the survey shows a difference of responses across sectors, with the industries more in contact with the consumers, such as financial services and consumer products, more careful to environmental issues, while other industries, such as manufacturing and energy, are more cautious on the topic, probably due to the impact that a complete environmental revolution would have on their activities.

1.1.7 *The impact of ESG investors on environmental issues*

Established the good purposes of ESG investors, is interesting to understand if this investment strategy produces a real impact on the three aspects of interest of a company. Considered the importance that the fight against climate change has gained during the last decades, most of the research is concentrated on the effects that these investment strategies are having and how corporate behaviour has changed with the increase of sustainable investments.

The relationship between ESG performance and the cost of capital of a firm has been extensively studied by several empirical studies which, almost univocally, have shown that companies with better ESG parameters experience lower cost of capital. Moreover, this result seems to be valid in both developed and emerging markets and regardless of the type of instrument analysed, stocks or bonds. It is worth emphasizing the importance that the cost of capital has for a business because it represents the amount at which it can be financed through debt and equity. With the raise of environmental concerns, it is therefore clear the power held by investors which can decide to invest in companies more coherent with their preferences and values. A compelling study on this topic has been proposed by De Angelis, Tankov and Zerbib (2020), who have examined how green investing urges companies to reduce their greenhouse gas emissions by raising their cost of capital. The study considers a sample of U.S. companies and shows that companies' emissions decrease when the proportion of green investors and their environmental commitment increase and when the costs for the reduction of the emissions decrease. The results of the empirical analysis are significative and point out that when 50% of the assets are managed by green investors, companies' carbon intensity decreases by nearly 5% per year, a not ignorable amount. The data considered from 2014 to 2018 reveal a growth of sustainable investments from 18% to 26% of the assets under management and, in the same period, a drop in the carbon intensity of NASDAQ AMEX and NYSE companies from 140 tCO2e per million dollars of revenue generated to 100 tCO2e per million dollars of revenue generated.

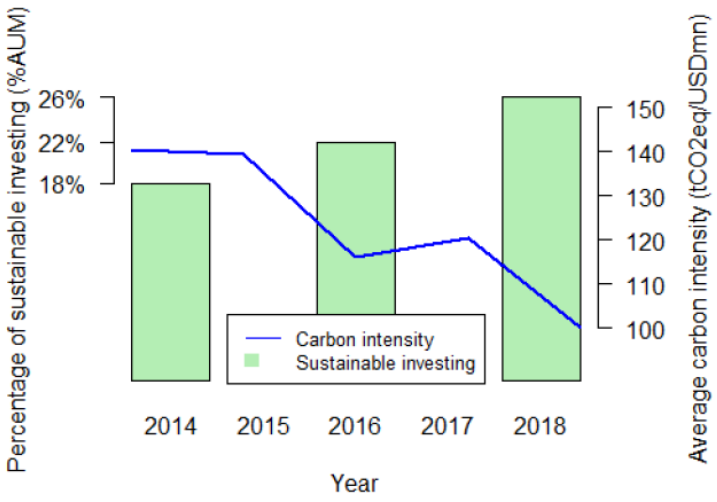

Figure 1.1 *Source:* De Angelis et al. (2020), "Environmental Impact Investing"

Despite the other numerous contributing factors, such as national and international regulations, the downward trend in corporate greenhouse gas emissions, clearly identifiable in *Figure 1.1*, is surely due to the pressure exerted by green investors who, by underweighting or excluding the most carbon-intensive companies from their investments, drive up their cost of capital.

This evidence points out the importance that normative can have on financial markets by establishing conditions for the development of green investments, as it has been made with the European Commission Action Plan in 2018. Secondly, they highlight the need to promote transparency and disclosure of companies' environmental impacts in order to reduce the uncertainty about the future environmental risks sustained by green investors.

1.2 The ESG Investment Landscape

1.2.1 *An overview of global sustainable investments*

In the last decade, the landscape of ESG and SRI is growing and changing very rapidly pushed by new rules and regulations developed by institutions that influence all the players of this wide market: banks, institutional and retail investors, companies and also rating agencies. An important factor that has pushed the growth of the ESG megatrend is the breakout of the global pandemic, which has clearly increased the interest of investors who have understand the crucial role of sustainable investments as instruments to contain future social, economic and financial crises.

The last report on global sustainable investments released by the Global Sustainable Investment Alliance (GSIA) points out a 15% increase of global sustainable investments in the past two years (2018-2020) and a 55% increase in the past four years (2016-2020), expecting a further growth in the coming years (Mutua and Poh, 2019). ESG investments and ESG thematic funds represent definitely one of the major trends in financial markets that will shape the asset management industry in the next years.

As it is possible to see in *Figure 1.2*, in the five major economies considered in the report, including Europe, the United States and Canada, the total sum of sustainable investments has reached 35.4 trillion dollars which represent a big share, equal to 35.9%, of the total professionally managed assets. In the last two years, the largest increase in this investment category has been experienced by Canada and Japan, which have seen a growth of 42% and 34% respectively between 2018 and 2020. A slower progression has been observed in Australasia with a growth of 25%, while Europe is experiencing the opposite situation with a countertrend 13% decline.

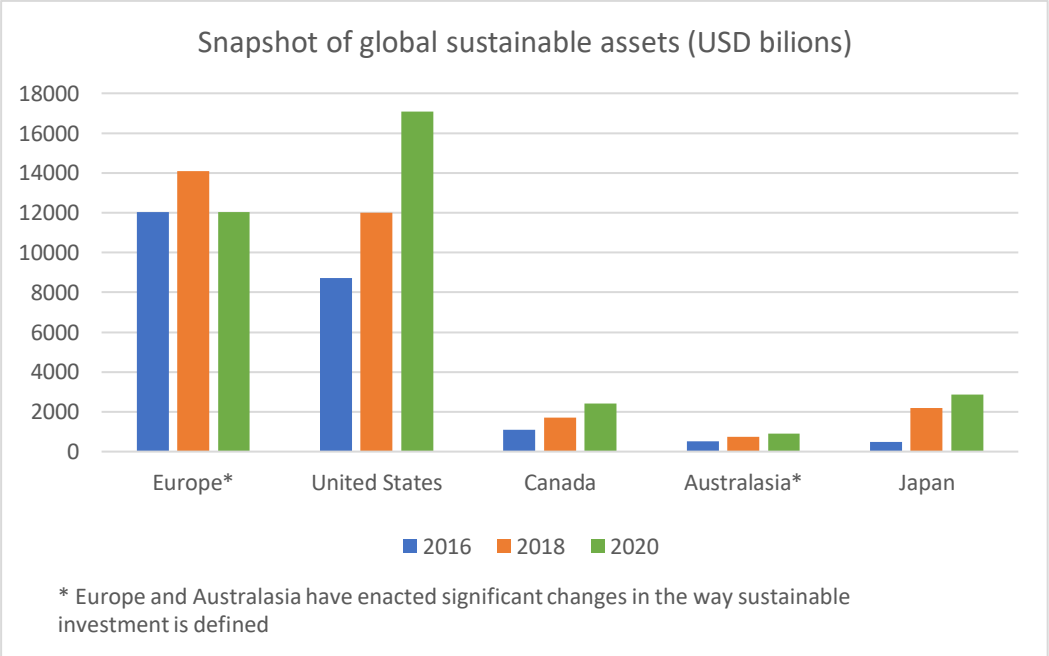

Figure 1.2 Source: Global Sustainable Investment Report 2020 (GSIR)

A plausible reason for this tendency can be identified with the significant change in the way sustainable investments are defined by the EU legislation explicated in the European Sustainable Finance Action Plan, which has entailed a relevant change in the measurement methodology making very difficult a comparison with past data. The same

situation can be observed with regard to the proportion of sustainable investing relative to total managed assets. Canada, the United States and Japan have experienced a consistent growth over time, while Europe and Australasia have seen a decline in particular in the last two-year period. Nevertheless, in 2020 the United States and Europe continue to gather more than 80% of global sustainable investing assets.

The success of the sustainable investing model in Canada is confirmed by the fact that the proportion of sustainable investments over the total assets invested in the country is equal to 62%, much higher than the 42% observed in Europe and the 33% in the United States. Furthermore, the difference between the diffusion of ESG practices in Europe compared to the US is probably due to the higher effectiveness of the guidelines issued for all the industries by European regulatory agencies which are more concerned about environmental, social and governance sustainability in the economy.

Following this megatrend, several new funds, both passive and active, are still emerging in order to take advantage from the rising opportunities. The ESG funds that follow active strategies are nearly 80% of the total, while passive and benchmark-replication strategies are the 20% of the total. Considering that this trend is still growing, those who are already exposed to these factors may be able to experience above-average returns in the years to come.

Several experts claim that ESG factors will shape the post-COVID world. In particular, social cohesion and good governance can accelerate a country's recovery, whereas the lack of this characteristics can be penalizing. Bloomberg forecasts that, within five years, 60% of assets managed by mutual funds will have the ESG label, even if in recent times several experts are pointing out the problem of a unique definition for ESG which, at the moment, does not exist and allows different possible interpretations.

1.2.2 *The 7 Strategies for Responsible Investing*

The European Sustainable Investment Forum (Eurosif) identifies seven investment strategies[6] that are generally followed by investors willing to purse a more sustainable investment decision process characterized by long-term sustainable returns obtained by stable, well-functioning and well governed social, environmental and economic systems. The first is the *Positive/Best-in-class* approach, which includes also the Best-

[6] https://www.eurosif.org/responsible-investment-strategies/

in-Class and best-effort approaches, where investments are divided by universe, category or class and selected or weighted based on ESG criteria. The best performing companies identified after the ESG analysis within a defined investment landscape are included in the investment allocation process.

The opposite strategy is based on the *Exclusion/Negative screening* of specific companies, sectors or countries involved in undesired activities, or not responding to specific criteria, from the landscape of possible investments. Typically, the exclusion criteria are based on ethical values determined by asset managers or asset owners which apply limits at individual fund or, more and more frequently, at the entire product range of assets.

The third possible strategy is the *Corporate Engagement & Voting* approach which evaluates the participation and influence of shareholders on ESG matters. The evaluation is based on the possibility for shareholders to influence, through proposals or direct voting, the behaviour of the company or increase the disclosure in the long term.

Another approach is the *ESG integration*, with the explicit consideration of ESG risks and opportunities derived from specific research sources into the process of analysis and investment decision.

A further strategy is *Impact and Community Investing* which has the aim to make investments into companies, organisations and funds with the intention to generate not only financial returns, but also a positive social and environmental impact. Often these investments are oriented towards a specific project from which the investor expect a positive financial return and are distinct from philanthropic activities. This strategy is applied in microfinance, community investing and social entrepreneurship funds.

The sixth approach is the *Norms-based screening*, which establishes the analysis of investments based on their compliance with international standards and norms covering ESG factors. Generally, the international norms applied in the screening process are those issued by international bodies such as the United Nations (UN).

The last most common strategy is the *Sustainability-themed* which promote investments in assets linked to the development of sustainability. Funds focused on this topic inherently contribute to address challenges such climate change, eco-efficiency and health. In order to be considered as appliers of this approach, funds must have an ESG analysis or screen of investments.

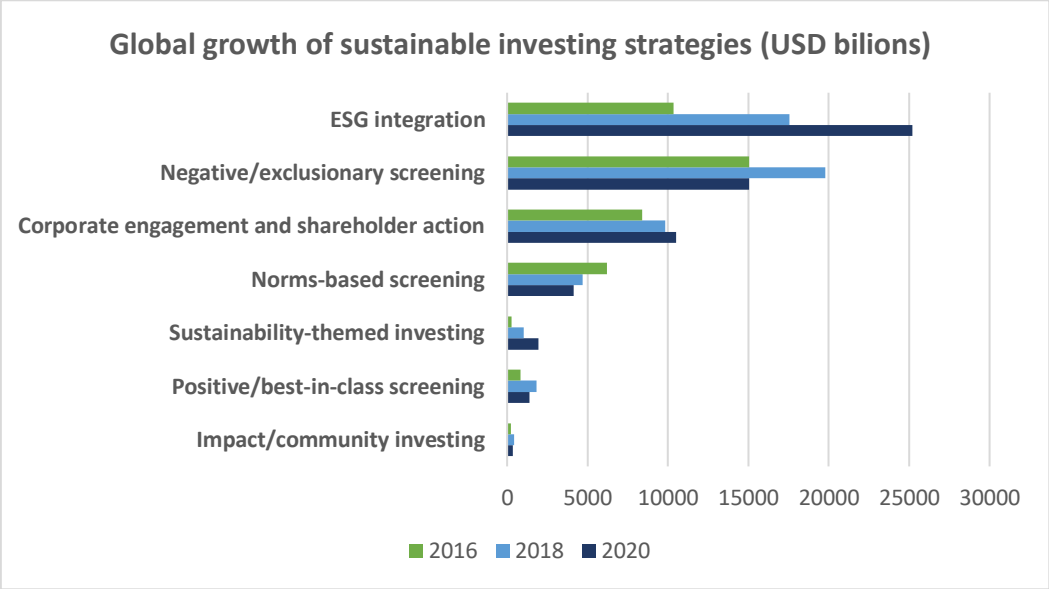

Figure 1.3 *Source:* Global Sustainable Investment Review 2020

Figure 1.3 shows the global growth of sustainable investment strategies in the four-year period between 2016 and 2020. A significant growth can be observed in particular for the ESG integration approach, by far the most employed strategy, sustainability-themed investing, which experienced a 605% growth from 2016, and corporate engagement. All the other strategies have followed variable trajectories since 2016 with the exception of the one based on the norms-based screening, which has experienced a 33% decline in the last 4 years.

1.3 The EU taxonomy for sustainable activities

In order to direct investments towards sustainable projects it is necessary to have a common language and a clear definition of what can be considered "sustainable". For this reason the action plan on financing sustainable growth called for the creation of an "EU taxonomy", a common classification system establishing a list of environmentally sustainable economic activities. This common taxonomy will provide companies, investors and policymakers the definitions under which economic activities can be considered environmentally sustainable. It will also create stronger security conditions for investors, protecting them from greenwashing, helping companies in understanding what can make them more climate-friendly, mitigating market fragmentation and helping direct investments where they are most required.

The common EU Taxonomy Regulation entered in force on 12 July 2020 but without the technical attached to be used to confer the mark of "sustainable activity". These criteria will define in detail the threshold to be reached in order to be defined sustainable, for example establishing the maximum quantity of CO2 that an activity can produce. For this purpose, the Taxonomy Regulation establishes six environmental objectives:

1. Climate change mitigation
2. Climate change adaptation
3. The sustainable use and protection of water and marine resources
4. The transition to a circular economy
5. Pollution prevention and control
6. The protection and restoration of biodiversity and ecosystems

The main obstacle to the set of common technical criteria is the huge amount of investments destined to these objectives to which the big players of industrial sectors do not want to renounce.

One of the crucial points on which the discussion is focused is the inclusion or not of some energy sources among those considered as sustainable. For example, in the initial text the limit of emissions necessary to obtain the "green mark" was equal to 100g of CO2 equivalent per kWh, which is not actually respected by none of the existing European gas-fired power plants, which may lose billions of euros of private investments. In the new draft of the taxonomy this technical limit has changed, including natural gas among the fuels necessary for sustainable development. An analysis produced by the International Energy Agency (IEA) shows that investments in natural gas are necessary for the substitution of coal and to give flexibility and accumulation capacity to the energy supply system. Moreover, the scenario hypothesized by the IEA for 2030 is compatible with the increase of temperatures under 2°C. So, also resorting to investments in natural gas in the next decade, the energy system may guarantee an increase of the temperatures compliant with the Paris Agreement.

Another industry strongly impacted by the decisions of the European Commission is the nuclear sector. Initially excluded by the taxonomy, after the remonstrations of France and other six countries of Eastern Europe which rely on this energy source, it has been

reconsidered together with natural gas. The main argument against nuclear energy is that, even if it produces very low emissions, the difficult management of nuclear wastes may contrast with other objectives such as biodiversity, circular economy and oceans protection.

In addition to the strictly environmental taxonomy, there is wide room for improvement in the social criteria field. In fact, it is not sufficient to specify that some minimum safeguard thresholds must be respected, they must be clearly defined by the Platform on sustainable finance which is working on their integration with the environmental criteria already defined.

In conclusion, the taxonomy will be addressed to all the financial institutions in the EU, including pension funds which will have to provide all the necessary information about the relevance of their products to the taxonomy. With this purpose, starting from 1st January 2022, every operator in the financial market have to declare if the underlying investments are aligned to the Taxonomy, expressed as a percentage of the investment. Moreover, all the listed banks and insurance companies subject to the Non-Financial Reporting Directive, will have to disclose information on their activities connected to the Taxonomy which becomes the reference also for the attribution of European incentives.

CHAPTER 2

2. ESG RATINGS

In the previews chapter has been illustrated the relevance that the ESG framework has gained over the last years, both for financial and ethical reasons. This fact implies an increased demand for high quality information on the behaviour of companies for what regards the three pillars of ESG. The main providers of ESG data are the ESG rating agencies, which collect and process data by scrutinizing businesses and then supply to institutional and non-professional investors different performance metrics based on their own research methodologies. In the last decade, after the Great Financial Crisis in 2008, these agencies have acquired a growing market share becoming a reference for companies, financial markets and researchers looking for reliable data to evaluate the sustainability of a business. One of the difficulties in assigning ESG ratings is the inability of rating agencies to internalize the social impact, which can be solved by reducing the discrepancy of expectations between the society and rating agencies about sustainability and sustainable development. The existence of this divergence of expectations can affect the social legitimacy and trust of both companies and ESG rating agencies.

In order to overcome these differences and increase the quality of the services offered, this market is experiencing an increasing concentration with the main agencies that continuously merge with and acquire their competitors. The most important rating agencies have taken part in this process in order to acquire new knowledge and give further services to their clients, such as in the case of MSCI ESG Research which was set up as a result of the takeover of RiskMetrics and MeasureRisk by MSCI, one the most relevant international providers of financial indices. The presence in this specific market of such big players such as Bloomberg, MSCI and Thomson Reuters confirms the importance that ESG ratings have both for the society and the financial world which strongly relies on these metrics. The literature on this topic is not so wide and is mainly

focused on the evolution of the market of rating agencies, while it is very lacking when it comes to the effects that the agencies have produced with their evaluation criteria on the concept of corporate sustainability.
This chapter offers an overview of the main issues related to the methodologies and the ability of the agencies to correctly evaluate businesses with the possible implications of their judgments.

2.1 ESG Rating Agency Industry

The need to assess corporate sustainability is grown in particular in the last decade since the financial market is paying more attention to this issue, but the majority of existing tools, frameworks and mechanisms to measure this aspect have not been adequate. In order to respond to this need, an increasing number of ESG rating and information provider agencies have emerged to provide social and environmental information to socially responsible investors. By now, all international public and many private companies are evaluated and rated on their environmental, social and governance (ESG) performance by various agencies providing reports and ratings on these aspects of a business. During the investment process, institutional investors, asset managers, financial institutions and all the potential stakeholders rely on these information to assess the ESG performance of a company and compare it to its peers. Due to the grown interest of the investors for this type of corporate aspects, the assessment and measurement of these factors is a fundamental basis for investor engagement with companies on ESG matters. The issue with ESG rating is the great variety of ratings methodology, scope and coverage, which vary greatly among the dozens of providers operating in this field. In fact, some ratings are based exclusively on non-financial information while others combine financial and non-financial data to assess the sustainability of a business and doing so they create a non-homogeneous framework for the investor. In order to partly correct these discrepancies, rating agencies often encourage companies to improve or correct supplied data. The process of evaluation is very similar to the one used for credit rating appointment and is often performed by the same agencies, including the well-known Bloomberg ESG Data Service, DowJones Sustainability Index (DJSI), MSCI ESG Research, Sustainalytics Company ESG Reports and Thomson Reuters ESG Research Data.

The process of rating always starts with the collection of data that the companies themselves give to the agencies through questionnaires. Then, specialised work teams in different geographical areas elaborate the data cross-checking them with available public information such as other reports or news.

After the financial crisis in 2008, capital markets have experienced a strong positive shift in the perception towards the themes of corporate sustainability and responsible investing leading to a concentration process in the ESG rating agency market. The process of concentration has allowed the agencies to provide to the investors more precise and complete assessments of corporate sustainability, involving more professional and multidisciplinary work teams specialised on different sectors and aspects of corporate sustainability. From 2008 to 2018 this market has grown considerably and has already experienced the phase of consolidation also through the integration of financial rating and information provider agencies in the industry. This process has brought ESG rating agencies to become fundamental market actors no more oriented only to the limited market niche represented by investors interested only in sustainable investments. Moreover, the agencies have the power to influence both the behaviour of financial market actors and, maybe most importantly, the institutionalization of sustainability management in companies, being considered full-fledged "institutional entrepreneurs". This fact poses a further responsibility on the agencies that, by changing the assessment procedure of corporate sustainability, have an impact not only on the dynamics of financial markets but also on the society as whole.

2.1.1 *The main players in the industry*

Before starting to analyse the methodologies used by the main ESG rating agencies is worth looking at which are the main international rating agencies and how they developed their different business models over time. The increasing interest for sustainability in financial and credit markets is clearly deductible from the process of acquirement of ESG data providers by the major credit rating agencies.

Morgan Stanley Capital International – MSCI ESG Research Unit

MSCI has been for decades a provider of decision support tools for over two thousands institutional investors, including the most important international mutual funds, hedge funds and pension funds. Despite this, MSCI entered the ESG market quite late when, in 2010, RiskMetrics was acquired in order to obtain the knowledge, the methods and the clients necessary to operate in this peculiar market. Following this operation, MSCI reported a rise of $13 million in turnover, even if there is not a precise data available for this line of business. In addition, during the last decade MSCI has grown through a series of high-profile acquisitions of investment-risk metrics providers, which have allowed MSCI to become one the most important agencies of the rating industry. In total, as of June 2020, MSCI rates the ESG performance of 8’500 companies and more than 680’000 equity and fixed income securities globally.

Robeco Sustainable Asset Management (RobecoSAM)

Sustainable Asset Management was created in 1995 in Switzerland and in 2006 has been acquired by Robeco, establishing the RobecoSAM entity. Only recently, in 2020, RobecoSAM has changed denomination in Robeco Switzerland Ltd, becoming an ingredient brand of the Robeco group. In addition, in 1999 RobecoSAM in cooperation with Dow Jones Indexes has launched the world’s first family of sustainability indexes, the Dow Jones Sustainability Indexes (DJSI).

This rating agency has the peculiarity of carrying out research primarily for internal use, offering investment funds in clean energy, sustainability and water sectors. In addition to the supply of investment services there is the provision of data to third parties which constitutes only a secondary business required by the marketplace and currently can provide ESG data on over 4’700 companies around the world. From the beginning of its activity, the philosophy of SAM was based on sustainability and on the impact that companies’ actions can produce in the future, rather than on what have created in the past. Moreover, it assumes both a business and investor perspective in order to capture how sustainability create more value to a company.

Refinitiv

This ESG rating agency is the most recent of the three, having been founded in 2018 as a result of the sale for about $20 billion of the Financial & Risk (F&R) section of Thompson Reuters, which is still a minority shareholder, to the private equity firm Blackstone Group LP. With this operation Thompson Reuters transferred all its financial and risk product portfolio to the private equity fund which, only one year later, has ceded the rating agency to the London Stock Exchange Group (LSEG). Currently Refinitiv runs more than 130 fintech data, analytics, trading and risk assessment tools and serves more than 40'000 client companies in 190 countries.

Vigeo – EIRIS

Vigeo was founded in 2002 in France and, in response to the partnership between SAM and Dow Jones, launched the Advanced Sustainable Performance Index in cooperation with STOXX and a further index family with New York Stock Exchange Euronext. In 2005 Vigeo merged with EIRIS, a foundation with the scope to look for sustainable investment opportunities. As an ESG rating agency, Vigeo provides company-solicited ratings in addition to its core activity and main source of revenues, the investor-solicited ratings. Despite the diversification in its activities and more than 300 international institutional clients, during its twenty-year life Vigeo has reported several years of considerable losses.

2.2 The perspective of the investors

The increased interest of investors for the aspect of corporate sustainability is clearly confirmed by the report "Rate the Raters 2020: Investors Survey and Interview Results"[7] in which are collected the opinions of over 300 sustainability professionals in corporate, NGO, government and academic sectors. One of the key insights of this report is that from 2011 to 2018, the proportion of S&P 500 companies reporting their sustainability activities and ESG performance has grown from just under 20% to 86%[8].

[7] https://www.sustainability.com/thinking/rate-the-raters-2020/
[8] https://www.sustainability-reports.com/86-of-sp-500-index-companies-publish-sustainability-responsibility-reports-in-2018/

Following this trend, as *Figure 2.1* shows, 65% of investors surveyed affirm that they use ESG ratings at least once a week when performing the analysis of a viable investment.

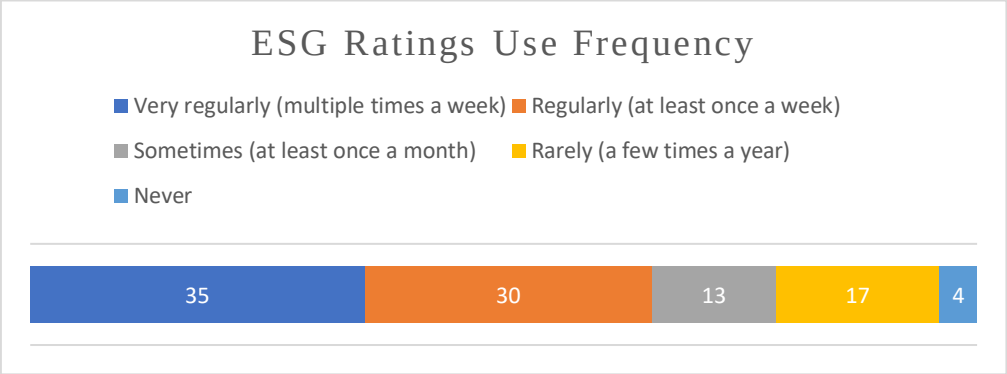

Figure 2.1 Source: Rate the Raters 2020: Investors Survey and Interview results

A further finding of the report is that every investor evaluates ESG ratings differently, frequently using more than one rating and preferring to access as much research as possible. The most important factors in the selection of the appropriate ESG rating are the number of companies covered by the rating, the quality and disclosure of rating methodology, the credibility of data sources and the experience of the research team.

A further interesting finding is that some investors use ratings directly in the investment decision process, while the majority of them use a more sophisticated approach. In particular, they do not consider the ratings provided by the agencies but re-elaborate the crude data about different sustainability aspects of a company to establish their own view of the sustainability performance. In this way ESG ratings are used only as a starting point to understand the possible investing solutions on which they need to do further own research. *Figure 2.2* shows the most useful sources of information on corporate ESG performance and, according to investors, corporate ESG ratings are in first place on a par with the direct engagement with companies, while the third most used source of information resulted to be corporate sustainability reports.

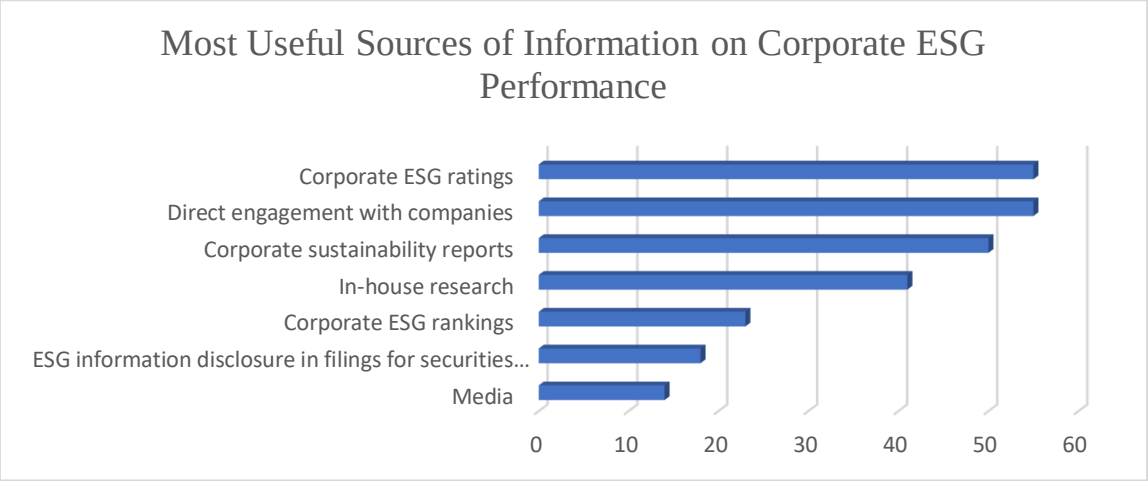

Figure 2.2 Source: Rate the Raters 2020: Investors Survey and Interview results

In addition, most of the times investors are not comfortable when using the rating provided by the agencies because considered inaccurate and based on backwards-looking data which cannot be distilled into a single score to provide a clear measure of the ESG performance of a company. A further complaint coming from the end-users of ESG data is about the number of errors and accuracy problems identified in the databases provided by the agencies, which are still rich in holes in underlying corporate data. For this reason, what the surveyed investors expect from ESG raters for the future is real time data in shorter reports to be directly integrated in the investment process, in addition to a higher transparency on the criteria and assessment processes followed during the evaluation. In addition, some investors would find interesting also to consider the expectations of different stakeholders on the evaluation process, in order to know if the scores assigned are coherent with their view of the company.

One of the merits of the ESG rating framework is that the research for sustainable business models is becoming more and more widespread among investors, who are thinking beyond operational performance and are increasingly considering how a company's net activities benefit and hurt society applying that thinking to portfolio creation. This has increased the awareness of ESG issues while helping to educate the investment community and the stakeholders on the relevance of these issues for a business. In spite of the critics for the scarcity and not so high quality of data, most of the investors recognize to ESG ratings the merit of helping drive sustainability at the centre of investment thinking and practice.

2.3 ESG rating methodologies

One of the main issues in the ESG rating landscape is the absence of a common framework that can be taken as a reference by the rating agencies. This can cause confusion in investors who are not able to identify the most relevant criteria in the assessment of the sustainability of different businesses and also in the companies themselves that need to understand the main sustainability topics on which they put their efforts. For this reason is important to identify some financially material ESG factors, namely the factors that could have a positive or negative impact on a company's business model and value drivers, such as capital, risk and growth.

In order to overcome these complications, a useful support comes from the Materiality Map which represents a guide to identify which information is most useful for financially related decisions. One of the reference tools in this context is the Sustainability Accounting Standards Board Materiality Map shown in *Figure 2.3*. With this map SASB identifies issues that are likely to have an impact on the financial condition or operating performance of a company and so mainly observed by investors, differentiating the importance of the topics across different industries and sectors.

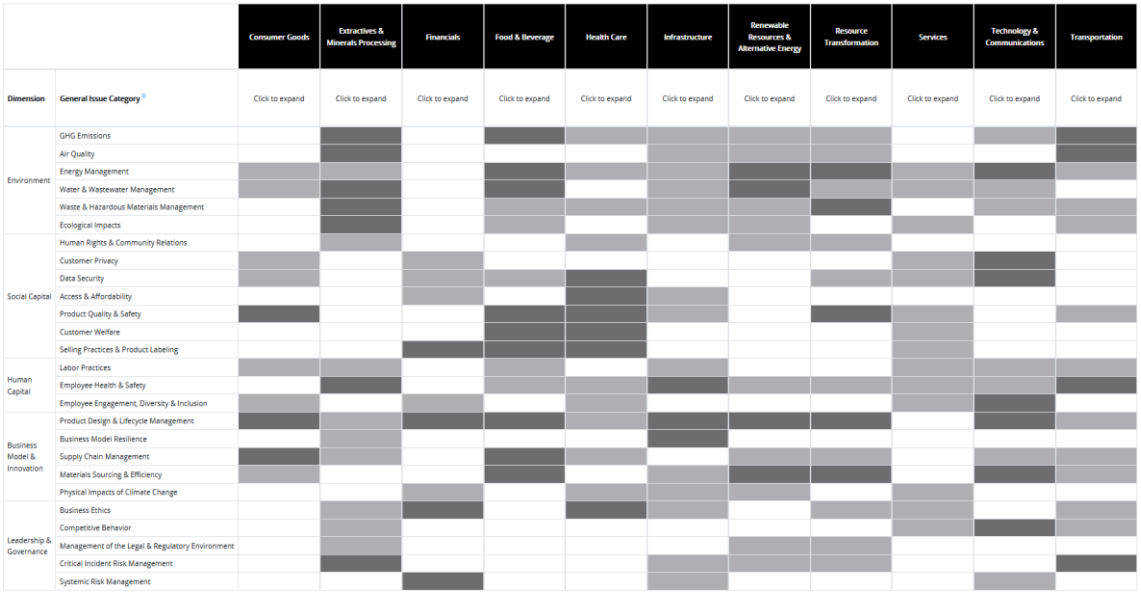

Figure 2.3 Source: SASB Materiality Map

Crossing the general issue categories with the different sectors, the darker is a cell the more likely an issue is to be material for more or less than 50% of industries in the

sector, while blank cells show that a specific issue is not material for the companies of a sector. Looking at the matrix, it is clear that material factors are different from one sector to another and every company should concentrate only on the factors that produce an impact on either the amount of cash flow generated or the cost of external financing, the weighted average cost of capital. This difference exists not only among sectors but also among different ESG rating agencies that have developed their own definition of materiality, worsening the problem of ESG ratings discrepancy.

2.3.1 *The ESG rating framework*

During the last decades, every rating agency has developed its own rating methodology creating an inhomogeneous framework for the investors. For this reason, analysing the different assessment processes used by the agencies is useful not only to make a comparison within the industry, but especially to understand if the ratings assigned by different providers are coherent or not. The ESG rating agencies analysed are the same scrutinized in the previous paragraph.

Morgan Stanley Capital International – MSCI ESG Research Unit

MSCI[9] uses a rules-based methodology to identify industry leaders and laggards where companies are rated on a scale where AAA is the highest rating and CCC the lowest one. More specifically, a company with a rating of AAA-AA is considered a leader on ESG issues, if the rating is between A-BBB-BB it is an average company and if it is rated with a B-CCC the company is considered a laggard. The assessment is made considering the exposure of each company to ESG risks and opportunities and the ability of the business to manage these risks compared to peers operating in the same industry or with the same characteristics. The same assessment process is made both for private companies, governments, mutual funds and ETFs.

The approach used does not provide the use of questionnaires and starts with the collection and standardization of public data from three main sources: NGO databases with governmental and regulatory data, company disclosure documents and 3’400 media sources monitored daily. Then the process continues with the creation of the

[9] https://www.msci.com/zh/esg-ratings

metrics through a standardized methodology to assess the risk exposure and risk management implemented by the company compared to industry peers. Moreover, in order to produce a rating as detailed as possible, the communications team of the agency engages with the company in order to verify the reliability of the data. The third step through which the company is evaluated, requires the scoring of 35 industry-specific key issues that are rated on a scale from 0 to 10 based on the daily monitoring and update of controversies and events regarding the company under examination. These industry-specific issues are gathered in 10 macro categories referred to the three ESG factors and they are: climate change, natural resources, pollution and waste, environmental opportunities, human capital, product liability, stakeholder opposition, social opportunities, corporate governance and corporate behaviour. Finally, the 35 key ESG issue scores are weighted and combined in order to obtain the overall ESG rating which is checked and reviewed constantly in order to capture emerging controversies or changes in the profile of the company.

Robeco Sustainable Asset Management (RobecoSAM)

The Corporate Sustainability Assessment (CSA) process developed by RobecoSAM[10] involves the use of a questionnaire submitted to the companies under examination. The form includes industry-specific criteria and is reviewed yearly in order to assess issues materially significant for the companies. The answers to the questioners aim to assess how businesses think about long-term risk and opportunities connected to sustainability and need to be supported to documents in order to be verifiable by the research team. In addition, the information provided is crosschecked with the documentation provided, checking publicly available information and by verifying the company's track record on crisis management with media and stakeholder reports.

Every question receives a score from 0 to 100 and is assigned a defined weight for the calculation of the final score. The following step is application of a Media and Stakeholder Analysis (MSA) through which criterion scores are adjusted and can be inputted in the weighted computation of the score. The final score is the sum of the scores received by the company on three macro-dimensions, the economic dimension which counts for 38 over 100 points, the environmental dimension which is worth 27

[10] https://www.spglobal.com/esg/csa/static/docs/measuring_intangibles_csa-methodology.pdf

over 100 points and the social dimension which has a weight of 35 points on the total of 100 that is the maximum total sustainability score. RobecoSAM's analysts consider in the assessment process 61 different industries and for each of them 50-60% of the questions are specific, due to the specific risks and challenges faced by different businesses. Moreover, the same criteria applied to different industries can have a different weight in the final evaluation considering the peculiarities that, for example, the financial industry has compared to the energy industry.

Refinitiv

ESG ratings cover over 70% of the global market cap, approximately 9000 companies worldwide, across more than 500 different ESG metrics. The CSA process[11] created by Refinitiv is based on 10 main themes derived from the three main ESG categories and covers the following topics: emissions, resource use and innovation for the environmental aspect, workforce, human rights, community and product responsibility for the social aspect and management, shareholders and corporate social responsibility strategy for the governance aspect.

The management of the data collection process is entrusted to a large team of content research analysts appointed to process numerous publicly available information such as annual reports, company websites, MGO websites, stock exchange fillings and CSR reports. Then, these data are stored in the ESG Database where they are checked and audited daily and reviewed in order to address problematic topics and guarantee the highest possible information quality.

The scoring process is based on a five-step process flow, starting from simple Boolean questions aiming to understand if a company satisfies a particular ESG requirement, continuing with the calculation of the weights for every category based on the Refinitiv ESG materiality matrix and finishing with the overall ESG score calculation and pillar score. In particular, ESG scores are aggregated based on the 10 categories listed before and then a grade between 0 and 1 is given to each of them. The category weights have a different weight across different industries for the environmental and social categories, while for governance the weights are the same across all industries. The pillar weights

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

are normalized to percentages ranging between 0 and 100 in order to obtain the final score meanwhile the category weights vary according to industry. Ultimately, all the single scores are aggregated in the overall ESG score and in the ESG controversies scores which is adjusted when there are controversies during the fiscal year and the ESGC score is computed as the weighted average of these two values. If the controversies score is greater than the ESG score, then the ESGC score is simply equal to the ESG score.
Thanks to the reliability and numerosity of data provided, Refinitiv scores will be used in the analytical part of this work in the fourth chapter.

Vigeo – Eiris

The ESG score generation process begins with the generation of the ESG criteria scoring begins with the generation of the single ESG criteria scores, followed by the ESG scores and finally the ESG Overall Score.
The criterion-level score might be determined using the managerial questioning framework implemented by the agency and each of the dimensions included in the score are separately scored from 0 to 100 with different predetermined weights. The Environmental, Social and Governance pillars are scored weighting the single ESG criteria previously evaluated. Consequently, the overall ESG score is based on the three weights assigned to the three aspects, 58% to the Environmental score, 47% to the Social score and 25% to the Governance score.

2.3.2 *The evolution of assessment criteria*

In order to respond to the changing needs of the investors and follow the emerging trends of the sector, rating agencies have changed their assessment process over time, focusing on the most important aspects for the investors. It is a fact that during the last two decades the concern of the public opinion for environmental themes has grown massively, posing to the agencies the need to focus more on these aspects in their ratings. In spite of the changes experienced due to the evolution of the focus of the investors, there are three aspects of the measurement process that are always consistent across different agencies: the three main categories evaluated (environmental, social and

governance) and the subcategories considered; the controversial activities and practices considered in the evaluation process; and standardization of the ratings by the industry.

In order to understand how the ESG rating framework has changed during the last decade, it is useful to consider the results of the paper by Olmedo et al. (2019) which discusses how the integration of ESG criteria has changed in the period from 2008 to 2018. When the three main dimensions (environmental, social and governance) are considered is clear the change of trend in particular looking at the environmental factor, which has been influenced by the increased awareness in the society for climate change and connected issues. A key event that has deeply influenced the environmental performance evaluation of a business during the period considered in the analysis is the 21st Conference of the Parties (COP21) in Paris in December 2015, during which it has been stressed the effort that all the society, companies included, has to put in place in order to tackle climate change and reduce greenhouse-gas emissions.

In *Figure 2.4* it is possible to see the comparison in the use of the main analysis criteria which confirms the increased interest towards specific aspects connected to climate change and greenhouse-gas emissions. In particular, the reduction of the weight of environmental policy/management from 100% to 87.5% is compensated by the increase of all the other categories, with major increases in the interest in the protection of biodiversity and the use and management of water. It is worth also noting the inclusion of new categories, such as the one measuring carbon intensity, due to the increased awareness of investors for what concerns greenhouse-gas emissions.

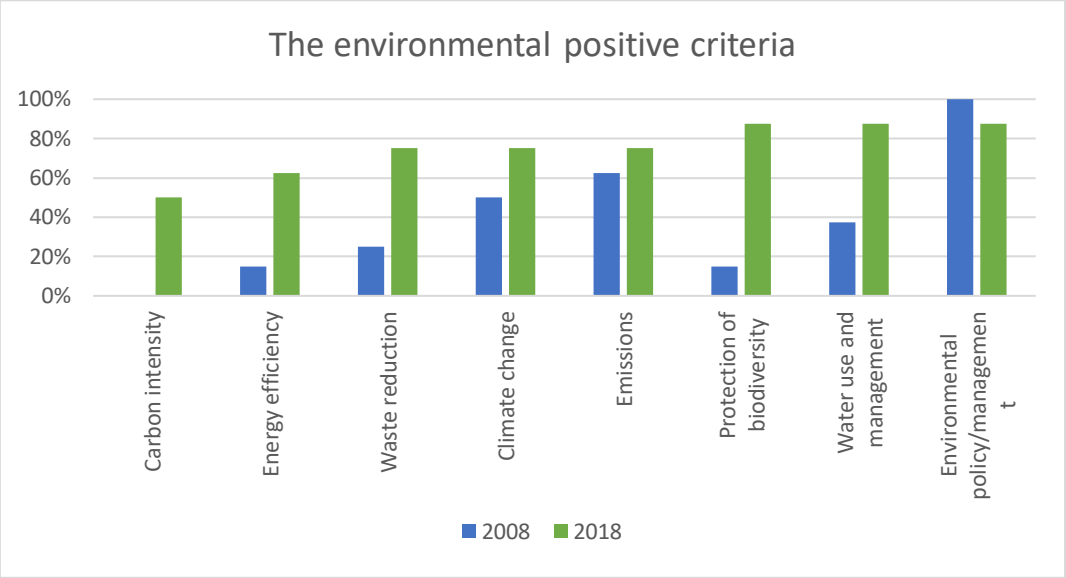

Figure 2.4 Source: Olmedo et al. (2019), "Rating the Raters: Evaluating how ESG Rating Agencies Integrate Sustainability Principles"

In *Figure 2.5* are considered changes in the social pillar criteria. In 2008 the main aspects considered in the assessment process by ESG rating agencies were human capital development and training, human rights and community relations. After the definition of Sustainable Development Goals in 2015, the paradigm of social sustainability has changed implying changes also on the criteria considered. The main innovation of these goals is the emphasis posed on the necessity to improve health and education, reduce inequalities and spur economic growth by changing the way in which a company is judged, so not only on its financial results but also on its ability to contribute to sustainable development. Following the introduction of these goals there has been a shift from the three criteria previously cited to other three criteria more coherent with the new framework. When looking at the main criteria incorporated in ESG ratings in 2018, it is evident the predominance of labour management, human rights and quality working condition, health and safety. Two further fundamental issues included in the list due to the increased attention for a more sustainable technological progress and the evolution of data collection tolls are data security and privacy and supply-chain management which were not even considered in 2008.

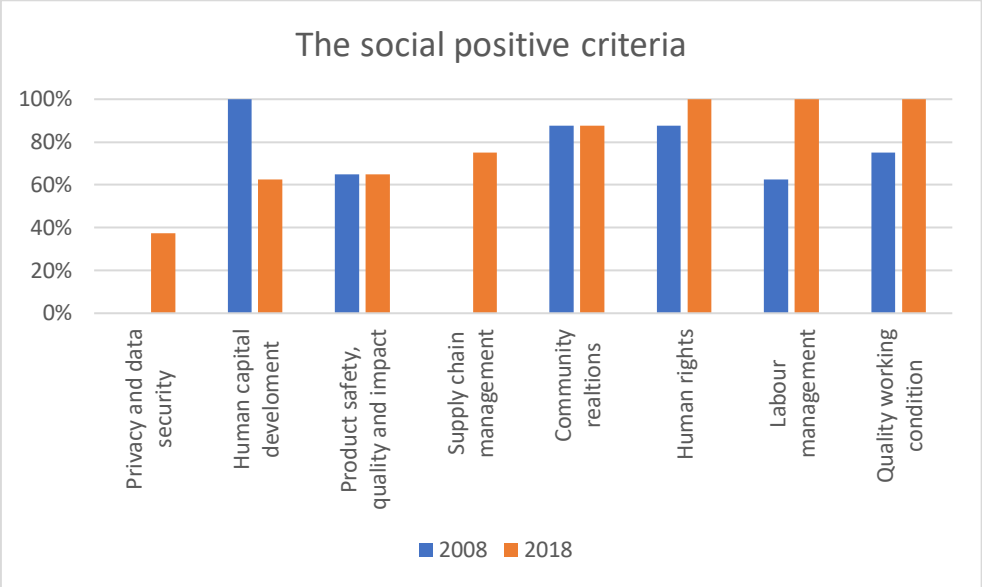

Figure 2.5 Source: Olmedo et al. (2019), "Rating the Raters: Evaluating how ESG Rating Agencies Integrate Sustainability Principles"

The last aspect concerning the corporate governance factor shows that both in 2008 and 2018 the most valuable criteria were corporate governance functions and committees, board structure and remuneration/compensation policy. In *Figure 2.6* is possible to observe that as opposed to the environmental and social criteria, the corporate governance ones seem to be remained stable over time, without experiencing meaningful changes in the period considered. Moreover, the criteria that require a complex and abstract evaluation, such as brand management, are not considered as key aspects in the ESG rating assessment. As in the case of social criteria, also in the governance factor has been included new criteria over time in order to follow the changes in the business environment. In particular, this is the case of the prevention of corruption and bribery and transparency issues which have become a key aspect considered in the rating process growing from 50% in 2008 to 87.5% in 2018. The increased importance gained by these topics in the assessment framework, such as in the case of the environmental concerns, is also due to the recommendations released by international organizations such as OCDE in order to tackle corruption both in the public and private sector. Another connected aspect that has collected increasing interest among investors, and so has been included in the assessment process, is the tendency of a company to suffer scandals and ruin its image because of illegal or opaque behaviours. For these reasons, in the last years, the majority of the companies is trying to increase

the transparency of their actions in order to improve the perception of the investors which are increasingly careful to these topics.

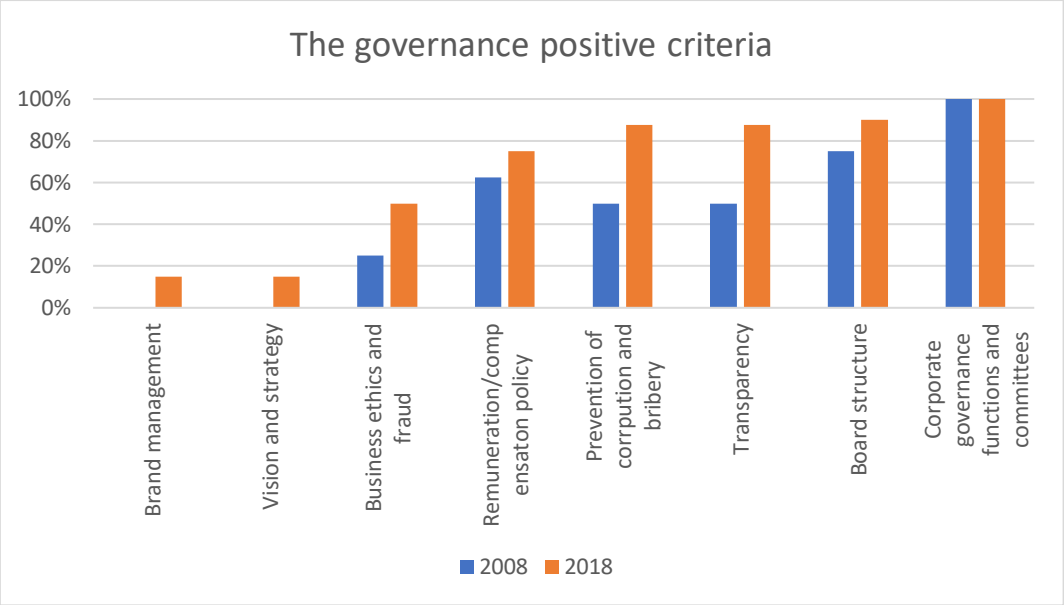

Figure 2.6 Source: Olmedo et al. (2019), "Rating the Raters: Evaluating how ESG Rating Agencies Integrate Sustainability Principles"

2.4 The divergence of ESG Ratings

Probably the main obstacle encountered by investors and researchers when dealing with ESG ratings is the discrepancy existing between the same ratings among different raters. In fact, in order to follow market demands, rating agencies are forced to frequently change their rating methodologies independently from companies' fundamentals, leading to confusion among investors and creating distortions in asset prices. Essentially, this is caused by the absence of a standard methodology, globally shared and accepted. Moreover, the lack of a unique standard for the certification of ESG data leads to the generation of very different scores for similar indicators that are analysed and weighted differently by every rating agency.

Several studies, such as the one produced by Chatterji et al. (2016), have confirmed that ratings from different providers disagree dramatically and this can lead to different financial decisions or discordant empirical results depending on the ESG rating considered in the analytical process. This situation is very different, for example, from the one observed in the credit rating landscape where the correlation between Moody's

and Standard & Poor's ratings is equal 0.99, as confirmed by the research by Berg et al. (2019). At the contrary, the dataset considered in that paper ,including five different ESG raters, have shown an average correlation of 0.61, and range from 0.42 and 0.73, but the focal point was to understand if this divergence is due to pure noise or if there are specific causes for the discrepancy. An important consequence of this evidence is that companies' ambitions towards an improvement of their ESG performance are frustrated by this situation because they often receive different grades from different raters that have a strong influence on the perception of the market towards the company. Moreover, as already underlined, the decision to choose one rather than another poses a challenge also for empirical research that can lead to very different results and conclusions depending on the selected agency. Altogether, this ambiguity is a not negligible factor in the financial decision-making process and could be an obstacle to a more environmentally sustainable and socially just economy.

The analysis by Berg et al. have produced a further crucial result, in fact they have been able to demonstrate which are the drivers of the differences between ESG ratings, identifying three main factors: *scope divergence*, *weight divergence* and *measurement divergence.* The first refers to the creation of the ESG rating based on different sets of attributes, so for instance one agency may include greenhouse gas emissions in its rating while another may not, leading to a conceptually different final score. The second is referred to the different weight assigned to the attributes (human rights, greenhouse gas emissions, product responsibility…) by different agencies and how a different weight given to a sub-score compensate the others. In this instance, is also included the decision to exclude an attribute from the rating and so assigning a weight equal to zero. The third source of divergence may be represented by measurement divergence, which derives from different scoring methods across different agencies for the same attributes. For example, the management of a company could be evaluated on the basis of the ratio of women on the total number of members in the management, or by the average age of all the components. Moreover, the data can come from different sources such as reports, public data sources, media news or public data sources so the final aggregate rating changes depending on the different data providers consulted and implicitly contains all three sources of divergence. The study shows that 53 percent of the differences of the ratings is due to measurement divergence, 44 percent comes from scope divergence and weight divergence accounts for a minimum part of 3 percent. Paraphrasing, 53 percent

of the divergences are explained by the fact that different ESG rating agencies measure the same categories in different ways and 47 percent of the discrepancy stems from joining data using different rules. Consequently, rating agencies could resolve the aggregate divergence by sharing the data on the indicator level and unifying the aggregation procedure to produce the final score.

A further aspect of the rating divergence is the presence of a *Rater Effect* which means that a firm to whom is recognized a good performance in one category by an agency, it is more likely to be evaluated well also for all the other categories, and *viceversa*.

Considering the increasing expectation from investors for good companies' performances in terms of ESG, and especially with regards to risks associated with climate change, there is a strong necessity for ESG raters to size the ratings on investors' expectations and try to find a unique set of coherent measures. Alternatively, ascertained that the divergence is not pure noise but is due to precise factors, researchers and investors should consider the option to build their own measures or simply giving their own weights to the attributes composing the scores. The convergence to a single ESG rating framework is fundamental not only for the quality of academic research, but would have an impact also on the financial performance of investors, who would be concentrated on a common set of attributes and measures allowing them to have a more reliable overview of their activity.

A further contribution to this field of study is given by the paper by Billio et al. (2020) where it is observed that among the leading agencies exists a discrepancy for what regards the definition of ESG characteristics, attributes and standards in defining E, S and G factors. As a consequence, this heterogeneity leads to opposite judgements by different agencies on the same company, causing a very low agreement between these providers. Moreover, the cited study proves that also by overlapping the main ESG indexes the percentage of common constituents is relatively low, approximately equal to 15%. An important consequence of this fact is the dispersion of the impact of ESG investors preferences on asset prices and the difficulty to identify the relevant ESG indexes to be used as benchmarks. In this respect, the annihilation of the impact of investors preferences has an effect on the financial performance of the ESG investors which does not seem to have an advantage on the non-ESG counterparties, even if sustainable and responsible are growing significantly in recent years. Moreover, this creates a not negligible impact on the operational side for investors which are no longer

able to identify reliable benchmarks to which compare their returns.

For these reasons, the main international authorities involved in capital markets and reporting, by emphasizing the crucial role of the financial sector in the transition to more sustainable future, have reinforced the need for investors to have comparable ESG data, encouraging the adoption of common sustainability reporting standards.

2.5 Greenwashing and related risks

In the last years, the increased request coming from investors and institutions to companies for higher compliance levels with sustainability principle has led to almost inevitably to reprehensible behaviours of greenwashing. The Nielsen Media Research presented that 66% of global consumers are willing to pay more for environmental-friendly products and so an increasing number of companies is developing green marketing strategies to show consumers their socially responsible attitude. This behaviour has been adopted also in the financial sector by several funds across Europe which rebrand themselves in order to meet the increased demand for sustainable investments, as it is shown in *Figure 2.7*:

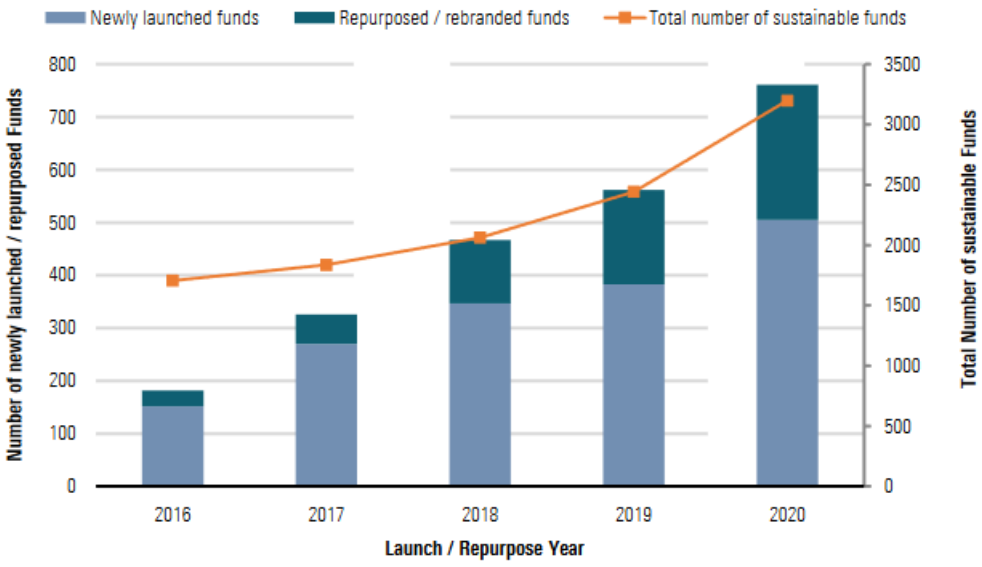

Figure 2.7 Source: "European Sustainable Funds Landscape: 2020 in Review"

Moreover, rebranding existing funds allows asset managers to leverage existing assets, thereby avoiding having to create new funds from zero. In 2020 has been identified 253 rebranded funds which added terms such as "sustainability", "ESG" or "green" to their names in order to enhance their visibility. The major worry is that, due to the lack of a

single shared set of rules to identify a fund as "green", some fund managers are simply following the trend in order to lift their business without producing any real positive effect for the environment.

In general, greenwashing is defined as "*the intersection of two firm behaviours: poor environmental performance and positive communication about environmental performance*", in particular for reputational and public relations reasons. This issue is not only relevant for businesses which claim to be more sustainable only as a consequence of small improvements or changes in their processes, but also for asset managers who try to make their portfolios look like they are ESG-friendly with spot actions, whereas they do not even apply ESG rules to the vast majority of their portfolios. In fact, it has been shown that it is frequent that asset managers claim to be engaged in sustainable investments when, actually, only 1% of their assets is oriented to sustainability and the remaining 99% is not even remotely sustainable.

Recent research has demonstrated that there are two main factors that increase the risk of greenwashing. The first one is the intrinsic uncertainty on the difference of future financial performance of high versus low carbon activities, which can be very different from the scenarios forecasted by financial supervisors. The second factor is related to the ability of investors to clearly assess the contribution of firms to the low-carbon transition efforts and their exposure to risks associated with the transition process. In fact, even if more and more companies regularly produce reports where the efforts made to transform their businesses in more sustainable ones are described, it remains difficult to estimate the real effort put in place in terms of actual climate-aligned capital expenditures.

One of the most emblematic cases of greenwashing is represented by the Volkswagen scandal in late 2015, when using an emissions-cheating software the German car manufacturer deceptively advertise diesel vehicles as clean and environmentally friendly cheating on the real emissions. After that the fraud was discovered, several studies have been made on the consequences for the environment and for public health produced by the fraudulent emissions, causing huge financial and reputational damages to the automaker. Several countries all over the world sued Volkswagen for fraud and false advertising and bringing actions against the managers of the company which has settled to buyback all the cars on trial and pay $2.7 billion for environmental mitigation and another $2 billion for clean-emissions infrastructures. Following the scandal, the

financial consequences on the corporate have been numerous and heavy. In November 2015, Moody's downgraded Volkswagen bonds credit rating from A2 to A3 and Fitch Ratings downgraded the Long-Term Issuer Default Rating by two notches contributing to the 20 percent fall of the share price on the first trading day after the scandal.

This emblematic case shows how much in the last two decades sustainability has become crucial for the market in particular for what concerns the environmental aspect. It is worth emphasizing the reaction that the main credit rating agencies had after the event, confirming the strong impact that corporate sustainability has in the evaluation of the credit rating of a company, even more for the second biggest car manufacturers in the world. An effective way to reduce the impact of greenwashing on the markets would be to create a unique set of rules in order to classify investments as environmental-friendly or not. The European Union, for example, is working on a set of common conventions to identify green investments, so it is desirable that this issue might be almost completely eradicated in a few years.

CHAPTER 3

3. ESG AND CREDIT RISK

In the previews chapter has been shown the relevance that ESG issues have gained in financial environment. A crucial issue and direct consequence of the ESG rating assigned to corporates and businesses is the impact on debt financing conditions, in particular with respect to the cost of debt and to the capability for a company to access the financing markets. Extensive research has highlighted that seem to exist a positive relation between the ESG performance of a firm and its debt financing conditions, but still with some relevant opposite exceptions. In fact, investments in ESG may be a waste of resources resulting in lower cash flows and higher firm risk.

As one of the main risks linked to companies' activities, credit risk has been defined as the risk of an economic loss from the failure of a counterpart to fulfil its contractual obligations (Jorion, 2007), which is affected by various firms' characteristics such as leverage, earnings, collateral, reputation and management competency (Altman & Hotchkiss, 2006). A fundamental role in the assessment of credit risk is played by credit rating agencies whose purpose is to assess the likelihood of an entity to meet its financial obligations, to pay back debt and pay interests, in full and on time. As ESG factors are becoming increasingly important in the quality assessment of issuers, the credit rating industry is slowly absorbing some of the main ESG rating and data providers, demonstrating the increasing relevance of these themes for investors and financial institutions.

Among companies' stakeholders, the most interested to ESG and Corporate Social Responsibility practices are the bondholders since these virtuous practices can lead to lower levels of uncertainty and risk. This is confirmed by the fact that the best companies from a Corporate Social Responsibility prospective enjoy lower levels of cost of debt with respect to their less faithful competitors, meaning that financial

intermediaries and investors perceive these factors as significant indicators of a better performance.

3.1 Literature Review

3.1.1 *The ESG effect on credit risk*

According to Merton (1974), higher and less volatile flows thanks to ESG practices produce an improvement in company valuation, i.e. in higher overall value of assets, lower probability of default and, hence, lower credit spreads.

Several researches have focused on determinants of CDS spreads rather than bond yields and prices, in fact they are more liquid instruments and are updated more frequently than credit ratings. The determining factors of CDS spreads are several and have been deeply analysed in several researches, finding that credit ratings, stock return, firm's leverage and stock return volatility are significant factors in influencing this measure of credit risk. Furthermore, a recent paper by Barth, Hubel and Scholz (2020) have uncovered that clients may accept to pay a premium for products and services of long-term sustainable companies, suppliers would allow more favourable payment terms and investors may be more motivated to make long-term investments in these companies. Furthermore, they found evidence that higher ESG score affects the probability of default of a company and so its CDS spread. These favourable conditions are due to a better perception from the market and consequently allow also to adapt to innovations and regulatory changes. In fact, Franklin (2008) observes that investors are more inclined to invest in companies with better reputation and compliant with the effective regulations, allowing the firm to enjoy better financing conditions and lower default probability.

At the contrary, Goss and Roberts (2011) affirm that overinvestment in sustainability may be an important issue for some companies, because they may result to a waste of scarce resources and so a higher credit risk for the firm. Moreover, Perez-Batres et al. (2012) observe that in some cases there may be a conflict between the management, which sees ESG investments as a long-term opportunity of growth, and shareholders which have to bear the costs of the investments with the subsequent increase in firms' fixed costs.

All previous arguments have been shown to be extensively valid for US firms,

meanwhile when looking at European firms, there is not a complete agreement on these themes. In particular, the paper by Merz (2010) shows that, for European companies, higher ESG compliance does not imply higher bond yield spread, even if other studies reveal no clear-cut boundaries on this matter. By analysing a sample of Italian and Spanish companies, Devalle et al. (2017) discover that ESG performance is positively associated with higher credit ratings but doesn't seem to exist a strong association with the default probability. Moreover, when focusing on the single ESG factors scores, ESG performance seems to be meaningfully affected by social and governance metrics, whereas the environmental factor does not seem to have a significant effect.

3.1.2 *ESG and cost of capital*

The literature on Environmental, Social and Governance (ESG) issues is extensive, but the heterogeneity of results on different aspects and implications doesn't allow to draw certain conclusions. One of the few topics on which there seems to exist a broad agreement is the positive effects of ESG on the cost of capital which, however, has not been studied extensively. Some researchers argue, in fact, that credit intermediation suffers of lack of transparency concerning borrower's social commitment, so they prefer to consider equity capital markets instead.

An ample ESG literature review by Roy Henriksson et al. (2018) have assessed that companies with better ESG scores tend to be able to borrow more cheaply, have higher credit rankings and also have lower cost of equity capital. Bauer and Hann (2010) analysed more than 2'200 bond issues in the United States and found that companies with better environmental management standards have lower loan costs. Analogously, Chava (2011) compared more than 5'800 loan facilities made to about 1'400 US-based firms and has found that corporations with several environmental concerns pay significantly higher interest rates on their loans. A similar finding is evidenced by Schneider (2011) who concludes that scarce environmental performance represents a strong indicator of future compliance and clean-up costs that can be so large to bring the polluting firms to default.

Some other works focused the attention on the impact of governance on the cost of debt financing, finding that a higher percentage of institutional ownership and outside directors is positively correlated with higher bond ratings and lower bond yields

(Sengupta, 2003). Other research made by Chava, Livdan and Purnaanandam (2009) highlighted the fact that firms with lower antitakeover defences pay on average significantly higher spreads on bank loans. Di Giulio *et al.* observed the existence of a negative relationship between corporate social responsibility and the weighted average cost of capital of a firm, assumed as proxy of the risk perceived by stakeholders.

When observing specifically the cost of debt and the associated risks, a research by Goss and Roberts (2011) that borrowers with low-quality sustainability standards experience higher loan spreads. Moreover, according to Menz (2010) corporate governance and CSR are "missing risk factors" rarely considered in risk assessment processes which, instead, may be useful to explain the observed risk premiums for certain firms.

3.1.3 *Environmental performance and Cost of Debt*

The impact of environmental performance on the cost of debt is one of the main topics of interest in this context of study and has been extensively reported in several studies.

Mengze and Wei (2015) observe that environmental risk affects credit risk in three ways, directly, indirectly and reputationally. Also the reputation of a creditor can be damaged if he is found to support financially projects or borrowers clearly environmentally irresponsible. It may also suffer direct risk due to direct liability for cleaning up pollution caused by an insolvent borrower or may be hit indirectly if the borrower is liable for paying financial penalties due to the environmental damages caused by its activities.

Furthermore, Weber et al. (2010) shown that the incorporation of corporate sustainability criteria in the lending process improves by approximately 7.7% the correctness of credit default predictions. This evidence confirms that creditors should place increasing importance on environmental credit risk management in their corporate lending operations.

3.1.4 *Corporate Governance and Cost of Debt*

It is a widespread and consolidated argument that firms with good corporate governance practices are perceived as more transparent and trustworthy by creditors and, therefore, with a lower default risk profile. Already Sengupta (1998), Bhojraj and Sengupta (2003)

and Andreson e*t al.* (2004) observed in their works that firms with high governance standards and high disclosure quality enjoy lower interest rates and better financing conditions.

Despite these evidence, little attention has been paid to the impact of governance controversies on credit risk. Empirical analyses have shown that bad governance practices can impact firm's trustworthiness and risk perception by external counterparties (Bedard and Johnstone, 2004). Moreover, Fich and Slezak (2008) observed that distressed firms' governance characteristics significantly affect the probability of bankruptcy. These different findings raise the issue if it is correct to consider the overall governance factor as indivisible or if it is better to isolate the single indicators which may have different effects on the default risk.

3.2 How Credit Rating Agencies integrate ESG factors in their ratings

As environmental, social and governance themes become more and more relevant, also due to the impact of the pandemic, rating agencies have to pay increasing attention to them also by giving a higher weight to ESG considerations in their ratings which have not really considered ESG factors as a direct component so far.

Especially in the last year, sustainability themes have grown in importance above all the social component, due to the impact of the pandemics on employees and civil society. During this catastrophic period, the three most prominent rating agencies, Standard & Poor's, Moody's and Fitch Ratings have all included ESG themes into their credit rating methodologies, corroborating the hypothesis that environmental, social and governance issues have an impact on the credit risk of a company. In order to that, S&P and Moody's have also acquired entities with a specific knowledge in the ESG fields. In particular, they have incorporated two of the main providers of ESG financial and non-financial data already cited in this dissertation, S&P has bought RobecoSAM while Moody's has acquired Vigeo Eiris, two market leaders in ESG assessment.

The importance of the social factor as a credit determinant has emerged especially during the peak of the pandemic, when social distancing and health concerns were having a direct heavy impact on business activities. During the same period, there has been an intensification on institutional preparedness for global environmental and social risks, including healthcare access and economic inequality. So, corporates face at the

same time two different challenges: the first is to urgently prepare for ESG risks in the medium-to-long-term, while the second is to manage their credit ratings, which requires managing short-to-medium-term capital (*capex*) and operating (*opex*) expenses that can have an impact on credit metrics. This requires a careful management of the ESG transition which may cause more damages than benefits to a firm in the short term if not handled properly.

So far, ESG components have not been a direct component of credit ratings as isolate concepts, rather environmental, social and governance issues are considered in relation to the impact that these factors have on corporates and their financial risk profiles. Substantially, rating agencies ESG analysis is becoming an increasingly important component of the credit rating process and will for sure continue to be so.

3.2.1 *The case of two major Credit Rating agencies*

Moody's and Standard & Poor's are two of the main international credit rating agencies and in the last decade have shown to be very careful to ESG themes and how they impact the credit risk of the companies they have to judge.

Moody's doesn't have a univocal methodology for every company, in fact the approach changes depending on sector and country to which the firms belong. This strategy is adopted in consideration of the fact that ESG factors affect differently the credit risk of a company. For example considering the car manufacturers or energy sectors, the attention is particularly concentrated on CO2 and greenhouse gasses emissions, whereas for financials this aspect is less relevant and more relevance is given, for instance, to governance and social aspects. The same differences can be observed also in sovereign ratings because, for example, emerging markets are more subject to environmental risks compared to developed markets.

Moody's Investor Service (2021) explains that in the rating analysis is established an Issuer Profile Score (IPS) for each of the pillars, which indicate the extent to which a given issuer or transaction is exposed to E, S and G risks or benefits for to these risks. As can be seen in Figure 3.1, the IPSs are inputs to credit ratings and ESG credit impact score (CIS) which communicates the impact of ESG considerations on the rating of an issuer or transaction.

Environmental risks are evaluated considering two main types of risks: *"the*

consequences of regulatory or policy initiatives that seek to reduce or prevent environmental trends or hazards" and *"the adverse effect of direct environmental trends and hazards, such as pollution and climate change"*. Moody's dedicates particular attention to environmental factors which are assuming particular relevance for the credit risk due to the increased frequency of extreme climate events and relevance of these themes in the society and in the regulatory framework. Social risks, instead, take into consideration mainly product safety, supply-chain considerations, business reputation and employee relations. Governance risks, finally. Are driven by external factors such as regulation or demographic change. All these factors are considered influential for future cash flows or can increase future costs for a company. As a general rule, ESG risks are not evaluated singularly but at aggregate level, in this way the rating agency can evaluate all the risks avoiding problems connected to the lack of consideration of relevant risks.

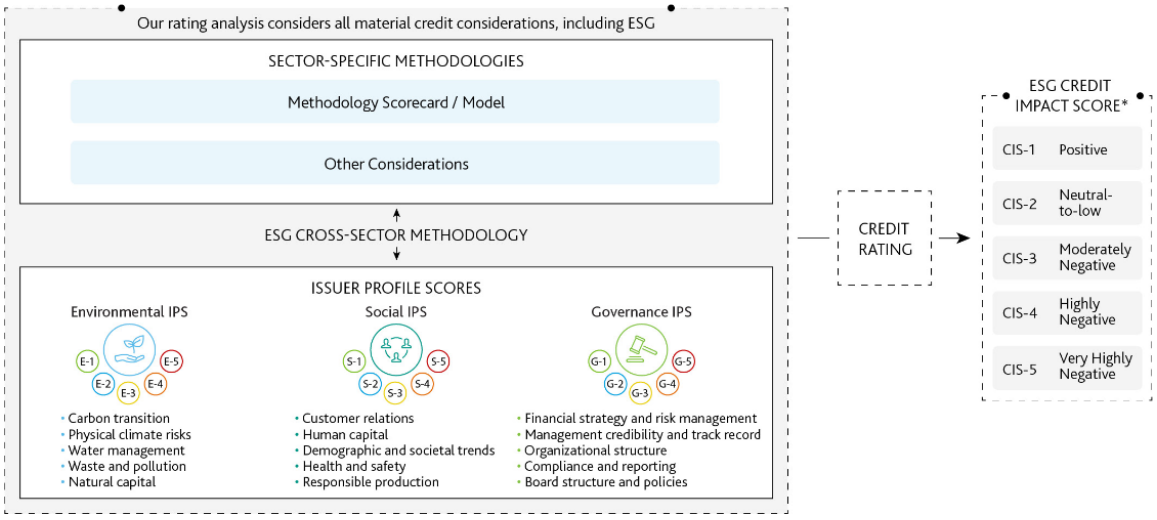

Figure 3.1 Source: General Principles for Assessing Environmental, Social and Governance Risks Methodology, Moody's Investors Service (2021)

A further factor that is considered in the process of incorporation of ESG profile scores is the time horizon during which specific events produce an effect on companies. A higher weight on the valuation is given to risks that may produce effects in the short term and so can be estimated precisely. At the contrary, the risks that produce effects in the long term or that are hardly quantifiable, are still incorporated in the rating but have a lower impact on the rating compared to short term risks. This is due to the conviction

that, considering the higher predictability of the risks in the long term, firms can protect themselves adapting to the changing context. This is evident in the case of new regulations; those how are recently implemented and that produce immediate effects have a potentially stronger impact on the risk profile of the issuers and their sectors. At the contrary, those regulations that will have effects in the long period are more difficult to include in the valuation, also because they involve uncertainty for the issuers on how to adapt to the new rules. In these situations Moody's also performs a general analysis on the political context in which the firm operates. The same is true for the environmental risks, giving higher value to those that have a higher probability to impact the firm in the short term.

A similar approach is assumed by Standard & Poor's that aims to incorporate quantitative and qualitative ESG analysis on the longest possible time period and the longer is the time period considered in the rating the higher is the number of factors considered in the credit rating. The ESG factors considered in the valuation are those that can influence the capacity of the issuer to repay its debts.

3.2.1 *The impact of ESG factors on Credit Rating actions*

One the biggest changes, that the growing of ESG investments has caused, is the increased attention of the major credit rating agencies for sustainability themes which are more and more frequently, but one might say always, incorporated in their credit rating actions intended as down or upgrades. The protraction of COVID-19 Pandemic has inevitably changed the economic framework in which companies all over the world have to challenge themselves and so also the way in which they can be valued. It has also implied a deep revision of the major risks to be considered by rating agencies and lending institutions in the process of lending and credit analysis.

ESG credit factors are those ESG factors can materially influence the creditworthiness of a rated or issues and, although they are not standalone credit risk indicators, their impact on debtors' business and financial profiles have led to several rating actions in the last two years during which over 98% of ESG effects have related to health and safety issues connected to COVID-19. ESG credit factors are incorporated through the application of sector-specific criteria which have shown that the most affected businesses in the last year have been air travel companies, media and leisure, higher

education and retail, as well as restaurants and hotels. Conversely, financial services ratings have experienced very few ESG-related impacts over the past 14 months.

Standard & Poor's declares that between April and December 2020 just above 30 percent of total rating actions in the corporate sector were affected by ESG factors, of which 14% were related to environmental issues. Already in 2017 S&P was reporting that more than 1000 credit rating decisions were linked to environmental, social and governance concerns. A similar situation is pointed out by Moody's whose credit rating actions have been affected by ESG factors in 33 percent of all reports on private sector companies of which 20 percent were related to social issues. Fitch, instead, has had around 25 percent of its rating decisions influenced by one or more ESG impact scores of which 20 percent was related to governance considerations as of September 2020.

The increased concerns about, in particular, environmental threats have put in the spotlight the oil and gas industry with several negative implications for the risk profile of several European, North American and Chinese companies in the sector. Standard & Poor's has revised the industry risk to "moderately high" from the previous "intermediate" due to the increased environmental threats posed by greenhouse gas emissions and the subsequent governmental policies and emission standards.

CHAPTER 4

4. THE EFFECT OF ESG RATINGS ON CDS SPREADS: EMPIRICAL METHODOLOGY AND RESULTS

This chapter is the core of the thesis and provides the details of the quantitative methodology used to test the hypothesis in order to try to solve the initial research question that is how ESG factors affect the market-implied probability of default of a firm and so its credit risk. In particular, the aim is to understand which factors mainly affect the probability of default of a company.

The aim of this research is to provide a contribution to the past academic literature analyzing the impact of ESG on the credit risk of European companies, considering the Credit Default Swap spread as the output variable. In this context the use of the CDS spread is particularly interesting, in fact it represents a precise indicators of credit risk, that is easily comparable across firms and accounts for the majority of the firm level determinants of default risk (Forte and Peña 2009), (Tang and Yan 2010). On the other side, the numerousness of different ESG scores provided by the main ESG rating providers requires a careful evaluation in order to understand which one is the most appropriate for this analysis and how much is actually extended the divergence between them.

First of all, it is crucial to highlight that, in order to conduct the following analysis, several data providers have been used but in several cases it has been impossible to find a coincidence between credit default swaps data, ESG ratings and credit ratings coming from different sources. Moreover, as already explained in the theoretical chapters, there is also a problem of homogeneity between ESG ratings which have led to a selection of the possibly best ratings. The third, and maybe most relevant problem, is connected to the availability of financial data for the companies of the sample, limiting the number of

control variables that will be considered in the empirical model. Moreover, it has been observed a shortage of CDS data and ESG ratings, also when more than one data provider is considered. In fact, at the time of the analysis, there were available only monthly ESG ratings until 2019, while CDS data were available daily until June 2020.
So, for these reasons, the complex preliminary work has been focused on the necessity to identify the companies for which all these data were available and from a starting sample of 480 companies, only 181 fit the required characteristics.

4.1 Research Hypothesis

Considered everything exposed in the previous chapters, the research hypothesis analysed in this thesis are focused on the commitment of European firms to environmental, social and corporate governance sustainability:

H_0: ESG Scores have a negative impact on European firms' CDS Spreads, i.e. β coefficients are negative

This first hypothesis takes into consideration the overall impact of ESG ratings on CDS spreads and so on the probability of default. According to the revision of past literature, in this study it is expected to find an inverse effect of ESG scores on the credit risk of European firms, implying that a higher ESG score results in lower CDS spread, i.e. lower probability of default.
The analysis takes into consideration 181 European companies listed on different national stock exchanges and belonging to different sectors. Some of the sectors considered are more prone to sustainable actions by their intrinsic nature, whereas others, such as oil and gas companies or weapons producers, may be impacted on a very different way by ESG ratings.
The second hypotheses tested is the following:

H_0: ESG Scores have different impacts on European firms' CDS Spreads, i.e. the E, S, G factors, and their components, have different β coefficients and signs

With the first hypothesis the focus is pointed on the overall ESG score assigned to the firms, while with the second one are considered the scores assigned to every single ESG pillar, in order to understand which factors are more influential and how much they affect the credit risk of the companies. Considering that the existing literature does not

agree on the effect that environmental, social and governance scores have on credit risk, this empirical analysis aims to effectively contribute to this puzzling debate.

4.2 Sample and Descriptive Statistics

The sample considered is composed by 181 European firms belonging to the MSCI Europe Index and takes into consideration the period between 2010 and 2019. The specific purpose is to avoid the period before and during the Great Financial Crisis. Moreover, due to the limited availability of data for the 2020, it has been decided to avoid this particular period which has been certainly influenced by the COVID-19 pandemic. Every firm is represented by the corresponding 5Y CDS Spread.

Looking at the nationality of the firms, the sample includes in particular French (~27%), German (~16%) and Italian (~12%) companies. Anyway, even if some companies are more represented than others, the sample is sufficiently heterogenous and allows to perform an analysis not biased by country specificities or macroeconomic events.

The complete list of the countries considered in the analysis is presented in Table 01:

Table 01: Firms' Country Distribution

COUNTRY	OBSERVATIONS	COUNTRY WEIGHTS %
Austria	5	2.8%
Belgium	2	1.1%
Denmark	5	2.8%
Finland	5	2.8%
France	50	27.6%
Germany	28	15.5%
Greece	1	0.6%
Hungary	2	1.1%
Italy	22	12.2%
Luxemburg	2	1.1%
Netherlands	18	9.9%
Portugal	6	3.3%
Spain	17	9.4%
Sweden	17	9.4%
TOTALE	181	

The companies considered belong to 11 different industries but mainly to the financial sector (~21%), the industrial sector (~17%) and the utilities sector (~10%). This heterogeneity is fundamental in order to prevent possible biases due to different

regulations, corporate governance commitment across different sectors or industry-related trends. Considering the widespread attention for ESG issues, all the industries are included in the analysis assuming that different events may have a similar impact on different industries.

The sector concentration and the weight of each industry on the sample are listed in Table 02:

Table 02: Firms' Industry Distribution

INDUSTRY	OBSERVATIONS	COUNTRY WEIGHTS %
Communication Services	16	8.8%
Consumer Discretionary	16	8.8%
Consumer Staples	13	7.2%
Energy	8	4.4%
Financials	39	21.5%
Healthcare	4	2.2%
Industrials	31	17.1%
Information Technology	6	3.3%
Materials	14	7.7%
Real Estate	3	1.7%
Utilities	18	9.9%
-	13	7.2%
TOTALE	181	

4.2.1 *The Time Horizon*

The time horizon considered in the analysis goes from 1 January 2010 to 1 January 2020. This choice is driven by the necessity to have a wide sample on which the analysis is performed and, consequently, by the scarcity of data relative the firms which have required to consider a period of time longer than expected. The panel data considered is strongly balanced, so only monthly data is taken into account, because they are available for each of the variables in the model.

Moreover, the decision to consider sufficiently long period of time and the 5-year CDS is due to the peculiarity of the topic under examination, i.e. ESG scores and corporate sustainability, which can be evaluated only on the medium-long term in order to be able to see substantial changes in the behaviour of a company under this aspect.

An important point that must be underlined is the increasing production of new regulations and ESG policies during the period considered, in particular the Paris

Agreement in 2015 which represents a milestone in the process of reduction of greenhouse gasses at a worldwide level. After this agreement, the attention for the themes connected to sustainability has grown among common citizens but also, most importantly for this research, among institutional and retail investors which started to believe that ESG investments can lead to above average value creation.

4.3 Credit Default Swaps (CDS)

Credit Default Swaps are contracts traded over-the-counter (OTC) between two counterparties in order to transfer the credit exposure of the underlying company. The CDS spread quoted in basis points (bps) represents the price that the investor has to pay to insure against the company's default. This measure has the advantage to be constantly updated during daily market negotiations and so all valuable information, including ESG scores and related news, are rapidly absorbed in the CDS price (spread). For the sake of clarity, if the CDS spread is, for example, 100 bps, it means that the investor pays $100,000 a year to buy protection on $10 million worth of the company's debt. As default risk rises, so does the cost of CDS, i.e. the spread, because it is more likely that the company will default on its obligations.

For these purposes, the CDS data have been downloaded from Eikon, the data provider software by Refinitiv and, initially, have daily frequency which has been reduced to monthly frequency in order to meet the frequency of ESG and credit rating data. The majority of researches on this topic are focused on the impact of the ESG factors on corporate bonds, such as in the papers by Menz (2010) or Oikomomuo et al. (2014) who have conducted an analysis on the American corporate bond market, concluding that better ESG performances lead to a reduction of bond yield spreads.

The choice to use CDS rather than bond yields, or other parameters of credit risk, is due to the fact that CDS are much more liquid instruments than corporate bonds (Ederington, Guan e Yang 2015) and they are updated more frequently than credit ratings (Finnerty, Miller e Chen 2013). Moreover, bond prices can also be affected by other factors, like embedded options (Barth, Hubel e Scholz 2020), specific characteristics of that bond issuance or Central Banks short-term policies, making comparison across firms rather difficult. On the contrary, CDS have a standardize structure and this characteristic allows to compare probability of default across firms

more easily. In particular, in this analysis is used the 5-year maturity CDS which is the most traded one, even if also the 1-year and 10-year CDS have a high liquidity.

All the CDS considered in the sample belong to European companies, are denominated in Euros and have monthly observation frequency. After the data cleaning and reordering process, for this variable there are 8043 data points available covering the firms in the sample. This process has required to remove all the spreads higher or equal to 4000 basis points distorted by the illiquidity of the instruments or severe valuations. This approach is borrowed by the paper by Zhang, Zhou and Zhu (2019).

In Table 03 the Average CDS Spread, the Max Spread and the Min Spread for each of the years considered are summarized:

Table 03: Average, Maximum and Minimum CDS Spread

Year	Average CDS Spread	Max Spread	Min Spread
2010	134.6	1325.3	5.6
2011	166.6	1344.8	0.7
2012	168	1733.5	2.4
2013	116.1	917.3	0.4
2014	87.3	952.4	1.3
2015	119.7	2883	1.2
2016	90.3	2540.8	0.1
2017	59.5	643	0.6
2018	95.8	708	0.1
2019	104	580	11.8

From the table it is possible to observe the trend followed by CDS Spreads that, on average, show higher values in the period immediately after the Great Financial Crisis and, in particular, during the European Debt Crisis.

Since CDS Spreads are quoted in bps, they can reach extreme values so, instead of the crude value, the logarithm of the spreads is considered, as it levels all variables almost at the same scale.

4.4 ESG Aggregate and Factor Ratings

As explained in previous chapters, all ESG rating providers employ different methods to assign scores collecting data from different sources and evaluating them giving different weights to similar aspects of sustainability. Usually the scores are assigned yearly, so they are not able to rapidly integrate the relevant events or the actions taken by the companies to enhance their sustainability profile. The differences in the models and methodologies used to assign the scores implies that for the same company there could be several discordant scores. Of course, for the purposes of this research it is important to use data from a single data provider, specifically Refinitiv EIKON. In this way, all the variables considered in the model are retrieved from the same platform, ensuring a theorical coherence between them. The description of how the scores are generated by Refinitiv can be examined in depth at paragraph 2.3.2. Summarizing, the overall ESG score is the combination of the score of each pillar (E, S and G) and the score of each pillar is based on the score of the different categories of sustainability. Then, the scores assigned to each category are determined by more than 70 key performance indicators calculated from more than 400 data points values. The advantage of this score is that it is constantly updated in case of relevant events, significant news or controversies, so it provides a constantly updated image of the sustainability profile of the company.

The ESG scores produced by Refinitiv can assume values between 0 and 100 and, as already explained in the previous chapters, it is an aggregate score based on self-reported information in the environmental, social and governance pillars, and which assigns different weights to each pillar according to the industry of belonging.

Usually, in industries like the energy sector, the E pillar has a particularly high weight with respect to the other pillars (usually from 40% to 55%), whilst in industries like Telecommunication, Healthcare or Financials the social factor is the factor with the higher weight (usually from 35% to 45%).

The same holds at a lower level for the scores of the three pillars which are the aggregation of specific key performance indicators.

The following table provides some useful descriptive statistics about the main ESG scores considered in the analysis:

Table 04: ESG Scores Descriptive Statistics

	ESG Score	E Score	S Score	G Score
Mean	68.936459	71.4764019	73.00922	59.58555
Median	72.4746	77.6289	78.0059	62.7833
Standard Dev	16.323106	21.8732503	18.8359	21.71638
Minimum	2.8460519	0	4.307683	2.037037
Maximum	94.773979	98.7360756	97.92599	97.7747
Kurtosis	1.7918088	2.01536396	0.992402	-0.68797
Skewness	-1.245047	-1.5043492	-1.17245	-0.44499

	Resource Use	Emissions	Environmental Innovation	Workforce	Human Rights	Community	Product Responsibility	Management	Shareholders
Mean	78.02	78.05	57.69	83.31	65.85	69.35	68.76	61.04	52.26
Median	85.75	86.43	63.74	88.66	76.32	78.33	78.95	65.09	52.06
Standard Deviation	23.55	23.35	31.77	18.10	30.30	27.05	28.82	27.90	29.03
Minimum	0	0	0	0.29	0	0	0	0.94	0.47
Maximum	99.81	99.88	99.67	99.91	99.41	99.83	99.69	99.72	99.67
Kurtosis	3.10	3.06	-0.95	4.95	-0.27	-0.49	-0.11	-1.01	-1.12
Skewness	-1.82	-1.83	-0.55	-2.08	-0.97	-0.80	-1.03	-0.39	-0.07

It is interesting to observe that the lowest average scores are registered in the governance field and the highest in the social.

4.5 Structural and Control Variables

4.5.1 *Leverage, EBIT and Credit Rating*

In addition to the main independent variables object of this study, further structural and control variables have been considered. In particular, the starting variables considered in the model are Leverage, Earnings Before Interests and Taxes (EBIT) and Credit Rating. These variables are considered as control variables as soon as the focus of the study are ESG scores. Control variables are not of interest to the study's aims but are controlled because they could influence the outcomes and, in this way, the internal validity of the study is enhanced by limiting the influence of confounding and other extraneous variables. Past studies, first and foremost the one by Merton (1974), have assessed the correlation existing between CDS spreads and these variables, determining that asset value, asset volatility and leverage are primary determinants of corporate credit risk for US firms.

The data have been got back from Refinitiv EIKON platform and then only monthly

observations, coinciding with the ESG scores data, are kept to perform the analysis.
In order to obtain the leverage for each company, the monthly values for total long and short-term debt and total assets have been downloaded from Refinitiv EIKON platform in order to compute the ratio between these two total values. Several researches have proved that, also for European companies, higher levels of leverage imply higher credit risk for companies and investors.
On the contrary, the preliminary analysis performed before the regression analysis have shown that, for the sample considered, stock returns are not significant determinants of CDS spreads so they are not considered in the final model.

4.5.2 *Credit Ratings*

A further independent variable considered in the model is the monthly credit rating assigned to each company. This variable, even if it is employed as control variable, can be considered for all intents and purposes a structural variable in the determination of CDS Spreads and an alternative reliable measure for credit risk. It has been decided to rely on the monthly credit ratings of the three main rating agencies, Standard & Poor's, Moody's and Fitch. This seems to be the most appropriate solution, because the ratings from each of these three agencies are not available for all the 181 companies in the sample, so considering all of them we can have a larger set of data.
As already underlined, the peculiarity of this variable is due to the possibility to include it in the model as a structural or a control variable. Moreover, there may be multicollinearity problems between ESG ratings and credit ratings, even if the majority of the determinants of ESG Scores are peculiar and doesn't coincide with the determinants of CDS Spreads. So also this issue has been considered before estimating the model and the results are shown in the following paragraph.
The main problem arising when three different credit ratings are used is the incoherence of the valuation scale:

- Standard & Poor's ratings are calibrated on a 24 rating classes scale ranging from AAA (Prime grade) to D (Deafult)
- Moody's ratings are calibrated on a 21 rating classes scale ranging from Aaa (Prime grade) to C (Default)

- Fitch ratings are calibrated on a 23 rating classes scale ranging from AAA (Prime grade) to D (Default)

In order to unify these three rating scales, the linear transformation provided by Afonso et Gomes (2007) shown in Table 04 has been applied in order to obtain the following unique scale of 21 classes later used in the regression model.

This transformation is possible considering that there is a correspondence between each rating level as shown in Table 04:

Table 04: S&P, Moody's and Fitch rating systems and linear transformations

Characterization of debt and issuer (source: Moody's)		Rating			Linear transformations	
		S&P	Moody's	Fitch	Scale 21	Scale 17
Highest quality	Investment grade	AAA	Aaa	AAA	21	17
High quality		AA+	Aa1	AA+	20	16
		AA	Aa2	AA	19	15
		AA-	Aa3	AA-	18	14
Strong payment capacity		A+	A1	A+	17	13
		A	A2	A	16	12
		A-	A3	A-	15	11
Adequate payment capacity		BBB+	Baa1	BBB+	14	10
		BBB	Baa2	BBB	13	9
		BBB-	Baa3	BBB-	12	8
Likely to fulfil obligations, ongoing uncertainty	Speculative grade	BB+	Ba1	BB+	11	7
		BB	Ba2	BB	10	6
		BB-	Ba3	BB-	9	5
High credit risk		B+	B1	B+	8	4
		B	B2	B	7	3
		B-	B3	B-	6	2
Very high credit risk		CCC+	Caa1	CCC+	5	1
		CCC	Caa2	CCC	4	
		CCC-	Caa3	CCC-	3	
Near default with possibility of recovery		CC	Ca	CC	2	
				C		
Default		SD	C	DDD	1	
		D		DD		
				D		

Barth, Hubel and Scholz (2020) observe that credit ratings, stock returns, firm's leverage and stock return volatility are significant factors with an impact on the CDS spread and the aim of this thesis is to understand if also the overall ESG Score and the scores assigned to the three ESG pillars can be considered additional determinants of the CDS spread.

In order to do so, the ESG scores provided by Refinitiv are considered because of their construction that measure the ESG performance of a company across three main dimensions covering 10 sustainability themes. These dimensions are environmental

(resource use, emissions, and innovation), social (workforce, human rights, community, and product responsibility) and governance (management, shareholders, and CSR strategy). These indicators are considered a comprehensive evaluation of the company's sustainability impact and conduct based on the reported data in the public domain.

Considered the results obtained from past researches, from this analysis on more than one hundred European firms we expect a higher ESG score to result in lower credit risk and therefore a lower CDS spread, i.e. a lower probability of default of the company. In fact, we expect to obtain results confirming the risk mitigation view of sustainable and ESG practices.

4.5.3 *Further descriptive statistics*

The main summary statistics for the control variables are reported in Table 05:

Table 05: Structural and Control Variables Descriptive Statistics

	Credit Rating	Leverage (%)	EBIT (10^9)
Mean	13.60	113.75	55.70
Median	14	58.84	13.45
Standard Deviation	2.53	2.24	318
Minimum	1	11.14	-160.28
Maximum	19	2796.77	7751
Kurtosis	1.45	89.23	16.50
Skewness	-0.59	8.50	13.45

It is interesting to note that the average leverage is particularly high with a low standard deviation. On the contrary, the EBIT, which has been divided by 10^9 in order to reduce the scale, shows a high standard deviation due to the presence of several values with extreme negative values, far below zero. Moreover, it is worth noting that comparing the credit rating statistics with the ESG statistics they are very similar. In fact, comparing the mean and the standard deviation with a 0-100 range scale they are similar to the same statistics of the ESG Score.

Moreover, for a preliminary analysis, the Pearson correlations coefficients between variables are calculated, in particular between the aggregate ESG Score, the ESG Scores

for the three factors and the single ESG Scores composing the three factors and the CDS Spread. The three tables showing the correlations are reported in Table 06, Table 07 and Table 08:

Table 06: Correlations between CDS Spread and 4 independent variables

Correlations	CDS Spread	Credit Rating	ESG Score	EBIT	Leverage
CDS Spread	1.000	-0.641	-0.206	-0.292	0.269
Credit Rating	-0.641	1.000	0.263	0.456	-0.230
ESG Score	-0.206	0.263	1.000	0.266	-0.231
EBIT	-0.292	0.456	0.266	1.000	-0.144
Leverage	0.269	-0.230	-0.231	-0.144	1.000

The correlation matrix reports correlations between explanatory variables and CDS Spreads consistently with the expectations. In fact, it shows a clear negative correlation between the CDS Spread, the aggregate ESG Score, the transformed Credit Rating and EBIT, meaning that to a higher ESG Score, Credit Rating or EBIT, corresponds a lower CDS Spread and so a lower default probability. On the contrary, there is a positive relation between the CDS Spread and the leverage of the firms, so, as expected, higher leverage implies higher firm's assets risk and so default probability. Moreover, it may be noted that the correlation between the ESG Score and the other explanatory variables is nearly ±0.20, so there should not be present multicollinearity. As underlined in the previous paragraph, this is particularly relevant in the relationship between ESG Scores and Credit Ratings.

Table 07 reports the matrix containing the correlation coefficients between the CDS Spreads and the three ESG Pillars Scores which compose the aggregate ESG Score:

Table 07: Correlations between CDS Spread and 3 independent variables

Correlations	CDS Spread	Environmental Pillar Score	Governance Pillar Score	Social Pillar Score
CDS Spread	1.000	-0.104	-0.180	-0.179
Environmental Pillar Score	-0.104	1.000	0.227	0.528
Governance Pillar Score	-0.180	0.227	1.000	0.221
Social Pillar Score	-0.179	0.528	0.221	1.000

As expected, the correlation coefficients show negative correlations between the CDS Spread and the Scores of the three ESG pillars. In particular, the Governance and the Social Pillar Scores seem to be the scores with the highest negative correlation between the three and the Environmental Pillar Score the one with the lowest correlation. Moreover, as shown in the previous table, Earnings Before Interests and Taxes and credit rating show a negative correlation with the CDS Spread, meanwhile leverage is positively correlated to with this measure.

The correlation matrix reported in Table 08, instead, reports the correlations between the CDS Spreads, the 10 sustainability themes composing the three ESG Pillars which compose the 3 ESG Pillars Scores:

Table 08: Correlations between CDS Spread and 13 independent variables

Correlations	CDS Spread	Resource Use Score	Emissions Score	Environmental Innovation Score	Workforce Score	Human Rights Score	Community Score	Product Responsibility Score	Management Score	Shareholders Score	CSR Strategy
CDS Spread	1.000	-0.078	-0.058	-0.175	-0.054	-0.154	-0.224	-0.050	-0.162	-0.106	-0.115
Resource Use Score	-0.078	1.000	0.528	0.235	0.526	0.342	0.338	0.324	0.011	0.037	0.024
Emissions Score	-0.058	0.528	1.000	0.310	0.549	0.268	0.169	0.310	0.106	0.006	0.072
Environmental Innovation Score	-0.175	0.235	0.310	1.000	0.212	0.247	0.278	0.248	0.257	0.213	0.223
Workforce Score	-0.054	0.526	0.549	0.212	1.000	0.272	0.196	0.344	0.096	0.041	0.035
Human Rights Score	-0.154	0.342	0.268	0.247	0.272	1.000	0.377	0.193	0.064	0.053	0.035
Community Score	-0.224	0.338	0.169	0.278	0.196	0.377	1.000	0.281	0.153	0.147	0.127
Product Responsibility Score	-0.050	0.324	0.310	0.248	0.344	0.193	0.281	1.000	0.073	0.057	0.065
Management Score	-0.162	0.011	0.106	0.257	0.096	0.064	0.153	0.073	1.000	0.216	0.183
Shareholders Score	-0.106	0.037	0.006	0.213	0.041	0.053	0.147	0.057	0.216	1.000	0.193
CSR Strategy	-0.115	0.024	0.072	0.223	0.035	0.035	0.127	0.065	0.183	0.193	1.000

The correlation coefficients between the ten scores and the CDS Spread are all negative, except for the score on the quantity of emissions produced by a firm and the one referred to product responsibility. The magnitude of the correlations reflects the composition of the scores of the three pillars, in fact the lowest coefficients are those referring to the social pillar.

4.6 Panel Data Model

Panel data, also called longitudinal data, are employed when it is necessary to embody in the analysis information across both time and individuals. A panel data set has a cross-sectional and a time series dimension and is constructed by observing the same individuals across time. In this research, the two dimensions are represented by the data points of each firm for each variable and the data points of each firm for each month in the period considered. In this way, it is possible to observe the variations of a variable across different firms and across time simultaneously, accounting for firm heterogeneity.

Panel data models assume that the values assumed by the same variable over time are dependent one another, which is the opposite assumption of cross-sectional models.

The standard linear panel data regression model can be expressed as:

$$y_{it} = \alpha_i + \beta_1 X_{1,it} + \cdots + \beta_k X_{k,it} + u_{it} \qquad [1.0]$$

where:

- y_{it} is the independent variable
- α is the intercept, also called individual effect
- β it the *k x 1* vector of parameters to be estimated
- X_{it} is the *1 x k* vector of observations of explanatory variables over time
- *t* refers to different time points (*t = 1,…,T*) and *i* refers to different entities (*i=1,…,n*)

More specifically, the α_i are entity-specific intercepts that capture heterogeneities across entities.

Generally, the empirical applications involve one of two main assumptions about the individual effect (α_i): random effects (RE) model, where α_i is uncorrelated with X_{it}, and fixed effects (FE) model, where α_i is correlated with X_{it} and is treated as unknown parameter to be estimated. In our case, the regression is developed via FE model. In this way the intercept is allowed to change between entities (cross-sectionally) but not across time. The advantage is that the fixed effects estimator is robust to the omission of any relevant time-invariant regressors, incorporating all the determinants that impact CDS Spreads cross-sectionally but not over time (i.e. the industry or the country in which a firm operates).

Moreover, the error term of the fixed effects model can be decomposed as in expression 1.1:

$$u_{it} = \mu_i + v_{it} \qquad [1.1]$$

where:

- μ_i is the entity fixed effect
- v_{it} is the idiosyncratic error (or time-varying error)

So, the general panel data regression model with entity fixed effect assumes the following structure:

$$y_{it} = \alpha + \beta_1 X_{1,it} + \cdots + \beta_k X_{k,it} + \mu_i + v_i \qquad [1.2]$$

or alternatively:

$$y_{it} = \beta_0 + \beta_1 X_{1,it} + \cdots + \beta_k X_{k,it} + \gamma_2 D_{2i} + \cdots + \gamma_n D_{ni} + u_{it} \quad [1.3]$$

where $D2_i$, $D3_i$,…, Dn_i are dummy variables referred to the n companies in the sample.
In the cases in which the dependent variable is supposed to vary across time but not cross-sectionally, a time-fixed effect model can be estimated. With this approach the intercept varies across time but not across entities, so it is not the case of this analysis.
In order to make a reasoned choice, the Durbin-Wu-Hausman test have also been performed and the fixed effect model is appointed as the most efficient between the two.
As already discussed, a possible problem in the estimation of the model could be represented by multicollinearity which arises when two variables are highly correlated or depend on the same determinants. So, prior to the estimation of the model, the variance inflation factor (VIF) has been computed for all the parameters in all the models developed. This measure quantifies the severity of multicollinearity between the parameters of a regression and, in our case, considering that it is equal to ~1 for all the parameters, it shows that there is no correlation between them, allowing to safely estimate the regression model.
The estimation of the model has been made through the Least Square Dummy Variable (LSDV) estimator which is the most efficient with-in group approach.
In order to analyze the possible relation between CDS Spreads and ESG Scores across entities and time, the following models have been estimated:

Model 1: $lnCDS_{it} = \alpha + \beta^{ESG} ESG_{it} + \beta^{CR} CR_{it} + \beta^{LEV} LEV_{it} + \beta^{EBIT} EBIT_{it} + u_{it}$

where:

- ESG_{it} is the Refinitiv's overall company score based on the self-reported information in the environmental, social and corporate governance pillars.

Model 2: $lnCDS_{it} = \alpha + \beta^{E} E_{it} + \beta^{S} S_{it} + \beta^{G} G_{it} + \beta^{CR} CR_{it} + \beta^{LEV} LEV_{it} + \beta^{EBIT} EBIT_{it} + u_{it}$

where:

- E_{it} is the weighted average relative rating of a company based on the reported environmental information and the resulting three environmental category scores.

- G_{it} is the weighted average relative rating of a company based on the reported governance information and the resulting three governance category scores.
- S_{it} is the weighted average relative rating of a company based on the reported social information and the resulting four social category scores.

Model 3: $$lnCDS_{it} = \alpha + \beta^1 ResourceUse_{it} + \beta^2 Emissions + \beta^3 Environmental\ Innovation_{it} + \beta^4 Workforce_{it} + \beta^5 HumanRights_{it} + \beta^6 Community_{it} + \beta^7 ProductResponsibility_{it} + \beta^8 Management_{it} + \beta^9 Shareholders_{it} + \beta^{10} CSR_{it} + \beta^{CR} CreditRating_{it} + \beta^{LEV} LEV_{it} + \beta^{EBIT} EBIT_{it} + u_{it}$$

where:

- Resource use category score reflects a company's performance and capacity to reduce the use of materials, energy or water, and to find more eco-efficient solutions by improving supply chain management.
- Emission category score measures a company's commitment and effectiveness towards reducing environmental emission in the production and operational processes.
- Environmental innovation category score reflects a company's capacity to reduce the environmental costs and burdens for its customers, and thereby creating new market opportunities through new environmental technologies and processes or eco-designed products.
- Workforce category score measures a company's effectiveness towards job satisfaction, healthy and safe workplace, maintaining diversity and equal opportunities, and development opportunities for its workforce.
- Human rights category score measures a company's effectiveness towards respecting the fundamental human rights conventions.
- Community category score measures the company's commitment towards being a good citizen, protecting public health and respecting business ethics.
- Product responsibility category score reflects a company's capacity to produce quality goods and services integrating the customer's health and safety, integrity and data privacy.

- Management category score measures a company's commitment and effectiveness towards following best practice corporate governance principles.
- Shareholder's category score measures a company's effectiveness towards equal treatment of shareholders and the use of anti-takeover devices.
- CSR strategy category score reflects a company's practices to communicate that it integrates the economic (financial), social and environmental dimensions into its day-to-day decision-making processes.

All the three regressions have been estimated through an entity fixed effects model and an entity fixed effect model with robust standard errors that are clustered by firm and by month. The fixed effect approach allows to avoid non-observed heterogeneity across different group in panel data. Moreover, through the errors clustering, observations between entities have unknown correlations, but different groups in the sample have no correlated errors.

4.7 Results & Findings

After the definition of the three models, the panel data regression is estimated with the methods discussed previously, so through the fixed effect model with and without clustered standard errors. The regression models have been estimated using the statistical software Stata16 and the coding language Python and the results of these regressions are reported in the following tables.

Every table reports the estimated results for the period 2010-2019 using both the standard entity fixed effects model with and without clustered errors. In this way, it is possible to verify if the results are consistent with both approaches or if they are biased. The fixed effects approach allows to avoid non-observed heterogeneity across different groups in panel data. Moreover, variable's coefficients could be biased if correlated with the variation of non-observable variables across panel groups. In fact, in this case the assumption that errors v_{it} are identically and independently distributed is violated, so clustered errors are needed. Using this method, observations between entities have unknown correlation but different groups in the sample have no correlated errors (Nichols and Schaffer, 2007). So, clustered standard errors account for not identically and independently distributed errors within each group and not across groups. In other words, clustering errors means that errors are not considered independent and

identically distributed for entities in the same cluster as there could be a correlation due to some of the characteristics of the cluster.

Every table shows both the entity fixed effects model and the regression with clustered errors, so it is possible to compare them. In addition, for all the regressions are reported also the sub-regressions for the periods 2010-2015 and 2016-2019 in order to intercept possible variations between the two periods. The partition in these two sub-periods is due to the subscription in 2015 of the Paris Agreement that is unanimously considered a milestone event in the ESG and sustainability framework.

Table 09 reports the results for these six regressions:

1. Panel Data Entity Fixed-Effect with monthly observations and ESG Score for the 2010-2019 period;
2. Panel Data Entity Fixed-Effect with clustered errors, monthly observations and ESG Score.
3. Panel Data Entity Fixed-Effect with monthly observations ESG Score for the 2010-2015 period;
4. Panel Data Entity Fixed-Effect with clustered errors, monthly observations and ESG Score for the 2010-2015 period;
5. Panel Data Entity Fixed-Effect with monthly observations and ESG Score for the 2016-2019 period;
6. Panel Data Entity Fixed-Effect with clustered errors, monthly observations and ESG Score for the 2016-2019 period.

Table 09: Panel Empirical Results with ESG Score

	2010-2019		2010-2015		2016-2019	
	(1) ln(CDS)	(2) ln(CDS)	(3) ln(CDS)	(4) ln(CDS)	(5) ln(CDS)	(6) ln(CDS)
ESG Score	-0.016***	-0.016*	-0.009***	-0.009*	-0.021**	-0.021*
	(-10.88)	(-2.88)	(-5.63)	(-2.16)	(-2.9)	(-1.91)
Credit Rating	-0.109***	-0.109**	-0.16***	-0.16**	-0.035**	-0.035*
	(-8.08)	(-2.95)	(-10.73)	(-2.87)	(-1.9)	(-1)
Leverage	0.222***	0.222**	0.026***	0.026*	0.382**	0.382**
	(10)	(2.48)	(3.16)	(1.05)	(5.64)	(1.64)
EBIT	-0.001***	-0.001*	-0.001***	-0.001*	-0.001**	-0.001*
	(-3.27)	(-1.03)	(-2.04)	(-1.04)	(-1.42)	(-1.25)
Intercept	6.592***	6.041***	7.264***	7.264***	4.558***	4.558***
	(31.72)	(7.25)	(32.04)	(8.73)	(7.76)	(2.5)
Entity Fixed Effects	X	X	X	X	X	X
Clustered Standard Errors		X		X		X
R-Squared	0.426	0.426	0.443	0.443	0.395	0.395
N	6081	6081	3551	3551	2530	2530

t-statistic in parentheses

** p<0.05, ** p<0.01, ***p<0.001*

The coefficients estimated with the first two regressions are all significant and show the expected signs. In particular, the coefficients report low p-values, all lower than 0.001 in the first case and all lower than 0.01 in the second case with the exception of the EBIT variable. This is a strong result because shows that all the variables in the model affect the CDS Spreads in the time horizon considered. Looking at the coefficients it is interesting to note that they are all consistent with expectations: firstly, the ESG Score impact negatively on CDS Spread, meaning that a lower ESG Score increases the credit risk of a company and the same is valid for Credit Rating and EBIT. On the contrary, leverage impacts positively CDS Spread, meaning that to higher levels of leverage correspond higher values of the CDS Spread. However, it is important to highlight the magnitude of these effects. In fact, the main variable of interest of this study, the ESG Score, does not affect strongly the CDS Spread, reporting very low coefficients much lower than zero. These results are consistent with the existing literature, in particular with the paper by Barth, Hubel and Scholz (2020) who have shown that an

improvement in ESG is estimate do reduce the CDS of firms. Moreover, their results confirm the increased market-perceived credit risk for firms with lower performance due to the higher exposure to the new risks emerged after the Paris Agreement.

Looking at the main variable of interest, the ESG Score, it is possible to transform the coefficient obtained with the log-linear model in order to understand the real impact of this variable on the CDS Spread. In terms of effects of changes in X on Y, each 1-unit increase in X multiplies the expected value of Y by e^{β}. So, in the specific case, a 1-unit increase of the ESG Score produces a -1.57% change on the CDS Spread. The coefficients estimated for Credit Rating and Leverage are higher than the Beta of the ESG Score, meaning that these variables have a higher impact on the dependent variable respectively equal to ~-11% and ~22%. A lower effect can be seen instead in the EBIT coefficient which is 10 times lower than the effect produced by a change in the ESG Score. So, excluding Earnings Before Interests and Taxes, the ESG Score is the variable with the weakest effect on the probability of default of a company within those included in the model.

Moreover, when the regression with clustered standard errors is considered, it is possible to see a reduction of the level of significance for all the variables in the model, meaning that when the model accounts for non i.i.d. errors over entities, the model's ability to predict decreases. Nevertheless, also with clustered standard errors all the variables in the model are significant at 95% confidence level.

Secondly, when the analysis is split in the two periods 2010-2015 and 2016-2019, it is possible to see the change of magnitude of the impact of the ESG Score on the CDS Spread. During the first period the coefficient of the rating is -0.009 at 95% significance level. When considering the second period it is possible to appreciate an increase in this coefficient which becomes -0.021 at 95% significance level in model with clustered standard errors, which may demonstrate the increased awareness of the credit market towards sustainability after the Paris Agreement. This increase means that before 2016 a 1-unit increase of the ESG Score would have produced a -0.89% change on the CDS Spread, while after 2016 this effect is more than doubled, equal to -2.07%.

Finally, it is important to discuss the R-Squared which is nearly 0.43, meaning that 43% of the data fit the regression model, so a possible improvement would be to include further significant variables.

The following step of the analysis is to perform the estimation of other six regressions in which, instead of the total ESG Score, the scores for the three single ESG pillars are included.

Table 10 reports the results for the following six regressions:

1. Panel Data Entity Fixed-Effect with monthly observations and 3 ESG Pillars Scores for the 2010-2019 period;
2. Panel Data Entity Fixed-Effect with clustered errors, monthly observations and 3 ESG Pillars Scores for the 2010-2019 period;
3. Panel Data Entity Fixed-Effect with monthly observations and 3 ESG Pillars Scores for the 2010-2015 period;
4. Panel Data Entity Fixed-Effect with clustered errors, monthly observations and 3 ESG Pillars Scores for the 2010-2015 period;
5. Panel Data Entity Fixed-Effect with monthly observations and 3 ESG Pillars Scores for the 2016-2019 period;
6. Panel Data Entity Fixed-Effect with clustered errors, monthly observations and 3 ESG Pillars Scores for the 2016-2019 period.

Table 10: Panel Empirical Results with E/S/G pillars Scores

	2010-2019		2010-2015		2016-2019	
	(1) ln(CDS)	(2) ln(CDS)	(3) ln(CDS)	(4) ln(CDS)	(5) ln(CDS)	(6) ln(CDS)
Environmental Score	-0.005**	-0.005	-0.003*	-0.003	-0.002*	-0.002*
	(-3.67)	(-0.8)	(-2.27)	(-0.82)	(-1.38)	(-1.15)
Social Score	-0.016***	-0.016**	-0.006***	-0.006*	-0.012***	-0.012**
	(-14.72)	(-3.98)	(-4.25)	(-2.49)	(-4.36)	(-2.34)
Governance Score	0.004*	0.004*	-0.001	-0.001	0.005**	0.005*
	(5.59)	(1.68)	(-0.92)	(-0.34)	(2.64)	(1.97)
Credit Rating	-0.107***	-0.107**	-0.159***	-0.159**	-0.041**	-0.041*
	(-8.04)	(-3.01)	(-10.66)	(-2.82)	(-2.16)	(-1.39)
Leverage	0.194***	0.194*	0.248*	0.248*	0.164*	0.164*
	(8.85)	(2.09)	(2.12)	(0.56)	(5.77)	(2.47)
EBIT	-0.001*	-0.001*	-0.001*	-0.001*	-0.001*	-0.001
	(-2.66)	(-1.07)	(-2.08)	(-1.95)	(-1.36)	(-1.23)
Intercept	6.129***	6.129***	7.325***	7.325***	4.821***	4.821**
	(32.66)	(7.82)	(32.12)	(8.59)	(7.62)	(2.56)
Entity Fixed Effects	X	X	X	X	X	X
Clustered Standard Errors		X		X		X
R-Squared	0.4279	0.4279	0.4281	0.4281	0.4182	0.4182
N	6081	6081	3551	3551	2530	2530

t-statistic in parentheses

** p<0.05, ** p<0.01, ***p<0.001*

The coefficients of the control variables in the first two regressions are all significant and show the expected sign. On the contrary, not all the scores of the three ESG pillars are significant at least at a 95% confidence level and, moreover, the sign of the governance pillar score is not consistent with the expectations. In particular, the environmental pillar score is significant for the period 2010-2019 only in the model with entity fixed effects, while it loses significance in the model with clustered standard errors. On the contrary, the social pillar score shows a negative and significant score as expected in both the regressions for the 10-years period, while the opposite result can be observed for the governance pillar score, which is significant in both the regressions but with a positive unexpected sign at a 95% confidence level. This means that during the entire period considered only the social pillar score and the governance pillar score have

an impact on the default probability of a company, with the first producing a negative effect (a 1-unit increase of the social pillar score produces a -1.6% effect on the CDS Spread) and the second unexpectedly a positive one (a 1-unit increase of the social pillar score produces a +0.44% effect on the CDS Spread). Similarly to the previous case, the coefficients are very low and much lower than zero, confirming the weak effect of ESG scores on CDS Spreads. Similar results have been achieved by Devalle, Fiandrino and Cantino (2017) whose research highlights the difficulties in reaching unanimous results on the topic. In particular, their results suggest that ESG performance, specifically concerning social and governance metrics, affect the creditworthiness of Italian and Spanish companies. Similarly, Sassen, Hinze and Hardeck (2016) found out that the total risk of a company is reduced through higher performance in the social dimension, the environmental performance is sharp only in environmental industries and the governance performance does not significantly affect the risk of a company.

When looking at the two sub-periods before and after the Paris Agreement some interesting insights can be extrapolated. In fact, the environmental score is not significant before 2015, but it turns negative and significant at 95% confidence level starting from 2015, so it is possible to suppose that this could be due to the subscription of this Agreement focused on climate and environment. The social pillar score confirms its significance and its negative effect in both the periods, both in the model with and without clustered standard errors, so it is possible to affirm pretty safely the robustness of these results. The only difference between the two periods is the magnitude of the effect produced by this variable on the CDS Spread, in fact it seems to increase after 2015 and this may be due to the increased awareness for sustainability and ESG themes in recent years (the difference between the effects in the two periods is about 0.64%). Finally, the governance pillar score is strangely significant and positive only after 2015, meaning that this sustainability aspect of a company produces an opposite effect compared to the expectation. This may be due to the higher interest of investors for the social and environmental aspects, disregarding the aspects connected to the governance pillar.

As in the previous regressions, the control variables are significant and show the expected sign in the whole period considered. Credit rating seems to have a higher impact on CDS Spreads before 2015, after which its coefficient is lower but still significant. The same is valid for leverage which shows positive and significant

coefficient during the whole period both before and after 2015. Only Earnings Before Interests and Taxes seems to lose their predictive power in the second sub-period considered. Finally, when the regression with clustered standard errors is considered, it is possible to see a reduction of the level of significance for all the variables in the model, meaning that when the model accounts for non i.i.d. errors over entities, the model's ability to predict decreases. Nevertheless, also with clustered standard errors the majority of the variables considered in the model are significant at 95% confidence level.

As for the previous regressions, the R-Squared is nearly 0.43, meaning that 43% of the data fit the regression model.

The last step of the analysis is to perform the estimation of other six regressions in which are included the 10 ESG categories composing the three single ESG pillars.

Table 11 reports the results for the following six regressions:

1. Panel Data Entity Fixed-Effect with monthly observations and the Scores for 10 ESG Categories for the 2010-2019 period;
2. Panel Data Entity Fixed-Effect with clustered errors, monthly observations and the Scores for 10 ESG Categories for the 2010-2019 period;
3. Panel Data Entity Fixed-Effect with monthly observations and the Scores for 10 ESG Categories for the 2010-2015 period;
4. Panel Data Entity Fixed-Effect with clustered errors, monthly observations and the Scores for 10 ESG Categories for the 2010-2015 period;
5. Panel Data Entity Fixed-Effect with monthly observations and the Scores for 10 ESG Categories for the 2016-2019 period;
6. Panel Data Entity Fixed-Effect with clustered errors, monthly observations and the Scores for 10 ESG Categories for the 2016-2019 period.

Table 11: Panel Empirical Results with ESG categories Scores

	2010-2019		2010-2015		2016-2019	
	(1) ln(CDS)	(2) ln(CDS)	(3) ln(CDS)	(4) ln(CDS)	(5) ln(CDS)	(6) ln(CDS)
Resource Use Score	-0.001	-0.001	-0.002*	-0.002	-0.001	-0.001
	(-0.16)	(-0.04)	(-1.26)	(-0.46)	(-0.33)	(-0.12)
Emissions Score	-0.003	-0.003	0.0015	0.0015	-0.01***	-0.01*
	(-1.63)	(-0.47)	(1.06)	(0.33)	(-3.43)	(-1.29)
Environmental Innovation Score	-0.003**	-0.003*	-0.002***	-0.002*	-0.004**	-0.004
	(-3.36)	(-0.83)	(-3.3)	(-1.31)	(-2.94)	(-1.29)
Workforce Score	-0.009***	-0.009**	-0.009***	-0.009**	-0.009***	-0.009**
	(-5.98)	(-2.01)	(-6.49)	(-2.36)	(-3.05)	(-1.34)
Human Rights Score	-0.004***	-0.004***	-0.006***	-0.006**	-0.002**	-0.002**
	(-10.25)	(-3.6)	(-8.09)	(-2.75)	(-3.05)	(-1.89)
Community Score	-0.003**	-0.003*	-0.002**	-0.002*	-0.004*	-0.004
	(-11)	(-2.68)	(-2.2)	(-1.68)	(-1.97)	(-0.53)
Product Responsibility Score	-0.002*	-0.002	-0.001	-0.001	-0.005**	-0.005
	(-3.57)	(-1.05)	(-1.16)	(-0.39)	(-2.63)	(-1.13)
Management Score	0.005**	0.005	0.008*	0.008	0.001	0.001
	(3.88)	(1.2)	(1.16)	(0.41)	(0.74)	(0.27)
Shareholders Score	-0.001	-0.001	-0.001	-0.001	0.002*	0.002
	(-2.17)	(-0.7)	(-0.42)	(-0.14)	(2.17)	(0.98)
CSR Strategy	0.005*	0.005	0.008	0.008	0.002	0.002
	(2.09)	(0.68)	(0.92)	(0.3)	(1.02)	(0.82)
Credit Rating	-0.106***	-0.106**	-0.13***	-0.13**	-0.045**	-0.045*
	(-7.94)	(-2.06)	(-9.28)	(-2.28)	(-1.44)	(-1.29)
Leverage	0.203***	0.203**	0.072**	0.072*	0.384***	0.384***
	(9.34)	(2.34)	(3.17)	(1.13)	(5.52)	(2.22)
EBIT	-0.001***	-0.001*	-0.001*	-0.001*	-0.001*	-0.001
	(-2.76)	(-1.81)	(-2.08)	(-1.58)	(-1.45)	(-1.26)
Entity Fixed Effects	X	X	X	X	X	X
Clustered Standard Errors		X		X		X
R-Squared	0.441	0.441	0.431	0.431	0.422	0.422
N	6081	6081	3551	3551	2530	2530

t-statistic in parenthesis

** p<0.05, ** p<0.01, ***p<0.001*

The coefficients of the control variables in the first two regressions are all significant and show the expected sign. On the contrary, not all the scores of the 10 ESG Categories are significant at least at a 95% confidence level and, moreover, the sign for two of the three scores in the governance field are not consistent with the expectations. These results are mostly consistent with the existing literature. For instance Razak, Ibrahim and Ng (2020) found that the effect of different CSP dimensions on credit risk is not uniform and risk-reducing effects could be achieved with better performance in climate change, resource use and human capital dimensions. At the contrary, the intuition of some researches which show a negative effect of the governance performance is not confirmed in the present dissertation.

In the analysis performed, among the environmental scores, only environmental innovation score is significant for the period 2010-2019 in both the models with and without clustered standard errors. On the contrary, all the social scores show a negative and significant score, as expected, in both the regressions for the 10-years period. Instead, the opposite result can be observed for the governance pillar scores, which are neither significant nor negatively signed as it can be expected. This means that during the entire period considered only the social pillar ratings have an impact on the default probability of a company, with the workforce score producing a negative effect (a 1-unit increase of the workforce score produces a -0.93% effect on the CDS Spread), such as the human rights score (a 1-unit increase of the human rights score produces a -0.44% effect on the CDS Spread) and the community score (a 1-unit increase of the community score produces a -0.25% effect on the CDS Spread). Similarly to the previous case, the coefficients are very low and close to zero, confirming the weak effect of ESG rating scores on CDS Spreads. On the contrary, the governance scores are significant at 95% confidence level only when the model without clustered fixed effect is considered, while when adding this feature to the regression they lose all their significance.

When looking at the two sub-periods, before and after the Paris Agreement, the results confirm what has been observed in the analysis with the scores for the three ESG pillars. In fact, the only significant environmental score at 95% confidence level before 2015 is the environmental innovation score which shows negative sign and significance also with clustered standard errors. Its coefficient becomes insignificant starting from 2015, year from which becomes significant the emissions score; hence it is possible to

suppose that this could be due to the subscription of the Paris Agreement which considers first and foremost the climate and the environment. The workforce and the human rights scores confirm their significance and their negative effect in both the periods and in both the models with and without clustered standard errors, so it is possible to affirm pretty safely the robustness of these results. The only difference between the two periods is the magnitude of the effect produced by these variables on the CDS Spread, in fact it seems to increase after 2015 and this may be due to the increased awareness for sustainability and ESG themes over time in recent years.

As in the previous regressions, the control variables are significant and show the expected sign in the whole period considered. Credit rating shows a higher impact on CDS Spreads before 2015 after which its coefficient is lower but still significant. The same is true for leverage which shows positive and significant coefficient during the whole period both before and after 2015. As in the previous regressions, also Earnings Before Interests and Taxes lose their predictive power in the second sub-period considered. Finally, when the regression with clustered standard errors is considered, it is possible to see a reduction of the level of significance for all the variables in the model, meaning that when the model accounts for non-independently and identically distributed errors over entities, the model's ability to predict decreases.

As for the previous regressions, the R-Squared is nearly 0.43, meaning that 43% of the data fit the regression model.

CONCLUSIONS

The relevance of sustainability and in particular of ESG factors has constantly grown over the last years. By now, almost all the biggest players of the financial world include sustainability factors and considerations in their decisions and strategies. The financial industry has assumed a prominent role directing capitals towards green investments and companies with positive ESG performance. Especially during the last lustrum, thanks to the increased awareness on climate change and environmental changes, a number of international agreements and conferences has been held, lastly the UN Climate Change of the Parties (COP26) in Glasgow, from 31st October to 13th November 2021. The purpose of this conference has been to adopt robust rules for implementing the Paris Agreement, but even if some steps forward have been made, the final outcome cannot be considered truly satisfying. Much more progresses must be made if countries actually intend to reduce their greenhouse gas emissions and at least try to reverse the worrying trend of climate extreme events that the world is experiencing more and more frequently. As recognized also by the European Commission, the financial industry plays a critical role in this programme and, by including ESG factors in the investment process, may finance deserving businesses dedicated to make a positive impact on the planet and on the society. All the major investment firms are directing their investments towards companies with strong ESG programs and more than 70 asset managers, including BlackRock and Vanguard, have signed a pledge to help achieve net-zero greenhouse gas emissions by 2050.

As discussed in the second chapter, a crucial role is fulfilled by ESG rating agencies whose judgments are consulted at least once a week by investors, in order to consider them in their investment decisions. The main drawback of the spread of this practices is that ratings from different providers often disagree dramatically, leading to different financial decisions or discordant empirical results depending on the ESG rating considered in the analytical process. This discrepancy is due to the lack of a globally accepted standard methodology and common clear taxonomy, allowing different agencies to develop their own methodologies which lead to opposite of very different judgements. Moreover, different ESG rating agencies always have different methods to estimate sustainability ratings and each of them weights differently the ESG factors

considered, leading investors to prefer one ESG provider rather than another. An important step forward in the direction of a harmonization of the taxonomy for sustainable activities has been made by the European Commission with the Regulation (EU) 2020/852 with which has been established a common framework to facilitate sustainable investment. In June 2021, the G7 Finance Minister and Central Bank Governors have formalized their commitment to address ESG challenges and move quickly toward multilateral economic cooperation. Likewise, in the United States the chairman of the Securities and Exchange Commission (SEC) has declared he wants mandatory disclosure on climate risks, demonstrating that the ESG reporting landscape is moving toward globally harmonized standards.

Among the most impacted sectors by the raise of ESG risks and opportunities there is the credit risk market. Extensive empirical research shows that companies with better ESG performance experience lower cost of capital, lower risks and less uncertainty for shareholders and bondholders. Contextually, higher and excessive investments in sustainability and ESG related projects may cause an increase of companies' credit risk, showing that it could be difficult for a business to balance advantages and disadvantages. Another relevant aspect to which companies are increasingly paying attention is their reputation among investors and customers. Companies perceived as "sin stocks", so associated with unethical or immoral activities, will be certainly subject to higher reputational risks in the near future, exposing themselves to regulatory changes with possible repercussions on their core businesses.

The core of this dissertation is concentrated in chapter 4 where the empirical analysis and the findings are presented. The results are statistically and econometrically significant, providing useful insights also for investors focused on ESG themes operating in the credit risk market. The estimations are consistent with expectations and the initial hypothesis have been confirmed by the results also when clustered errors are implemented in the model.

The results obtained through the first panel regression, considering the aggregate ESG Score assigned to the companies by Refinitiv Eikon, shows a negative effect of the ESG rating on the CDS spreads and so on the probability of default. Nevertheless, this effect is very weak if compared to the impact of the other control variables (Credit Rating, Leverage and Earnings Before Interests and Taxes). By way of comparison, a 1-unit increase of the ESG Score produces a -1.57% effect on the CDS Spread, while the effect

of Credit Rating and Leverage is roughly equal to -11% and 22%. The same result is still consistent with clustered errors at 95% significance level, confirming the robustness of this result. When two different sub-periods at the turn of the ratification of the Paris Agreement on Climate Change in 2015 are considered, the results show that after this event the effect of the ESG Score increases, more than doubling. Moreover, when the total ESG Score is decomposed in the three scores for the Environmental, Social and Governance pillars, what emerges is that only the Social score has a negative and significant effect equal to -0.016, while the Governance score seems to produce a positive effect and the Environmental score doesn't have any appreciable impact. Finally, when the single ESG Score components are considered, those seeming to have an impact on the default probability are the scores evaluating companies' capacity to reduce the environmental costs and burdens for its customers, their effectiveness towards job satisfaction, healthy and safe workplace, the effectiveness towards respecting the fundamental human rights conventions and the commitment towards being a good company, protecting public health and respecting business ethics. An interesting result obtained splitting the time horizon considered is that the Emissions Score becomes significant and negative after 2015, suggesting that the adoption of the Paris Agreement could have been a factor also for the financial market to start including in the valuations the risks connected to climate and so the judgments given by ESG rating agencies.

Despite the significance and coherence of the results obtained, the weakness showed by the coefficients may be due to the immaturity of the ESG rating sector. The wide differences among different raters could be the main cause of the very low weight given by investors to these scores. As previously observed, a harmonization of the key ESG concepts carried on by the international financial and reporting authorities may be one of the most incisive ways to increase the confidence of investors in ESG ratings. Most importantly, the research on the ESG Rating framework is relevant for the climatic and social challenges our society and future generations are going to face in the next decades and may give them the possibility to know the level of sustainability of the companies in which they will invest.

Concluding, this research contributes also to the investigation of the determinants of CDS Spreads in the European market, highlighting that, even if in a very weak way compared to other variables, ESG Ratings have an impact of this measure of default

probability. Possible improvements to be implemented by future researches, and that have not been possible to be investigated in this thesis due to the lack of data, may be to compare how ratings from different agencies affect differently the probability of default of these firms. In this way, it would be possible to assess how wide the difference between ESG ratings assigned through different methodologies is. Finally, it may be very interesting to assess how much the COVID-19 pandemic has changed the attitude of European companies and investors towards sustainability themes, which have clearly stepped into the limelight in the last two years.

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