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ESG RATINGS AND CREDIT RATINGS

by

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Abstract

In this study, I examine the relationship between environmental, social, and governance (ESG) performance and firms' credit risk. In addition, I investigate which pillar of ESG influences this relationship. The research starts with a review of the asymmetric information issues and the rating assignments used by the economic participants to deal with these problems. I point out the determinants of the credit ratings and highlight the weaknesses in the definition and measurement of the ESG. The presentation of the relationship between ESG ratings and a firm's financial performance completes the literature review. Using a sample of 600 firms during the period from 2002 to 2020, I find that ESG ratings are positively related to corporate credit ratings, but only social performance contributes to this relationship.

Keywords: ESG Ratings, Credit Ratings, Corporate sustainability, ESG (Environmental, Social, Governance).

Περίληψη

Σε αυτή τη μελέτη εξετάζω τη σχέση μεταξύ της περιβαλλοντικής, κοινωνικής και διακυβερνητικής (ESG) επίδοσης και της πιστοληπτικής ικανότητας των επιχειρήσεων. Ακόμη, διερευνώ ποιος από τους πυλώνες της επίδοσης ESG συνεισφέρει σε αυτή τη σχέση. Η μελέτη ξεκινάει με μία ανασκόπηση των προβλημάτων της ασσυμετρίας πληροφόρησης και των βαθμολογήσεων που χρησιμοποιούν οι οικονομικοί παράγοντες για να τα αντιμετωπίσουν. Σημειώνω τους προσδιοριστικούς παράγοντες των βαθμών πιστοληπτικής ικανότητας των εταιρειών και τονίζω της αδυναμίες στον ορισμό και στον τρόπο μέτρησης της επίδοσης ESG. Η παρουσίαση της σχέσης μεταξύ της επίδοσης ESG και της χρηματοοικονομικής επίδοσης της εταιρείας ολοκληρώνει την επισκόπηση της βιβλιογραφίας. Με χρήση ενός δείγματος 600 εταιρειών για την περίοδο από το 2002 έως το 2020, βρίσκω μίας θετική σχέση μεταξύ των ESG βαθμολογήσεων και των βαθμών πιστοληπτικής ικανότητας των εταιρειών, με μόνο τον πυλώνας της κοινωνικής επίδοσης να συνεισφέρει στη σχέση αυτή.

Λέξεις κλειδιά: Βαθμολογήσεις επίδοσης ESG, Βαθμοί πιστοληπτικής ικανότητας, Εταιρική βιωσιμότητα, ESG (Περιβάλλον, Κοινωνία, Εταιρική διακυβέρνηση).

<u>Contents</u>

Introduction

The financial system is critical for the functioning of the economy. It helps the channeling of funds between savers and borrowers, and ensures that the resources are efficiently allocated towards promoting economic growth and social welfare. The financial intermediation process must function smoothly, maintaining stability in the financial markets and the economy. The information plays a key role in the well-functioning of the financial system.

The lack of accurate and reliable information affects the investment decisions, especially the direct flow of savings and leading to tightening in financial conditions, and the reduction of credit. This leads to market failure, with severe consequences for the economy.

This problem is known as asymmetric information. The term refers to when one party in a transaction possesses superior information than the other. The lack of symmetric information causes the adverse selection and moral hazard issues. These problems affect the selection of creditworthy borrowers before the deal, and the efficient use of the resources after the deal.

There is a significant cost for the investors in gathering all the information to deal with asymmetric information issues. However, there are private companies providing data to the public at a lower cost. The credit rating agencies are private companies, which provide credit ratings to the public, identifying the borrowers' creditworthiness.

The credit ratings are significant factors influencing the investment decision of the economic participants. However, their accuracy and reliability are usually under scrutiny. The criticism of the rating assignments creates the need to understand their information value and the credit ratings criteria. In this thesis, I present academic articles identifying the determinants of credit ratings, and I examine if the company's Environmental, Social, and Governance (ESG) performance is an additional determinant.

ESG are the three central factors in measuring the sustainability and the ethical impact of the company. The firm adopts policies to manage ESG risks and improve its sustainability. Also, investors examine a firm's ESG issues to evaluate its financial performance. The findings of the academic studies presented support that the ESG performance is consistent with a firm's cost of capital and access to finance. However, not the ESG factors contribute the same to a firm's value.

In addition, there are ESG data and ratings providers, helping the investor deal with the issues of asymmetric information. They gather raw data such as a firm's voluntary disclosures and estimate the firm's ESG performance, but the variety, the inconsistency, and the unavailability of the data and measures lead to differences in the providers' assessments. The low correlation between the providers assignments diminishes the ESG scores information value, making more difficult for the investor to integrate them in its decision-making.

In this thesis, I examine the relationship between the ESG scores and a firm's credit rating. I want to identify whether the firm's sustainability leads to easier access to finance and less capital constraints in terms of the firm's credit risk. I collect the ESG scores from the Refinitiv database for a period from 2002 to 2020. Thus, I investigate whether the Refinitiv's assessments are consistent with firm's ESG performance. Also, I search if all the pillars of the ESG are determinants of the credit ratings.

My empirical research results show that the Refinitiv's ESG scores are determinants of the firm's credit ratings. Also, I provide evidence that the firm's Social performance is the ESG's pillar with the most explanatory power. In addition, I examine whether the ESG scores explain the differences in the firm's ratings assignments by different credit rating agencies (split ratings). However, the findings are insignificant, hence I couldn't relate the ESG with the split ratings.

The thesis is organized as follows. Section 1 describes the role of information in the financial system, presenting the problems of asymmetric information, and its economic implications. Section 2 presents the academic studies examining the role of credit rating agencies, the credit ratings determinants, and other issues consistent with their information value. Section 3 describes the ESG scores, their relationship with a firm's financial position, and the weaknesses of the ESG data. Section 4 presents the data sample and the econometric models used in the empirical research. Section 5 provides the empirical evidence.

1. The role of information

1.1 Introduction

The importance of information in the economy can be seen from its effects on the global financial system. The financial system includes different institutions and financial instruments, and channels significant amounts of funds from the creditors, people who save their money, the borrowers, people having investment opportunities. As a result, the lack of information can have adverse consequences for the economic relations between counterparties and the functioning of the financial system.

I describe the role of information through the difficulties experienced by investors in the valuation of financial products and the asymmetric information issues between the economic participants. I base the following analysis on Antzoulatos (2020).

The information plays a key role in the risk assessment and the valuation of financial products. That kind of product does not guarantee specific cash flows or gains, but it promises cash flows or gains in the future. That's the most significant feature of them, one which distinguished them from the other products and services, both before and after the investment.

The most important elements of the decision to purchase such products (stocks, loans, bonds, etc.) are the ex-ante screening and contract writing. However, these procedures may not be enough, amplifying the need to ex-post monitoring and influence the issuer's decisions, as their return depends on developments on financial markets and his post-market actions and failures.

Investor's main problem is that the return of the investment will be lower than expected. It will require substantial resources to identifying the real cause for this event. Also, the information gathering and analysis, which an investor needs to implement to protect his rights, requires time and significant funds. He will gather qualitative and quantitative information covering all aspects of market conditions and the issuer's environment.

Although the aforementioned procedures will help to deal with the problem, it is much harder to estimate its real cause and even harder to verify facts and events. The reason is that the issuer has better information than the investor, also known as asymmetric information. Thus, the asymmetric information is one of the biggest problems that threaten the stability of the financial system, rising additional costs to investors. The term refers to a situation where one counterparty has superior information, which makes up a comparative advantage over the others.

Interestingly, the market institutions and the market discipline contribute big to investor's protection. Market institutions such as auditors, credit agencies, financial analysts limit transaction costs and reduce the information asymmetry problem. More specifically, they help investors verifying facts and identifying undesirable actions and failures as quickly as possible. Market discipline refers to the actions of all parties against those who display undesirable behavior. Hence, the need for detailed contract writing diminishes.

1.2 Required Information

The investor faces the uncertainty of an adverse event. The term uncertainty refers to risk the likelihood of an adverse event that may occur. Since the purchase of a financial product, there is the constant risk which appears when the event occurs. Then the uncertainty declines and is replaced by losses. Hence, an investor must reduce the likelihood of such an event happening and its potential loss to protect himself. This procedure of self-protection includes screening, contract writing, monitoring, and influencing. At all stages of the procedure, information is the most important component.

Furthermore, the investors need a significant amount of data to identify the features and evaluate financial products. In particular, they need data about the current conditions in the economy and financial markets, domestic and foreign, which can be found easily. They need to know about the conditions in specific industries. This information, qualitative and quantitative, can be found easily but is costly because only a certain number of agencies provide this data. Above all, investors should name the character of the issuer and that is the most challenging part. They will need to gather information, qualitative and quantitative, from different sources and some of them are impossible to get found.

At the stage of ex-ante screening, the investor should estimate the probability of the event occur and the loss caused by the event to assess the size of risk. He must be able to judge the current condition, the outstanding prospects (financial perspectives), and the character of the borrower. The current condition and financial perspectives are consistent with the possibility of the borrower to fulfill his obligations. The character is related to the borrower's willingness and attitude to comply with the terms of the contract.

Additionally, there are inevitable risks, like business and financial, resulting from changes in financial markets and the economy. The issuer's income declines because of the economic downturn or he suffers a loss caused by an unfavorable change in the spot foreign exchange rate. Those risks are independent of the issuer and no one can avoid them. One way to overcome this problem is to use the most suitable financial products to reduce those risks.

In particular, they can avoid some risks, such as the agency problem, ineffective management, excessive risks taken by the issuer, and others. As the agency problem, we define the conflicts of interest between the owners of the firm and its hired managers. Ineffective management refers to the lack of existence of satisfactory internal control mechanisms. So, it is harder for the firm's managers to identify the problems in the production process, relations with their employees, clients, suppliers as soon as possible.

To make sure the protection of the investment, contract writing should help the investor impose specific rules on the issue. He must be able to influence the borrower's actions when the terms of the contract are violated. In particular, a company should maintain specific levels of liquidity, return on equity, leverage ratios to get financed. The investor should ask for higher collateral or interest rate if the credit or market risk increases because of an economic downturn or a decline in the borrower's creditworthiness. Also,

the borrower should provide enough information, which the investor needs to exercise effective monitoring.

Ex-post monitoring's and influencing's main target is to avoid the occurrence of the problems described. The investor should track the investee's and economy's progress and examine the compliance with the conditions of the contract. He must interfere to end or decrease potential loss, whether considered proper. The monitoring and the fear of effective interference act as a deterrent to the issuer's undesirable actions.

Overall, influencing and tracking issuer's progress is an inevitable cost. The information gathering and the information analysis cost significant funds and human resources. The recruitment of experienced researchers, statisticians, and lawyers requires capital. It is a necessary expense to achieve as much protection as possible against risks rising from every investment.

1.3 Asymmetric information

1.3.1 Adverse Selection and Moral Hazard

The first aspect to point is that despite the quantity and the quality of information collected and analyzed by the investor, the investee has superior information than him. Besides the financial product, the borrowers are more concerned about, if they will have enough liquidity to fulfill their payments or if they will be ready to respond fast enough technological changes in their industry. Investors want to have access to all this data, but it is impossible.

Borrowers know better than the creditor their current situation and prospects, the risks of their investment projects, and their willingness to work hard to achieve those goals. These factors affect their possibility of serving the terms of their arrangements. Also, they have a thorough knowledge of their attitude to fulfill their obligations and their will to be consistent with their liabilities.

This information benefit of the investee, known as asymmetric information, forces the investors to gather more information and write more complex contracts in which they want to obtain every possible adverse scenario. Besides that, the cost of facts verification and implementation of agreements is rising. The higher the information benefit of the borrower is the more complex the contract writing, and the more expensive the information gathering procedures will be. For example, the investors try to integrate firm's sustainability in their decision-making, and they rely on firm's ESG information disclosures. The firm may provide inflated ESG score in specific issues to have access into financing. The asymmetric information problem is bigger because of the lack of standardized process of disclosing the data, definition, and measurement of the ESG issues.

The asymmetric information causes the problems of the adverse selection and the moral hazard. These problems affect the investment-decision of all the economic participants in

money and capital markets. In the rest of this section, we will describe in which way these issues exist in the case of a bank loan, in the stock market, and in the bond market.

When the arrangement of a bank loan occurs, the adverse selection refers to the situation that the bank cannot identify the high-risk borrower from the low-risk one. In such case, it protects itself by charging everyone with the same interest rate, imposing the same terms in contracts. The higher interest rate and the strict conditions make the loans unattractive for the low-risk borrowers or generally for the borrowers. Thus, banks are going to approve loans only for the high-risk ones, or for no one at all.

Particularly, the banks overestimate the probability of default of the borrower and the loss given default because of information asymmetry, and they ask for a higher interest rate than the suitable one for their client's credit risk. Hence, they will approve high-risk loans, which they tried to avoid.

The incentives of the high-risk borrowers do not help banks at all. If they succeed in their high-risk-reward plans, they will have sufficient liquidity to meet their liabilities. Otherwise, they will default. The possibility of succeeding in this investment is small. As a result, the high-risk borrowers will have an incentive to present themselves as the low-risk ones, making the selection much harder for the banks.

Similarly, the adverse selection problem rises in the stocks and the bonds markets. The lack of sufficient and reliable information about the investee misleads the investor. In the case of the stock market, he will be willing to pay an average price for these securities. As a result, only the high-risk company's managers will sell shares to the investor, because they know that their stock has a lower value.

In the case of bonds, the investor underestimates the high-risk firm's credit risk, while overestimating low-risk firm's credit risk. He is willing to pay a price based on an average interest rate. Again, only the high-risk firm's managers will sell debt to the investor.

Furthermore, I examine these cases in terms of the moral hazard. Starting with the case of. the bank loan, this issue refers to the borrowers' incentives to use the capital for other purposes beyond that was agreed. This leads to the decrease in the probability of loan repayment. This problem occurs after the financing. Activities increasing the risk for the banks are the debtors' potential high-risk investment plans, their inadequate effort to achieve their goals, and the misuse of the capital borrowed.

After disbursement of the loan, the debtor has the incentive to make actions increasing their wealth, but they are not acceptable by the bank because lead to the increase of probability of default and loss given default. They exist many similar actions, such as high-risk investments, purchase of stocks instead of fund efficient projects, the refusal to meet their liabilities even if they have the liquidity. As a result, a low-risk borrower, even if he can meet their liabilities, will have the incentive to present himself as a high-risk one who cannot repay his loan.

Moreover, the moral hazard is a problem for the relations of every rational and intelligent thinker. Including situations that the actions and failures of some counterparties negatively affect others, without the latter ones can identify or impact them.

For example, in the stock market, the moral hazard refers to the situation where the management team hides or falsifies information from its shareholders relating to their actions which are not consistent with maximizing the shareholder's wealth, but are intended to increase executives' private wealth. Similarly, in the bond market, the moral hazard problem arises since issuers are withholding information from the bondholders. In particular, information about potential high-risk actions which are going to increase issuers' credit risk.

Finally, an important form of moral hazard refers to the case when an enforcement measure is taken and it creates perverse incentives which adverse reactions may be worse than the initial problem. This important dilemma makes more difficult the design and implementation of the institutional framework. Such measures lead to the decline of perverse incentives of auditors and credit agencies.

1.3.2 Tools to help solve asymmetric information problems

The ex-ante screening, the contract writing, and the ex-post monitoring procedures reduce the adverse selection and the moral hazard issues. By monitoring the investee's activities, the investor can identify whether he complies with restrictive covenants and enforcing the covenants if he is not. Also, the investor can write provisions in the debt contract (contract writing), such as covenants discourage undesirable behavior or covenants, which are forcing the borrower to provide information about his activities.

Although writing covenants help reduce these issues, they do not eliminate them. Monitoring and writing contracts that rule out every risk is costly. Thus, many investors try to take advantage of other investors (bondholders, shareholders, etc.) who are monitoring and enforcing covenants.

An efficient way to reduce asymmetric information is the provision of information to investors by private companies. The increased demand for high-quality information creates an industry of data providers. The investors prefer the data providers in terms of cost than gathered the information on their own.

In addition, a category of these private companies are the credit rating agencies. They estimate the investees' credit risk, and sell the ratings to their clients. In that way, they help investors reduce adverse selection issues. However, the sale of information does not eliminate adverse selection problem. The free-rider problem occurs when the participants who don't pay for information take advantage of the data from other investors who paid for.

In addition, there is the possibility that the use of the data gathered by private companies will encourage banks to stop producing ratings on their own, increasing risks in the banking system.

Collateral reduces adverse selection and moral hazard problems. When the borrower has to post collateral, he will think twice about asking for financing for the high-risk investment, in which probability of succeeding is not high enough. In terms of moral

hazard, the borrower's undesirable behavior comes with a significant cost for him. For instance, collateral is reducing the probability of default and loss given default in a bank's credit risk model.

However, the protection of collateral against risks has proved smaller than expected. The reasons are the potential reduction in its value, difficulties in the contract's implementation's terms, added problems to borrowers, since the restrictions are increasing the possibility of them go bankrupt, and the reduction in the bankruptcy law's effectiveness.

Another tool used especially by banks to reduce asymmetric information issues is the short-term financing. The short-term loan will give the choice to the bank to not renew the contract if borrowers' probability of default rises. Nevertheless, banks lose the opportunity to create a long-term relationship with the borrower and face the risk of losing "good" clients because of massive competition.

Finally, the role of financial authorities plays a key role in the reduction of information asymmetry. Government can produce information to help investors distinguish the good from the bad investees. The existence of accounting standards, reinforced by heavy penalties imposed on companies who haven't got accurate financial statements, helps investors with the screening and monitoring processes.

The bankruptcy law is very important. If it is less favorable for borrowers, the probability of default will diminish.

1.4 Cost-Benefit Analysis & Statistical Techniques

The ex-ante screening, the monitoring, and the implementing contracts have a significant cost. Gathering and analyze information and the legal procedures cost too. The investor performs a cost-benefit analysis to decide the number of funds he can spend.

Moreover, the investor integrates statistical techniques, artificial intelligence, critical thinking, expert advice, and every information in their investment-decision process. The size of the investment and the type of investee are the main determinants of the choice of the tools used.

The investors use statistical techniques to make a risk assessment, creating a model estimating each specific risk or a combination of them. In particular, they need to identify factors that affect the possibility and willingness of the issuer to meet his liabilities. Then, they quantify the impact of each one of them. Although these models are easy to use, they have got a lot of weaknesses.

Some of the variables are qualitative, thus they can't be precisely quantified. For example, the estimation of the debtor's willingness to fulfill his obligations is not as straightforward as we think. It has many rankings which aren't necessarily quantifiable.

Another issue is that sometimes they are not enough data over a considerable period to estimate the model. The fact that it is not possible to find all the information needed will

affect the measurement of the factor and underestimate its effect (coefficient). In particular, there are models used data only from periods of economic euphoria because of the lack of other information. Also, the identification of factors and the estimation of their coefficients is a dynamic process. They change together with the economic and social conditions and the institutional framework.

Moreover, the investors use past data to estimate their models, usually accounting variables, but past data is not always reliable. They try to capture the effect of their factors in the future by using variables representing the factor's performance in the past. In addition, in other models is applied information from financial markets, such as stock prices. Again, the investor should not rely on this data, because the estimators derived may not accurately captured the investee's willingness and ability to fulfill its obligations. For example, in the periods economic booms which may lead to bubbles in the financial markets, the stock prices lay at higher levels than usual, leading to the underestimation of the firm's credit risk. Accounting information is not always reliable. Issuers have incentives to manipulate this data to attract more investors.

Also, statistical techniques and models for risk assessment will vary according to the type of financial product. They will be different because investors will face a different type of risks in each product. For example, banks face a higher probability of default in consumer loans than mortgages because they don't have any collateral. Additionally, if every investor has got the same information and uses the same statistical models, it will be highly unlikely to receive the same results. The reason is the qualitative nature of the data used.

Although all these models have the same logic and they use more or less the same information and techniques, they will reach in different, but similar, conclusions about the size of the risks. Combined with their increased use by investors and regulators. The fact that the models many not capture accurately some possible risk factors threatens financial stability. In other words, the systematic risk may be larger than that the models estimate.

Furthermore, the investors must combine logical and critical thinking with the techniques to find useful results. Specialists may help him identify the risks and analyze the information may ignore previously. However, their services require significant funds. An example that quantitative techniques are not reliable is the methodologies used by private companies, providing information to the investors, such as credit rating agencies. Their analysis is based on quantitative and qualitative information, combined with critical thinking to provide reliable results.

Overall, their failure to protect investors from the global financial crisis in 2008 reinforces the criticism of the accuracy of those models. Their advocates state that the crisis can be considered as a tail event that occurred, and they postulate that is impossible for every model to be reliable under that situation. However, the crises don't just drop out of the sky; they are events result from the decisions taken by the participants in the markets under certain periods of time.

2. Credit ratings

2.1 Introduction

In the previous section, I highlight the role of the information in the financial system. The lack of reliable data complicates the investor's investment-decision process. Thus, there are private companies providing reliable information to the public, helping them deal with the information asymmetric issues.

The credit rating agencies are private organizations providing information about sovereign's, firm's, and financial products' credit risk. They publish credit ratings, representing the probability of default of the issuer. The investors, and the regulators integrate the ratings in their decisions.

In this section, I describe the role, and the purpose of the credit ratings agencies. I present their development over time, and the problems rise from their operations. Based on specific academic studies, I highlight the criteria used, in their rating assignments. More specifically, the studies by Cantor and Packer (1996), Reusens and Croux (2017) identify the determinants of sovereign credit ratings.

Moreover, I present studies identifying the corporate credit ratings criteria, combined with the examination of specific issues, such as split ratings, and unsolicited ratings. The studies of Ashbaugh-Skaife, Collins, and LaFond (2006), Alp (2013), and Baghai, Servaes, and Tamayo (2014) highlight the determinants of corporate ratings. In addition, they provide evidence, whether the corporate governance is a determinant, and if the agencies became more conservative on their assignments over time.

In the rest of the section, I deal with the split ratings, solicited and unsolicited ratings and the differences in the business models of the credit rating agencies. These are issues consistent with the differences in the rating methodologies of the agencies, and in the way they operate in this oligopoly industry. We present the studies of the Bowe, and Larik (2014), and Livingstong, Wei, and Zhou (2010), examining split ratings, and the studies of Poon, Chan (2010), and Byoun, and Shin (2011), investigating the relationship between an agency's solicited and unsolicited ratings. Finally, I introduce the study of Xia (2014), comparing the ratings from two agencies with difference business models (investor-paid, and issue-paid).

2.2 Credit Rating Agencies

Credit agencies help to reduce asymmetric information issues and provide additional information to investors. They apply motoring and screening procedures to the issuers, publishing the outcome of their analysis. Hence, all interested parties can obtain data that is hard and expensive to gather on their own.

They are organizations that provide analytical services based on the principles of independence, objectivity, credibility and disclosure. The best-known agencies are Moody's, Standard & Poor's (S&P's), and Fitch IBCA. Also, their recognition as rating agencies ultimately depends on investors' willingness to accept their judgment. They have to publish rating definitions and reports on ratings criteria and methodology, to be feasible for the investor to understand their assignments and use them properly.

The credit rating agencies' (CRAs) purpose is to produce and provide ratings about the credit quality of the debt issued by corporations, governments, etc. They also provide services to everyone, and they can rate every financial product. Undoubtedly, they have the know-how, the technical expertise, and the access to information to provide ratings.

In 1909 John Moody published the first publicity available bond ratings, followed by Poor's Publishing Company in 1916, the Standard's Statistics Company in 1922, and the Fitch Publishing Company in 1922. These firm's bond ratings were sold to investors. In the following table we can see that most credit agencies have their own system symbols for ranking the risk of default.

Table 1: Long-term Issuer Credit Ratings

Investment Grade Rating			Speculative Grade Ratings		
S&P and others	Moody's	Interpretation	S&P and others	Moody's	Interpretation
AAA	Aaa	Highest quality	BB+ BB BB-	Ba1 Ba2 Ba3	Likely to fulfill obligations, on ongoing uncertainty
AA+ AA AA-	Aa1 Aa2 Aa3	High quality	B+ B B-	B1 B2 B3	High risk obligations
A+ A A-	A1 A2 A3	Strong payment capacity	CCC+ CCC CCC-	Caa	Current vulnerability to default or in default(Moody's)

(continued)

Table1: Continued

BBB+	Baa1	Adequate payment capacity	C	Ca	In bankruptcy, or default, or other marked shortcoming
BBB	Baa2		D	D	
BBB-	Baa3				

Source: *Cantor Richard and Packer Frank (1996), "Determinants and Impact of Sovereign Credit Ratings", New York Fed Economic Policy Review. (p.3)*

Ratings have gained acceptance in the marketplace. The reliance and the increased use of credit ratings by the supervisors of the financial institutions create the need for reliable ratings. In 1975, specific credit rating agencies were designated by the SEC as Nationally Recognized Statistical Rating Organizations (NRSROs). Since, only the NRSROs rating assignments can be used for regulatory and legislative purpose. The Moody's, the S&P, and the Fitch, who are dominant entities, all of them are NRSROs designated since then.

In particular, the credit ratings issued by an NRSRO matter only in most rating-dependent rules. For instance, SEC declared that only this kind of ratings can be used for the determination of the broker-dealer's capital requirements or safety requirements for the commercial paper (short-term debt) held by financial institutions.

Although, these rules meant that the "opinions" of credit agencies become of central importance in debt markets, SEC procedures for designating agencies as NRSROs are not very clear. As White (2010) argued that SEC never announced specific criteria, and never explained formally why it designates some firms as NRSROs and some others not. In fact, SEC tends to accept agencies that have already been accepted by the market.

The credit rating agencies, as we have already mentioned, produced ratings, which were sold to investors. That specific business model, known as the "investor pays" model, was their basic model since 1909.

However, in 1970, the basic business model of the CRAs changed to an "issuer pays" model. Several reasons force them to this change. The free-rider problem occurred, because of the fact that a lot of investors stopped paying for ratings, and they obtained them from other investors for free. Also, the bankruptcy of the Penn-Central in 1970 made issuers approach credit agencies requesting for ratings to assure investors that they were low risk. The aforementioned regulations made agencies realize that issuers needed their ratings to get their bonds into the portfolios of financial institutions.

As a result, the "issuer pays" business model created incentives in the determination of upward ratings by the agencies to keep the issuer happy. On the other hand, reputation risk is a major concern for credit agencies, hence the potential conflict of interest mentioned above is mitigated.

According to some critics, the major complaint about the rating agencies was that they were too tough, too powerful, and often too mistaken. Some of the issuers were very disturbed to credit agencies underrated their bonds massively when the events occurred didn't call for such a downgrade, or deliberately in retaliation for the decision to give their business in another agency. To illustrate, Moody's slashed its rating for Greece to "junk" when the country attempted to reduce its debt upon the guidance received by the EU and IMF.

The CRAs have been accused of stickiness in their ratings in the sense that sluggishness persists in adjusting their credit ratings. As Cantor R. and Packer F. (1994) point out that credit ratings shouldn't be used as a measure for absolute credit risk, since default probability for a given latter changed over time.

The agencies claim that they provide ratings with a long-term perspective, rather than an up-to-time assessment. Therefore, the ratings will not change to capture all variations of issuers' financial fundamentals, which may fluctuate with general economic conditions, in contrast with market-based measures. This "through-the-cycle" approach ensures rating stability, which in turn facilitates the use of ratings by financial regulators and investors (Staikouras K. P., 2012).

More sophisticated approaches have noted that credit rating agencies' ratings are not inferior to market-based measures in terms of creditworthiness assessment, but also that they are more stable, and therefore, less procyclical.

Moreover, the extreme use of the ratings assignments by financial regulators generates demand for them. The issuer may seek for specific assignments to comply with the regulations, instead of high-quality ratings. Thus, the ratings are "fit for purpose" and lose their informational value.

However, there have been studies supporting the informational value of credit ratings, indicating that the ratings impact securities' market prices, and reduce asymmetric information. Also, the issuers' tendency to pay more than one credit rating agency to rate a specific instrument, indicates that ratings convey information to the market.

Furthermore, the role of the CRAs in the 2008 financial crisis had attracted the most criticism, calling for the design and implementation of strict regulatory and supervisory constraints in the industry. The CRAs fail to price the risk of complex instruments, like asset-backed securities. Also, they were slow in the downgrades of these securities as their losses become apparent.

More specifically, the credit rating agencies became highly involved in the design of mortgage-backed securities. They consulted with the issuers about the rating would earn each kind of mortgage. Obviously, the higher the ratings the higher the profits for the issuer.

On the one hand, the reputational risk is still a major concern for the agencies, on the other hand, the market of mortgage-related securities is different from the typical corporate and government debt market. This market involved a small number of investment banks with a high volume of this kind of instruments. Thus, the threaten of an

issuer to displace their business in another agency is higher. Moreover, these products were far more complex than bonds or stocks. Hence, it was much more difficult for investors to spot the undesirable risks as soon as possible.

The CRAs were operating in a field where they had no experience (design of the securities) and they were under pressure by the issuers to provide the desired for them (securitizers) ratings. In addition, the tight and protected oligopoly of the rating industry and the high use of ratings from financial institutions and their supervisors, has led many investors to trust the agencies on mortgage-related securities.

The burst of the construction and real estate bubble in the USA has led to massive downgrades in mortgage-backed securities. Even AAA mortgage-backed securities had been downgraded, with an 80% of them downgraded below investment grade.

The main policy responses to the criticism have involved attempts to increase entry, limit conflicts of interest, and increase transparency in the rating industry.

In 2003, the SEC added Dominion Bond Rating Services (DBRS Morningstar) a Canadian credit rating agency as a fourth "nationally recognized statistical rating organization". In 2005, the SEC designated the fifth one, and in 2006 the sixth. However, the SEC criteria have remained unclear. The SEC was forced by the competent authorities to stop being a barrier to entry and specified the criteria SEC must use in designating NRSROs. In 2021 there are nine NRSROs agencies.

To address issues of conflict of interest and transparency, the SEC designed and applied regulations on the NRSROs. Restrictions on the undesirable incentives, which can arise under their "issuer-pays" business model. Moreover, conflicts of interest may emanate from three additional areas: the access to and potential abuse of inside information by credit rating agencies, the provision of ancillary services to rated entities by credit rating agencies, and the development of financial linkages with rated issuers.

In particular, the rules such as the prohibition on the rating of complex securities that the credit rating agencies have helped to design, limit conflict of interest issues. The requirement that the credit rating agencies reveal details on their methodologies, assumptions, and track records in the rating process, ensures transparency.

In 2009, the EU legislature adopted, the first legally binding text in EU history concerning the rating business, Regulation 1060/2009. The European Union designed a set of rules to increase competition in the rating market (the authorization system of Eu Regulation), limit conflict of interest issues, and lack of transparency.

Although the financial regulators impose restrictions on CRAs, there is the threat that they will results in an increase in the importance of the three major agencies. Even more that kind of regulations wouldn't change any of the rules that have made the agencies' "opinions" so powerful. Moreover, restrictions increase costs and discourage entry and innovation in information gathering analysis. The increase in transparency may help reduce problems of information asymmetry, but also have the potential for eroding a rating firm's intellectual property.

To conclude, as White (2010) points out "public policy with regard to the credit rating agencies could proceed in a quite different direction. This approach would begin with the withdrawal of all of those delegations of safety judgments by financial regulators to the rating agencies" (p.223). Also, Staikouras (2012), in his study highlights not only the need for stricter regulation in credit industry but also the need for efficient assessments upon the potential distortions the implementation of those rules may cause.

2.3 Sovereign credit ratings

The sovereign credit rating represents the probability that a government will default on its obligations. The investors need reliable information about a country's credit risk, to integrate them in their investment-decision process. More specifically, the increase of the debt issued by governments lead to an increase in the demand for this kind of rating assignments.

I have already mentioned the important role of information in the financial system. Thus, the credit rating agencies must be accurate on their assessments on sovereign's credit risk. However, the estimation of credit risk is a multi-dimensional process. It requires the synthesis of quantitative analysis and qualitative judgments that capture the willingness, and the ability of the sovereign to meets its debt obligations.

The credit rating agencies evaluate all the available current and historical information, and they assess the potential impact of foreseeable future events, to assign accurate ratings. They all use similar approaches, creating statistical models to analyze the data. However, the agencies differentiate with each other in the definition and process of qualitative issues. In particular, Fitch recognizing that no quantitative model can fully capture all the relevant influences on sovereign creditworthiness. Hence, they employ a forward-looking qualitative adjustment.

The data selection and analysis, and the subjective adjustments often prompt the economic participants to question the consistency of the sovereign credit ratings. To address that concern, the researches examine how clear are the criteria underlying sovereign credit ratings. I present the studies by Cantor and Packer (1996), and Reusens and Croux (2017), in which the authors identify the determinants of these ratings.

More specifically, Cantor and Packer group the variables that appeared more often in the major credit rating agencies' reports as determinants of sovereign credit rating, and they estimate which of these are significant as credit rating determinants. Reusens and Croux, collect data about the determinants from the existing literature.

Overall, in both studies they authors identify similar determinants of sovereign's credit rating. However, Cantor and Packer find that budget deficit has a controversial impact on sovereign ratings, Reusens and Croux conclude that during a financial crisis a positive financial balance have got a significant influence on the rating procedure.

Moreover, I present the Moody's approach on rating sovereigns, seeking for the criteria applied by the agency in their assignments. Moody's introduce a scorecard in its reports,

which is used in most cases to approximate credit profiles. This scorecard comprises four factors: Economic Strength, Institutions and Governance Strength, Fiscal Strength and Susceptibility of Event Risk.

The economic strength indicates the sovereign's sustainability to shocks. This factor comprises three sub-factors: growth dynamics, scale of the economy, and national income. A low or volatile level of economic growth can affect debt serviceability. Scale is an important indicator of an economy's diversity and complexity, which influences the sovereign's ability to generate stable revenue streams to service its debt. Also, higher income generally signals a lower probability of default.

Moreover, the strength of institutions and governance provides a strong indication of a government's willingness to repay its debt. Strong institutions and governance ensure financial stability, and assist the sovereign to implement fiscal and monetary policies that support growth and socio-economic stability. Obviously, a sovereign with weak institutions will have problems servicing its debt in the future. This factor comprises two sub-factors: quality of institutions and policy effectiveness.

Moody's in their 2019's rating methodology report supports, that transparent institutions are important drivers of the strength of a sovereign's creditworthiness. Where legislative and enforcement institutions are weak, the position of investors in sovereign debt is correspondingly more uncertain and credit risk higher, and the adaptability of a sovereign in shocks diminishes.

The fiscal strength as measured by debt burden and debt affordability is a direct indicator of government's debt sustainability. Moody's uses these two quantitative sub-factors, and defines as debt affordability the ratio of general government interest payment to revenue. Moreover, the susceptibility of event risk is an important indicator of a sovereign's creditworthiness. Sudden extreme events can severely damage a country's economy. The main risks affect sovereign's susceptibility are political risk, government liquidity risk, banking sector risk, and external vulnerability risk.

Finally, Moody's combine all these factors and sub-factors and provide the final credit rating. It is important to notice that the credit rating agency make adjustments in those factors, based on the economic environment and the continuous changes, and their analysts' critical ability. Also, they use some quantitative factors, but they have to make predictions for them too, credit ratings determination is a forward-looking process.

Furthermore, Cantor and Packer (1996) define the following variables as potential determinants of sovereign credit ratings. The variables used are: The per capita income captures the effect of GNP per capita on the ability of government to service its debt. They expect that the higher the GNP the higher the government's ability to repay its debt. The GDP growth, measures the country's economic growth, and they expect a negative relationship with country's creditworthiness. The inflation, as measured from annual consumer price index, will have a positive relationship with sovereign's credit risk. They use fiscal balance for budget deficit, hence the larger the deficit the lower the sovereign's rating. The external balance, and the external debt represent the current account deficit,

and the foreign currency debt respectively. They expect a negative relationship for both variables with credit rating.

Also, the authors suggest that economic development is a potential determinant, supporting that if a country reach a certain level of development, it is less likely to default. They use two dummy variables. The first equals to one when the country is industrialized, and the other when the country has defaulted on his debt in the recent past.

The authors present their dependent variables for their analysis which are: Moody's, S&P, or the average of the two agencies' ratings assigned to sovereigns. They convert the letter ratings into numerical equivalents using an ordinal scale from 3 for the B1 (B+) ratings to 16 for Aaa (AAA), and sovereign debt spreads over Treasuries.

Furthermore, they examine the significance of each variable as determinants of those ratings. Their findings suggest that all the coefficients of explanatory variables except fiscal, and external balance are statistically significant and have logical sings.

To find if ratings provide additional information to the market, they estimate two regression models using as dependent variable the bond spreads against the average ratings, and the variables described above. Comparing the fit of both regression models, they find that average ratings have more explanatory power. Therefore, it appears that ratings add more information than this contained in the variables assumed as sovereign rating determinants.

Cantor and Packer conclude that there is a significant change of the yields at the announcement day after examining a large sample of rating announcements. Also, having estimated a multiple regression of the change in relative spreads against four dummy variables which are set equal to one if the rating announcements involve actual rating decisions, positive events, Moody's decisions, or speculative-grade sovereigns, they find that there is a substantial difference in the magnitude of change when it's a Moody's announcement or it's related to speculative grade.

Continuing the presentation of scientific literature on credit ratings determinants, introduce a comparison of the determinants of sovereign credit ratings before and after the European debt crisis by Reusens and Croux (2017). To examine how the importance of credit ratings determinants changed during the European debt crisis, they gather data from the major credit rating agencies (Moody's, S&P and Fitch) for a fourteen-year period (2002-2015) of ninety countries' sovereign credit ratings.

Moreover, they describe the explanatory variables used, and assign their expectations from each variable's coefficient sign. The determinants are the GDP per capita, GDP growth, and they expect a positive relationship with credit ratings. Also, they support as credit risk factors the government debt, financial balance, external debt inflation and default history, expecting a positive relationship with sovereign's credit risk.

In addition, they state that economic development, in other words if the country is a member of the OECD, is a potential determinant of credit ratings, and the authors expect a negative relationship with the rating assignments. Finally, they examine if the eurozone

membership status of a country and the current account have explanatory power over credit ratings.

Interestingly, the authors postulate that the membership to eurozone monetary union, and current account balance, have controversial impact on the sovereign credit ratings. Although, eurozone membership provide economic advantages for members, such as increased trade and economic activity due to the lower transaction costs and price stability, the fact that in 2009 the European Central Bank couldn't act as lender of last resort, make the members vulnerable to liquidity risk in a period of financial instability. Also, the current account balance has a controversial effect on credit ratings, since a deficit's impact depends on the investments made with this amount of money.

For their analysis, they estimate a multi-year probit model of credit ratings against the ten variables considered rating determinants. They also add an interaction term between GDP growth and government debt. An increase in GDP growth is going to decrease debt to GDP ratio, hence they expect a positive sign.

Finally, the authors present their findings. The influence of eurozone membership, financial balance, economic development and external debt on the credit rating changed substantially after 2009. More specifically, after 2009, if a country was member of European Union has lower probabilities to be assigned with high-grade, and the ability of government to implement strict fiscal policy to improve its budget deficit, has a significant positive impact in the likelihood of gaining a higher grade.

Also, higher growth on GDP, especially for countries with large amounts of government debt, becomes a significant determinant leading to a potential upgrade of higher rating assignment. All the other variables have logical signs, inflation has a negative impact before and after the crisis and current account's coefficient is insignificant.

2.4 Corporate credit ratings

As I have already mentioned there are no formulae to combining scores to estimate credit risk. Similarly with the sovereign credit ratings assignments, the credit rating agencies gather all the available information and combine them to assess the firm's credit risk. They differentiate in the definition of qualitative issues.

In particular, they examine all the available financial measures, combined with a thorough review in business fundamentals, and the company's environment. Also, it is important for the agencies' analysts to determine the pattern of firm's business cycle, its vulnerability to technological change, labor unrest or regulatory interference. Thus, during the analysis, they use all the available accounting ratios to identify the firm's financial profile, and they adjust based on their unique estimates about the firm's industry growth.

In this section, I present academic studies, identifying the determinants of firm credit ratings. More specifically, in the study of Ashbaugh-Skaife, Collins, and LaFond (2006),

the authors investigate whether strong governance results in stronger creditworthiness. They provide evidences that the credit rating agencies adjust their assignments based on corporate governance attributes, suggesting that corporate governance overall become an important determinant of firm's credit rating. The firms with strong governance gain higher credit ratings compare to firms which have management with large control over the board members, or management directors are also board members.

Baghai, Servaes, and Tamayo (2014), and Alp (2013) examine whether the firm credit rating criteria changed over time, especially after periods of crisis. Alp examines the relation between ratings standards and credit spreads and default rates. She finds that investment-grade ratings tightened between 1985 to 2002 and speculative-grade ratings loosen in the same period. She also finds that there is a break towards conservatism in rating standards around 2002 for both investment and speculative-grade ratings.

Baghai, Servaes, and Tamayo investigate the credit rating agencies' conservatism and the effects of this event in firm's finance decisions, and their results are consistent with Alp's (2013) on credit rating agencies' conservatism. In addition, they find that conservatism in credit ratings influence firms' financial decisions, leading them to issue less debt compare to firms assigned with a rating consistent with their credit risk. Also, stricter ratings have a negative impact on firm's growth and investments in acquisitions strategy.

Moreover, I provide summaries of articles consistent with the issues rising from the differences in credit rating agencies' methodologies. In the studies of Bowe, and Larik (2014), and Livingston, Wei, and Zhou (2010), the authors examine the split credit ratings, the difference in the ratings assigned by two agencies in a specific firm.

Bowe and Larik (2014), seek to identify the determinants of corporate split ratings assigned by Moody's and Standard and Poor's. They authors provide evidence that the credit rating agencies tend to agree for firms with a good financial standing, and for highly-leveraged firms too. Also, Livingston, Wei, Zhou (2010), investigate the split ratings between Moody's and S&P from a bond-yields', and investor's preference perspective. They find that yields are lower when a split with a superior rating by Moody's occur compare to splits with superior rating by S&P's.

Also, Poon, and Chan (2010), and Byoun, and Shin (2011) investigate the relationship between solicited and unsolicited ratings. Poon and Chan examine whether agencies' assign lower grades for unsolicited credit ratings. They provide evidence that the firm's financial standing is a crucial determinant of unsolicited ratings, since firms with strong financial profile is more likely to obtain solicited ratings, and that solicited ratings seem to be higher than unsolicited ones. In addition, Byoun and Shin (2011) examine whether unsolicited ratings add new information to the market. Similarly, to the study by Poon, and Chan, the authors find that unsolicited ratings are generally lower, and they argue that there aren't assessed any diversities in market reactions for downgrades between unsolicited and solicited ratings.

Finally, Xia (2014) examines the possible differences in firm's credit ratings because of their business model. He author examines the impact of an investor-paid model agency (EJR) coverage on issuer-paid model agency's (S&P's) ratings, finding that S&P change its credit risk assessments substantially after the EJR's coverage.

In all of these studies, are used similar financial measures as the determinants of firm credit ratings. More specifically, the authors try to capture all the most significant factors the agencies integrate in their rating assessments (size, leverage, profitability, etc.). The authors use identical firm-specific variables to identify the effect of the firm's, the industry's characteristics in the rating process.

2.4.1 Corporate Governance

Ashbaugh-Skaife, Collins, and LaFond (2006) state that the agency conflicts between management and stakeholders are common problems for every corporation. In addition, asymmetric information induces these events creating perverse incentives to almost every participant. Moral hazard creates incentives to the managers to increase their personal wealth at the expense of investors.

Hence, external stakeholders try to take control of the firm to control management decisions and protect their own wealth. The authors posit that independent and effective monitoring on managements' decisions increase firm's value, and they refer to that governance mechanism as "managerial discipline" hypothesis.

Undoubtedly, better monitoring of management is assigned with the interests of both shareholders and bondholders. However, it has been observed that some features of corporate governance placing greater power in shareholders', may have an ambiguous effect on bondholders' interests.

In particular, in a situation of financial distress, the moral hazard creates incentives to shareholders to take advantage of their voting power and reduce bondholders' wealth, who have seniority, when the firms go bankrupt. The reduction on bondholders' rights leads to lower credit ratings. They refer to this role of governance, affecting firms' credit ratings, as the "wealth redistribution" hypothesis.

Moreover, they decide to use ordered logit models model for their analysis. The dependent variable is firm's credit rating. They use long-term issuer ratings assigned by Standard & Poor's, and create seven categories converting the letter ratings into numerical equivalents using assigning 1 for the D ratings to 7 for AAA. Also, they split the dependent variable into two categories, investment grade and speculative grade, based on the S&P's classification to assign as speculative grade ratings below BBB-.

To measure corporate governance effects in firms' ratings, the authors use the framework developed by Standard & Poor's (S&P's) in 2002. S&P's focuses on four major components: Ownership Structure and Influence, Financial Stakeholder Rights and Relations, Financial Transparency, and Board Structure and Processes. To capture each component's impact, they create variables examining their explanatory power on credit ratings.

They start by gathering data to measure ownership structure effects. They create variables to capture the percentage of investors holding over 5% of a firm's outstanding non-premium stocks, and the amounts of shares owned by institutional investors. Also, the

authors state that the relationship between these variables and credit ratings depends on the restrictions applied from shareholders upon bondholders' wealth. Another important factor is the percentage of shares held by officers or directors (insiders), and they expect that it will be negatively related to ratings.

Furthermore, the authors use G_SCORE to determine the management's power and dominant influence over investors. They cannot make an a priori assumption of the variable's sign because under the "management discipline" hypothesis higher power assigned to managers will result a lower credit rating, and under the "wealth redistribution" hypothesis, greater power in shareholders' hands may have a negative impact in bondholders' interests and credit ratings.

The financial transparency reduces information asymmetry, hence mitigates the management's incentives to act opportunistically. Thus, Ashbaugh-Skaife, Collins and LaFond use the quality of firms' working capital accruals and timeliness of firms' earnings, anticipating negative relation with the dependent variable. To measure the reliability auditor's reports: they examine the audit firm's amount of fee, the objectivity of audit process as measured by the participation of outsiders in it, and they create a dummy variable coded one if the firm's audit committee has at least one "financial expert". They expect that auditor's fee has a negative relation, and the other two factors a positive relation with firm's credit ratings.

The authors use six variables to capture the effect of board structure and processes in firms' credit ratings: The independence of the board directors, and expect a positive coefficient, the magnitude of CEO's control over the board, anticipating to be negatively related to credit ratings. They measure board competency by the independence of boards of other companies and they expect a positive sign. The percentage of directors who are shareholders of the company too is another important variable and they anticipate a positive relation with firm's credit ratings. They also use a dummy variable equals one if a firm has a formal governance policy, and predict a positive sign. Finally, they use measure the percentage of insiders on finance committees, and interestingly they expect the variable to be positively related to credit ratings.

Moreover, the authors also add in their model additional firm-specific explanatory variables to capture the effect of firm's characteristics in its credit rating. These firm's characteristics are the most important factors on credit rating agencies risk assessments, based on the agencies' disclosures. Leverage, return on assets, and interest coverage are used as a measure of firm's creditworthiness. They anticipate a negative sign for leverage, and a positive one for ROA, and interest coverage. A dummy variable which is equal to one if the firm reports negative earnings in the current and prior fiscal year used, and they expect to be negatively related to credit ratings.

Also, they measure the firm's size by the natural logarithm of total assets, arguing that a larger firm is assigned with a higher credit rating. They construct a dummy variable coded one if the firm has subordinated debt, expecting a negative relation with credit ratings. In addition, they use the ratio of gross PPE to total assets measuring firm's capital intensity, and a dummy variable which is equal to one for financial institutions and utilities. For the latter two variables, they expect positive signs.

The authors estimate ordered logit models, using the seven categories of ratings as dependent variable against firm characteristics and corporate governance attributes. They aim to examine the predicted relations between corporate governance and credit ratings. The findings suggest that percentage of investors holding over 5% of firm's voting shares, G_SCORE, working capital accruals, timeliness of earnings, board's independent directors, CEO control over board, the measurement of boards competency, and percentage of board's members holding shares have significant explanatory power on credit ratings. All the firm's characteristics variables have the expected signs, and they are significant except dummy controlling whether the firm is a financial institution of a utility.

In particular, the negative coefficient of investors with significant voting power supports the "wealth redistribution" hypothesis, since a larger number of them can misuse their power and affect bondholders' wealth. The positive and marginally significant coefficient on G_SCORE indicates that stronger shareholder rights are associated with lower firm credit ratings ("wealth redistribution" hypothesis)**.** All the other significant coefficients of the governance attributes have the expected signs. More specifically, Ashbaugh-Skaife, Collins and LaFond state that a better board structure protects stakeholders' interests from the opportunistic managerial decisions.

Another logistic regression model with investment-grade assignment as the dependent variable leads to similar results with the main model. They find that better governance leads to a higher probability of achieving investment-grade credit rating, after computing the derivative of that likelihood relative to the changes in governance features.

Moreover, they state that beside the fact poor governance leads to higher cost of debt, some firms remain loyal to their business model and governance policy. It appeared that management directors are overcompensate in these companies. To investigate that the authors estimate an OLS regression model with CEO's excess payment as explained variable against economic determinants and board and ownership structure attributes.

To identify firm's financial profile, they assign the following determinants: sales, market value-to-book value, return on assets, stock returns, standard deviation of return on assets and stock returns. Their findings suggest that for the most of the firms in Speculative-Grade debt sample (where they find that CEO's overcompensation is greater), the magnitude of CEO is larger than the additional cost resulting from poor governance.

In addition, they examine if the CEO overcompensation, and the firm's investment-grade rating explain the firm's future performance, as measured by next year's ROA against current period. Their findings suggest that the higher the management's excess payment the lower to future performance of the firm will be.

Additionally, they find that a higher future performance it is more likely to occur in firms assigned with an investment-grade rating. Thus, the overcompensation is not due risk premia. Instead, the authors postulate that these results indicate that the agency problems are more intense on firms with poor governance, and the CEO overcompensation is a significant cost that affects the future wealth of all stakeholders.

Lastly, they test the governance attributes for endogeneity. If governance features are endogenously determined, there will be a factor that affect credit ratings, and the explanatory variables of governance. Given the difficulty to identify instrumental variables in accounting settings, the authors use empirical evidence that poor past performance may lead to strengthen governance. They estimate ordered logit models of credit ratings against firm characteristics, prior 1-year, 3-years and 5-years stock's return and governance attributes. The results are similar with the findings from the main regression model, thus there is no endogeneity between governance features, and corporate credit ratings.

2.4.2 Conservatism in credit ratings

Credit rating agencies faced severe criticism due to the fact they didn't predict the 2008 financial crisis. In the aftermath of the crisis, it appeared that asset-backed securities had been assigned with inflated ratings from the major agencies. In other words, it seems that credit rating agencies had relaxed their credit standards. The main problem was that financial institutions, regulators and investors were made the capital allocation decisions based on these ratings. Thus, they face severe losses, due to the increase in asymmetric information.

However, it is possible that the ratings became more conservative, after the technological crisis in 2001. Credit rating agencies applied stricter criteria in their assessments to protect from reputational risk. It is crucial to determine whether credit ratings were stricter during the period before 2008, and this change in credit rating agencies standards affect to firms' financial profiles. Thus, I introduce the studies Baghai, Servaes, and Tamayo (2014), and Alp (2013).

Overall, the evidence provided in this sub-section, indicate that credit rating agencies become more conservatism about their corporate credit ratings assignments, in the period before the financial crisis of 2008. The capital markets take into account this conservatism and ask for lower yields for firms affected by phenomenon.

Alp (2013) studies the agencies' credit standards stringency during the 1985 to 2007 period. She searches for differences in a firm's credit rating during this period, while firm's risk characteristics remain constant. She finds that stricter ratings are not assigned by credit rating agencies for every rating category. More specifically, loosen credit ratings observed is some rating categories during this period. Hence, she examines whether that rating agencies become stricter for investment grade and more lenient for speculative-grade assignments prior to 2002.

The author studies S&P's and Moody's reports, and she highlights that the majority of changes in credit ratings are downgrades indicating that credit ratings agencies become more conservative with their standards. She posits that due to heavy scrutiny after the agencies' failure to predict the 2001 technological bubble, they try to protect their reputation by applying stricter credit standards.

Also, she creates variables to capture specific-firm characteristics like: interest coverage, operating margin, leverage, firm's size, systematic risk, firm-specific risk, dividend payer, market value-to-book value ratio, research and expenses, retained earnings, capital expenditures, and cash balances and tangibility. She estimates a regression model of credit ratings against all these variables assigning a number to every rating letter: 1 for the CCC to 17 for the AAA.

She finds that the estimating coefficients of the regression for the 1985 to 2007 sample period are significant and have the logical signs except for the market-to-book ratio. More specifically, large profitable firms that pay dividends and firms with tangible assets, and higher growth opportunities are assigned with higher credit ratings. However, the results suggest that higher credit risk is expected for firm's holding more cash.

Furthermore, the author estimates another ordered probit model using as dependent variables two sub-samples, the one for the investment-grade and the other for speculative-grade firms, and present the results. The results of the latter model are identical to them presented above. Compare to the whole sample, the signs of long-term debt and total debt leverage are reversed for speculative-grade firms, suggesting that the rating for speculative-grade firms is depended on total debt leverage. Also, the coefficient of long-term debt leverage is insignificant, indicating the speculative-firms doesn't issue significant long-term debt amounts. She observes that unlike the investment-grade firms the cash balances coefficient is negative for speculative-grade, hence the negative cash balance in the entire sample is explained by speculative-grade firms.

Moreover, the author examines the changes of credit rating standards over time, using the year indicator variables. The results support that during the 1986 to 2002 period there is no clear trend because the coefficient estimates are close to zero. However, from 2003 to 2007 the coefficients are negative and significant, indicating that agencies adopt stricter credit standards post-2002.

She finds that year indicator variables were consistently negative in investment-grade subsample and positive in speculative-grade during the 1985 to 2002 period. It seems that credit rating agencies were more lenient in the speculative-grade ratings and stricter for investment-grade ratings. Therefore, based on the above evidence, she posits that there is shift towards conservatism in credit ratings around 2002, especially for speculative-grade firms.

Finally, the author examines the relation between ratings standards and credit spreads and the relation between ratings standards and default rates. She argues that if the investors understand that firms are downgraded because of the shift in stricter rating standards rather than increased credit risk, they should not ask for higher yields. The results of his analysis suggest that the changes in rating standards cannot be completely explained by a change in economic climate. In addition, she expects that the stringency of rating standards will decrease the credit risk of a given rating category because the increase in quality of the firms' grouped together.

Baghai, Servaes, and Tamayo (2014) investigate the credit rating agencies' conservatism and the effects of this event in firm's finance decisions. They state that there is a common

view that the issuer-paid model creates incentives to agencies' management, leading to inflated ratings. Their results are consistent with Alp's (2013) on credit rating agencies' conservatism.

In addition, they find that conservatism in credit ratings influence firms' financial decisions, leading them to issue less debt compare to firms assigned with a rating consistent with their credit risk. Also, the stricter ratings have a negative impact on firm's growth and investments in acquisitions strategy.

They present the explanatory variables used in their models as the determinants of firm credit ratings: leverage, convertible debt divided, rental expenses, cash and equivalents, debt-to-EBITDA ratio, interest coverage, profitability, the volatility of profits, size, tangibility, property, plant, and equipment, capital expenditures, the firm's beta as a measurement of firm's systematic risk, the firm-specific risk, and year indicator variables.

Moreover, they assess OLS and ordered logit models and they find that all explanatory variables are significant and have logical signs. More specifically, the firms with high amounts of debt, high rental payments, low profitability and increased uncertainty in their profits are more likely to default on their obligations. Similarly with Alp's (2013) study, they find evidence that firm saving cash is assigned with lower-grade ratings. However, they key variables are the year indicators, all of them are positive and significant, supporting that credit standards become stricter over time.

The authors postulate that credit standards had been readapted by credit rating agencies to the changes in the macroeconomic environment. Otherwise, the firms' credit ratings may be worse than those implied by their actual credit risk. Hence, if expected default rates decline overtime, the latter assumption will be valid. Their results confirm the hypothesis that credit ratings become stricter, since default rates decreasing over time during the sample period.

Furthermore, the authors expect the stringency in credit standards force firms to use less debt. Thus, they define as dependent variable the difference between actual firms' ratings and predicted firms' ratings (a measure of conservatism) and estimate a regression with the aforementioned explanatory variables. Their findings suggest that credit rating agencies' conservatism affect firm's capital structure. More specifically, they predict that firms with assets which can be used as collateral, lower expenses for development, significant and constant profits, and more often smaller is size, issue more debt among others. They also argue agencies' conservatism affect firm's financial decisions stricter ratings equal to less debt issues.

The authors study whether the increased stringency of the rating agencies had real effects. They focus on firm growth as well as various investment decisions: capital expenditures, acquisitions, and R&D and estimate models of growth and investment, including their measure of conservatism as an additional explanatory variable. The results indicate that stringency in credit ratings decreases firm's ability to grow and to participate in acquisitions.

In addition, they study whether the credit rating agencies conservatism influence bond spreads. To determine whether investors understand the increase in conservatism over

time when they make their cost of debt assessment, the authors estimate a regression model of spreads against the difference between actual firms' ratings and predicted firms' ratings, and some control variables. Their findings are similar with Alp's result in the specific hypothesis. It seems that investors understand credit standards stringency and ask for lower yields, hence the spreads get tighter.

To sum up, Baghai, Servaes, and Tamayo results are consistent with Alp's (2013) on credit rating agencies' conservatism. In addition, they find that conservatism in credit ratings influence firms' financial decisions, leading them to issue less debt compare to firms assigned with a rating consistent with their credit risk. Also, stricter ratings have a negative impact on firm's growth and investments in acquisitions strategy.

2.4.3 Split ratings

The conservatism can be detected even among credit rating agencies, since they commonly disagree in their assignment of credit ratings on specific firms or securities. Their disagreements (split ratings) can impact on economic environment. Splits ratings increase the asymmetric information, through growing uncertainty upon which rating is the right one. The split ratings influence investors decisions are contrary to the ratings informational value.

However, split ratings were beneficial for financial institutions because they were allowed to use the higher one. Instead, debt securities were priced by both higher and lower credit ratings leading partially to inefficient decisions for asset managers. Hence, it was important for firms and investors to understand the factors result in split ratings, in order to provide them sufficient information to take the best decisions as possible.

Bowe and Larik (2014), seek to identify the determinants of corporate split ratings assigned by Moody's and Standard and Poor's. They hypothesize that Moody's apply stricter credit standards, hence the authors investigate whether the Moody's ratings are systematically lower than S&P in a split. They refer to this as "the Moody's conservatism hypothesis". The authors provide evidence that the credit rating agencies agree for firms with a good financial standing, and for highly-leveraged firms too. They state that corporate governance is an important determinant for credit ratings and significantly affect the split rating decisions. However, the authors conclude that Moody's and S&P weight differently the governance attributes, suggesting that Moody's put a significant weight on governance in its assignments. Finally, their results provided support the "Moody's conservatism hypothesis".

In the analysis they use as main determinants of corporate credit ratings the same variables with the Ashbaugh-Skaife, Collins, and Lafond (2006), combined with macroeconomic and regulatory indicators. In particular, the authors employ the following variables, to define a firm's main characteristics: firm leverage, interest coverage, profitability, and firm's size. They expect that firms with low coverage and ratio of net income-to-total assets, and high leverage their ratings will suffer more likely by splits, and they refer to this as "credit boundary ambiguity" hypothesis. Therefore, they argue

that in split-rated firms, it's possible that Moody's will assign a higher rating in a low leveraged and profitable, supporting Moody's conservatism hypothesis.

In addition, they incorporate governance variables such the amounts of shares held by institutions, the boards independence, and the G-score variable. They expect that poor governance will lead to split ratings, and that a G-score will be negatively related, and the other two variables a positive relation, with Moody's conservatism on split-rated firms. They also add firm's measurement of systematic risk (equity market beta) and expect that higher systematic risk will more likely lead to split ratings.

As macroeconomic indicators the authors use the GDP growth to identify procyclicality, expecting a positively relation of GDP growth with the Moody's conservatism hypothesis. Also, they assume that the increase in competition in credit ratings industry, and especially between major agencies (after the entry of Fitch) lead to inflated ratings, hence they create a binary variable coded 1 if a firm has three ratings, indicating resulting in a higher probability of receiving split ratings. Finally, they introduce a dummy variable to capture the impact of FD regulation, which is set equal to 1 for the post-FD period, and they expect a negatively relation with Moody's conservatism hypothesis.

They estimate a bivariate probit model, which combines the likelihood of the split rating to occur and the likelihood Moody's to assign a higher rating in the split as one interrelated event. More specifically, the authors describe a two-stage procedure. They use dummies as explained variables, hence in stage once the dummy coded one if a split ratings occurred, and in the second stage another dummy set equal to one if Moody's assigned a higher rating than S&P.

Moreover, they present their results from the first stage of regression analysis. The variable of size, interest coverage, and profitability are significant and negative, supporting that agencies' ratings are not differentiate on firms with good financial standing. Interestingly, both agencies tend to agree on their ratings for highly leveraged firms, since the leverage variable is negative. Also, all three governance-related variables are significant and negative, supporting the fact that poor governance may lead to split ratings. For the macroeconomic indicators and regulations factors, their findings support in post-FD regulation period the credit rating agencies will differentiate on firms' credit ratings their ratings more often.

Additionally, Bowe, and Larik present their findings for the second stage analysis. The variables of size, coverage, profitability, and governance (except G-score) are significant and positive and leverage is negative and significant supporting the Moody's conservatism hypothesis. The negative sign on G-score indicates that the decrease of the power of stakeholders, will lead to a lower rating assignment from Moody's compare to S&P. Therefore, Moddy's assumes that the effective monitoring over management decisions is an important factor for assigning a higher credit rating. Moreover, they conclude that the increased competency in major credit rating agencies, and the assignment of three ratings to a firm will more likely lead to higher rating by Moody's. Also, it seems that the conservatism of Moody's increased during the post-FD period, since the dummy's coefficient is significant and negative.

Furthermore, the study by Livingston, Wei, Zhou (2010), is an investigation of the split ratings between the aforementioned credit rating agencies from a bond-yields', and investor's preference perspective. They find that yields are lower when a split with a superior rating by Moody's occur compare to splits with superior rating by S&P's. The threat of two agencies' ratings as equal by financial regulators and academics may create ambiguous results from their analysis. In general, the authors posit that investors prefer ratings from the most conservative agency. Hence as the agency's rating standards become stricter, investors will use those ratings to estimate credit risk. Also, they postulate that credit rating agencies try to protect from reputational risk, becoming more conservative over time.

To begin with, the authors construct the foundations of their analysis: the rating equivalence hypothesis, and the systematic difference hypothesis. In the aforementioned studies we can observe that rating agencies use almost identical determinants for their firm credit rating assignment. The authors assume that the two major credit rating agencies' use exactly the same factors and assign the same weights to each one of them, and they call this view rating equivalence hypothesis. Therefore, if this hypothesis is valid, which agency has assigned the highest rating in a split does not concern us anymore because the bond yields will be equal.

Also, they assume that there are systematic differences between the two rating agencies. More specifically, they provide evidence that Moody's ratings are slightly better at predicting default than S&P ratings and refer to this as the systematic difference hypothesis. Obviously, we are going to observe lower yields in splits ratings with a superior rating by Moody's compare to splits with S&P's superior rating. Overall, they examine, whether split ratings are a systematic event, and if the investors more likely prefer the ratings of one of the two agencies.

Livingston, Wei, and Zhou estimate multivariate regressions of the split-rated bonds yields minus the treasury yield against: thirty-three dummy variables one for each rating category (letter), and some control variables. In these control variables, they include bond characteristics such as the maturity, magnitude of the issue, the seniority of the debt security, the characteristic of the bond to be callable, variables trying to capture the effect of different registration methods in debt issues, and a dummy variable coded one if the issuer belongs in utility industry. The authors expect that magnitude of the issue and seniority will be negatively related with spreads. The callable characteristic of the issue, and the bonds aren't shelf-registered and especially for Rule 144A issues is more likely to be positively related with the yields. They also use the excess return of the security with the market variable to capture the security's systematic risk, and the coefficient of this variable is expected to be positive. Finally, as a test variable they construct a dummy coded one if Moody's rating is the highest, and they expect a negative relation with spreads.

They find that most of the explanatory variables are significant and have the anticipated signs. More specifically, the variable that captures the seniority of the issue has a positive sign, but the coefficient on the test variable is negative and significant, indicating that indeed, the investors prefer the bonds assigned with higher rating by Moody's.

In addition, to examine evolution of conservatism in rating standards over time they split the sample into two sub-samples based on period: 1983-97 and 1998-2008. Estimating their regression model over these two periods, they conclude that the test variable is highly significant for the 1998-2008 subsample, suggesting that Moody's conservatism increased during this period. They also create an interaction term between the test dummy and a time trend variable and add it to the main regression model. They find that the interaction term is negative and significant, supporting the investors' preferences are inherent with more conservative ratings**.**

To sum up, the major credit agencies systematically disagree on some of their credit rating assignments on specific firms. The likelihood of split ratings is explained by both financial and governance variables. The researchers identify that Moody's apply stricter credit standards on its ratings, and the investors ask lower yields for split-rated bonds with Moody's superior ratings during the 1998 to 2008 period.

2.4.4 Solicited and unsolicited credit ratings

The next topic is solicited and unsolicited ratings assigned by the major credit rating agencies. Solicited called the ratings provided by an agency in exchange for a payment amount by the issuer. However, it has been observed that the major agencies tend to provide unsolicited ratings too, based on the public information about the firms or debt securities.

The main problem of unsolicited ratings was their reliability. There was criticism that unsolicited ratings were lower than solicited ratings and overall downward biased, and that credit rating agencies assign lower ratings to punish issuers, who didn't want to obtain solicited ratings by them. In addition, there is severe scrutiny to the agencies that they used the lower unsolicited ratings as leveraged to squeeze firm's management teams to ask for a rating by them and earn obtain new clients. However, the solicited ratings may be higher because it is based on public and non-public information, hence the rating estimation is more reliable. To investigate the unsolicited ratings, the determinants and the quality of information obtained in them, we present the studies of Poor and Chan (2010), and Byoun and Shin (2011).

Poon and Chan examine whether agencies' assign lower grades for unsolicited credit ratings. They conduct a global study of S&P's solicited and unsolicited corporate credit ratings during the period 1998-2003. They investigate the determinants of the decision to obtain a rating, and the diversities between grades assigned to solicited and unsolicited ratings. They find that the firm's financial profile is a determinant of unsolicited ratings, since firms with strong financial standing is more likely to obtain solicited ratings, and that solicited ratings seem to be higher.

The S&P's ratings are used as dependent variable for the main regression model. They apply firm characteristic variables as potential determinants of those ratings. In particular, they use: return on capital, operating margin, and ROA to measure profitability, measures for leverage, firm's total debt, operations cashflows, net cash flow, short-term, and cash

and equivalents, and some accounting ratios. Current ratio, quick ratio, cash ratio, and total assets and total sales as a measure of the size of a corporation, and variables for firm's fixed assets. We can observe that in all of the studies presented, the authors tend to agree around the firm characteristic variable and the variables used to capture its influence on credit ratings.

Moreover, their findings suggest that there are significant diversities between solicited and unsolicited ratings, as a consequence Poon and Chan examine if those differences are related with the firm's financial status. They present descriptive statistics for the aforementioned variables, and their conclusion is that highly leveraged firms, with low and uncertain profits, are more likely to assigned with unsolicited credit ratings.

Furthermore, they introduce the main regression model of this study. In order to test the hypothesis that the firm's characteristics affect the decision of obtaining a rating are also credit rating determinants (sample-selection bias), they estimate a probit regression model of the rating decision against firm characteristics, sovereign credit, and a dummy variable coded one if the firm is based in Japan (unsolicited ratings appear only in Japan firms). Then, they use the probability result from this model as an instrumental variable to the following regression of credit ratings against all the explanatory variables described above and the instrument.

Finally, Poon and Chan present their conclusions based on the regression analysis. They find that firm size, sovereign risk, and profitability significant, positively related with credit ratings. Also, the variables of debt and leverage are significant too, and have logical signs, suggesting that higher leverage lead to lower ratings. The instrument variable is positive and significant, indicating the existence of sample-selection bias, and that the solicited ratings are generally higher than unsolicited.

Byoun and Shin (2011) examine whether unsolicited ratings add new information to the market. Similarly, to the study by Poon, and Chan, the authors find that unsolicited ratings are generally lower, and they argue that there aren't assessed any diversities in market reactions for downgrades between unsolicited and solicited ratings. They also investigate how the unique Japanese corporate governance mechanism affect Japanese firms' decisions to obtain ratings. Also, they examine if solicited or unsolicited ratings can explain better the firm's future profitability, and even more which agency's ratings are better determinants of future profitability, R&Ds (a Japanese credit rating agency) or S&P's ratings.

Also, they find that investors and market participants in general tend to be more cautious about unsolicited ratings and especially for the lower-grade ones. Hence, their reactions are more severe in those ratings downgrades. Interestingly, most of them react in the same way for downgrades in solicited ratings of low-grade too. Finally, the authors provide evidence that market understand the downgrades on unsolicited ratings as a negative signal about firm's future performance.

They start by setting the following hypotheses as the foundation for their research. They hypothesize that unsolicited ratings are going to be low-grade. Byoun and Shin posit that based on market efficiency unsolicited ratings will not influence firm's value. However, they state that the investors and regulators support that the credit rating agencies' have

the skills and the know-how to make accurate assessments of credit risk. Thus, changes to firm's value are expected due to unsolicited ratings, and accordingly more severe reactions for lower rating classes.

Furthermore, they develop two more hypotheses to test the effects of Japanese corporate governance in solicited and unsolicited ratings. In particular, they highlight that Japanese firms with a keiretsu link, are protected significantly in a period of financial distress. The potential bailed out make those firms care less about external credit assignments. Thus, they hypothesize that firms affiliated with keiretsu doesn't have the incentive to obtain ratings to access funding, and they subject weaker changes in their value due to unsolicited ratings announcements.

They estimate a probit regression model of the dummy variable coded one if the firm's rating assignment is investment grade against some control variables including firm's characteristics like debt and market-to-book ratio, dummy variables identifying the type of keiretsu linkage, and a dummy variable equals one if the firm's rating is unsolicited. Their findings are identical with Poon and Chan (2010) supporting that, unsolicited ratings are consistent with lower rating grades, since the latter dummy is negative and significant.

Additionally, they investigate if the investors' reactions on rating announcements are more intense to the unsolicited ratings announcements. Thus, they calculate the abnormal returns for a specific time window and sample of announcements. Byoun, and Shin find that downgrade announcements considered as a negative sign from the investors, and they react selling or avoiding the specific securities, leading their prices to fall.

However, the market participants tend to react in the same way for unsolicited and solicited ratings for these downgrade announcements. The authors provide evidence that the market's reaction on downgrades differentiate between rating-grades, supporting their hypothesis that is more severe on speculative-grade assignment.

Moreover, they examine how Japanese corporate governance (keiretsu) influence the firm's decision to obtain a credit rating. They estimate a regression model of market model's residual against the aforementioned explanatory variables and an interaction term between the dummy variable equals one for firm with unsolicited rating and dummies capturing they type of keiretsu for the firm. In addition, they estimate a regression of future profitability, as measured by return on assets, against the difference between R&I and S&P's ratings.

In the end, the results from the former regression models support that keiretsu link is consistent with more intense market reactions on downgrade announcements in both solicited and unsolicited ratings. In other words, investors believe that the firms under this corporate governance mechanism are less transparent. From the latter regression model, they find that for solicited ratings the larger difference between R&I and S&P's ratings, the future profitability will be significantly lower. However, for unsolicited the corresponding coefficients are insignificant, indicating that this difference does not provide any additional information about firm's future value.

2.4.5 Issuer-paid vs. investor-paid ratings – Comparison

The issuer-paid model dominates the credit rating industry over time. Still the majority of NRSROs agencies are issuer-paid. However, there are evidence from the financial crisis of 2008 that inflated ratings occurred, the issuer-paid business model is criticized. More specifically, the credit rating agency's accused that created linkage with the issuer and they loosen their credit standards for specific clients and products. Hence, they add more systematic risk in investors' portfolios.

Moreover, a logical solution for this problem is the return to the investor-paid model. Although, this will terminate the conflicts of interest between credit rating agencies and issuers, a free rider's problem will arise. Also, investors want to buy securities in low prices, which creates perverse incentives for investors to ask from credit rating agencies lower rating assignments. Overall, we can assume that both business models have their weaknesses.

In addition, it is interesting to compare the ratings' quality of investor-paid model and issuer-paid model agencies. The increase of competition in the oligopoly rating industry allows the entry of some investor-paid agencies. Thus, it is interesting to test the differences between their ratings and major credit agencies following issuer-paid model. For this purpose, we follow the study by Xia (2014).

In this article, the author examines the impact of an investor-paid model agency coverage on issuer-paid model agency's ratings. He investigates if investors' expectations will lead S&P to adjust their ratings, without the impact of EJR coverage. Lastly, he tries to identify if the S&P's adjustments to its ratings are due to the fact that they extract new information about the underlying firms and debt securities, or S&P reacts strategically to protect its reputation.

He finds that S&P change its credit risk assessments substantially after the EJR's coverage. It seems that S&P performs changes that it may not be implemented if the investor-paid agency hadn't published these ratings. Also, Xia posit that S&P to protect from reputational risk, adjust its ratings when face lower ratings by EJR's coverage, but it doesn't make changes when higher ratings from EJR had been observed.

The author introduces the Egan-Jones Rating Company (EJR) an investor-paid model rating agency with a significant presence in credit rating industry. Xia states that EJR gives a different perspective on rating assignments, thus someone can use those ratings as a comparison on issuer-paid agencies ratings. It is certified as a "Nationally Recognized Statistical Rating Organization".

Furthermore, he examines the responsiveness of S&P's ratings to credit risk. Corporate defaults are the most important credit events that S&P's credit ratings seek to capture. He estimates an OLS regression model of S&P's ratings against a dummy variable captures EJR coverage and firm characteristics variables such as: leverage, profitability, M-B ratio, sales, leverage volatility, profitability volatility. He also adds as explanatory variable the expected default probability of the firm derived from the Merton model, and an interaction between this variable and the EJR's coverage dummy. He finds that the default

probability, and the interaction term are significant and positive, indicating that EJR assessments are consistent with S&Ps, and that S&P make adjustments to its credit risk estimations after the EJR's coverage.

Additionally, he investigates market reactions due to S&P's rating adjustments announcements. He expects that the adjustments in ratings provide new information to investors, if their reactions are more intense. He presents univariate statistical tests and observes that downgrades lead to severe market reactions compare to upgrades. Thus, he suggests that the additional information provided by the agencies to the investors through rating revaluation and adjustments supports the agencies' strategy to maintain its reputation.

The author examines the main model for endogeneity. More specifically, he concerns if investors preferences can lead to S&P's rating readjustments by themselves without the coverage of investor-paid agencies. Initially, he chooses the econometrical solution of instrumental variable, and he uses firm's industry market capitalization as an instrument, given that EJR tends to provide assignments for large cap companies. He implements this instrument for EJR's timing of coverage.

Xia estimates a logit regression model of S&P ratings against the instrument, all the explanatory variables used in the initial regression, and an interaction term between the instrumental variable and default probability derived by Merton model. His findings support the assumption that investor-paid model agencies coverage improve the information quality of S&P's ratings. In other words, S&P's ratings become more consistent with firm's credit risk after EJR coverage.

Finally, the author examines if the improvement of S&P's ratings in response to EJR's coverage reflects a reputation mechanism (concern if the investors' confidence in agency's high ratings becomes lower) or a "learning" mechanism (S&P updates its assessments to mimic EJR's ratings). He creates two subsamples: a firm's EJR rating is lower than S&P's existing, and the firm's EJR is higher. The latter mechanism predicts that S&P's responses should be symmetric in the two cases. However, the former one might predict a stronger response by S&P when EJR rating is lower. He estimates a regression of those two sub-samples against default probability and EJR coverage dummy, and control variables measuring firm characteristics. The findings provide evidence that S&P ratings changes take place when EJR coverage result in lower ratings than S&P, and that there is no change when EJR ratings are higher. Thus S&P is more concerned about reputational risk and trying to be protected.

3. ESG ratings

3.1 Introduction

Environmental, Social, and Governance (ESG) has become increasingly important in recent years. There is a growth in the firms adopting policies to improve their sustainability, and in institutions consulting corporations on how to achieve higher ESG performance. Also, a significant number of investors prefer investing in corporations pursuing sustainability.

To identify firms with high ESG performance, investors integrate ESG data as inputs in the financial analysis. Thus, the increased interest in information, lead to the origination of ESG ratings and data products providers. They gather raw data from a firm's public disclosures and develop various ESG data products for their clients.

The accuracy and the reliability of the ESG data depend on the availability and the quality of the inputs. Also, the providers use different metrics and methodologies to estimate the firm's ESG performance. Thus, there are a lot of issues in ESG measurement and data, and the economic participants must be aware of those problems.

Investors rely on this data to identify high sustainability firms. In the following presentation of the literature, there are articles supporting that companies with higher ESG scores have lower cost of equity capital, easier access to finance, and they create higher economic value in the long-term. Also, high ESG scores firms encourage stakeholder engagement and increase their voluntary disclosures in sustainability issues.

In this section, I start with the description of the largest ESG data and ratings providers. All of them use as inputs raw data, which is gathered in different manners, estimating a firm's sustainability. Moreover, I present the studies examine the relationship between ESG scores and financial performance.

More specifically, I introduce the study by Ghoul, Guedhami, Kwok, and Mishra (2011) investigating the relationship the relationship between CSR and firm's cost of equity capital, and NG, and Rezaee (2015) examining the financial performance relative to firm's cost of equity capital, and the impact of ESG performance on this relationship. Also, there is a summary of the studies by Cheng, Ioannou, and Serafeim (2014) examining the argument that the adoption of CSR policies leads to lower capital constraints, and Eccles, Ioannou, and Serafeim (2014) investigating the impact of corporate sustainability in a firm's financial performance.

In addition, I present the studies of Lins, Servaes, and Tamayo (2017) examining the performance of high-CSR firms to low-CSR ones during the 2008 financial crisis, and the study by Polbennikov, Desclée, Dynkin, and Maitra (2016), in which the authors try to identify the relationship between ESG ratings and firm's economic value.

In the rest of the section, I mention the weaknesses observed by researchers in ESG data, through the studies by El-Hage (2021) in which he highlights the problematic nature of

ESG ratings, and explore potential consequences due to the implementation of mandatory disclosure, and Katsantonis, and Serafeim (2019) present several important problems of ESG measurement, and data, and potential solutions. Additionally, I present the study by Stubbs and Rogers (2013) in which they shed light on the rating methodology of Regnan, an ESG ratings agency. Finally, I introduce the studies by Tang, Yan, and Yao (2021) investigating if the ownership status of the firms rated, and the rater plays a substantial role in the rating assessment, and Gyönyörová, Stachoň, and Stašek (2021) in which the authors identify the issue of convergence validity between the major players in ESG data industry.

3.2 Sources of ESG data and ratings

Investors' increased interest in investing in companies with high ESG performance has grown considerably in recent years. They integrate in their investment decisions the firm's actions to improve sustainability. Thus, the role of ESG information is important for the well-functioning of the financial system.

The need for reliable ESG data, as investors tend to pay a premium to obtain sustainable assets, leads to a growth in ESG data and ratings industry. Those agencies provide data based on environmental, social and governance criteria, which investors found useful in decision-making. Ratings provide select specific issues for each ESG theme, and estimate the firm's exposure to these risks and the way it manages them.

The ESG data providers develop a variety of ESG data products to meet investors' demand. In particular, they gather raw data from firms' public disclosures, and any available public information. There are ESG data providers collecting their information from questionaries. Also, if raw data for some issues is not available, they use statistical techniques and estimate approximately those data points.

Moreover, they provide screening services, estimating the firm's exposure to sustainability risks. They also monitor the firm's activities, trying to capture potential controversies issues consistent with its ESG performance. Overall, all the products derive from collected or estimated raw data.

In addition, there are ESG scores and ratings providers. They use the same raw data inputs as ESG data products providers. ESG scores and ratings are assessments of the firm's exposure to ESG risks and opportunities. Their analysts use quantitative and qualitative analysis, combined with reports explaining the whole process and the outcome.

Those products', and ratings' accuracy depend on the availability and the quality of the inputs. The providers use different methods and metrics to overcome these problems. However, there isn't a standard practice for the manner in which they gather information. For example, some ESG data products and ratings providers collect all the publicly available information about the rating entity for their analysis. Then, they engage with the entity to check the accuracy of the data. Other providers gather information through questionnaires.

Similarly, with the information-gathering process, the providers differentiate in their methodological approaches. Even in the quantitative procedures, they estimate in various ways the weights must be assigned to different ESG issues. Also, in some ESG components is extremely difficult to estimate the exposure to risk, and the potential controversies. In particular, in the Environmental pillar there is not standard manner to measure those issues, and combine them to drive in an overall score. These problems, combined with the availability, quality, and comparability of ESG data, lead to low correlation in ESG ratings and products between the providers. Although the ESG ratings and products should help investor to deal with the asymmetric information issues, the lack of mutual agreement between the providers reduces their information value.

Gyönyörová, Stachoň, and Stašek (2021) count over 70 different ESG ratings agencies in 2019. The authors also categorize the providers as market data providers, such as Bloomberg, Thompson Reuters, ESG exclusive data providers as RobecoSAM, Sustainalytics, and specialized data providers such as Carbon Disclosure Project (GDP), Institutional Shareholder Services (ISS).

Moreover, the ESG rating industry expansion leads major data providers and credit rating agencies to enter. In particular, the Bloomberg acquired New Energy Finance, Morningstar acquired Sustainalytics, and major credit ratings agencies such as Standard and Poor's, and Moody's, acquired RobecoSAM ESG ratings, and Vigeo Eiris respectively. Also, the first major ESG rating agency "Kinder, Lydenberg, Domini & Co. Research & Analytics" (KLD) acquired by MSCI.

KLD, founded in 1988, was the primary data source for academic studies. As Ghoul, Guedhami, Kwok, and Mishra (2011) argue that KLD is an independent agency gathering and processing ESG data, providing the outcome to investors interested in social responsibility characteristics into their investment decisions. KLD's data collection is based on various sources, such as government agencies, NGOs, firms' annual reports, regulatory filling, articles in press, academic process. Thus, there are no selection biases. Ng and Rezaee (2015) present that KLD ratings assessment procedure combines strength and concerns of 80 indicators in the following categories: community, corporate governance, diversity, employee relations, environment, human rights, and products. In addition, KLD STATS organizes the various scores not only in qualitative areas but also in business issues, such as alcohol, gambling, tobacco, firearms, the military and nuclear power industry.

Another major ESG rating provider with a participation of about 20 years in the industry is Refinitiv/Asset4, a major division of Thomson Reuters. Thomson Reuters Asset4 is a Swiss-based company specializing in providing objective, independent, and systematic ESG information to investors. In particular, investors with significant assets under management, such as BlackRock, use Asset4.

Cheng, Ioannou, and Serafeim (2014) mention in their study that Asset4's analysts collect over 900 data points per firm every year. They focus on public information, which is objective. More specifically, the ESG data consists of information for environmental factors such as carbon emissions, pollution, renewable energy, water and waste recycle, and social factors such as accidents, women employees, health and safety, injury rate.

The analysts use those 900 points as inputs to assess 250 key performance factors, which are going to be grouped in 18 categories within four pillars: environmental performance, social performance, corporate governance, and economic performance. Also, the authors obtain directly from Asset4 more specific scores, such as stakeholder engagement.

Sustainalytics is another leading ESG data provider for over 25 years. Their analysts provide ESG risk ratings, measuring the magnitude of a firm's unmanaged ESG risk. They publish scores from 0 to 100, indicating the lower the score the lower the unmanaged ESG risk. The analysts gather data on ESG issues, and group the information into three blocks: corporate governance, material ESG issues, and idiosyncratic issues. Material ESG issues (such as business ethics, human capital etc.) can impact the economic value of the firm and are the center of their methodology. Additionally, the block of idiosyncratic issues stands for the unexpected and unrelated issues to the specific industry and business models observed in the industry.

Moreover, they assess exposure and beta. Exposure is measured from a set of ESG factors that pose potential economic risks for companies. Beta assessment is a key component of the procedure, reflecting the degree of firm's exposure to material ESG issue deviation from the average exposure to that issue within its industry. Therefore, the firm's ESG factor exposure derived from the multiplication of the company's issue beta and the industry's exposure score to the specific issue. Finally, to compute the firm's ESG risk rating, they sum all the unmanaged risk scores of the individual material ESG issues, which is derived from the difference between the firm's exposure and firm's managed risk on each ESG issue.

Eccles, Ioannou, and Serafeim (2014) collect data for environmental and social issues from Sustainable Asset Management (SAM) data provider. SAM gathers information and constructs the Dow Jones Sustainability Index. Interestingly, SAM acquired by a major credit rating agency Standard and Poor's. Therefore, S&P's move into ESG rating industry providing Global S&P ESG scores. Once a year S&P's ESG department initiates and leads an independent sustainability assessment of 8000 firms around the world, around the 90% of global market capitalization. Following the methodology of SAM, S&P's analyst base their estimation procedures on a questionnaire of 130 questions or more on environmental, social, and governance and economic issues, giving an increased weight on the long-term value creation. Its scores are scaling from 1 to 100 with 100 being the best, and it is a combination of available public information for the company and the firm's responses on each years Corporate Sustainability Assessment (CSA). This questionnaire is designed to ensure objectivity and reliability of the qualitative data gathered, since limits qualitative answers through a multiple-choice system.

In addition, there are companies provide data on specific components of ESG. Carbon Disclosure Project (CDP) assesses ESG scores based on company's degree of commitment on climate change mitigation. It estimates each company's transparency on climate change strategy. CDP uses questionnaires to collect the data inputs for the analysis. Its scores range from 0 to 8 from the worst to the best score.

Institutional Shareholder Service (ISS) is another specialized data provider, publishing scores based on governance practices of each firm. ISS tries to identify for every company

its governance risk. Its scores range from 1 to 10, from the best to worse. Finally, Gyönyörová et al. (2021) use Bloomberg ESG Disclosure score in their study. The score is based on 120 quantitative and qualitative public information, with which agencies' analysts try to estimate the firm's ESG data transparency.

3.3 ESG and firm's economic value

Nowadays, the increased interest of economic participants in corporate social responsibility (CSR) strategies reflects the commitment of financial markets to forward environmental, social, and governance (ESG) criteria. The adoption of policies on ESG issues by companies in their business models, and the growing number of funds managed by Principles for Responsible Investment (PRI) signatories, indicate this trend towards sustainability investing. However, as Cheng, Ioannou, and Serafeim (2014) point out, the economic participants do not know in advance if a firm's economic value influenced, and in which ways by the improvement in ESG performance.

In this sub-section, I present academic articles providing that CSR increase the firm's value, including empirical researches on the relationship of firm's ESG performance with cost of equity capital and financial constraints. Also, there are studies examining the relationship between ESG performance and financial performance in the 2008 financial crisis, and in terms of corporate bonds.

More specifically, Ghoul, Guedhami, Kwok, and Mishra (2011) identify the relationship the relationship between CSR and firm's cost of equity capital, finding that CSR have a negative relationship with cost of equity capital, and that not all CSR features are associated with cheaper financing. Similarly, NG, and Rezaee (2015) examine the financial performance relative to firm's cost of equity capital, and the impact of ESG performance on this relationship, providing evidence that firm's ESG performance is negatively related to cost of equity, and especially growth opportunities, research effort, environmental, and governance performances have a significant impact over firm's economic value. Cheng, Ioannou, and Serafeim (2014) provide evidence that the adoption of CSR policies leads to lower capital constraints, and especially the social and environmental components of CSR have a stronger impact.

Also, I present the study of Eccles, Ioannou, and Serafeim (2014) investigating the impact of corporate sustainability in firm's financial performance, finding that the high CSR score firms encourage stakeholder engagement and increase the voluntary disclosure of non-financial activities' performance. They state that in the long-term, these firms create greater wealth for their shareholders compared to its competitors with low-CSR scores.

In addition, Lins, Servaes, and Tamayo (2017) examine the performance of high-CSR firms to low-CSR ones during the 2008 financial crisis, providing evidence that the adoption of CSR policies, and the increased CSR performance leads to higher stock returns during periods of low trust in capital markets. Finally, we present the study by Polbennikov, Desclée, Dynkin, and Maitra (2016), in which the authors support the

positive relationship between ESG ratings and firm's economic value, providing evidence that high-rated ESG firms outperform the low-rated ones.

Overall, the most of these articles come to the same conclusion, that ESG ratings have a positive impact on a firm's economic value. The adoption of CSR policies, the encourage of stakeholders' engagement, and the improvement in transparency of non-financial information related with ESG, appear to be a positive signal to capital markets. The investors' preference for firms with improved sustainability performance could be beneficial for the firms in terms of cost of equity, and stock prices performance, increasing shareholders' wealth.

3.3.1 Firm's Sustainability Performance - Cost of Equity Capital, and Financial Constraints

Ghoul, Guedhami, Kwok, and Mishra (2011) examine the relationship between a firm's ESG performance and its cost of equity capital. The authors investigate in which way the corporate social responsibility (CSR) performance influence firms' cost of equity capital. As cost of equity capital, they define the rate of return investors require investing in the specific firm in regard to its riskiness, and as a key factor influencing a firm's long-term investments. Their results indicate that CSR is priced and has a negative relationship with cost of equity capital. Interestingly, they find not all CSR features are associated with cheaper financing, and the firm's involving in tobacco and nuclear business sectors are assigned with higher cost of capital by the market participants.

In addition, they argue that corporate governance strategies reduce information asymmetry problems, resulting in a lower cost of equity capital. They hypothesize that firms applying CSR strategies will have lower cost of capital compare, to firms which assume that the adoption of environmental and social policies will reduce their economic value, due the additional costs occurred.

They start with the presentation of the main arguments derived from their research in the literature, to support their hypothesis, such as the statement that the larger the investor base in the firm, the lower its cost of capital based on Merton's model on market equilibrium. Additionally, other researchers provide evidence that social conscious investors don't seek for low CSR firms, and that the firms belonging in industries such as tobacco, alcohol, gambling may face higher litigation risks, which support their initial thesis.

Moreover, the authors shed light on the data gathering procedure about CSR issues and state the variables used for their analysis. They collect information about CSR features from KLD STATS. More specifically, they obtain information about the occurrence of strengths and concerns on every qualitative area of ESG (community, diversity, employee relations, environment, human rights, and product quality) for each firm in their sample, provided by KLD. Using these dummy variables' results (identifying the existence of strengths and concerns for every firm), they assess an overall CSR rating from the sum of each qualitative area score, which derived from the difference between the number of

strength and concerns. They also seek for data about the concerns in controversial business issues (alcohol, tobacco, gambling, firearms, the military, and nuclear power), and obtain the assignments by KLD. Similarly, KLD construct dummies to capture the involvement of specific firms in a set of concerns regarding these sectors. The authors use a dummy variable coded one if a firm is participating in these controversial business areas.

Moreover, they use some firm-specific variables such as beta, size, book-to-market ratio, and leverage to control for a firm's characteristics impact on cost of equity capital. Ghoul, Guedhami, Kwok, and Mishra use four different models for the cost of equity capital assessment. From the results of each model, they estimate an average rate of return used as the dependent variable in their regression models.

Their analysis starts with the regression of cost of equity against the estimates of CSR score and firm characteristics, resulting in a negative and significant coefficient for the explanatory variable, which is consistent with their initial argument. In addition, they split the sample into sub-periods to estimate a regression of cost of equity capital against the aforementioned variables, and they find that CSR score is negative in the whole period, and significant after 2000, suggesting an increase in the investors interest over time on a firm's sustainable policies adoption.

Furthermore, the authors perform sensitivity analysis, examining the relation between each individual factor of CSR score and cost of capital. They assess multiple regressions using every CSR category score (community relation, diversity, employee relations, environmental performance, human rights, and product characteristics) separately as explanatory variable. The analysis result in negative and significant coefficient estimators only for the employee relations, environmental performance, and product characteristics variables, suggesting that firms applied policies related to these pillars of CSR enjoy lower financing costs. Equivalently, the authors assess the relationship between a firm's cost of equity capital and its involvement in controversial business areas. They find that the dummy variables of participation in tobacco and nuclear power industry are positive and significant, indicating that the increase of investors' risk aversion against these two business sectors.

Finally, they test for endogeneity, testing the argument that better financial performance leads to the adoption of CSR policies by firms. They apply an instrumental variable to deal with this potential endogeneity, using as an instrument for CSR score, the industry average CSR score and a dummy variable, capturing the existence of loss in last year's balance sheet. Their results suggest that there is no endogeneity since the variables are significant and negative, reinforcing the previous conclusions.

In the study by Ng and Rezaee (2015) the relationship between components of economic sustainability disclosure (ECON), and environmental, social, and governance (ESG) with the cost of equity is investigated. Similarly, as ESG composition, ECON comprising three factors: growth opportunities, operational efficiency, and research efforts. They examine if the different components of ECON, and ESG have an impact on firm's economic value, and whether the relationship of the financial part of sustainability performance with cost of equity influenced by ESG ratings. Also, they investigate in which way the interaction

between financial and non-financial features of sustainability performance has an impact on cost of equity determination.

They provide evidence that ECON and ESG performance are negatively related to cost of equity, and especially growth opportunities, research effort, environmental, and governance performances have a significant impact over firm's economic value. They also find that ESG performance reinforcing the positive influence of economic sustainability performance over a firm's cost of capital.

The authors posit that ECON information is reliable since it has been provided by management teams, after auditors' and regulators' review. However, the ESG data increases information asymmetry because it is currently provided voluntary. They also hypothesize that firms with both higher ECON and ESG scores will be benefit from lower cost of equity capital, and they cite several reasons: the adoption of such policies leads to better communication with all stakeholders, while helping them increase their own wealth. Another reason is that make increase firm's transparency in terms of non-financial information disclosure.

Furthermore, Ng and Rezaee build the theoretical framework, and develop the main hypothesis for the empirical analysis. They present two controversial theories. On the one hand, the management teams' target to maximize shareholders' wealth by undertaking positive NPV projects is referred as "shareholder theory". On the other hand, the firm's meeting of its environmental and social obligations will increase the firm's stakeholders' welfare, and its long-term economic value, referring to this as "the stakeholder theory".

They argue that the combination of those two theories will lead to a firm's financial performance maximization. In other words, the trade-off between shareholders' and stakeholder's interest will result in increasing the economic value in the long run. Therefore, they test three main hypotheses that the ECON and ESG aren't significantly related to cost of equity, and that the relationship between ECON and cost of equity isn't influenced by ESG ratings assignments. More specifically, they investigate separately the association of every factor of ECON and ESG with cost of equity.

To estimate a firm's economic performance, they gather data about variables such as Tobin's Q, return on equity, sales and sales growth, market to book value ratio, research and development expenses, and variables that capture dividend payments. Moreover, they group the variables associated with growth opportunities, operational efficiency, and research effort into three equivalent categories to replicate the ECON components.

For the ESG data, Ng and Rezaee use MSCI ESG STATS database (former KLD) and estimate cost of equity capital with Gordon's model, and the industry weighted earnings to price ratio. Also, they add control variables such as firm's leverage, size, and beta, which are related to cost of equity regarding to previous research they estimate their regression models.

To address the problem of incorrect estimation of test statistics in panel dataset due to year-specific and firm effects influencing time-series correlation, they apply fixed effects for industry and year levels in all their models. Testing the relationship between ECON and firm economic value, they assess regressions of cost of equity against ECON, and

separately of each component of economic sustainability disclosure combined with firm-specific control variables. They find that growth opportunities and research efforts are negative and significant, and operational efficiency is positive and significant. However, the coefficient of ECON total performance is negative and significant for both measures of cost of equity used, reinforcing the negative relation argument with cost of equity capital.

Next, the authors explore whether the ESG sustainability performance creates value, estimating a regression of cost of equity against each of ESG components separately and the total ESG score. They also add to these models, total ECON performance score variable, and metrics of firm's characteristics. Their findings indicate a negative and significant relationship between ESG ratings and cost of equity capital. In addition, they find that environmental and governance sustainability performances demonstrate positive effects in firm's economic value, while social performance coefficient is insignificant. Obviously, they repeat their analysis without controlling for ECON performance, and receive the same results, reinforcing their initial results validity.

To investigate the interaction between ECON and ESG performance over cost of equity, they estimate multiple regression models using as explanatory variables ECON performance score, firm specific variables, and ESG components performance scores. To complete their analysis, they add separate interaction terms of ECON performance with every component of ESG and overall ESG score. Their results suggest that environmental and governance performance have a negative impact on cost of equity capital without ECON performance score influence this relationship. Interestingly, Ng and Rezaee conclude that social sustainability performance has a positive and significant impact on a firm's economic value when a firm has a high ECON score.

Cheng, Ioannou, and Serafeim (2014) argue that corporate social responsibility strategies have a positive impact on a firm's value by facilitating access to finance. This is accomplished because firms adopting such policies face lesser financial constraints. They provide evidence that better stakeholder engagement and transparency around non-financial disclosures leads to lower capital constraints. More specifically, they find that this contribution to a firm's value is driven only by environmental and social components of ESG. From an investor perspective, their results indicate that market participants prefer high-CSR score firms to allocate their capitals. In other words, the investors with a long-term investment horizon prefer these firms, since the stakeholder engagement and information transparency for CSR activities, affects firm's long-term economic value.

The authors postulate that CSR score have a positive impact on firm's financial performance by attracting more-skilled employees, providing cheaper access to finance, and from a stakeholder perspective, it lowers the likelihood of legislative actions, penalties by regulators, and firm will more likely attract socially responsible investors. However, they state that neoclassical economics supports the existence of an increase in unnecessary costs for firms applying CSR policies.

Also, the authors define capital constraints as the inability of firms to undertake positive NPV investments because they cannot get resources to finance them. In the markets there are asymmetric information issues, and the investors demand compensation to bear these

risks. Thus, the firms adopting CSR policies may have been assigned with lower cost of financing, and as a result, face lower capital constraints. Overall, the authors argue that the reduction in agency costs and asymmetric information, because of CSR policies, leads to lower financial constraints.

Moreover, Cheng, Ioannou, and Serafeim present the data sample used for their empirical research. They gather ESG performance data from ASSET4 database. More specifically, they receive environmental, social, and governance scores for every year, To examine in which way CSR policies adoption affect capital constraints, they use a specific score from ASSET4, which captures the stakeholder engagement in firm's activities, and they construct a variable to measure firm's ESG disclosure, by counting all the metrics that the firm didn't provide information.

Also, they apply Kaplan and Zingales index, as dependent variable, measuring the level of capital constraints. The KZ index is a combination of a firm's financial characteristics, such as cash flow, and dividends to total capital. Higher values of the index suggest that the firm faces more financial constraints. However, to ensure the validity of their results, they estimate financial constraints using other models too, such as Hadlock's, and Pierce's SA index, and an index constructed by White and Wu.

Furthermore, the authors assess their linear regression models to identify the relationship between CSR performance and financial constraints. They find that CSR score index is negative and significant in every regression, regardless of the way the dependent variable is specified. Thus, the firms improving their sustainability performance face lower capital constraints.

To address the problem that their coefficient estimators could be biased due to omitted firm characteristics, they implement firm fixed effects on their models and repeat the analysis. The results are like the initial ones, so there was no bias in their initial estimations.

The authors examine possible endogeneity, based on the argument that only firms facing lower financial constraints incorporate CSR policies, referring to this as "luxury good". Thus, they split the firms in their sample into three groups base on the magnitude of financial constraints. They investigate whether firms with lower financial constraints have a stronger relationship with CSR performance with the interaction of CSR scores with a dummy variable captured the involvement of specific firms in each of the sub-samples. Their findings support that the coefficient of CSR score for firms with lower constraints is significant and positive, indicating that the relationship is weak, hence there is no endogeneity due to "luxury good".

In addition, they test for endogeneity due to ESG ratings assignments' impact on CSR performance. They concern that firms assigned with a lower rating will improve their CSR performance more than firms with higher assignments. To address this, they choose low CSR-score firms, and matching them with other firms of their country-industry, with the same initial constraints and higher CSR-score belong. In that way, they can examine whether a firm with a low initial CSR score can achieve a better improvement in terms of CSR performance than its higher rated pair. The authors find that firms with low ESG

rating assignments face a higher reduction in their capital constraints than firms with better scores.

Finally, Cheng, Ioannou, and Serafeim investigate the relationship between stakeholder engagement and CSR information transparency and each CSR component with the firm's financial constraints. They estimate a regression of KZ index against stakeholder engagement and CSR disclosure separately and combined. They find that both variables are negative and significant, supporting their initial argument, that strategies increase stakeholder engagement and transparency of non-financial information over ESG issues, lead to lower restrictions in financing. When both included in the regression models they are both negative and significant, indicating that one of the two factors is constant, the other one still has a significant impact on capital constraints.

Similarly, they use the ESG pillars (environmental, social and governance performances), instead of the overall score. Their results indicate that each one of the components has a negative relationship with financial constraints, but when all of them combined in the regression model, the corporate governance performance exhibits an insignificant influence, while both environmental and social performances remain negative and significant.

3.3.2 Firm's Sustainability Performance and Financial Performance

Friede, Busch, and Bassen (2015) examine over 2000 empirical studies to identify the impact of ESG on corporate financial performance. They make a detailed overview of these studies and conclude to the general argument that the ESG ratings have a positive influence upon a firm's economic value. They postulate that their results support the existence of environmental and social responsibility investing out performance opportunities in many markets and asset classes. These opportunities are more likely to be identified and captured by sophisticated investors. Therefore, they highlight that every rational investor should consider turning to long-term sustainable investing, and try to understand the ESG criteria, and how to use them efficiently.

They posit that the number of the global assets managed by PRI signatories is growing. However, they highlight that mainstream investors do not adopt sustainable investment practices at the same pace, and only a small percent of professionals worldwide are trained properly on how to apply ESG criteria in investment analysis.

The authors apply two-step research at the data sample, while group the studies' findings in two categories: vote-count and economic review studies. In the first step of the analysis, they identify vote-count studies, which are the number of studies with results categorizes as positive, negative, and nonsignificant, and the authors consider the category with the highest score as the winner. Moreover, they continue with the meta-analysis (second step) in which they group the findings of economic review studies. Also, they present the data used for their analysis, a sample of 2200 empirical studies, investigating the relationship between ESG ratings and corporate financial performance from the beginning of 1990s

to 2015. More specifically, they use only academic studies with quantitative summaries of their results included.

Furthermore, the authors estimate distributions of the findings and correlation effect sizes to compare the results of vote-count studies and meta-analyses. In particular, they define as vote-count, the studies which are concentrated in significant statistics of primary studies, hence may come to biased estimators. Meta-studies are those importing effect sizes and samples to arrive at conclusions. After the assessment of vote-count studies distributions and the second-order analyses, they argue that 90% of their sample support a non-negative relationship between ESG scores and corporate financial performance. They find that the percentage of negative relation findings in the vote-count studies cannot be considered as significant, based on the fact that it diminishes over time, while the proportion of positive results increasing. Also, in the meta-analyses, only one study displays a negative correlation of ESG rankings and a firm's economic value.

In addition, the authors try to identify the differences between portfolio and non-portfolio studies. In portfolio studies, the researchers try to replicate the performance of a specific mutual fund portfolio or index. The findings of this kind of studies lead to a lower level of positive results of ESG and financial performances relationship. Especially, it has been observed an increase of negative results compare to non-portfolio studies. Fried, Busch, and Bassen state that these results are consistent with the institutional, and private investors believes that the ESG and firm's financial performances relationship is neutral based on Modern Portfolio Theory, and Efficient Market Hypothesis. These findings may be also consistent with the fact that management fees and other costs (performance fees, trading costs) are included in these portfolios.

Similarly, they find that in the different asset-classes sub-samples, most of the results support a positive relationship between ESG and firm's economic value. Interestingly, non-equity asset classes (bonds, real estate) studies have a higher proportion of positive results compared to equities. Also, their findings from the sensitivity analysis of each ESG component support the positive impact of ESC scores over a firm's performance, while governance factor displays the highest share of positive and negative findings. Importantly, the examination of this positive relationship in different regions, provide evidence that there is a larger proportion of positive results in emerging markets, and in North America, compare to developed markets and Europe, respectively.

Next, I present the study by Eccles, Ioannou, and Serafeim (2014), an investigation of corporate sustainability policies' impact on a firm's organizational processes and performance. Similarly with the study of Cheng, Ioannou, and Serafeim (2014), firms applying such policies support the engagement of their stakeholders in their processes, and they will more likely publish voluntary information about their non-financial activities. The authors find that this kind of firms, will be more likely assigned with high CSR performance scores, and will outperform their competitors in the long-term.

They postulate that a growing number of companies have adopted corporate policies consistent with environmental and social issues. Therefore, they seek for evidence on how these firms differentiate form the companies' following neoclassical economic corporate structure, in terms of governance, disclosure, investment horizon and strategies, and

performance targets. The authors highlight the importance of stakeholders' welfare and its impact over the shareholder value, despite that many support the argument that the adoption of environmental and social responsibility policies leads to agency costs and higher costs.

Also, they expect that high sustainability firms will differentiate significantly in governance structure from their competitors, since these firms aim not only to an increase in financial performance but also to an improvement in environmental and social sustainability performance. More specifically, these firms will undertake projects to maximize their long-term economic value, while implement their stakeholders' engagement and non-financial performance disclosure mechanisms. Eccles, Ioannou, and Serafeim provide evidence supporting their initial hypothesis. They show that in the long-term, high-sustainability firms present significant returns in terms of stock prices and other accounting ratios, capturing firm's financial performance.

The authors collect information from ASSET4 database for CSR issues. They focus on firms that have adopted policies on areas such as diversity, environment, employee welfare, and product quality, and that they have applied none of sustainability strategies. Besides the information collected by the data provider, they interview with firms' executives to identify when and at which level these policies had been adopted. They conclude that after late 90s most of the companies adopted sustainability policies.

To construct their final sample, the authors match every high-CSR score firm with another identical one belonging to the same industry, in terms of size, sales, growth opportunities, and leverage. Obviously, they collect data for control variables to measure issues consistent with every firm's financial profile, such as return on assets, market to book value, and liabilities over assets ratios.

To investigate the relationship between CSR policies adoption and governance structure, they use S&P Global ESG ratings database to collect information on corporate governance attributes. More specifically, they apply a combined score of board members' responsibilities over sustainability, and executives' compensation linkage on environmental and social performance issues as the dependent variable in an OLS regression model. As explanatory variables, they use a dummy variable, coded one when the firm has a high-CSR score, and the above firm variables. The results show that high sustainability firms connect more likely their top managers payments with social and environmental performance targets and create independent comities to auditor those policies implementation. The size and profitability are factors that underpin the adoption of sustainability policies.

Additionally, Eccles, Ioannou, and Serafeim examine the relationship between high-sustainability firms and factors like stakeholders' engagement, investment horizon, performance measurement, and a firm's transparency over CSR activities. They use information about the differences between high and low CSR score firms over stakeholder engagement issues such as training, the encourage on every stakeholder to rise its own concerns about firm's activities, reporting the engagement process and others. They estimate an OLS regression model and find that high-sustainability firms show an

increased interest in their stakeholders' welfare, implementing significantly more stakeholder engagement strategies compare to their competitors.

They posit that high CSR score firms attract more the long-term investors. They support that statement by collecting data on the percentage of shares outstanding of every firm in their sample, held by long- and short-term investors. The results derived from a linear regression indicate a positive relation between the difference of the share ownership of high and low sustainability firms by long-term focused investors and the adoption of CSR policies.

To investigate the performance measurement and disclosure mechanisms of firms with an environmental and social profile, they estimate similar models. We just show that high sustainability firms support stakeholder engagement in the processes, the authors expect that the high sustainability firms will support the engagement of the employees, the customers and the suppliers in their processes, and their management teams will try to measure the performance and improvement of these relationships. Their findings for employees and suppliers support their expectations, but surprisingly not the results for the costumers. They couldn't identify any difference between the various levels of CSR score firms in the sample for the customers' factor variable, hence only a small proportion of those firms adopt policies on customer issues.

Similarly, the authors examine the firm's transparency about its environmental and social activities. They use as dependent variables, scores from different data providers for firms' ESG data disclosure, and a variable that captures the difference between financial and non-financial discussion topics in conference calls. They result in a positive and significant coefficient estimator for high-sustainability firm's dummy variable, indicating that firms adopting sustainability policies disclose more information about non-financial activities, compared to low sustainability ones.

Furthermore, the authors provide evidence that high CSR score corporations outperform their competitors because of the attraction of better quality of employees, and avoid conflicts and legislation costs over social and environmental issues. They estimate a four-factor Fama-French style model combining and momentum factor for both high and low sustainability firm groups. They find both portfolios outperform the market during the period from 1990 to 2010, and that the annual abnormal return of high-CSR score portfolio is higher than the portfolio of firms didn't adopt sustainability strategies.

In addition, they use the four-factor model while controlling for differences in specific industries performance. Their results support that high sustainability firms participating in business-to-consumer industry, and in sectors where the natural resources extraction is the primary field of operations outperform substantially their low-sustainability competitors. Similar behavior it is observed and for firms competing in sectors where brands and human capital matters most.

Finally, the authors perform sensitivity and endogeneity tests. They investigate whether the stock prices performance results are driven by the increase of socially responsible investors' involvement. Examining the accounting performance of the two groups of firms, they find that the out-performance reported at their initial results, isn't occurred

due to price pressure. Moreover, they perform a test for endogeneity assuming sustainability as "luxury good", and other tests trying to identify possible bias due to omitted variables. The results support their initial findings, hence there is no endogeneity in their models, nor bias in their estimations.

To sum up, Eccles, Ioannou, and Serafeim create a sample of about 180 matched companies, categorized as high and low sustainability firms during the period from 1993 to 2010. They examine the impact of the adoption of environmental and social responsibility policies on different areas of corporate governance mechanisms and performance. They highlight postulate that high CSR score firms encourage stakeholder engagement in their activities, generally give greater attention to non-financial issues, and increase the voluntary disclosure of such activities' performance. Also, it has been observed that in the long-term, these firms create greater wealth for their shareholders compared to its competitors with low-CSR scores.

Continuing the presentation of the literature, I introduce the study by Lins, Servaes, and Tamayo (2017) identifying the relationship between high-CSR performance and a firm's economic value during the period of 2008 financial crisis. They provide evidence that CSR performance strategies restore the trust between the investors and the firms during a period of financial instabilities. Trust in capital markets was a major problem after the start of the crisis in 2008.

More specifically, they find that the adoption of CSR policies and the increased CSR performance leads to higher stock returns during periods of low trust in capital markets. This relationship between stock prices and environmental and social sustainability performance holds during crisis periods, while being weaker in post-crisis period. In general, they posit that their findings support that CSR strategies are beneficial for firm's economic value, especially during instability periods financial markets. CSR strategies can be used as insurance that pays off on a period of lower trust.

The authors highlight the role of trust in the economic life, and especially on the conservation of financial stability in the markets. However, the measurement of social capital trust is an extremely difficult task. In this study, the researchers use CSR strategies as a proxy of firm's capital trust. They also focus in the 2008-2009 period when a significant reduction of public trust in firms' activities took place, hence it is easier the identification of firms with superior performance driven by social capital trust in such period.

Lins, Servaes, and Tamayo postulate that consistent with the study by Eccles, Ioannou, and Serafeim (2014) stakeholder engagement and other social activities, such as increased transparency, motivate the public to trust these firms, which is a significant dynamic especially in low-trust periods of financial instability. Thus, in these periods, the market participants' incentives to invest in the stock market are driven by the risk-return trade-off combined with the firm's trustworthiness.

Moreover, they present the sample used to arrive at their empirical results. They use MSCI ESG STATS database (former KLD) to collect information on environmental and

social issues. They also gather data on stock returns and some firm characteristics accounting variables.

The authors seek for evidence that stock returns of high-CSR score firms increase during financial crisis. They estimate regression models of stock returns against CSR total score and firm characteristics such as long- and short-term debt, profitability, cash holdings, book to market value ratio. They find that CSR performance and cash holdings variables are positive and significant, suggesting that firms with higher CSR scores perform better, and that firms tend to hold more cash in the financial crisis. Debt variables are significant and negative, supporting that during a crisis, the firms with lower debt benefit in terms of investments.

Also, they perform the same analysis in the period of Enron/Worldcom scandals. Their findings support the initial hypothesis that during crisis and periods when investors' trust over firm's activities have been diminished, the adoption of social responsibility strategies and a good CSR performance score matters most for capital markets.

To reinforce their main argument, they compare the relationship of a firm's stock returns and CSR performance during and post-crisis periods. More specifically, they add interaction terms of CSR scores and dummies identifying if the period is during o after the crisis. They find that the interaction term of CSR score with the crisis period dummy is positive and significant, while the interaction term relative with the post-crisis period is insignificant, supporting that during crises high CSR performance firm's benefit with an increase in their stock prices. Equivalently, they add an interaction term of CSR performance score and a dummy variable coded one if a shock to the supply of credit exists from 2007 to 2008. They find that this term is insignificant, indicating that a change in the supply of credit does not explain the positive relationship between CSR and stocks' performances.

The authors investigate whether specific components of overall CSR score index have a substantial influence over stock returns during the crisis. They create two groups of variables to use them as explanatory: internal stakeholders' issues (employ relations and diversity), and external stakeholders' issues (community, human rights, environment). Their findings suggest a positive and significant relation for both groups with stock prices during the financial crisis. In other words, both features of CSR performance are equally important in the increase of stock returns during low-trust periods.

In the end, I introduce the study by Polbenikov, Desclée, Dynkin, and Maitra (2016). The authors investigate the impact of ESG ratings on valuation and performance of corporate bonds. They postulate that firms with low ESG scores will face a decrease in their value and changes in their business model due to market reactions. Their findings support the positive relationship between ESG ratings and a firm's economic value, providing evidence that high-rated ESG firms outperform the low-rated ones. Even if the acquisition of those firms' bonds comes at a higher cost, they argue that ESG scores capture risk factors that are not fully prices and could lead to significant returns.

The authors notify the main argument of a significant number of studies, indicating that there is a linkage between a firm's performance and ESG ratings. Therefore, they support

that these scores will be beneficial to investors, adding elements to their decision-making process that didn't get captured by typical risk factors. Using MSCI database, they collect information about ESG ratings and each pillar (environmental, social, governance) separately.

Moreover, they present a major index used by investors to replicate the performance of well-diversified portfolios based on ESG criteria. The Barclays MSCI Corporate Sustainability Index is a market capitalization-weighted index, including fixed-income securities (corporate bonds) with high ESG ratings assignments by MSCI. In comparison with other Barclay's indexes, such as sustainable, responsible investing, and sustainability indexes, ESG index provides more general results, and outperforms the others during a period from 2007 to 2015.

The authors examine the characteristics of MSCI ESG scores. Environmental scores are stable over time, indicating that a high-rated company will maintain its environmental score over time. The other two of the main pillars of ESG appear to be volatile. Testing the correlations between the change of environmental, social, and governance scores, they conclude that, after 2011 become slightly negative. They also posit that each of the ESG components can have a significant impact on a firm's financial performance. They test ESG ratings relationship overtime with credit ratings. The results support the argument that ESG ratings and credit ratings are almost uncorrelated. However, it has been observed a positive relation of environmental scores and credit ratings in the whole sample period.

Furthermore, they use statistical analysis of ESG spreads and tracking error process of ESG portfolios performance to identifying whether investors earn positive returns from ESG investing, and if these results are reflected in bond asset class. They find that high-rated issuers, in terms of ESG, are more expensive compared to the low-rated ones. However, estimating a regression of excess returns of corporate bonds over treasuries against ESG scores, they find a positive and significant relationship between each other. In addition, every individual factor of ESG is positive and significant, indicating that high ESG ratings are associated with higher returns. The impact of every pillar differentiates between various industries. A high environmental performance score is more important for firms in energy and transport sector.

Their findings from tracking error analysis support a significant out-performance of high-ESG score portfolios (with governance pillar providing the higher impact to portfolios' returns) after 2011, compared to low-rated ESG portfolios. Still, the portfolios with high ESG ratings securities underperform during the financial crisis period (2008-2011). These results indicate that portfolios of high-rated corporate bonds face the same risks with typical strategies, behaving similarly during periods of instability in capital markets.

3.4 Weaknesses of ESG ratings

As mentioned in the previous sub-section, there are factors influencing a firm's financial performance that are not included in financial statements. These factors are related to the ESG issues like employee relations and human rights, climate change and carbon

regulations, stakeholder welfare, product quality, disclosure, and transparency. Therefore, there is an increase in the demand for information about companies' environmental, social and governance performances, leading to the appearance of various ESG metrics.

The growth of sustainability investing strategies creates the need for accurate and reliable ESG data and ratings. Hence, the investors require accurate information capturing firm's performance, to integrate them in their decision-making. The number and the variety of these metrics impede the identification of the material and accurate data by the economic participants. Although the voluntary disclosures have been increased by the firms adopting ESG criteria, each one of these firms measures its performance uniquely. Thus, the economic participants question about the level of transparency of each firm and across the sector, and the measurement difficulties. Also, the acquisition of ESG rating providers by major data providers and credit rating agencies increases the concern about potential conflicts of interest.

In this sub-section, I mention the weaknesses observed by researchers in ESG data, and ratings, and potential solutions in terms of regulatory intervention in the industry, and the statistical methods which can be applied to the data. More specifically, El-Hage (2021) highlights the problematic nature of ESG ratings, explores potential consequences due to implementing mandatory disclosure, and introduces the current arguments in favor of mandating ESG disclosures. He posits that ESG mandatory disclosure is difficult to be applied and may create additional costs to the companies, but it may be beneficial in terms of market efficiency and litigation risk. Also, the current situation in ESG ratings industry may lead to confusion in the economic participants, reducing their information value. Thus, a strict framework of ESG disclosures will lead to more reliable and accurate information.

Katsantonis and Serafeim (2019) present several important problems with ESG measurement, and data, and potential solutions. They encourage companies to work as groups or industries and define a standardized approach in reporting ESG data. They suggest that investors should pressure the firms for more meaningful disclosures, and that stock exchanges should support the firms' initiates to a more standardized approach in reporting, and provide guidelines to enhance the firm's transparency. Also, the authors support that data providers should improve their transparency, publish not only their methodologies in detail but also information about the peer's components and the data filing process.

Moreover, Stubbs, and Rogers (2013) shed light on the rating methodology of Regnan, an ESG ratings agency. They find that Regnan assignments do not meet all the requirements for objectivity based on accounting literature, but the peer review is beneficial to reduce bias in their ratings. Also, they highlight Regnan's and other providers' arguments that the uniformity and transparency cannot be achieved in a competitive and newly established market.

Tang, Yan, and Yao (2021) find that the ownership status of the firms rated, and the rater, plays a substantial role in the rating assessment. More specifically, the rating agencies tend to assign higher ratings to sister firms (companies with the same owner as the rater).

Lastly, Gyönyörová, Stachoň, and Stašek (2021) identify the issue of convergence validity between the major players in ESG data industry.

Overall, the main problems are the inaccurate and unreliable ESG data due to the differences in definition and measurement of ESG issues, by ESG ratings and data providers. The lack of transparency in their rating methods, and the potential bias in the voluntary disclosures by firms, create a greater confusion for investors, questioning about rating information-quality. This is opposite to the provider's role, which is to help the economic participants with asymmetric information issues. Also, the conflicts of interest in the rating agencies may lead to inflated ratings for specific firms, increasing the risks for investors. Many argue that regulators must create rules, leading to uniform rating methods and ESG issues definitions. Interestingly, it is possible that regulations similar to those implemented in credit rating agencies may need to be applied and in ESG rating industry.

I start with the presentation of the study by El-Hage (2021). The author highlights the problematic nature of ESG ratings, explores potential consequences due to the implementation of mandatory disclosure, and introduces accurate information, and that the implementation of mandatory disclosure will increase costs.

The author identifies the problem with current voluntary disclosures, which lies on the definition and the measure of ESG factors. The most information used by the rating agencies is raw data voluntary disclosed by companies, leading to problematic inputs in their models. Also, the major ESG rating agencies use different methodologies for their assignments, leading to significant differences in their results. Additionally, the lack of transparency in rating methodologies make markets to question about the quality of those scores.

Moreover, the investors start to integrate the ESG factors into financial analysis, to capture the impact of ESG-related risks in firm's long-term economic value. In other words, the market's increased interest in sustainable investing, make investors seek for firms with high ESG ratings. Thus, the various metrics and results on environmental, social, and governance performances are confusing the investors.

The author provides a deeper analysis of the problem of inconsistency of ESG rating agencies. He argues that the lack of a common framework in ratings assessment lead to split ratings. More specifically, splits in ESG ratings occurred more frequently than splits in credit rating assignments from different agencies. He postulates that the main reason for this difference is that credit rating agencies use information based on specific standards and the legal framework governing the way firms disclose the relevant data. The author highlights that ESG data provided voluntary by issuers is unaudited, increasing potential interest conflicts between the issuer and the rater.

Also, he identifies three kinds of biases across rating methodologies. The positive relationship between firm's size and ESG ratings, as evidences from ratings indicating, could be biased. It has been observed that high-rated large-cap companies had been involved in high-profile controversies. While, some small-mid cap firms implementing ESG strategies had been assigned with low ratings. Additionally, it has been observed a

positive bias in favor of European companies, and a miss-judgment of firm-specific risks in ESG ratings assignments, resulting an industry sector bias. Apart from these, the author argues that rating agencies fail to estimate risk, since high-rated companies participated in scandals such as Volkswagen's environmental pollution.

El-Hage lists positives and negatives on making ESG disclosures mandatory. Reliable and complete information will ensure market efficiency. Many state that the SEC's intervention in ESG disclosures will increase confidence in capital markets, but the danger of additional costs burden for the firms always occurs. Also, companies which are not provide voluntary disclosures are exposed to higher litigation risk, which is a very strong argument for mandatory ESG disclosure. However, companies may still bear some penalties from regulators, if they get caught providing mis-leading information. The author concludes that the risks of mis-leading information and the pressure from investors for reliable data made firms more responsible in their disclosures over environmental, social, and governance issues.

In addition, he argues that the whole procedure of mandatory disclosure is a challenge for SEC, because of the difficulties in definition of ESG issues, and the current market's methodologies in estimation of ESG scores. Also, the determination of the material issues in each industry has a significant influence on investors' decision-making.

Moreover, material disclosures are generally a major issue for rating agencies. If rating assignments independence and unbiased nature is a material disclosure, is a main concern to be reconsidered by SEC as Eccles, and Youmans (2015) points out. Finally, the author postulates that mandatory disclosures should be focused on specific factors of ESG, or it can be focused on all factors, and let investors decide the material ones for each industry.

Overall, El-Hage posits that ESG mandatory disclosure is difficult to be applied and may create additional costs to the companies. However, it may be beneficial in terms of market efficiency and litigation risk. The current situation in ESG ratings industry may lead to confusion in the economic participants. Thus, a strict framework of ESG disclosures will lead to more reliable and accurate information.

Next, I present the study of Kotsantonis and Serafeim (2019) in which they identify the problems in ESG measurement and data. The main problems are: the existence of a variety of measures, and ways of reporting data, the definition of companies' peer groups (benchmarking), the address of data gaps, and the fact that the firms providing large quantities of ESG data, will face greater differences in their ESG ratings assignments.

Also, they argue that the economic participants' demand for non-financial information, and especially for those reflecting the way firm's activities influence society, lead to the creation of environmental, social, and governance (ESG) metrics. These metrics aim to measure a firm's ESG performance, resulting in accurate information which can be used by investors in their financial analysis. The main concern is whether a firm's performance is measured accurately.

Moreover, the authors present the problem of data inconsistency, which is related to the confusion derived from the various ESG metrics used by the rating companies. They find several ways that firms report specific issues of ESG, in terms of definition and units of

measure. Therefore, the lack of comparability between those issue, create significant problems in investor's ESG integration process.

The second limitation they identify is the selection of the benchmark, and they posit that there are two ways to determine the benchmark: peer group and absolute levels of performance. ESG performance can be calculated based on a global sample of companies (universal peer group), or a sample of companies that belong to the same industry (industry peer groups). That is a decision the data provider must take, hence each one of them can use a different peer group to measure a firm's performance. Also, data providers can define specific ranges of performance to use as benchmarks.

Furthermore, they present a more technical problem with ESG data imputation. In other words, the problem is that there is not a specific framework defining how the providers should deal with data gaps. The variety of approaches for gap filling among data providers can cause very different scores. A common approach is to replace missing values with zero, or with sector averages. It is the simplest approach, since no statistical methods are needed. Another way providers can deal with gap filling is by estimating the firm's performance on a specific ESG issue based on firm-specific and macroeconomic variables.

Also, they introduce and some statistical methods, such as regression methods, and machine learning alternatives. Regression methods such as multivariate imputation via chained equations (MICE), allow data providers to replace missing values with estimation provided by a regression of the variable with missing data against a specific set of explanatory variables defined by the data provider. Then the fitted value is used to fill the gap. Alternatively, predictive mean matching is a machine learning method, in which an observed value closest to the value derived from the regressions is selected to replace the missing data, instead of the fitted value method described above.

Finally, Kotsantonis, and Serafeim provide some guidance to companies, investors, stock exchanges and data providers, to address these concerns on ESG data. They encourage companies to work as groups or industries and define a standardized approach in reporting ESG data. They suggest that investors should pressure the firms for more meaningful disclosures, and that stock exchanges should support the firms' initiates to a more standardized approach in reporting, and provide guidelines to enhance the firm's transparency. Also, the authors support that data providers should improve their transparency, publish not only their methodologies in detail but also information about the peer's components and the data filing process.

The increase interest in ESG lead to the increased number of data providers and ESG rating agencies. I present the study by Stubbs and Rogers (2013), in which they try to shed light on ESG rating agencies' methodologies, examining the methods of an Australian rating agency. They find that perfect objectivity is impossible to be accomplished in ESG rating assignments. The regulators should focus on uniformity of ratings and implement measures to increase transparency and uniformity. As a result, rating agencies may bear additional costs from this type of regulations.

The authors argue that the reliable and accurate ESG data reduces asymmetric information and benefits investors in decision-making. However, the differences in ratings between ESG agencies make investors question about the transparency and unbiased nature of ratings. Hence, it is important for economic participants to understand how the agencies make their assessments, because if they rely on misleading ratings, they will bear greater systematic risk. To examine the transparency in rating industry, the authors explore Regnan's, an Australian ESG rating agency, ethics performance rating method.

Moreover, they state that the improvement of corporate ethical performance in the product quality, human resources, environment, and community areas will make conflicts of interest, and the likelihood of insider trading scandals, and frauds diminished. The investors pressure the firms to adopt corporate governance policies to increase their economic value and reduce agency costs. Also, they seem to recognize the quality of ethical, social, and environmental as material to investment decision-making. The authors argue that there is an increased reputation risk for companies, which do not improve their ethical, social, and environmental performance. A loss of reputation due to these issues will lead to a loss in a firm's financial performance.

In addition, Stubbs and Rogers posit that rating agencies have a different weighting scheme during the company's performance assessment. Hence, they argue that economic participants accuse rating agencies of bias in their methodologies. The lack of uniformity in rating practices leads to less accurate and reliable information for a firm's ESG performance.

The authors introduce Regnan, an ESG rating agency in Australia, which provides data to institutional investors and fund managers, about a firm's environmental, social and governance performance. They follow the specific agency, because they have access to internal documents and information. Regnan conducts research on corporate governance, environmental and social material issues. More specifically, the agency examines issues impacting a company's earnings, but it doesn't estimate how ethical is a company in terms of ESG performance. Regnan analyzes factors like corruption, and bribery, fraud, failure to disclose financial information to identify business ethical failures. In other words, it identifies a company's ethical performance as its ability to comply with laws and standards of behavior.

Furthermore, Stubbs, and Rogers describe the Regnan's gap methodology, assessing firm's ESG risk management. The agency measures the firm's exposure to ESG risks and identifies the strategies the firm adopts to mitigate these risks. It is called gap methodology, because Regnan's rating derived from the difference between the management score and exposure score. This score gap is converted into a rating scaling from 1 to 5, indicating that the larger the score, the better the firm is managing those risks.

However, the measurement of the gap score, and its conversion in to rating, is a subjective process, based on analyst's assumptions on which ESG issue is material from every company. To reduce any individual bias, the analyst's assessments are subject to peer review. Therefore, the analyst can identify the material issues for the industry the firm is belonging, and to have a consistency in the scoring ESG risks, and management controls.

Also, Regnan believe that the most difficult part in their methods is to identify firm's exposure to ESG risks, since it demands a detailed screening process, to identify which factors influence firm's value. The authors state that the screening is focused on cultural warning signs, like domineering CEO, ineffective board, optimistic growth targets, aggressive business practices and concerns over accounting and disclosure practices. With exposure assessment, their analysts aim to identify companies that are more likely to face ethical breach in the future.

Moreover, the authors posit that Regnan estimates risk management through research in the following five categories: ethics policies, and codes of conduct, recognition of ethics, and culture risks, and opportunities, ethics and culture risk identification systems, ethics culture board oversight and remuneration, and ethics and culture programs and initiatives. For this purpose, Regnan's analysts use only public information, based on the view that the material information must be disclosed to the market same as financial ones. The analysts can process and other data relevant to a firm's ESG risk management.

Finally, the authors postulate that the criticisms over ESG rating agencies are related to the lack of transparency in rating methods, and the subjectivity of specific factors measurement. They highlight that in credit rating agencies, the NRSROs are required to provide information about their quantitative and qualitative rating methodologies, and that SEC is responsible for issuing guidelines about these procedures and examine every year agencies' rating models. However, ESG ratings agencies are accused of subjectivity in their assignments, due to the fact their methods are not well explained, and the use of raw data based on voluntary disclosures makes investors question their information quality.

The authors provide evidence that Regnan's rating processes are objective, because of peer review's independent nature. They highlight that the uniformity in rating standards may lead to unreliable information. It has been observed that uniformity has been impractical in many cases in accounting standards. However, they state that the uniformity will ensure comparability between ratings, and will increase transparency. Transparency is necessary in rating industry, because it is the only way for investors to differentiate between the agencies. Regnan states that the current transparency level is low in ESG rating industry, since ESG rating assessments are still in an experimental stage, and the owners of these agencies require a level of confidentiality for their methods.

Tang, Yan, and Yao (2021 find that firms with the same owners with the rater receive higher ratings. In other words, conflicts of interest lead to inflated ratings for specific firms, impact investors' decision-making. Similar problems it has been observed with credit ratings, especially in asset-backed securities, when the conflicts of interest derived from issuer-paid business model result in a significant inflation in ratings.

The authors highlight the growth in ESG ratings industry, with respect to the increase interest of economic participants for environmental, social, and governance performance of corporations, and the need for high quality ratings. Thus, they argue that it is crucial to understand whether a firm's actual ESG risks are reflected in ratings.

They posit that ESG rating industry is not only less scrutinized but also less regulated compared to the credit rating industry. It is possible the existence of inflated or deflated ratings. They support that firm's characteristics are significant explanator of the recent ESG ratings, and that companies with the same owner with rater, "sister" firms, are assigned with higher ratings. More specifically, the authors provide evidence that raters tend to inflate the immaterial factors of ESG ratings, and the strengths of ESG issues, while the market focused in material factors and concerns. Also, they find that sister firms underperform significantly in terms of ESG.

Moreover, they define ESG ratings as the assessments upon firm's environmental, social and governance performances, and mention the major players in ESG rating industry: KLD, Refinitiv/Asset4, RobecoSAM, Vigeo Eris, and Sustainalitics. Most of these firms have been acquired by public firms in data and credit rating industries. Hence, the investors holding shares of the parent firms could have shares in companies, seeking for ESG rating assignments. The authors posit that it is possible for these investors to pressure for inflated ratings. The lack of regulation and the confusion created by the variety of measures and definitions on ESG issues make harder for the investor to identify the determinants of ESG ratings, and whether conflicts of interest exist and affect rating assignments.

Tang, Yan, and Yao postulate that the nature of ESG ratings is consistent with some subjectivity. The difficulties from the definition and the measurement of qualitative issues give room for the rater to make its own adjustments. They hypothesize that ESG raters provide higher rating assignments to their sister firms. Also, they state that if the owners with significant amounts of shares in the rating firm pressure of inflated ratings for their firms may benefit more than others. In other words, the sister firms of large shareholders may appear to have higher ESG ratings than other sister firms.

Secondly, they present the data used for the analysis. They collect information for three data providers: KLD for ESG data, Compustat for financial information, and Thomson-Reuters 13F data base to gather ownership information. They gather data for every ESG factor, and for variables capturing firm's financial profile, such as return on assets, boot-to-market ratio, dividends, cash holdings, leverage, R&D expenses. The latter ones are used as explanatory variables in the regression of ESG ratings against firm characteristics, trying to identify the determinants of ESG ratings in pre- and post-acquisition periods. They find that size was insignificant pre-acquisition and positive and significant post-acquisition. In addition, cash holdings and leverage are significant, positive, and negative, respectively, in the whole sample. The coefficient on institutional ownership variables is significant and negative, indicating that the increase likelihood of conflicts of interest lead to lower ESG ratings.

Moreover, the authors construct their main regression model to identify the relationship between sister firms and ESG ratings. They use ESG ratings as the dependent variable and create a dummy variable coded one if the firm owned by a large shareholder of the rater's parent firm, to use as an explanatory variable combined with firm characteristics. Their findings suggest a positive relation between ESG ratings and the sister firms,

supporting their initial hypothesis that the sister firms receive higher ratings compared to non-sister firms.

However, the source of increased ratings for sister firms could be common criteria. More specifically, firms with better financial profiles may not only attract investors to acquire large amounts of shares but also this may be the reason for higher rating assignments. To address this endogeneity problem, they create a variable to capture pseudo-sister firms, companies held by the same shareholders, pre-acquisition. Hence, if the inflation in ESG ratings in sister firms is driven by common criteria, they expect that both sister and pseudo sister to be positive and significant. Their results support that there is no endogeneity in their analysis, since pseudo-sister dummy is negative and significant.

Also, Tang, Yan, and Yao examine specific mechanisms as potential drivers of these increases in sister firms' ratings. They find that investors with a long-term investment horizon and an active management style tending to hold large stakes in firms they will influence the ESG rating assignments of sister firms. They investigate if only the immaterial ESG issues are inflated, resulting in high ratings. The authors argue that if material issues are inflated, they will lead to a reduction in shareholders' value. They find that only the immaterial issues variable is positive and significant. Although the higher ratings due to inflation in financial immaterial issues will not reduce shareholders' wealth, the authors posit that it may affect other stakeholders' value.

In addition, they use another agency's ratings as benchmark, to test whether the coefficient estimator of sister variable is biased due to omitted variables, and if any differences between ratings of KLD and Refinitiv ratings diminish over time. First, they estimate a regression of the difference between KLD and Refinitiv ESG ratings against sister dummy and firm-specific variables. They find that the sister variable is positive and significant, indicating that KLD's ESG ratings assignments to sister firms are higher than Refinitiv's. Also, they state that if the inflation in ratings is information-driven, then any differences between the ESG ratings of these two agencies will diminish over time. They estimate a regression of Refinitiv future ratings against sister dummy, ESG ranking, and an interaction term between the two of them. They find a negative and significant interaction term, suggesting that when the upward trend of KLD ratings to sister firms is not followed by Refinitiv, hence the inflation is not information-driven.

Finally, the authors investigate the future performance of sister firms with the inflated ratings. In order to measure the performance of those firms, they search for ESG incidents. They state that if they count more ESG incidents for non-sister firms, then their sister-firm ratings reflect its true ESG performance. However, they find that more negative incidents occurred for firms with inflated ESG ratings.

To sum up, Tang, Yan, and Yao try to identify the determinants of ESG ratings, and if their quality is undermined by potential conflicts of interest. They find that ownership of the firms rated, and the rater plays a substantial role in the rating assessment.

4. Empirical research

4.1 Introduction

In this study, I examine the relationship between corporate credit ratings and ESG scores. The firm's ESG performance influences its cost of equity and access to finance, hence I expect that the credit rating agencies take account of the sustainability issues in their rating assignments. In other words, I investigate whether ESG scores are determinants of the firm's credit rating.

I start with the data-gathering process, collecting the ratings of the three major credit rating agencies, Standard and Poor's (S&P), Moody's, and Fitch. Then, I search for ESG data in Refinitiv's database. More specifically, I obtain Refinitiv's estimations about overall ESG, a combined score adjusted for controversies, and the score for each pillar. The addition of variables consistent with a firm's characteristics completes the data sample. Lastly, I construct the main regression model to use in the analysis.

In this section, I describe the data collected for the construction of the panel data set. I present the variables used in the analysis, and the Refinitiv's ESG scoring methodology. Also, I introduce the main regression model used, and descriptive statistics for the whole sample.

4.2 Data collection and description

The data gathered for this empirical study is based on the academic articles on credit ratings and ESG ratings presented. I create a panel data sample, including timeseries of firm specific, ESG scores, and credit ratings for Eurostoxx600's nonfinancial firms in a period from 2002 to 2021. Since 2002, Refinitiv provides ESG data to the public, and creates scores including a variety of ESG metrics. Therefore, I search for available time series for our variables starting in 2002. The firm specific variables gathered are those used by the major credit rating agencies for their rating assignments at a corporate level.

To examine the relationship between credit ratings and ESG ratings, I collect data on long-term issuer corporate/credit ratings issued by the three major credit rating agenceis, S&P's, Moody's, and Fitch. These rating assignments, especially the long-term ones, reflect in the best possible way the willingness and the ability of the firm to fulfill its financial liabilities. This data is used as the dependent variable in our econometric models. More specifically, in our final sample, we end up with 4206 observations of S&P's, 1678 of Moody's, and 2561 of Fitch's ratings, hence we apply S&P long-term ratings as our dependent variable.

Furthermore, I extract the data from Refinitiv/Eikon for all three credit rating agencies, including all 21 rating categories (AAA - D). However, I create the time series in our own based on the initial assignments, and downgrades or upgrades announcements, because

of the fact that the credit rating agencies have forbidden the major data providers, such as Bloomberg, and Thomson Reuters, to provide historical ratings. Therefore, the required time series had been created by the announcements of a change in the credit rating of the specific firm. I start by extracting the credit ratings in the end of the 2001, and I adjust them in the end of every year until 2021 based on the announcements provided by Eikon, constructing time series of credit ratings for every firm in the sample during 2002 to 2021. Also, I decide to omit the observations of the year 2021 from the sample, because there are rating announcements pending.

Moreover, I present the control variables and the independent variables used for the econometric analysis. For the choice of the control/firm-specific variables, I rely on the academic studies. More specifically, I collect data for the variables: total assets, total debt, market value to book value of equity, return on assets, beta, capital expenditures, cash and equivalents, net property, plant, and equipment, total sales, interest coverage ratio, operating profit margin, research and development expense, and retained earnings. All of them described and used in the studies of Ashbaugh-Skaife, Collins, and LaFond (2006), Xia (2014), Baghai, Servaes, and Tamayo (2014), Alp (2013), Bowe, and Larik (2014), Livingston, Wei, and Zhou (2010), Poon, and Chan (2010), and Byoun, and Shin (2011).

The total assets of the firm (Total_Assets) are included as a measure of the firm size. This variable is defined as the combination of total current assets, long-term receivables, investments in unconsolidated subsidiaries, net property plant and equipment, and other assets, according to Refinitiv. I use the natural logarithm of total assets because of the large dispersion in the data. I expect that larger firms face lower business risk hence they will be assigned with higher credit ratings.

The following accounting-based ratios are used as proxies for a firm's default risk: total debt to total assets, return on assets, and interest coverage. The leverage ratio (Total_Debt) is calculated from Refinitiv as the percentage of the sum of short-term debt and the current portion of long-term debt to total assets. Short-term debt is the portion of debt payable within one year, and the current portion of long-term debt represents the amount of long-term debt due within the next twelve months. Generally, the numerator of this ratio includes notes payable arising from short-term debt, current maturities of participation and entertainment obligations, and others. High the leverage ratio reflects greater default risk. Thus, I expect a negative relationship with a firm's credit ratings.

Moreover, the return on assets (ROA) is a measure of profitability of the firm. The data provider calculates this ratio as the sum of net income and the after-tax difference of interest expense on debt and interest capitalized to the average last year's, and current year's total assets. I expect a positive relationship between the return on assets and credit ratings, because firms with higher profitability face lower default risk. Also, the interest coverage ratio is the ratio of operating income to interest expense (Operating_income_to_interest_expense). Operating income is the difference between sales and total operating expenses, and interest expense represents the total amount of interest paid, including interest expense on debt, and interest capitalized field. I expect that firms with higher interest coverage ratio will be assigned with higher credit ratings.

I apply the market to book value (MV_to_BV_capital), research and development expenses (R&D), and capital expenditures (Capex) variables in our model to identify the investment and growth opportunities of the firm. Market value to book value of equity is defined by Datastream as the market value of the ordinary common equity divided by the balance sheet of the ordinary common equity in the company. I expect a positive relationship between this variable and firm's credit rating. The R&D expense variable represents all direct and indirect costs related to the creation and development of new process, techniques, applications, and products with commercial possibilities. Again, I expect a negative relationship of R&D expenses with a firm's credit risk. Finally, the capital expenditures to total assets variables represents the funds used to acquire fixed assets other than those associated with acquisitions, and I expect the positive relationship with credit rating assignments.

Furthermore, I use other variables such as property plant and equipment, cash and equivalents operating profit margin, retained earnings, total sales, and beta. The firm's beta (Beta) is a measure of its business risk, and especially the systematic risk. Datastream measures the beta factor of firm's stock from the least square regression between adjusted prices of the stock, and the corresponding market index created by Refinitiv. The relationship of beta with the default risk of the firm is expected to be positive. In addition, I assume that retained earnings (Retained_earnings) are a determinant of a firm's credit risk, because it reflects its ability to be independent of external financing. Datastream calculates the accumulated after-tax earnings of the company, which have not been distributed as dividends to shareholders or allocated to a reserve account. Thus, I expect a positive relationship with credit ratings.

The relation of tangibility with credit risk is captured by the application of net property, plant, and equipment to total assets (PPE) in our econometric model. Net PPE represents gross property, plant, and equipment less accumulated reserves for depreciation, depletion, and amortization. Firms with higher amount of PPE face lower credit risk, because they have better quality of collateral. Also, the ratio of operating income before depreciation to net sales or revenues, known as operating profit margin (Operating_income_to_sales) is a measure of the firm's financial risk. Firms with higher operating profit margin face lower default risk, leading to higher credit ratings.

Additionally, I use the asset turnover ratio (Sales_to_total_assets), an activity ratio, which is calculated as the gross sales and other operating revenue fewer discounts, returns, and allowances. I expect that larger amount of sales lead to higher credit ratings. Finally, I collect data for the cash and equivalents (Cash_and_equiv) to measure a firm's ability to pay off its debt even if it faces a low profitability period. Many argue that cash holdings' role as a credit factor is to ensure that the firm will proceed to debt payments even if a profitability shock occurred. Based on Datastream's assessments, this variable includes cash and short-term investments, cash on hand, undeposited checks, cash in banks, checks in transit, credit card sales, and other similar elements.

The relationship between cash holdings and credit ratings is controversial. A large amount of cash and equivalents can be useful when the firm faces problems with profitability, leading to lower credit risk. However, there is evidence provided in the aforementioned

academic studies that precautionary cash holdings can be seen as a negative signal. More specifically, the company retains a higher amount of cash because they have serious reservations about their product, the adoption of new policies, or the performance of their upcoming projects. Thus, due to asymmetric information, the credit rating agencies may assess a positive relation between precautionary cash holdings and credit risk.

Besides the variables I collect to control for firm-specific characteristics in our models, the main regressors are Refinitiv's scores on ESG performance. I search for the oldest available data for environmental, social, and governance scores in Datastream, and for an overall ESG score. Consistent with the studies of Ghoul, Guedhami, Kwok, and Mishra (2011), Ng, and Rezaee (2015), Cheng, Ioannou, and Serafeim (2014), Eccles, Ioannou, and Serafeim (2014), Lins, Servaes, and Tamayo (2017), and Tang, Yang, and Yao (2021), I select the Refinitiv's variable of overall ESG score, which is a combination of all material ESG issues for every firm. Also, I obtain data for each pillar separately and the Refinitiv's ESG combined score (ESGC).

4.2.1 Environmental, Social, and Governance (ESG) scores from Refinitiv

In this sub-section, I describe in detail the way Refinitiv constructs the variables I integrate into my analysis. Refinitiv is one of largest ESG data providers, issuing ESG scores since 2002 with the use of over 500 different ESG metrics. Refinitiv highlights that its scores are designed to transparently measure firm's relative ESG performance, commitment to sustainability policies adoption and performance goals, and effectiveness, based on a firm's ESG disclosures. The scores are data-driven, focusing on the most material metrics of each industry, benchmarked against the Refinitiv Business Classifications for all environmental and social issues.

Refinitiv's methodology maintains the principles of: Unique materiality weightings in ESG scores, as the importance of ESG issues differs across sectors. Transparency stimulation, company's disclosures are the core of the methodology, especially the highly material data points. ESG controversies overlay. Refinitiv identifies a firm's actions against commitments and quantifies their impact on the overall score, constructing an adjusted score. Industry and country benchmarks to facilitate comparable analysis. Percentile rank scoring methodology, score ranges from 0.0 to 1. For example, firms with scores of 50% to 75%, are companies with good relative ESG performance and above-average degree of transparency in reporting material ESG data publicly, and as we are moving to higher scores, the ESG performance and the degree of transparency of the firm are higher.

Refinitiv's analysts process over 500 ESG metrics for each company, to capture the information and make them comparable across the entire range of companies. The quality of data is a key part of the collection process, hence they use the following methods to achieve this goal. They use error checks logics in the data entry stage combined with over 300 automated quality check screeners. In addition, independent auditors examine the sample on a daily basis, and management reviews take place on a monthly basis. These

methods are improved constantly based on new learning and the growth of the industry. Also, the database is updated in continuous basis, and the recalculation of the ESG scores takes place every week. The ESG data is updated every year, consistent with companies' ESG disclosures. Interestingly, Refinitiv let all historical scores constant expect the five most recent, in case company restatements or data corrections occurred.

I have already highlighted that Refinitiv's ESG scores are transparent data-driven assessments of a firm's relative ESG performance. Two overall ESG scores are available to users: ESG score which is a report of the firm's ESG performance combined all three pillars, and ESG Combined score, which is the overall score adjusted for controversies, providing a more accurate evaluation of firm's sustainability performance over time.

In the ESG score, Refinitiv group the most material and comparable of the 500 ESG metrics in 10 categories that formulate the three pillars. The pillar score is a relative weighted sum of the categories varying per industry. ESGC score represents the ESG performance of the firm adjusted to negative media stories. This happens with the incorporation of material controversies into the overall scores. This score is calculated as the weighted average of the overall scores and ESG controversies score per fiscal period, with the recent controversies to be consistent with the latest period.

Also, the ESG controversies score is calculated by Refinitiv based on 23 ESG controversy topics. More specifically, if a scandal occurs, and the company involved penalized during the year, the ESGC score is adjusted. Equivalently, for other negative events such as lawsuits, ongoing legislation disputes, all these new materials are grouped into a score by Refinitiv, called ESG controversies score. This score also controls for the market cap bias occurred, because large cap firms attract more media attention, hence more increased criticism than smaller ones.

The Refinitiv construct the ESG scores based on the following 5-step methodology. The steps are: ESG category scores, Materiality matrix, Overall ESG score calculation and pillar score, Controversies scores calculation, and ESGC score. Firstly, their analysts create the 10 ESG categories of Emission, Innovation, Resource use, CSR strategy, Management, Shareholders, Community, Human rights, Product responsibility, and workforce, and apply a score to each one of them for every firm.

Every category includes specific issues, quantitative variables which have to be assigned with a score. Some of the data is boolean, converted to numeric, and numeric data reported by the companies too. Then, the score for each theme of ESG category is calculated as a percentile rank score of the sum of the number of companies with a worse value in the specific issue with the half of the number of firms with the same value included the current company, to the number of companies with a value.

Next, Refinitiv applies a specific weighting scheme to the ESG issues, focusing on the relative importance of each theme to each individual industry group. More specifically, materiality is defined in the form of category weights. Analysts use an objective and data-driven approach to find data points with sufficient disclosure to use as a proxy for important issues in each industry. All these important themes are included in the materiality matrix. Based on these important data points, they create the magnitude

weight of every ESG category, and divide it with the sum of magnitudes of all categories to derive the category weight of an industry group. Then, the overall ESG score is the weighted sum of all 10 categories, and ESG pillar scores are the relative sum of the category weights.

Furthermore, Refinitiv calculates the ESG controversies score based on 23 ESG controversy topics. Controversies are benchmarked on industry group, and companies with no controversies will get a score of 100. Every last completed fiscal year's ESG controversy score includes the controversies of next fiscal years. For example, if the last completed fiscal year is the 2019 and there are two controversies, one in 2020 and one in 2021, both are accounted in 2019 score and 2020 score. The 2021 year's score includes only the controversy of 2021. Finally, the ESGC score is derived from the average of the overall ESG score, and the ESG controversies score. If the controversies score is greater or equal to ESG score, the ESG Combined score equals the overall score. However, if the controversies scores and less that ESG score, then the ESGC score is the average of both of them.

In the following figure is a summary of the procedure described above, and the following table provides a detailed view on the ESG themes Refinitiv covers for every category.

Figure1: Refinitiv's ESG score construction
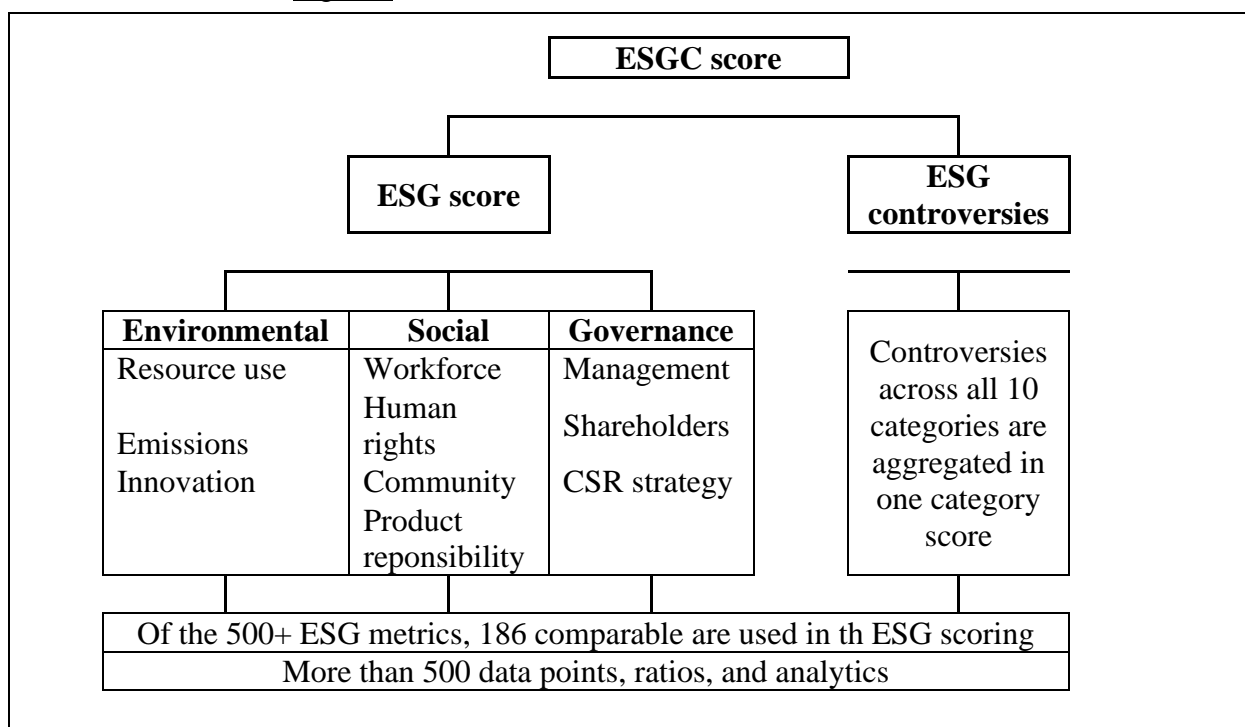
Source: *Refinitiv (2021), "Environmental, Social, and Governance (ESG) scores from Refinitiv". (p.3)*

Table 2: ESG pillars and its components

Pillars	Categories	Themes
Environmental	**Emission**	Emissions Waste Biodiversity Environmental management systems
	Innovation	Product innovation Green revenues, research and development (R&D), and capital expenditures (CapEX)
	Resource use	Water Energy Sustainable packaging Environmental supply chain
Governance	**CSR strategy**	CSR strategy ESG reporting and transparency
	Management	Structure (independence, diversity, commitees) Compensation
	Shareholders	Shareholder rights Takeover defenses
Social	**Community**	Equally important to all industry groups, hence a median weight of five is assigned to all
	Human rights	Human rights
	Product responsibility	Responsible marketing Product quality Data privacy
	Workforce	Diversity and inclusion Carrer development and training Working conditions Health and safety

Source: *Refinitiv (2021), "Environmental, Social, and Governance (ESG) scores from Refinitiv". (p.10)*

Given the definition of both ESG and ESGC scores, it is important to examine whether these scores have any explanatory power for credit ratings of the firm. Also, I want to investigate if Refinitiv's ESG scores represent a firm's actual ESG performance. Thus, we use them in our econometric analysis as the main independent variable, each one of them separately.

4.3 Econometric analysis

In this study, I seek for evidence whether Refinitiv's ESG and ESGC scores are determinants of a firm's credit rating. To examine this relationship, I create a panel dataset, including the credit ratings of the major credit rating agencies (S&P, Moody's,

and Fitch), and all the aforementioned control and ESG scores variables. The cross-sectional part of the dataset is the 600 firms forming the Eurostoxx600 index, and we collect timeseries data for every variable of each one of them from 2002 to 2021.

Given the structure of our sample, I create a panel least squares linear regression model to use for the econometric analysis. As the dependent variable, I decide to use S&P's ratings because I obtain more observations than Moody's, and Fitch's. The explanatory variables are the ESG scores collected from Refinitiv and all the firm-specific variables described in the previous section. Thus, I examine the following hypotheses that the ESG score variable is not a determinant of S&P's credit ratings, and the ESGC score doesn't explain the dependent variable (S&P ratings).

These are our main hypotheses, which we are going to examine during the period of 2002 to 2020 and 2011 to 2020. I omit year 2021 because the fiscal year is not complete and there are credit rating and ESG score assignments pending in many firms. Also, I reiterate our analysis of the sub-sample consisting of the period from 2011 to 2020, because the interest in a firm's ESG performance has been significantly increased during the last decade. Thus, to test our hypothesis, the regression model is the following:

$$Y_{i,t} = \beta_o + \beta_1 ESG_{i,t} + \beta_2 X_{i,t} + \epsilon_{i,t}$$

where, $Y_{i,t}$ is the dependent variable of S&P's credit ratings, β_0 is the intercept, β_1 is the coefficient estimator of ESG score variables, β_2 is the vector of the coefficient estimators of control variables, which are including in vector $X_{i,t}$, for the firm i at time t, and $\epsilon_{i,t}$ is the error-term of the regression.

The panel datasets have got some certain issues. Some firms may be assigned with a higher credit rating during the estimation period because of some unobservable characteristic, or that the credit ratings of all firms vary over time, especially during crisis. To address these concerns, I apply firm and time fixed effects to our initial linear model, constructing our main regression model:

$$Y_{i,t} = \beta_0 + \beta_1 ESG_{i,t} + \beta_2 X_{i,t} + \alpha_i + \alpha_t + \epsilon_{i,t}$$

where α_i and α_t represents the firm and time fixed effects, respectively.

Moreover, the credit ratings are published as letters from credit rating agencies, hence we convert them into numerical equivalents starting from 0 for D to 20 for AAA rating category. The dependent variable can be defined as ordinal data based on its data type. In ordinal data, we don't know the distance between the ranks. It should be noted that the use of ordinal dependent variable in the linear model is not the optimal solution, because the linear model assumes that the absolute distance in the credit risk between the rating categories is equally spaced. However, the linear regression with fixed effects, when credit ratings are the dependent variables, is used by Cantor, and Packer (1996), Xia (2014), and Baghain, Servaes, and Tamayo (2014) in their studies. Also, we calculate descriptive statistics of all the variables used in the models. In the following table, we present the summary for every variable in the sample.

Table 3: Descriptive statistic

VARIABLES	OBSERVATIONS	MIN	MAX	MEDIAN	MEAN	STDEV	SKEWNESS	KURTOSIS
S&P ratings	4206.00	3.00	20.00	13.00	13.23	2.40	-0.11	0.57
Moody's ratings	1678.00	5.00	19.00	13.00	13.31	2.00	0.55	0.96
Fitch ratings	2561.00	3.00	20.00	13.00	13.44	2.35	-0.05	0.11
ESG	7228.00	0.42	94.52	59.89	57.29	20.48	-0.42	-0.62
ESGCombined	7560.00	0.42	93.73	54.39	53.36	19.18	-0.29	-0.58
Environmetal	7223.00	0.00	99.16	60.43	56.01	27.10	-0.47	-0.81
Social	7223.00	0.73	98.63	62.49	59.12	24.04	-0.40	-0.86
Governance	7228.00	0.52	99.33	58.25	55.77	22.48	-0.29	-0.83
Total_Assets	9610.00	7.84	21.60	15.94	15.93	1.93	-0.16	0.00
Total_Debt	9595.00	0.00	269.79	24.07	25.24	17.88	1.24	8.40
MV_to_BV_Capital	9378.00	-944.31	1315.83	2.13	3.56	24.39	19.98	1491.79
ROA	9438.00	-120.97	269.11	6.08	7.24	11.19	8.40	184.10
Beta	9465.00	-15.30	26.76	0.89	0.94	0.60	6.49	431.38
Capex	8903.00	0.00	34645.99	3.70	8.93	367.21	94.29	8895.17
Cash and equivalent	9577.00	0.00	99.59	8.03	11.65	12.57	2.74	10.72
PPE	8720.00	0.00	231189.8	15.04	337.11	3594.13	40.22	2198.41
Sales to total assets	9605.00	-10.14	1582.49	68.99	80.40	69.32	4.44	57.28
Operating income to interest expense	969.00	-454.60	1197804	2.30	1510.7	39094.22	29.83	909.35
Operating income to sales	9592.00	-10760.13	2416.34	11.51	13.53	120.97	-72.77	6581.79
R&D	4464.00	0.00	3905.20	1.07	14.59	132.76	21.77	534.81
Retained Earnings	9425.00	-750.29	176.90	23.36	23.59	33.50	-4.83	66.66

To address the problem of outliers in our main sample, I decide to use winsorization for 1st and 99th percentile. The observations belonged below the 1st and above the 99th percentile of the data sample, converted to NAs (trimming). Also, I remove all NA values. Another problem I have to deal with was the problem of multicollinearity. I observe that the control variables of R&D expenses (R&D), and the interest coverage ratio (Operating_income_to_interest_expense) lead to perfect multicollinearity, hence I didn't use them in our models.

The analysis is based in a general to specific process. I run linear regression models and remove the variable with the highest p-value until I receive only statistically significant coefficient estimators for the explanatories. Since I don't have a theoretical model to specify which are the determinants of credit ratings, I assume that the ESG scores are related to the firm's credit risk in some way. So, I want to identify if this relationship is affected by firm-specific characteristics. In other words, this actual relationship may be insignificant, and ESG will appear to be a strong explanator of credit ratings due to the effect of another factor, I omit. Using this general to specific approach, I want to end up

only with statistically significant coefficients, to have as long as possible accurate conclusion for the main independent variables of ESG score.

To increase the robustness of the models, I have to deal with the error term of the regression. I use White's method to deal with heteroscedasticity, in order to get robust errors. However, to address with the complexity of the panel dataset, I decide to use cross-sectional clustered robust standard errors. I repeat the general to specific process and recalculate all regression for our main linear model with fixed effects, applying White's robust standard errors and clustered standard errors by firms.

5. Results

5.1 Introduction

The main results of the aforementioned academic articles are the positive relationship between a firm's ESG score and its financial performance. The researchers find that the companies with higher ESG performance have lower cost of equity, and easier access to finance. In particular, their findings support that only specific components of ESG lead to an increase in a firm's economic value.

Also, the authors identify the weaknesses in ESG data, which lead to differences between the ESG rating providers' assessments. The various definitions and metrics of specific ESG issues hamper their integration in investor's decision-making process.

In this section, I present the results of the empirical research, providing evidence that the ESG overall scores and ESGC are positively related with firm's credit ratings during the periods of 2002 to 2020, and 2011 to 2020. Also, the Refinitiv's scores represent the firm's ESG performance in consistency with these results.

Moreover, I compare the results between the two periods, to identify whether the explanatory power of the ESG variables increased after 2011. In addition, I provide the findings of the analysis using as independent variables the ESG pillar scores. Also, I examine whether the Refinitiv's scores assignments are influenced by firm's credit rating.

Finally, I perform an analysis of the split ratings between S&P and Fitch against the ESG scores. I examine whether the differences in the agencies' rating assignments are influenced by the firm's ESG score, providing the results of the regressions of split ratings against ESG, ESGC scores. Also, I investigate whether the difference between these overall scores is a determinant of the split ratings. The sensitivity analysis using the ESG pillars as explanatory variables is performed for the split ratings, too.

5.2 Estimation of Rating Models using ESG scores as independent variables

I start with testing the hypotheses that the Refinitiv's ESG scores are determinants of S&P's credit ratings, during the periods from 2002 to 2020, and 2011 to 2020, using the regression models described above. I present the results of all regressions in the following table for White's robust standard errors and one-way robust standard errors.

Table 4: Ratings Regressions

	2002-2020	2002-2020	2002-2020	2002-2020	2011-2020	2011-2020	2011-2020	2011-2020
	ESG	ESG	ESGC	ESGC	ESG	ESG	ESGC	ESGC
Std. errors	White	Clustered	White	Clustered	White	Clustered	White	Clustered
(Intercept)	2.422 (1.826)	2.422 (4.057)	2.59 (1.839)	3.008 (3.859)	0.939 (2.031)	1.722 (3.683)	-0.067 (2.065)	1.279 (3.52)
ESG	0.013*** (0.003)	0.013** (0.005)			0.009** (0.003)	0.01* (0.004)		
ESGC			0.009*** (0.001)	0.009** (0.003)			0.006*** (0.001)	0.006* (0.002)
Total_Assets	0.545*** (0.094)	0.054** (0.205)	0.542*** (0.095)	0.537** (0.191)	0.532*** (0.104)	0.532** (0.196)	0.593*** (0.104)	0.572** (0.185)
Total_Debt	-0.018*** (0.004)	-0.019** (0.007)	-0.017*** (0.004)	-0.017* (0.007)	-0.013*** (0.004)	-0.014* (0.006)	-0.013** (0.004)	-0.014* (0.006)
Beta	-0.728*** (0.097)	-0.728*** (0.164)	-0.7*** (0.097)	-0.727*** (0.166)	-0.28*** (0.094)	-0.327* (0.157)	-0.252** (0.097)	-0.286· (0.159)
Sales_to_total_assets	0.007*** (0.001)	0.007 · (0.004)	0.007*** (0.002)	0.008* (0.004)	0.008*** (0.002)	0.008** (0.003)	0.008*** (0.002)	0.008** (0.003)
Operating_Income_to_sales	0.038*** (0.007)	0.038*** (0.011)	0.039*** (0.007)	0.042*** (0.011)	0.023*** (0.005)	0.028** (0.008)	0.025*** (0.006)	0.029** (0.009)
Capex	0.077*** (0.017)	0.077· (0.04)	0.067*** (0.018)		0.079*** (0.013)	0.072** (0.025)	0.083*** (0.022)	0.067** (0.025)
ROA	0.017** (0.008)	0.017· (0.009)	0.018** (0.008)	0.02* (0.009)				
Retained_Earnings	0.017*** (0.002)	0.017** (0.006)	0.016*** (0.002)	0.017** (0.005)	0.009*** (0.003)		0.01** (0.004)	
PPE					-6.73E-05** (2.59E-05)		-8.13E-05** (2.78E-05)	

(continued)

Table 4: Continued

	2002-2020	2002-2020	2002-2020	2002-2020	2011-2020	2011-2020	2011-2020	2011-2020
	ESG	ESG	ESGC	ESGC	ESG	ESG	ESGC	ESGC
Std. errors	White	Clustered	White	Clustered	White	Clustered	White	Clustered
Cash_and_equiv					0.011** (0.004)		0.011* (0.004)	
MV_to_BV_Capital								
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	2273	2273	2274	2292	1557	1614	1555	1617
R-squared	0.86	0.86	0.86	0.86	0.92	0.92	0.92	0.92
Adjusted R-squared	0.85	0.85	0.85	0.84	0.91	0.91	0.91	0.91

The results of the OLS regression models of S&P ratings against ESG overall score, ESGC score, and control variables. The S&P's credit ratings are transformed from letters into numerical scale format, for AAA = 20, AA+ = 19, AA= 18 to D=0. We apply firm and year fixed effects, and we use White's robust standard errors and one-way clustered standard errors. Also, (***) indicates statistical significance in 0.1% level of significance, (**) indicates statistical significance in 1% level of significance, (*) indicates statistical significance of 5% level of significance, (.) indicates statistical significance in 10% level of significance.

The main independent variables of ESG scores explain credit ratings during the period from 2002 to 2020 and during the period from 2011 to 2020. More specifically, the ESG overall score variable is positive and significant in 1% level of significance and in 5% level of significance, in the period from 2002 to 2020, and 2011 to 2020, respectively. Hence, the Refinitiv's ESG overall score is a determinant of firm's credit ratings. Also, the ESGC score variable is positive and significant in 1%, and in 5% level of significance, in the period from 2002 to 2020, and 2011 to 2020, respectively. Thus, the Refinitiv's ESG score adjusted for controversies (ESGC) is a determinant of firm's credit ratings.

In addition, all the control variables have the expected signs, except the PPE variable, which is significant and negative from 2011 to 2020. A possible explanation is that the S&P assumes that holding a large amount of fixed assets may result in a liquidity problem, whether the firm's need for cash increases. However, the absolute value of the coefficient estimators is small and its explanatory power diminishes under the clustered robust standard errors.

The results indicate that firms with higher ESG score will be assigned with higher credit ratings, thus, they will have easier access to finance. In other words, high credit ratings allow companies to borrow from financial institutions and public markets, with better terms on the loans. The findings are consistent with the study of Cheng, Ioannou, and

Serafeim (2014), in which they provide evidence that high sustainability firms face less capital constraints.

In comparison with the results of the sample over the period of 2002 to 2020, the findings of the sub-sample support that the explanatory power of the ESG variables diminished. More specifically, both the p-values of the ESG and ESGC score are increased in the sub-sample, and they become significant at the 5% level of significance, when in the main sample they were significant at 1%. Also, the regression of credit ratings against both the ESG and adjusted ESG score combined with control variables, lead to an insignificant coefficient for the main independent variables. In addition, the effect of beta over the credit ratings appears to be weakened in the sub-sample, and the profitability measure (ROA) is insignificant, and the variable of retained earnings too, despite the weak significance found during the period of 2002 to 2020. Also, the capital expenditures appear to be a determinant of the credit ratings in the period from 2011 to 2020.

The aforementioned results show that ESG and ESGC score are positively related with firm's credit ratings. Additionally, there are some indirect or combined hypotheses tested. I examine that the credit rating agencies apply in their rating models to the firm's ESG performance in both periods. Also, in every regression model, I test the hypothesis if the Refinitiv's ESG ratings are related with the firm's ESG performance. I raise my concerns about the fact that the variables Refinitiv try to measure are qualitative and made several assumptions through its rating process.

More specifically, the variety of definitions of the material issues in every industry, the different ESG metrics, the weighting scheme in every ESG category and ESG pillar, and the consistency and the availability of ESG data which is based on voluntary disclosures may lead to subjectivity in ESG ratings. There are differences in the ESG scores from various providers, making the economic participants question about their information value. Thus, Refinitiv's ESG score may not capture the firm's ESG performance.

I examine this hypothesis in every regression, and I find that these scores are determinants of the S&P's ratings assignments. Also, the ESGC score is important to explain a firm's credit ratings, because it supports that the Refinitiv's score captures a firm's ESG performance under controversies.

Moreover, I perform a sensitivity analysis recalculating the regressions, starting with both ESG scores (ESG, ESGC) and all the control variables. For the period 2002 to 2020, we find that the ESG is not significant any more, and the ESGC score variable is positive and significant, indicating that ESGC is a better explanator of firm's credit ratings than ESG score. Similarly, for the 2011 to 2020 period, we end up in the same conclusion.

Overall, the findings from the analysis support that the Refinitiv's ESG variables, both ESG overall score, and the ESG score adjusted for controversies are determinants of the S&P's credit ratings during the period from 2002 to 2020. However, we find that their explanatory power weakens as we focused on the period from 2011 to 2020. This is not consistent with our expectations, as we were waited for an even stronger relationship between the firm's credit risk and the firm's ESG performance. Thus, we perform the same analysis using the ESG pillars as independent variables instead of the ESG scores.

5.2 Digging further

The results of our main models indicate that ESG scores have significant explanatory power over credit ratings. However, the reduction of the significance of them during the period of 2011-2020 is unexpected. Then, I repeat our analysis using the ESG pillars as independent variables. I recalculate the regressions, using a general to specific approach, identifying which pillar of the ESG explains firms' credit ratings in the main sample, and the sub-sample.

The findings are presented in the following table:

<u>Table 5</u>: Ratings Regressions – ESG pillars

	2002-2020	2002-2020	2011-2020	2011-2020
Std. errors	White	Clustered	White	Clustered
(Intercept)	1.189 (1.828)	1.584 (0.409)	-0.421 (1.952)	0.324 (3.561)
Environmental				
Social	0.008*** (0.002)	0.009* (0.004)	0.011*** (0.002)	0.011** (0.004)
Governance	0.003* (0.001)			
Total_Assets	0.557*** (0.095)	0.556** (0.191)	0.550*** (0.099)	0.543** (0.189)
Total_Debt	-0.018*** (0.004)	-0.016* (0.007)	-0.013** (0.004)	-0.013· (0.006)
Beta	-0.736*** (0.099)	-0.736*** (0.164)	-0.227** (0.092)	-0.313* (0.151)
Sales_to_total_assets	0.008*** (0.001)	0.009* (0.004)	0.008*** (0.002)	0.008** (0.003)
Operating_income_to_sales	0.038*** (0.007)	0.043*** (0.011)	0.025*** (0.006)	0.029** (0.009)

(continued)

Table 5: Continued

	2002-2020	2002-2020	2011-2020	2011-2020
Std. errors	White	Clustered	White	Clustered
Capex	0.070*** (0.018)		0.087*** (0.021)	0.069** (0.025)
ROA	0.023** (0.007)	0.021* (0.009)		
Retained_Earnings	0.017*** (0.002)	0.018 ** (0.006)	0.008* (0.003)	
PPE			-6.09E-05* (2.54E-05)	
Cash_and_equiv			0.011** (0.04)	
MV_to_BV_capital				
Firm fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Number of observations	2,232	2,298	1,581	1,623
R-squared	0.86	0.86	0.92	0.92
Adjusted R-squared	0.84	0.84	0.91	0.91

The results of the OLS regression models of S&P ratings against ESG Pillars score: Environmental, Social, and Governance scores, and control variables. The S&P's credit ratings are transformed from letters into numerical scale format, for AAA = 20, AA+ = 19, AA= 18 to D=0. We apply firm and year fixed effects, and we use White's robust standard errors and one-way clustered standard errors. Also, (***) indicates statistical significance in 0.1% level of significance, (**) indicates statistical significance in 1% level of significance, (*) indicates statistical significance of 5% level of significance, (.) indicates statistical significance in 10% level of significance.

I can observe that the only significant component of ESG is the Social-pillar. More specifically, the variable of the Social is positive and significant in 5% level of significance from 2002 to 2020, and in 1% level of significance from 2011 to 2020, supporting that the firm's Social-performance is a determinant of its credit ratings. Also, the Governance variable is positive and significant at 5% level of significance under White's robust standard errors during the period of 2002 to 2020. All the control variables have the expected signs discussed in the previous section, expect the PPE, which is negative and significant only under White's robust standard errors from 2011 to 2020.

One possible explanation is that the Social-pillar's themes are incorporated by the credit rating agencies in their rating methodologies, which is partly consistent with findings in the aforementioned academic studies. Also, it appears that the Governance-pillar is not a determinant of the credit ratings, especially for the period of 2011 to 2020, despite the fact that it is an issue of great concern to the companies and the academics, since 1990s.

Interestingly, the results support out initial expectations that in the sub-sample (2011-2020) the ESG performance, in terms of social, is taken in greater account by the credit rating agencies.

Although the interest around ESG is increased and the credit rating agencies seem to recognize the ESG as determinant of the firm's credit risk, we observe that the Environmental component is insignificant. I assume that the difficulties in the definition and the measurement of Environmental issues led the agencies to be cautious towards the firm's voluntary disclosures and ESG providers' scores. In addition, the Refinitiv Environmental score seems to not represents the firm's Environmental performance. Similarly, I assume that the public disclosures on social issues are more consistent and available than the environmental ones. Also, it seems that the social issues are easier to be measured, or there is an agreement for measuring these ESG issues. Hence, the results support that the social pillar is a determinant of the credit ratings, and its explanatory power increases during the period of 2011 to 2020.

I investigate whether the Refinitiv's ESG score assignments is influenced by the credit rating agencies assignments. More specifically, a firm with higher credit rating face lower risks, hence Refinitiv may assign a higher ESG score to this firm based on the credit rating agency's judgements. To address this concern, I estimate my initial regression model adding interaction terms between ESG overall score and the firm's assigned with credit rating grades from AAA to AA- and from A+ to A-. The findings indicate that the companies with higher credit ratings are assigned with higher ESG scores by Refinitiv. It seems that the information around ESG scores are derived mainly from credit ratings.

Moreover, I examine the relationship between the split ratings and the ESG scores during the period of 2011 to 2020. In the aforementioned academic studies, there is evidence that the credit rating agencies sometimes differentiate in the assignments from a specific firm. I investigate whether these differences can be explained by the ESG, ESGC scores. In other words, I try to determine if the credit rating agencies assign the same weights to ESG and ESGC scores in their rating methodologies. Additionally, I examine if the split ratings explained by the difference between the two scores, indicating that some agencies apply only the ESG score in their assessment process.

I search for firms rated by two rating agencies, and we find 650 observations of ratings from both S&P's and Moody's, 842, and 487 observations from both S&P's and Fitch, and Moody's and Fitch, respectively. Thus, I decide to examine if the differences in the firm's rating assigned by S&P's and Fitch are explained by the Refinitiv's ESG scores for the specific firm.

I calculate the absolute value of the differences between the ratings of the two agencies. I find 462 observations in which both agencies assigned the same rating, and 380 observations with differences between the agencies' ratings. Next, I recalculate the regression models using as dependent variable the split ratings, and independent the ESG scores. From the general to specific model, applying White robust standard errors and one-way clustered standard errors, we find that the ESG scores, both the Refinitiv's overall score, and the ESGC, are not significant, hence they cannot explain the split ratings between S&P and Fitch.

In addition, I group split ratings in three numerical categories. The first category includes all the observations of absolute value between the ratings is zero, the second and the third one includes the splits with the value of one, and greater than one, respectively. I estimate a multinomial probit regression of the split ratings against the ESG scores, but again, this analysis led to insignificant coefficient estimators for the ESG variables. Also, the regression of the split ratings against the difference between ESG and ESGC score leads to insignificant coefficient estimator for the ESG scores difference.

Finally, I use the ESG pillars as independent variables, repeating the general to a specific procedure. The results didn't show any relationship between ESG components and the split ratings.

To sum up, the ESG scores have a positive and significant relationship with firm's credit ratings during the sample periods of 2002 to 2020, and 2011 to 2020. Interestingly, ESGC is a better explanator than the Refinitiv's ESG overall score, and the explanatory power of both scores diminishes as we focused in the sub-period of 2011 to 2020, opposite to our expectations. To examine this event, I use the ESG components as independent variables, and find that the social variable is significant in both periods. More precisely, the firm's social performance is a determinant of firm's credit rating, and its explanatory power is increasing as we focused in the sub-period of 2011 to 2020. Also, it seems that companies with higher credit ratings are assigned with higher ESG ratings. Lastly, I examine whether the ESG, ESGC scores, and their difference explain the splits ratings between S&P and Fitch assignments, but I cannot prove any significant relationship through my analysis.

<u>Conclusion</u>

The criticism of credit rating agencies creates the need to understand the determinants of their rating assignments. Investors rely on them to deal with asymmetric information issues. Hence, they should be assured that the inputs used in their decision-making are accurate and reliable.

In addition, the economic participants' interest on firm's sustainability is increased. More specifically, investors and academics examining whether the firms with superior ESG performance improves its economic value and access to finance. Also, they investigate the reliability of the ESG data, and the weaknesses of the ESG scores provided by private companies.

The research literature corroborates with the view that the adoption of ESG policies leads to an increase in a firm's economic value. The researchers provide evidence that the firm's with higher ESG performance face lower cost of equity, and easier access to finance. However, the relationship of the sustainability with a firm's financial performance and access to finance is driven by specific components of ESG. Also, the researchers find that the different ways companies report data combined with various methodologies used by ESG data and rating providers are opposite to their initial role to help economic participants deal with asymmetric information.

In this thesis, I examine whether the ESG is related with firm's credit risk. In other words, I investigate if the credit rating agencies apply ESG issues in their credit rating assignments. To perform the analysis, I use the Refinitiv's ESG scores. Thus, I can examine if the provider's scores are related to a firm's ESG performance. In addition, I investigate whether the relationship between ESG and credit risk is stronger after the 2011. Also, I want to identify which of the ESG scores pillars affect corporate credit ratings.

The results support that ESG is negatively related to firm's credit risk. More specifically, the Refinitiv's ESG and ESGC (ESG scores adjusted for controversies) scores are both determinants of the corporate credit ratings, indicating that firms with superior ESG performance have lower credit risk hence easier access to finance. However, the explanatory power of the ESG scores over rating assignments diminishes during the period of 2011 to 2020.

Also, I find that only the Social pillar of the ESG affects firm's credit ratings, which is partly consistent with the aforementioned academic studies' results. Interestingly, the Social pillar's explanatory power increases during the period of 2011 to 2020. One explanation is that the inconsistency of the ESG data and the various ESG metrics lead to an inconsistency in Refinitiv's Environmental score, and a firm's Environmental performance.

Finally, I examine the relationship between the split ratings assigned to a firm and its ESG scores. I hypothesize that given the various ways to report and measure ESG data and the differences in the credit rating agencies' methodologies, the differences in the firm's rating assignments by two entities will be explained by ESG scores. However, my findings can't prove this relationship since the ESG, ESGC scores, their difference, and ESG pillars couldn't explain significantly the split ratings. One possible explanation is

the need for a bigger sample with more firms rated by multiple agencies. The findings and the answers of this study create more concerns about ESG ratings, and the need for further investigation of the various aspects.

Appendix

Table 6: All the variables used in the empirical analysis

VARIABLES		
Dependent variable	**Definition**	
Credit Ratings	S&P's Long-term issuer ratings using a numerical scale: 1 for D to 21 for AAA	
Independent variables (control variables)	**Definition**	**Expected sign**
Total_Assets (Size)	Natural logarithm of total assets of the firm	+
Total_Debt (Leverage)	Total debt to total assets of the firm	-
MV_to_BV_capital (Investment and growth opprtunities)	MV of common equity to BV of common equity	+
ROA (Profitability)	Return on assets = the sum of net income and the after-tax difference of interest expense on debt and interest capitalized to the average last year's, and current year's total assets	+
Beta (Systematic risk)	The beta factor from the least square regression between adjusted prices of the stock, and the corresponding market index created by Refinitiv	-
Capex (Investment and growth opportunities)	The capital expenditures to total assets variables represents the funds used to acquire fixed assets other than those associated with acquisitions, (% of total assets)	+
Cash_and_equiv (Cash holdings)	The firm's ability to pay off its debt even if it faces a low profitability period,including: cash and short-term investments, cash on hand, undeposited checks, cash in banks, checks in transit, credit card sales, and other similar elements, (% of total assets)	controversial
PPE (Tangibility)	Net PPE represents gross property, plant, and equipment less accumulated reserves for depreciation, depletion, and amortization, (% of total assets)	+
Sales_to_total_assets	The gross sales and other operating revenue less discounts, returns, and allowances, (% of total assets)	+
R&D (Investment and growth opportunities)	The R&D expense variable represents all direct and indirect costs related to the creation and development of new process, techniques, applications, and products with commercial possibilities, (% of total assets)	+

Table 4: Continued

Operating_income_to_interest_expense (Interest coverage ratio)	The difference between sales and total operating expenses, and interest expense represents the total amount of interest paid, including interest expense on debt, and interest capitalized field	+
Operating_income_to_sales (Financial risk)	The ratio of operating income before depreciation to net sales or revenues, known as operating profit margin	+
Retained_earnings (Firm's independency of external financing)	The accumulated after-tax earnings of the company which have not been distributed as dividends to shareholders or allocated to a reserve account	+

Main independent variables	Definition	Expected sign
ESG	Refinitiv's overall ESG score	+
ESGCombined	Refinitiv's overall ESG score adjusted for controversies	+
Environmental	Refinitiv's Environmetal Pillar score	+
Social	Refinitiv's Social Pillar score	+
Governance	Refinitiv's Governance Pillar score	+

The above table presents all the variables used for the analysis. The name of every variable is described in the first column. The definition and the way each variable computed by Refinitiv presented in the middle column. In the third one we can see the expected sign of each variable's estimator coefficient of the regression of credit ratings against the independent variables. Note: the variables R&D expenses, and Operating income to interest expense are removed from the main model, due to perfect multicollinearity issues. Also, we decide to use as dependent variable S&P's ratings, because we obtain the greatest number of observations.

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