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How does greenwashing affect firm value? Empirical analysis from stock market reaction and companies' performance

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Abstract:

In recent years, due to the growing interest of investors in investing in environmental, social and governance issues, academic research has multiplied, highlighting the problems of information asymmetry. One of the information asymmetry problems is called greenwashing and is defined as the mis-disclosure related to environmental issues by companies. In this thesis we analyze this problem and its effects on companies' value. To detect greenwashing, we have used a method based on the wording of ESG reports inspired by Ruiz-Blanco et al. (2021). We have applied this method to our sample of 508 ESG reports, for the period extending from 2014 to 2019. The relationship between greenwashing and the short, medium, and long-term stock market reactions around the release of ESG reports, is then studied as well as firms' financial performance.

We found a positive effect of greenwashing on medium-term market reactions as well as on the company's economic performance. However, companies that did not engage in greenwashing had better long-term market reactions.

Finally, we have outlined possible future research directions, which complement the methods used in this thesis, using a more in-depth analysis of social ("bluewashing") and governmental ("blackwashing") issues in the ESG reports.

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1. Introduction

In recent years, there has been a surge of interest among investors to invest more responsibly by taking Environmental, social and governmental (ESG) criteria into account (CNBC, 2021). The number of funds has multiplied, increasing the number of global ESG investments from 22.8 trillion in 2016 (32% of global investments under management) to 37.8 trillion by the end of 2021 (34% of global investments under management) (Bloomberg 2021; Statista, 2022). This puts pressure on companies to issue ESG reports, increasing from 20 companies in the early 1990s (Kotsantonis et al., 2016) to several tens of thousands in 2019 (PWC, 2019). In theory, these reports should help investors better understand the company's non-financial initiatives, which also contributes to reducing the information asymmetry and helps investors make well-informed decisions. However, this is not the case as Candela et al. (2021) showed that the report presents asymmetry of information in most cases. A large number of academic studies, due to the increase in interest in ESG investments, are looking into this asymmetry of information which they call greenwashing. The latter is very abstract, complex, and therefore difficult to detect (Dumitrescu et al., 2022). Indeed, many observers think that certain companies engage in greenwashing but sometimes these preconceived ideas are not founded (Yu et al., 2020; de Silva Lokuwaduge & De Silva, 2022).

According to the literature, what helps companies to engage in greenwashing is that, unlike financial reports that are regulated, structured and mandatory, ESG reports are mostly voluntary, unstructured and unregulated (Thewissen et al., 2022). This leaves a lot of freedom for companies to disclose what they want and follow the standards they want (X. Du, 2015; Yu et al., 2020). However, governments are struggling to implement regulations, not having a broad understanding of how this information is used, and what information is important to consider in reporting. In this field, the aim of academic research is therefore to support policy makers in their attempts to put regulations around these reports (Yu et al., 2020).

The thesis is organized as follows. A review of literature is given in the next chapter, where we outline a global picture of ESG reporting today and the challenges that are related to it. Chapter 3 presents hypotheses that explain a possible relationship between stock market reaction and greenwashing, as well as one between performance and greenwashing. Chapter 4 provides the data details and methodologies in which we explain how we computed greenwashing scores and all specificities of our model. Chapter 5 presents the empirical results with the main findings. Chapter 6 discusses limitations where we open the doors to more comprehensive

research on the analysis of greenwashing in ESG reports. And the last Chapter draws the conclusion.

The added value of our research is that we propose an automated analysis of ESG report discourses inspired by Ruiz-Blanco et al., (2021). We have however only analyzed greenwashing for environmental issues and have made available our entire methodology so that this study can also be done on S&Gs. Until today, to our knowledge, no study has investigated the relationship between greenwashing and firm performance and between greenwashing and long-term cumulative abnormal returns (CARs), which represent the stock market reaction around the report's release date. With the method we used, we propose an analysis of these two relationships.

2. Literature Review

In this chapter, we will first explain the growing interest in environmental, social, and governance issues in the financial world. Then we will outline the theoretical concepts necessary to understand this paper. We will also provide an overview of the challenges associated with ESG reporting. We will conclude this section by explaining the background research we use throughout our study.

2.1 Introduction to sustainable finance and the development of ESG criteria

The traditional theory of the firm is based on the assumption of profit maximization, according to which a firm is a single unit with a single objective (Anning, 2018). This theory assumes that rational investment is based solely on the profit variable. Since the end of the 20th century, the capital allocation process changed in part with growing environmental awareness. Some investors are increasingly looking to invest in companies that reduce their environmental impact. These maneuvers do not mean that they are disregarding profitability. In fact, they still seek profitability while integrating the environmental and social consequences of the company's activities into their decision. To understand the evolution of this proposition, let us go back to May 1992 when sustainable finance was introduced for the first time by the United Nations (UN) leaders. They proclaimed that private finance would be the key to sustainable development¹. This marked a succession of initiatives such as the creation of the United Environment Program Initiatives (UNEP FI) group, as well as focus groups involving banks and insurance, in order to establish a framework of responsible investment.

In 2006, the UN launched the six Principles for Responsible Investment (PRI). It guides institutional investors to act responsibly over the long term by integrating environmental, social and governance (ESG) issues into their investment practices (Sievänen et al., 2013). The PRI gathered nearly 1,500 signatures from over 50 countries and represented \$60 billion of responsible investment (UN, 2006). Investors who have signed commit themselves to these PRI's. In 2015, with the adoption of the Paris Agreement and the Sustainable Development Goals, sustainable investment increased significantly. Indeed, since 2015, a 30% increase has

¹ Sustainable development is “The development that meets the needs of the present without compromising the ability of future generations to meet their own needs.” (Our Common Future, 1987)

been noticed in investments subject to ESG criteria, which represents about 30 trillion dollars (Howard-Grenville, 2021). By the end of 2025, these could reach 53,000 trillion dollars, representing a third of global assets (Bloomberg, 2021).

2.2 ESG reports

In the following sections 2.2.1, 2.2.2, and 2.2.3 we elaborate on the concept of ESG reporting, add an explanation of the different frameworks that have been initiated in order to support companies in reporting, and end with a comparison of the status of the laws in three different regions of the world, Europe, United States, and China.

The latter three are interesting because environmental awareness is not the same. Moreover, China is an emerging market, and the factory of the world with the highest pollution rate in the world and therefore does not represent the same challenges as Europe and the United States. (Bloomberg 2021)

2.2.1 ESG reports introduction

An ESG report is a non-financial report published publicly and, in most cases, voluntarily by companies about their environmental, social, and governance impacts (PWC, 2022). It complements the financial reports, with a deeper and broader view of the company. Therefore, it reduces the information asymmetry and builds trust between companies and stakeholders. From the companies' side, the literature has revealed that publishing an ESG report is an added value. Indeed, many studies have demonstrated that taking ESG challenges into account is more likely to be risk-aware (Kotsantonis et al., 2016; EY, 2014; Howard-Grenville, 2021). Huang & Huang (2020) add that a better risk management leads to a better cash management. Moreover, Daliwal et al. (2011) show that companies that disclose ESG reports reduce their cost of capital. Indeed, with their sample of 650 companies, mostly from the S&P 500, Daliwal et al. (2011) found that, on the year companies initiate self-disclosure of their CSR activities, companies have a lower cost of capital than the year before. However, there are also many challenges involved with ESG data disclosure. Indeed, ESG data are not audited; there is no global governance body; and there is a lack of specific regulatory guidance to ensure compliance of all reports (Tschopp & Huefner, 2015; Khan et al., 2016; State Street Global

Advisors, 2017). Therefore, the lack of a common framework makes it difficult to compare companies, as stakeholders must rely on company signals that do not always accurately represent their actual ESG performance (Serafeim & Yoon, 2021). As Du (2015) and Serafeim & Yoon (2021) suggest, a global framework is needed to provide greater transparency and comparability as well as to mitigate the risk of false disclosure

2.2.2 Existing Global ESG Framework

As mentioned above, there is no global framework for ESG performance disclosures. There are a myriad of guidelines and standards, each with specific requirements and targeted audiences. This makes it difficult for companies to navigate through these guidelines and standards. The four most frequently used guidelines are the Global Reporting Initiative (GRI), the sustainability accounting standards board (SASB), the Carbon Disclosure Project (CDP), and taskforce on climate-related financial disclosures (TCFD): see Singhania & Saini (2021). Each of these frameworks has its own characteristics and may be incomplete, unsuitable, or outdated as ESG constantly evolve, as Flammer (2013) points out. Moreover, none of them are mandatory or have legal sanctions attached to them. However, some countries require companies that meet certain conditions to publish ESG reports.

2.2.3 Countries' ESG laws

In Europe, the 2014/95/EUDirective, also called the Non-Financial Reporting Directive (NFRD) has been implemented, which obliged companies with more than 500 employees to report ESG. This rule concerns 11, 000 companies including listed companies, banks, insurance companies, and companies with a public interest designated by the relevant national authorities. From January 1, 2024, the 2014/95/EUDirective will switch to the corporate sustainability reporting directive (CSRD), which will require more than 50,000 companies to report. However, it is not yet clear how the EU will sanction companies that do not comply (EC Europa, 2021; S&P, 2021 ; Pettingale et al., 2022).

In the U.S., the Security Exchange Commission (SEC) does not require companies to report on their environmental policies, although there are many ongoing discussions about making it mandatory. The advantage is greater transparency for stakeholders, which ensures that

investors can make better-informed decisions. However, the disadvantage is an additional cost for companies, and SEC members are not convinced that this will lead to better business practices. One of the reasons the SEC does not want to follow suit is that they do not have a clear enough understanding of what kind of information is important in ESG, and what information supports the understanding of a company's financial condition (Grewal et al., 2017). On the other hand, Section 302 of the Sarbanes Oxley Act demands that companies disclose information about their business risks related to the environment, safety issues, and health. However, there is no requirement that it should be in the form of ESG disclosure (Huang & Huang, 2020).

In China, the China Securities Regulatory Commission (CSRC), in collaboration with China's Ministry of Environmental Protection has required all listed companies and bond issuers to report on ESG. Since February 2022, companies that do not follow the rule can be fined a minimum of \$1,579 US dollars, and in the worst case, they can be suspended from their activities (Huld, 2022; Ministry of Ecology and Environment of China).

Since there is very little verification of the accuracy of the data reported and since companies can choose very different guidelines and standards, this leaves room for them to make false disclosures or to engage in greenwashing.

2.3 Greenwashing

2.3.1 Definition

The concept of greenwashing is very abstract and is understood in different ways by the public. (Yu et al., 2020; de Silva Lokuwaduge & De Silva, 2022) Based on previous research, we propose a definition that we will use later for the effects of this phenomenon on corporate value. We also note that we use the definition of greenwashing only for environmental issues and not for social and governance issues. Finally, we provide an analysis of the main drivers of greenwashing.

The term greenwashing appeared in the late 1980s and is used in marketing to give a green image (i.e., that respects the environment) to a product that is not green (Guardians 2016; Huang & Huang, 2020). Due to the consumers' increasing interest in the environment,

companies invest a lot in advertising to appear green without implementing concrete actions behind it. This term is also becoming more common in finance to express false disclosures in sustainability reports to deceive the stakeholders (Lyon and Maxwell, 2011; Lyon et al., 2013; Marquis et al., 2016). Among the multiple definitions given in the literature, the one that stands out most often is the following: "Greenwashing is the distance between what is disclosed in the reports and the actual ESG performance of the company" (Yu et al., 2020; Ruiz-Blanco et al., 2021). Greenwashing can be issued in reports in two different ways. The first technique is to disclose false information to increase the company's value, that is, overstating its actual environmental performance (Lyon and Maxwell, 2011; Lyon and Montgomery, 2013; Marquis et al., 2016). The second is selective selection which means that companies cherry-pick the information they want to report. For example, they only provide the good news but will not report the bad ones (Lyon and Maxwell, 2011; Lyon et al., 2013; Marquis et al., 2016).

2.3.2 ESG-washing versus green, blue and black washing

In most articles in the literature, the word 'greenwashing' is used to refer to ESG-washing. Indeed, it covers in reality all three pillars, environmental, social, and governance, not only environmental issues. However, several studies separate the three pillars and use the terms greenwashing for the environmental issue and 'bluwashing' or 'social washing' for social issues (Chen et al., 2018). Recently, Ruiz-Blanco et al. (2021) defined a new word, 'blackwashing', to illustrate governance issues. In this paper, the term greenwashing will be used to refer to environmental issues

2.3.3 Greenwashing drivers

The false disclosures of companies can be explained by several phenomena such as the legitimacy theory, competitiveness and the reputational management. The principle of legitimacy of a company means that a company is considered legitimate if its means and ends appear to conform to the social norms, values, and expectations of society (Parsons, 1958, Ashforth & Gibbs, 1990; Dowling and Pfeffer, 1975). Indeed, organizations seek to establish congruence between the social values associated with or implied by their activities and the norms of acceptable behavior in the more extensive social system of which they are a part.

Mathews (1993, p450) claimed that when an actual or potential mismatch exists between the two value systems, organizational legitimacy is threatened. The second theory is competitiveness. According to this theory, brown companies (i.e., those that pay less attention to the environment) fear being left behind by sustainable companies and engage in greenwashing to stay in the race (Huang & Huang, 2020; Candelon et al., 2021). The more competitive the environment, the more companies will act in the same manner as their counterparts in terms of disclosing false information (Arouri et al., 2021). The third is reputation management. Reputation is considered as an intangible asset (Dowling, 1993). This value drives managers to make a good impression by maintaining a good image. For this, they use what they call impression management, i.e., the process of influencing the stakeholders on how they perceive the company (Leary, 1999).

2.4 Signal theory and evidence about the greenwashing

In Sections 2.4.1 and 2.4.2, we explain the limited ways in which companies can demonstrate that they are taking the actions they disclose. As well as internal factors, i.e., company size, and external factors, i.e., media exposure of companies that influence greenwashing.

2.4.1 Signal theory

The signal theory is based on asymmetric information and imperfect markets, with an assumption that the managers of a company know the quality of their company. Investors, on the other hand, do not have this information and cannot distinguish between high and low-quality firms. The purpose of signaling for a company is therefore that investors detect that they are actually doing what they say in their report. (George et al., 2017).

In the case of ESG issues, an increasing number of sustainable companies are entering the market, making it even harder for investors to compare companies claiming the same environmental benefits when few follow through with their promises (Hohnen et al., 2007). Companies can benefit from the insights of the signal theory to reduce information asymmetry and subsequently legitimize their activity (Ruiz-Blanco et al., 2021). For example, by using an independent body to monitor their sustainability reports, they can ensure more reliable ESG reporting (Larroque, 2013; Simnett, 2012).

Green labels have also been suggested as another way to ensure reporting. However, these labels have not shown successful outcomes. Since many companies have self-proclaimed labels that are nothing more than a label associated with sustainability, it is difficult to detect which ones are true (Yu et al., 2020). For a label to be trusted, it must be issued by an independent body and not be subject to the company's internal control. In conclusion, the possibilities for companies to signal are limited, and, therefore, companies that greenwash are not easily detected (Seele and Gatti, 2017, p.248).

2.4.2 Evidence about the greenwashing

Academic research has shown, that certain internal and external factors can positively or negatively affect disclosures. Internal factors are defined as variables that the company has the power to act on, while external factors are about the firm's environment (i.e., the industry or the country) that the company has no control over (Dragnic, 2014). On the internal side, the literature has shown that in companies with government ownership, gender diversity on the company's board improves the quality of ESG reports (Liao et al., 2015; Ming et al., 2015; Lagasio & Cucari, 2019; Huang & Huang, 2020). Moreover, there is an interesting link between company size, ESG reporting, and greenwashing. Indeed, the company's size is positively correlated with an increase in the level of information disclosure. That does not mean an increase in the quality; indeed, a larger firm is leading the greenwashing trend, according to Roulet & Touboul (2015). On the external side, companies that are more exposed to the media appear to do less greenwashing because its repercussion via the feedback effect can be accentuated (Brammer et al., 2008; H. Rupley et al., 2012). To demonstrate the power of the media, Aerts & Cormier, (2009) have shown that after a high-profile environmental accident, companies tend to publish more content regarding their environmental actions to maintain a social reputation and legitimacy.

Furthermore, contrary to their original hypotheses, Huang & Huang (2020) found in their sample of Chinese firms that environmentally sensitive industries and proximity visibility industries greenwash more than their peers. They assume that this may be due to a higher public pressure. In their paper, Huang & Huang (2020) define environmentally sensitive industries as companies that are subject to greater environmental controls. They include oil companies, and proximity visibility industries, as companies that are well known to the general public as consumers of that product or service, i.e., food and beverages.

2.5 ESG score and rating agency

In this section, we overview the ESG scores given by the rating agencies. ESG ratings monitor a company's environmental policies and performance and create a score that helps investors take ESG factors into account when building their portfolio (Bloomberg, 2021). However, the rating agencies do not use the same methods to calculate these scores, which hinders an accurate comparison. Li & Polychronopilos (2020) compare the differences between several ESG rating providers in their study. It shows different scores for the same company when using different ESG ratings. Therefore, investors need to understand the parameters they are evaluating to align with the ESG criteria that are important to them. (Li & Polychronopilos, 2020). Moreover, ratings are rarely audited by a third party. In the article “Stock price Reactions to ESG news: the Role of ESG ratings and disagreement”, Serafeim & Yoon (2021) study whether ESG ratings predict future company news. The results seem conclusive, but the effect is diminished when the different rating agencies disagree on the score. Some rating agencies are known to be more robust than others and better at predicting future performance, such as KLD (S. Du et al., 2017), MSCI (Serafeim & Yoon, 2021), Thomson Reuters, and Bloomberg (Yu et al., 2020).

2.6 Investor’s reactions to ESG report

Several research studies have already analyzed the impact of ESG reports on market reaction. We summarize them in this section, as this is the basis for our research.

First of all, Serafeim & Yoon (2021) calculated the dollar benefit of sustainable reporting for Fortune 500 companies. The results are encouraging for a company with a positive sustainability performance, its yearly value increases by approximately 1.5% (starting value equal to \$23,563.16 million and increase of \$341.1 million per year) compared to companies with negative sustainability performances. Secondly, Yu et al. (2020) studied the reaction of investors via Cumulative Abnormal Returns (CAR)² in the short term and long term. In the short term, they found a positive market reaction to good news and an adverse reaction to bad news. That is, companies that report better ESG performance show higher abnormal returns;

² Abnormal returns are excess returns that were not expected by the market. They are measured as the difference between the actual returns that investors get on an asset and those that were expected (Corporate Finance Institute, 2020).

and companies in a low information environment (i.e., less exposed to the media and publish less) show higher CARs. If companies have already published their performance on their website, the market has already incorporated it into the price. In the long term, publishing ESG reports increases the relationship between sustainability performance and firm value. Positive changes in sustainability performance impact the firm's market value only if it publishes reports related to its performance (S. Du et al., 2017).

The studies mentioned above by Serafeim & Yoon (2021) and Yu et al. (2020) have shown that the stock market is responding to ESG reporting. Despite these facts, there is a lack of a deep understanding of how and why information is used by investors (Thewissen et al., 2022). Amel-Zadeh & Serafeim (2018) conducted a survey of investors in the U.S. and Europe to understand what motivates investors to invest in ESG. They found that investors often associate better environmental performance with better returns. According to the authors, this is a financial incentive rather than an ethical one. In addition, their survey finds that one of the barriers to investing in ESG is data reliability and lack of auditing, which seems to be more of a concern for U.S. investors than Europeans. Lastly, in terms of content, Thewissen et al. (2022) sought to determine which topic in the reports was of relevant value to investors. They broke down the reports into different subcategories for the E, S, and G. These three categories represent environmental, social, and governance issues. They found that investors also reacted to the content according to the topics covered, and not every topic has the same value.

2.7 Investor's reactions to greenwashing

In this section, we outline the various research related to the relationship between greenwashing and stock market reaction. This section is one of the pillars of our study.

Firstly Thomas Tayler, senior director of the center of excellence for sustainable finance at Aviva investors, said that the persistence of greenwashing carries significant risks for investors. He added that "If we cannot trust the information that companies or product providers publish about their sustainability credentials, market integrity is compromised" (Aviva investors, 2021). In addition to the threat to market integrity, greenwashing poses a significant problem in the global green transition goals (Swiatek-Barylska, 2016, p.278). However, greenwashing is not always observable, as Ruiz-Blanco et al. (2021) argue. Seele and Gatti (2017, p248) insist that there is no greenwashing without accusation. The accusation at present is mainly carried out

via media coverage. The case of Volkswagen³ is a good example; upon hearing of the emission scandal, in addition to the substantial fines received, the share price fell by 23%. Even though greenwashing is not always observable, X. Du (2015) proposes a technique to detect it in the media. And they studied the effects of greenwashing on CARs in China. They observed that the phenomenon negatively influenced CARs. However, their analysis is ex-post and not ex-ante because, to analyze greenwashing, they developed a technique of filtering positive and negative news from the environmental point of view.

Moreover, the reaction to the news can be justified by the return effect. After the revelation by the media of greenwashing, the reputation of companies can be perpetually damaged by what is called the ‘return effect’ (Brown and Dacin 1997; Serafeim & Yoon, 2021). It is defined as the process automatically triggered after a disturbance, aiming to provoke corrective action in the opposite direction. This makes the consequences even worse. Currently, the general public’s reaction to greenwashing and its effects is based on media-based information (X. Du, 2015). The companies discovered by the media are not the only ones that greenwash. Indeed, there are advantages to having positive news and a lack of control and regulations, leaving room for companies to disclose what they want. In other words, companies will continue to do it if the cost of greenwashing is lower than taking action to alleviate the cause of environmental impact. However, there is still a gap in the literature for better understanding of the cost or benefit of greenwashing in the short and long term.

2.8 Performance, report, and greenwashing

In this section, we detail the studies that have already examined the relationship between financial performance and ESG reporting. We add that the question of the relationship between financial performance and greenwashing in ESG reports has not yet been studied.

Despite the positive impacts described in the literature of publishing ESG reports on markets, only a small number of studies have evaluated the impact on companies’ performance. And those who have done so have not reached a consensus. In fact, the relationship between financial performance and ESG performance is complex because several variables must be considered; it is not a simple cause-and-effect relationship (Nirino et al., 2021). On the one

³ The Volkswagen affair or dieselgate is a scandal that broke in 2015 for which, the car group had fraudulently tampered with a program to make believe, during approval tests, that they had reduced their polluting emissions of NOx and CO2 (Blackwelder, 2016).

hand, Lu et al. (2017) showed that strengthening Corporate Social Responsibility (CSR) oversight by disclosing standalone reports within the company encourages managers to make better investment decisions. Besides that, Porter et Kramer (2016) have shown the positive effect of a company's sustainable behavior on its financial performance. Nirino et al. (2021) add that investing in sustainability can bring benefits such as reduced taxes and increased reputation that build customer loyalty and facilitates the signing of new contracts. On the other hand, for Kim & Lyon. (2015), this better allocation of fund within the company does not mean better performance. According to them, it is just a cost for the firm. Indeed, Chen et al. (2018) claims that companies that invest in their ESG issues have more significant expenses supported by the shareholders in the short run. To our knowledge, the literature has not yet studied the relationship between corporate performance and greenwashing.

3. Hypotheses development

In this chapter we set out our analysis based on the literature and develop the hypotheses that will be tested in this thesis.

3.1 Hypotheses

Companies use ESG reports to build a relationship of trust between themselves and their stakeholders as one of the foundations for their legitimacy (Nègre et. al., 2017). As mentioned before, the need for legitimacy of companies as well as public expectations pushes companies to use impression management to maintain a good reputation. That is, trying to convey a positive image to have the public's approval (Ruiz-Blanco et al., 2021). When these companies do not perform up to what they think the public expects, some decide to resort to greenwashing to improve their image (Fanning et al., 2022). Companies that resort to greenwashing assume that the gain of improving their image exceeds the punishment of being exposed. They consider either that the probability of being detected is very low or that the cost involved is low compared to the gain of lying (Kim et al., 2017; Seele and Gatti, 2017).

As mentioned earlier in the literature review, some studies have already proven post facto, that when if greenwashing is exposed by the media, there is a negative effect on the abnormal return effect in the short run. But to our knowledge, no study has assessed this short-term impact for companies that are not reported in the media and around the release date of the ESG report. Furthermore, we assume from several studies that markets react positively to good news around the release date of the report (X. Du, 2015; Yu et al., 2020; Serafeim & Yoon, 2021), We,

therefore, hypothesize that in the short run, markets react positively to companies that issue reports in which they greenwash.

H1: Greenwashing has a positive impact on short-term CARs.

Secondly, in the medium and long term, we assume that the climate performance of companies can be revealed by the media, and external organizations, i.e. NGOs. (X. Du, 2015) Therefore, investors should realize that ESG performance is not being met, which disappoints the markets. Companies trigger a return effect which means that the CARs react negatively in the long run (Brown and Dacin 1997; Yoon et al. 2003).

H2a: Greenwashing has a negative impact on companies' medium-term and long-term CARs

We suppose that companies that do not have greenwashing meet market expectations for their non-financial environmental performance. Indeed, there is less information asymmetry and the market can act accordingly to the accurate information. Moreover, as S. Du et al. (2017) show in their study, the companies that publish reports with good governmental performance positively change their market value. We, therefore, hypothesize that companies that do not greenwash in the medium and long run have a neutral or higher values on their CARs.

H2b: Companies not engaging in greenwashing show non-negative medium-term and long-term CARs

Thirdly, as mentioned before in the literature review, the effect on ESG reporting performance is still unclear. Indeed, Lu et al. (2017) and Porter and Kramer (2016) agree on the positive effect of sustainability on financial performance because the company makes better investments and is more aware of its risks. Nirino et al. (2021) add that it also improves stakeholders' perception of the company that brings positive effect such as increased sales. While Kim & Lyon stated that better allocation of funds does not mean better performance and for them it is just a cost supported by investors. To our knowledge, the relationship between greenwashing and performance has never been studied before, but given the positive effects of disclosure for the good perception of stakeholders but that it is a cost for the company. We hypothesize that in the short run, companies engaged in a higher level of greenwashing, benefit from the good reputation without it being a cost to invest. And therefore, there is a positive relationship between greenwashing and performance.

H3: Greenwashing has a positive impact on companies' performance

4. Methodology and data

In this chapter, we first analyze several methods already used to measure greenwashing in prior research, then we explain the one we have selected. We also develop the model we use to isolate the effect of greenwashing. We end up explaining the details of our data collection.

4.1 Methodology

4.1.1 Greenwashing

Prior studies:

Several methods have already been designed and empirically studied in the literature to measure greenwashing. We have identified three methods that are relevant. The first one comes from Huang & Huang (2020), who define greenwashing in two different ways, as we did in the literature review. The first defines greenwashing as a way to select information, and the second defines it a way to manipulate information. For the first definition, Huang & Huang (2020) established a series of 20 topics that should be disclosed and assigned one point when the topic of the report is disclosed and zero when it is not. To define greenwashing, they have separated the symbolic sentences from the substantive ones. By symbolic they mean the sentences with no numerical value that illustrate the statements, and by substantive sentences explained by numerical values.

This gave them:

1. Selective disclosure

$$Gwls = 100 \times \left(1 - \frac{\text{number of items disclosed}}{\text{number of items that should be disclosed}}\right)$$

2. Expressive manipulation

$$Gwle = 100 \times \left(1 - \frac{\text{number of symbolically disclosed items}}{\text{number of disclosed items}}\right)$$

3. $GW = \sqrt{Gwls \times Gwle}$

This technique is undoubtedly complete but difficult to adapt objectively due to certain biases such as the confirmation bias⁴. They attempted to diminish this bias, by having two independent readers score the reports and recording them only when both readers agreed 90% of the time. We did not select this method due to our large sample and unmanageable length of the report.

The second method comes from the study by Yu & al, (2020), where they tried to explain what kind of variables affect greenwashing. To calculate it they used the subtraction between speech and performance using two performance ratings, Bloomberg and Thomson Reuters. They normalized their measures by industry to give a comparable score of each company to its peers. According to this study, the Bloomberg's performance score was used to measure speech while that of the Thomson Reuters was used for performance. However, as most of studies in the literature recognized, the Bloomberg scores measure the ESG performance of companies, not just the speech.

Technique used:

We, therefore, decided to draw on the third existing technique, which comes from the study of Ruiz-Blanco et al. (2021). They also defined greenwashing as discourse minus performance. For the discourse they used a technique proposed by Berreta and Bozzolan (2004) which constructs a score for the discourse, that assigns the value of 1 for the sentences only textual, 2 for the sentences with numerical values, and 3 for the sentences with monetary values. This represents the accuracy of the discourse, ranging from the least accurate (qualitative sentences) to the most accurate represented by monetization. For the discourse ratio, they then did the total amount of weighted sentences divided by the number of sentences in the report. This gave a score out of 100. For the performance variable, they used the score given by Bloomberg which is out of 10. They scaled this score to be out of 100 so that they can be made consistent for subtraction.

We inspired ourselves from this technique, but we provided a few variations as we only wanted to calculate the greenwashing corresponding to the environmental issues. We separated the sentences in our ESG reports according to the words they contain. To select the words that denote the environmental topics of a report, we took the GRI framework that targets the categories of ESG reports. In addition to the categories of words used by the GRI framework, we added another category after reading some of the reports, because we noticed words that

⁴ Confirmation bias can be defined as "This bias describes the tendency to selectively look for evidence that confirms one's hypothesis rather than to look for evidence that falsifies it". (Rudiger, 2004)

were frequently used. These words are listed in Table 4.1.1. We also added the variations of these words, for example waste, wastes, wastage. Then we asked python to memorize the number of environmental phrases of each report and export it to a file (see, for code, Appendix 9.1).

Table 4.1.1

Environmental words library
1. Material, material
2. Energy, energies
3. Water, waters
4. Biodiversity
5. Emission, emissions
6. Effluent
7. Waste, wastes, wastage
8. Climate, Climates
9. Compliance
10. Transport, transportation
11. Environment, environments
12. Environmental
13. Environment initiatives
14. Environmental assessment
15. Recycling, recycle

After that, we assigned the points to the discourse following Ruiz-Blanco et al. (2021). We assigned 1 point when the sentence did not contain a number, 2 when it contained quantitative data, and 3 if the sentence contained the following words: euro, euros, and dollar, dollars, or one of the two signs \$ and €. We asked python to export to excel the number of points for the qualitative, quantitative, and monetized sentences. And then we standardized these scores so that they have the mean of zero and the standard deviation of 1. For the environmental performance variables, we used two different methods based on two different scores. The first was the Bloomberg score or the MCSI adjusted industry score, since they were the same. We visualized on a terminal the scorecards related to our companies. The scorecards separated the environmental issues from the social issues and the governmental issues; and detailed their scores by different sub-points (see Table 4.1.2). The same technique is used for each company, allowing for greater comparability between peers (Bloomberg 2021). We then subtracted our speech score and our performance score, which gave us our greenwashing score. To compute the greenwashing score with the second score, we used the same methodology. The only difference was that we based performance on MSCI Weight score. This score is weighted so that an important subject of the industry is highly weighted. For example, an industry that used

a lot of water resources had a weighted score for which water management is more important. See Table 4.1.2 for the decomposition of all issues considered in the total performance score.

4.2 Regression development

4.2.1 Independent variables

Table 4.1.2

MSCI - Bloomberg: Environmental issues
1. Carbon emissions
2. Product Carbon Footprint
3. Energy Efficiency
4. Insuring Climate Change Risk
5. Water Stress
6. Biodiversity and Land Use
7. Raw Material Sourcing
8. Financing Environmental Impact
9. Toxic Emissions and Waste
10. Packaging Managerial and Waste
11. Electronic Waste
12. Opportunities in Clean Tech
13. Opportunities in Green Building
14. Opportunities in Renewable Energy

To measure how markets react to greenwashing, we use the CARs technique already used in different studies (Du et al., 2017; Huang & Huang, 2020; Thewissen et al., 2022). Here, we determined the event as the date on which the ESG reports are issued. We transformed the CARs into absolute values in order to have a better comparability between them. To test our hypothesis 1, we created our model based on short-term investor reactions using the CARs around the release date at one-day, two-day, and five-day windows, denoted as $|CAR_{[-1,+1]}|$, $|CAR_{[-3,+3]}|$ and $|CAR_{[-5,+5]}|$, respectively.

Regression 1, 2 a:

$$|CAR_j| = \alpha + \beta_1 GW_Score + \beta_2 FirmControls + \beta_3 ESGPerformance + u.$$

Regression 2 b:

$$|CAR_j| = \alpha + \beta_1 Green_Score + \beta_2 FirmControls + \beta_3 ESGPerformance + u.$$

Note that the above equation includes the industry fixed effects and year fixed effects.

For Hypothesis 2a and 2b, we used the same regression with two variants: Cumulative absolute abnormal returns $|CAR_{[+1,+60]}|$ and $|CAR_{[+1,+180]}|$. Furthermore, as hypothesis 2a measures only firms that engage in greenwashing and hypothesis 2b measures only those that do not greenwash, we separated our sample into two parts. The first group for only the companies that have a positive greenwashing score and the second one with a negative greenwashing score, i.e., for which the performance score was better than the disclosures. We put this score in absolute value and name it Green SCORE.

For hypothesis 3, we used the same control variables and proxy the performance by Tobin's Q ratio⁵. It was also widely used in the literature and in several studies on ESG (Jakobsson & Lundberg, s. d ; Thewissen and al., 2022).

Regression 3

$$Tobin's\ q = \alpha + \beta_1 GW_Score + \beta_2 FirmControls + \beta_3 ESGPerformance + u.$$

The above equation includes the industry fixed effects and year fixed effects.

4.2.2 Control variables

To isolate the effect of greenwashing, we selected control variables that strengthen our model by explaining the reaction of investors to ESG reports. This reaction can be related to the financial performance of the company and to the non-financial performance. Firstly, financial performance can be characterized by company size. Indeed, larger companies have more pressure from their stakeholders to engage in ESG issues and disclose them. Size is also used in a number of research studies (Du et al., 2017; Huang & Huang, 2020; Ruiz-Blanco et al., 2021, Thewissen and al., 2022). They can also be explained by the return on asset (ROA), market-to-book ratio (MTB), financial leverage (LEV) and the intensity of research and development (R&D intensity). ROA explains the positive association between performance and investors behavior (Thewissen et al., 2022). The MTB measures the company's growth opportunity (KamaliArdakani et al., 2014). The LEV measures the risk that a company has to finance itself, the higher the risk, the more volatility in the markets (Thewissen and al., 2022).

⁵ This ratio was developed by James Tobin who defined q as the value of the firm/the replacement value of fixed capital. A q value greater than one indicates that a company has an incentive to invest because the market value will be greater than the amount invested. If this q is less than one, it means that the company has difficulty raising funds and therefore is less able to invest in the company, so dividends paid out will theoretically not increase (Chirinko, 1987).

The R&D intensity measures how much the company spends on R&D out of its total number of assets. We then added a control on volatility with the calculation of standard deviation of ROA over a 5-year period, following Thewissen et al. (2022). Next comes the set of non-financial variables selected in our study are the level of institutional ownership (INST). Prior studies already reported an correlation between institutional ownership performance and ESG performance (Lin & Fu, 2017). Finally, we included the year and the industry fixed effects.

4.3 Data details

4.3.1 ESG report and performance score

We started with a sample of 1,875 ESG reports, all dating from 2007 to 2019 and representing 570 S&P1500 companies. These reports were collected from the internet from several sources such as BusinessWire.com, and global reporting.org, directly from the companies' websites. These reports were then transformed into text format using the optical character recognition technique (OCR⁶) so that they are readable by the programming language Python. We then applied our methodology for the speech score described above and looped back to get the result for the 1875 reports in our sample. For the performance scores we collected them from Bloomberg and MSCI, they were available only from 2015⁷. Therefore, we reduced our sample range by taking only reports from after that date. This gave us a sample of 680 companies. We also sorted out and removed unreadable reports, i.e., those that had a score of 0 for speech accuracy. This is because the OCR technique is not powerful enough to read the complexity of all ESG⁸ reports. This reduced our sample to 508 companies (for the decomposition, see table 4.3.1).

⁶ Refers to computer processes for translating printed or typed images and text into text files.

⁷ These scores calculate the year of operation on which the ESG report is based. For example, the 2019 score is calculated for information related to 2019 operations.

⁸ There are many graphics, images and tables that are sometimes difficult to process by OCR.

Table 4.3.1 Summary statistics of ESG Greenwashing score

Statistic	N	Mean	St. Dev.	Min	Max
Speech Score decomposition					
Sentence numbers	508	173.644	161.453	12	975
1. Qualitative Sentences	508	89.069	86.680	7	577
% Qualitative Sentences	508	50.215	12.359	33	85.320
2. Quantitative Sentences	508	77.063	74.840	5	421
% Quantitative	508	44.033	11.697	12	80.650
3. Currency Sentences	508	7.512	9.602	0	107
% Currency Sentences	508	5.752	9.024	0	100
Speech final score					
1. Speech score	508	51.846	6.070	38.230	100
2. Speech score Standardized	508	0.029	1.013	-2.244	8.068
Performance ESG score					
1. Perf Env score	508	5.692	5.649	0.000	72
2. Weight Perf Env score	508	36.602	20.272	0.000	82
1.a Perf Env score ST	508	0.0005	0.988	-2.304	2.438
2.b Weight Perf Env ST	508	-0.00001	0.986	-1.747	2.271
Greenwashing score					
1. Gen Perf Env score GW	508	0.031	1.373	-3.696	9.393
2. Weight Perf Env score GW score	508	0.031	1.404	-3.271	7.877

4.3.2 Dependent variables

For the dependent variables (CARs), we used the release date of the reports which defines the event around which the analysis of the investors' reaction will be done. These dates come from the same sites where the reports were downloaded. In addition, those for which the date could not be found were also removed from our sample. This reduced the number of companies to 208. The CARs were collected from the Compustat⁹ database. In addition, the sample also excludes companies whose CARs could have been affected by events in the 5 days around the issue date, which could distort our results. These events are merger and acquisition, earnings press release or the issue of the 10-K (Thewissen et al., 2022). For the performance regression, we calculated Tobin's Q ratio by dividing the total market value by the total assets. The data

⁹ Compustat is a U.S. database that contains market and financial information for all public traded companies across North America (European University Institute, 2022).

for the two factors of the ratio also come from Compustat. For this regression, we used our total sample of 508 companies.

4.3.3 Control variables

The control variables used include the ROA, market-to-book (MTB) ratio, Size, leverage, volatility, R&D intensity, which are constructed from the data available from Compustat. More specifically for ROA, we divided net income by total asset, for size we used the logarithm of total asset, and, for MTB ratio, we divided total market value by company book value. For leverage, we calculated the ratio by dividing the debt (both long-term and short-term) by the total asset. And for R&D intensity, we divided the amount invested in research and development by the total asset. The volatility is measured using the standard deviation of the company's ROA over 5 years from time horizon $T_{-4\text{years}}$ to year $T_{1\text{year}}$. We also used the percentage of the company owned by institutional investors (INST), which was collected from the data closest to the release dates on guru.com. And for ESG performance, for ease of accessibility, we took the MSCI scores, available through the S&P1500 which puts a score for each company. MSCI is close to Bloomberg in its scoring (Bloomberg 2021). For more details about these data we added the summary statistic of each regression in the Appendix C. Finally, there are industry variables for which we have made a ranking based on MSCI and guru.com ranking: see appendix B (1). And the years we have sorted according to the year the report was published, as some of the text files had the date the content referred to, and some had the date it was published: see Appendix B (2).

4.3.4 Multicollinearity test:

In order to have more robust results we had to make sure that there are no problems of multicollinearity in our model. Multicollinearity means a high degree of linear inter-correlations among explanatory variables in a multiple regression model. It can adversely affect the variability of estimation and lead to falsified results of regression analyses (Kim, 2018). It can affect the results by increasing the standard errors of regression and distort the p-value of the statistical tests. In order to solve this problem by suppressing variables if it occurs, it is possible to analyze the correlation matrix of the different variables of the model and remove

the ones that are highly correlated (See appendix D). We observe that the two correlation matrices for the regression on CARs and the one on Tobin's Q the highest correlation is between the variable MTB and leverage with a score of 0.3974 and 0.3859 respectively. We decide therefore that the multicollinearity was not an issue in our model.

5. Empirical Results and Discussion

Before we discuss the empirical results, we should note that, for all regressions, we tried several different model combinations with the two variables related to greenwashing's scores of ESG performance. We only kept the regressions that had the greenwashing weight and score adjusted by industry since these were the ones that best explained the relationship explained in our model between independent and dependent variables. Now, in this chapter we will show and explain the different results we obtained with our sample. We will then discuss the results by comparing them with previous research.

5.1 Empirical results

5.1.1 Hypothesis 1 Market reaction to greenwashing at short term

To begin the discussion of empirical results, we start with hypothesis 1: i.e., we test for the presence of a positive relationship between greenwashing and stock market reaction measured by short-term CARs. As we can see in Table 8, the coefficients of greenwashing are slightly negative for the one-day and three-day window around the release date, i.e. ($|CAR_{[-1,+1]}|$, $|CAR_{[-3,+3]}|$), The value of these coefficients are -0.0003, and -0.001 respectively and are not statistically significant. While, for the third period represented by $|CAR_{[-5,+5]}|$, the result is slightly positive, almost zero with a coefficient of 0.0001. This means that the effect of greenwashing on CARs is very small and not significant (economically and statistically) in the short run in our sample. In addition, the ESG performance variable is not consistent with prior economic expectation either, with estimated coefficients being -0.001, -0.002 and -0.002 respectively for the three periods analyzed.

As for signs and significance of control variable, we have two statistically significant values for the size variable at the 5% level of significance, respectively for $|CAR_{[-3,+3]}|$ and $|CAR_{[-5,+5]}|$, both taking the value of -0.007. For these events windows, we can deduce that if the size (log of asset) is 1% larger, the CARS decreased by 0.7%. Moreover, in event window $|CAR_{[-1,+1]}|$,

the ROA is also significant at the 1% level with the estimated coefficient of -0.055, but it is no longer statistically significant thereafter. $\text{Log}(1+\text{Volatility})$, the average of the standard deviation of the ROA over 5 years (in natural logarithm), is statistically significant at the 10% level in the period $|\text{CAR}_{[-1,+1]}|$ and $|\text{CAR}_{[-5,+5]}|$. This means that a 1% increase in volatility for these two models increase the value of CARs by 0.184% and 0.344% respectively. For the $\text{log}(1+\text{RD})$, the coefficient for $|\text{CAR}_{[-5,+5]}|$ is 0.287, which is consistent with expectation and statistically significant at the 5% level. For MTB, Lev and Inst, the estimated coefficients are not statistically significant. More broadly, we can observe that Size, ROA and volatility, ESG performance score maintained the same signs over the 3 periods studied, while all other variables show the estimated coefficients changing their signs. Therefore, our hypothesis about a possible positive correlation between the greenwashing and the stock market reaction in the short term is not empirically validated.

Table 5.1.1
The relationship between greenwashing and stock market reaction (Short-term)

	<i>Dependent variable:</i>		
	$ \text{Car} - 1, +1 $	$ \text{Car} - 3, +3 $	$ \text{Car} - 5, +5 $
	(1)	(2)	(3)
Intercept	0.049*** (0.018)	0.091*** (0.029)	0.093*** (0.034)
Size	-0.003 (0.002)	-0.007** (0.003)	-0.007* (0.004)
ROA	-0.055*** (0.017)	-0.025 (0.027)	-0.037 (0.031)
$\text{log}(1 + \text{volatility})$	0.184* (0.100)	0.171 (0.158)	0.344* (0.184)
$\text{log}(1 + \text{R.D intensity})$	0.012 (0.067)	-0.018 (0.106)	0.287** (0.123)
MTB	0.00002 (0.0001)	-0.00001 (0.0001)	0.0001 (0.0001)
Lev	-0.00004 (0.001)	0.0004 (0.001)	-0.001 (0.001)
INST	-0.002 (0.005)	0.006 (0.008)	0.008 (0.010)
ESG performance score	-0.001 (0.001)	-0.002 (0.001)	-0.002 (0.002)
Env weight greenwashing	-0.0003 (0.001)	-0.001 (0.001)	0.0001 (0.002)
Industry fixed effect	Yes	Yes	Yes
Release Year fixed effect	Yes	Yes	Yes
Observations	217	217	217
R ²	0.106	0.057	0.120
Adjusted R ²	0.067	0.015	0.082
Residual Std. Error (df = 206)	0.016	0.025	0.029

Note:

*p<0.1; **p<0.05; ***p<0.01

5.1.2 Hypothesis 2a and 2b Market reaction to greenwashing and green companies in the medium term and long term

As a reminder, the hypothesis 2a stated that companies that greenwash have a negative impact on CARs in the medium and long term. To test this hypothesis, we have used a sub-sample of greenwash and non-greenwash companies and studied their impact on the medium-term and long-term market reaction. Firstly, regarding the companies with a positive greenwashing score (See table 5.1.2(1)), we can observe that for the medium term, if the companies greenwash more than one point, it positively affects the CARs by 0.025% with statistical significance. We also observed this positive trend for $|CAR_{[+1,+180]}|$ but it is not statistically significant. Furthermore, our sample did not show a significant relationship at the $|CAR_{[+1,+60]}|$ and $|CAR_{[+1,+180]}|$, between ESG performance scores and CARs. In addition, for the control variables, the only statistically significant one was the ROA for the event window $|CAR_{[+1,+180]}|$, which implies a negative relationship between the CARs and the ROA: when the ROA increased by 1%, the CARs is expected to decrease by -0.85%. All other control variables did not appear to give consistent results, it means that they did not explain significantly our regression. Lastly, with all the results analyzed above, the hypothesis 2a is not supported. Indeed, the result for the medium-term showed the opposite of what we hypothesized, and we didn't have any significant result for the long term.

Table 5.1.2 (1)
The relationship between greenwashing companies and stock market reaction (MT and LT)

	<i>Dependent variable:</i>	
	<i> Car 1, 60 </i>	<i> Car 1, 180 </i>
	(1)	(2)
Intercept	0.181 (0.187)	-0.105 (0.436)
Size	-0.019 (0.021)	0.028 (0.049)
ROA	-0.224 (0.159)	-0.865** (0.371)
log(1 + volatility)	-0.494 (0.769)	-1.068 (1.793)
log(1 + R.D intensity)	-0.506 (0.772)	1.651 (1.799)
MTB	0.0003 (0.0005)	0.001 (0.001)
Lev	-0.001 (0.005)	-0.005 (0.012)
INST	-0.045 (0.041)	-0.014 (0.095)
ESG performance score	0.001 (0.004)	-0.005 (0.009)
Env weight greenwashing	0.025** (0.012)	0.032 (0.028)
Industry fixed effect	Yes	Yes
Year fixed effect	Yes	Yes
Observations	130	130
R ²	0.287	0.281
Adjusted R ²	0.106	0.100
Residual Std. Error (df = 103)	0.085	0.198

Note: *p<0.1; **p<0.05; ***p<0.01

For the hypothesis 2b, we built our hypothesis under the following assumption: Companies that do not engage in greenwashing (green companies) should show a neutral or positive values of CARs in the medium and long run. First of all, as shown in Table 10, the green score of the companies that do not greenwash have a significant impact on the CARs over the two events window studied, $|CAR_{[+1,+60]}|$, $|CAR_{[+1,+180]}|$. Indeed, at the 10% significance level, an increase of the point of greenwashing by one unit is expected to decrease the CARs by -0.041%. And then, this effect become positive and statistically significant at the 1% level for the second period studied, $|CAR_{[+1,+180]}|$ with a marginal effect of 0.211% on CARs. This means that in the medium term, investors reacted negatively to companies with a higher Green score, and then this effect is reversed in the long run where they reacted more positively to the Green score.

Additionally, regarding the ESG performance score, the coefficient was positive for both medium and long term event windows, with statistical significance at the 5% level. In the

period $|CAR_{[+1,+60]}|$, the CARs increase by 0.0004% in response to an 1-point increase of performance, and in the period $|CAR_{[+1,+180]}|$ this result intensifies, and the marginal effect on the CARs became 0.211%. To finish the observations of the Table 5.1.2 (2), let us take a look at the control variables: size, ROA, R.D intensity and INST. At the event window $|CAR_{[+1,+180]}|$, the variable size was positively correlated to the CARs with a value of 0.206 with statistical significance at the 10% level. Then, the ROA around the for the model $|CAR_{[+1,+60]}|$ have a negative effect on CARs, i.e. 1% increase in ROA is expected to decrease the value of CARs by 0.694%. In addition, the log of R&D intensity and institutional ownership (INST) are statistically significant at event window $|CAR_{[+1,+60]}|$ at the 10% level, with a coefficient of -1.980 and 0.112 respectively. To sum up, these results are initially at odds with our hypothesis: indeed, for the medium term, the effect is slightly negative. However, in the second period, we have strong results that showed up at the long run for the model $|CAR_{[+1,+180]}|$, the companies having a better green score, had better results, that means better impact on CARs. This second part of the results partly confirms our hypothesis.

Some details should be added concerning these three regressions on CARs. If we put all these results together, our observation shows that the effect of greenwashing variable is only significant in the medium and long run as well as ESG performance. For the second general observation on the CARs for the 5 periods studied, we can say that the control variables that have the most impact are size statistically significant for $|CAR_{[-3+3]}|$, $|CAR_{[-5+5]}|$, and for green companies at $|CAR_{[1+180]}|$. However, the sign of the estimated coefficient is opposite to what we have expected in the short run, compared to the long run. The third observation is that the ROA is significant at 3 different occasions: $|CAR_{[-1+1]}|$, for companies that greenwash $|CAR_{[1+180]}|$, and those that do not engage in greenwashing $|CAR_{[1+60]}|$. All have negative correlation with the CARs.

Table 5.1.2 (2)
The relationship between green companies and stock market reaction (Long-term) :

	<i>Dependent variable:</i>	
	Car 1, 60	Car 1, 180
	(1)	(2)
Intercept	0.677** (0.292)	-1.799* (0.960)
Size	-0.055 (0.033)	0.206* (0.109)
ROA	-0.694*** (0.235)	-0.884 (0.773)
log(1 + volatility)	1.329 (1.211)	1.293 (3.989)
log(1 + R.D intensity)	-1.980* (1.083)	3.665 (3.566)
MTB	0.003 (0.003)	0.008 (0.011)
Lev	0.010 (0.009)	-0.043 (0.031)
INST	0.112* (0.060)	0.064 (0.199)
ESG performance score	0.0004** (0.007)	0.054** (0.023)
Greenscore	-0.041* (0.024)	0.211*** (0.079)
Industry fixed effect	Yes	Yes
Year fixed effect	Yes	Yes
Observations	86	86
R ²	0.459	0.357
Adjusted R ²	0.247	0.105
Residual Std. Error (df = 61)	0.094	0.309

Note: *p<0.1; **p<0.05; ***p<0.01

5.1.3 Hypothesis 3: Link between performance of the company, and greenwashing

Finally, we will develop the results of our hypothesis 3 which stated that there would be a positive relationship between performance and greenwashing, at the release year of the ESG report. We considered three models as labelled in Table 5.1.3: Model 1 (with only GW), Model 2 (with both FW and GW squared) and Model 3 (with only GW squared.)

The first thing we observe is the statistically significant impact of the greenwashing variable on the Tobin's Q at the 1% level: an increase of greenwashing level by one point was expected to increase the Tobin's Q by 0.155 point. To test the presence of possible non-linear relationship, we added the square of greenwashing variable to the model to have Model 2. We observe that the greenwashing remains significant but not the greenwashing squared. In Model 3 in Table 5.1.3 we put the greenwashing squared as GW variable and we observe that the result was significant. Although the squared term is statistically significant when included in

the model by itself without the linear term, its magnitude of its coefficient is very small. On this basis, we conclude that the relationship is most likely linear. This means that there is a linear relationship between greenwashing and our ratio of performance, Tobin's Q.

Furthermore, the overall ESG performance is positively significant at the 5% level. From Model 1 in Table 5.1.3, we find that companies that score 1 point higher in ESG performance is expected to have higher Tobin's Q value by 0.047 points, and similarly for Model 2 and 3 with the estimated coefficient being 0.045 and 0.043, respectively. For the control variables in our Model 1, we observe that size was negatively correlated to Tobin's Q and that volatility is positively correlated with it, both significant at the 5% significance level. In addition, ROA, $\log(1+R.D \text{ intensity})$ are positively correlated with Tobin's Q, with statistical significance at the 1% level: an increase of each by one point resulting in an increase of 5.305 and 11.014 points of Tobin's Q respectively. Model 1 (with only GW), Model 2 (with both FW and GW squared) and Model 3 (with only GW squared) have R^2 values that explain our model by 61.5%, 61.7% and 60.7% respectively, and a small residual sum of squares (RSS) of 0.936 for both. In brief, these results confirm our hypothesis that there is a positive correlation between company performance as measured by Tobin's Q and companies that greenwash.

Table 5.1.3 The relationship between greenwashing and companies' performance

	<i>Dependent variable:</i>		
	Only GW (1)	GW and GW ² (2)	only GW ² (3)
	tobinsq		
Intercept	1.363** (0.774)	1.418* (0.776)	1.376* (0.781)
Size	-0.240** (0.090)	-0.185** (0.091)	-0.179* (0.091)
ROA	5.305*** (0.562)	5.319*** (0.563)	5.334*** (0.567)
log(1 + volatility)	2.826** (1.211)	2.791** (1.211)	2.877** (1.219)
log(1 + R.D intensity)	11.004*** (1.926)	10.956*** (1.938)	11.083*** (1.950)
MTB	0.002 (0.001)	0.002 (0.001)	0.002 (0.001)
Lev	0.0002 (0.003)	0.0002 (0.003)	0.0002 (0.003)
INST	-0.004 (0.003)	-0.004 (0.003)	-0.005 (0.003)
Performance score ESG	0.047 ** (0.021)	0.045** (0.021)	0.043** (0.021)
ENV WEIGHT GW	0.155*** (0.038)	0.186*** (0.070)	–
ENV WEIGHT GW ²	–	-0.019 (0.018)	0.021** (0.010)
Industry fixed effect	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes
Observations	508	508	508
R ²	0.615	0.617	0.607
Adjusted R ²	0.594	0.594	0.552
Residual Std. Error	0.936 (df = 485)	0.936 (df = 485)	0.942 (df = 485)

Note:

*p<0.1; **p<0.05; ***p<0.01

5.2 Discussion:

For a better understanding of this section, we recommend that you refer to Table 5.2 while reading this section.

The first hypothesis we formulated in this paper was that markets react more positively to ESG reports that contain short-term greenwashing. This hypothesis had been constructed based on the investor reaction already studied by Du et al. (2017), Yu et al. (2020), and Serafeim & Yoon, (2021) to ESG reports. Indeed, they all found that markets react positively to ESG reports when they contain positive new content about their initiatives in ESG issue. We then considered that companies use greenwashing in their reports in order to improve the perception

of stakeholders, and that the detection of this phenomenon is very low in the short term. (Ruiz-Blanco et al., 2021 and Seele and Gatti).

On the one hand, our results do not follow the literature regarding the relationship between ESG performance and the CARs as we have no significant results that explain this relationship. In the short run, we also found no evidence that investors reacted differently to reports with greenwashing than to those without greenwashing. One thing that is important to note about the accuracy of short-term market reactions is that the reports were very unstructured; it was difficult to even get the exact date the report was released. And sometimes the release of the report in year T will come out 11 months later in year T_{+1} . And regarding the news on the release of the ESG report, some companies sent a clear signal, through a press release, however, for others we had no evidence of how they communicated with their stakeholders about their ESG report and therefore we could not be sure of the release date.

On the other hand, our results support studies that have claimed that greenwashing was not always observable. In other words, we claimed that investors did not differentiate in the short term between companies that practice greenwashing and those that did not. Detecting greenwashing by reading a report is, in fact, very complex. Indeed, in our sample for example 40% of the companies were considered green and 60% engaged in greenwashing. It happened that the first part of the sample made good scores and good reports, reports as good as the companies that engaged in greenwashing. As mentioned in the literature review, there is very little way to signal the accuracy of the report, and thus to detect those who are doing impression management from those who are honest (Huang & Huang, 2020).

To summarize, we cannot draw conclusions about the market reaction to greenwashing in the short term and distinguish between companies that do more greenwashing and those that do not.

Table 5.2 Summary of Key Results

Hypothesis	Key Findings	Hypotheses Supported ?
H1 GW and Stock Market Reaction (ST)	No significant relationship between GW and investor's behavior	No
H2a GW companies and Stock Market Reaction (MT,LT)	MT: GW positively affects the investor's behavior LT: No Significant Result	No No
H2b green companies and Stock Market Reaction (MT,LT)	MT: The green score negatively affects the investor's behavior LT: And then Green score positively affects the investor's behavior	No Yes
H3 GW and Performance	GW influences positively the firms' economic performance	Yes

For the formulation of hypothesis 2, we had split our sample in two, with a first group of green companies and a second group that greenwash. Then, following the research of X. Du (2015), we hypothesized that in the medium and long term, greenwashing companies are recognizable from the non-greenwashing ones thanks to the multiple analyses of NGOs, media exposure as well as the calculation of ESG performance. After that we assumed that green companies have neutral or positive stock reactions as they met or exceeded investors' expectations in terms of non-financial performance. And that greenwash companies do not meet market expectations and thus with a return effect on their CARs. By formulating these hypotheses with our two sub-samples, we contribute to the literature which, to our knowledge, has never studied the relationship between greenwashing and financial markets in the long term.

For Hypothesis 2a, we find that greenwash firms enjoy a slightly positive market reaction in the medium-term, which then becomes insignificant in the long term. These results don't support our hypothesis. However, companies with a higher green score had a slightly negative reaction in the medium-term. Afterwards, these results are mostly offset in the six-month post-reporting reaction, with a more positive response. Companies with a green score one point higher have an impact on CARs of 2.11%.

Hypothesis 2b is thus partially verified by our results in the long term. Here, we provide brand new evidence that firms respond in the long run to companies with better green score.

Finally, the analysis of Hypothesis 3 describes the relationship between firm economic performance and greenwashing. We observed firstly that ESG performance positively influences the financial performance of the firm but that greenwashing counterbalances this

effect. Indeed, when companies do greenwashing, their performance are even better. To analyze this relationship more closely, we added the R-squared, showing that the relationship was almost linear. Our results follow studies by Kim et al. (2015), who stated that better allocation of money in ESG not necessarily mean better performance, and Yi-Chun Chen (2018), who noted that investors support the costs of investing in ESG. We conclude that in our sample, firms engaged in greenwashing, had better financial performance in the reporting year. Looking at these analyses more broadly, we found two a positive relationships between green companies and long-term market reactions, as well as the relationship between firm financial performance and greenwashing. These two results therefore affect firm value, but they are contradictory. Indeed, companies with a better green score had easier access to capital, but conversely, when companies greenwash, they performed better.

As we can see on the appendix B, in our sample the phenomenon of greenwashing increased over time and as previous research claimed it increases the information asymmetry between the main stakeholders and the company. (Candelon et al., 2021) Greenwashing prevents investors, who are increasingly investing in ESG, from making well-informed decisions. Government should encourage companies to report because it gives them a broader understanding of ESG. But in regulating it because greenwashing is a phenomenon that creates a gap between the completeness of information provided by reports and the opinion that investors have of these reports. Furthermore, regarding the regression 3, our results did not indicate financial reasons for companies to stop greenwashing. To finish we have to remind that our results are based solely on US companies, for which the SEC is still discussing ESG reporting regulations (Grewal et al., 2021) .

6. Limitations of the thesis

In this section, we will explain in a broader framework where our thesis stands in the extant literature and what needs to be done to extend the present work. We also discuss a range of points that can improve the methodology employed in the thesis.

6.1 Broader studies

First of all, as we stated in the literature review, we have studied greenwashing based only on environmental issues. Therefore, we have not studied ESG-washing more broadly, including, as suggested by Ruiz-Blanco et al (2021), blue washing for social issues and black washing for governmental issues. Future research can complete our study taking into account these two others aspect of ESG issues. In our method, we have created a word library based on the environmental issue, it will be necessary to replace these words with those that allow to detect the phrases of social and governance. Moreover, for these last two themes, the literature has already provided some evidence. For example, the composition of a company's board affects greenwashing: indeed, more independent directors on the board and more female directors decrease the quality of ESG reports (Liao et al., 2015, Lagasion et al., 2019, Ming et al., 2015; Huang & Huang, 2020). Thewissen et al. (2022) show that some social topics are a value that investors are interested in with employee welfare and collaboration but the impact of SG-washing of these two topics has, in our knowledge, never been studied on CARs and performance. Studying them would give a better understanding of what is important to investors and see what it costs the company to invest in ESG. Concerning the performance, other ratio can be found to further strengthen these result, and it can be also analyzed on long term, using Tobin's Q for the time horizon $T_{+1\text{year}}$, $T_{+2\text{years}}$ and $T_{+5\text{years}}$.

Secondly, as far as the framework of our study is concerned, we only had a sample of large American companies listed in the S&P1500. It would be good to deepen this study and compare it with a panel of European and Chinese companies for example, which are much more advanced in terms of ESG regulation. And it would also be interesting to see how the results converge or diverge between these different institutional frameworks. Moreover, global awareness is not the same in the countries mentioned. (X. Du, 2015; Singhania & Saini, 2021) Note that Yu et al, (2020) have shown that the level of corruption of countries has an impact on ESG washing. In addition, the S&P 1500 represents only a panel of very large companies and as it requires a lot of resources to introduce ESG in the daily life of a company. It is

necessary to analyze, as Yu et al. (2020) already suggest, how small companies integrate ESG and whether they are more likely to resort to greenwashing in order to build their legitimacy and reputation.

For all of the above reasons, there is still much research to be done in order to gain a more comprehensive view of responsible investing today and the phenomenon of greenwashing that affects market information and firm value. We support Yu et al. (2020) who already claim, for this to happen, governments would have to provide regulation upon these reports as companies have little financial incentive to invest in ESG. As well as a global governance body to agree on common guidelines and provide a better understanding of ESG scores to further facilitate the reporting process. This will make the information regarding companies' real performance more accessible and comprehensive for investors and other stakeholders (Thewissen et al., 2022). These frameworks will also need to evolve as ESG issues change over time.

6.2 Methodology to improve

Although this paper advances the understanding of the value of false disclosure on the value of the company, there are some limitations in relation to the methodology employed that must be mentioned. At the beginning of our research, we received the file with the 1,875 OCR reports. We did not have any control over this, we sorted them according to their readability. As far as the other data is concerned, for the most part we have hand collected them. We did it carefully but due to the large amount of data sorted, there can be errors. For further work, having this process automated would alleviate these potential errors.

From a methodological point of view, studies on greenwashing and financial markets are very recent, and we do not yet have an optimal way to detect it. Indeed, it is a very abstract phenomenon. In this thesis, we tried to explain some facets of it. But it needs to be further developed. From a performance point of view, we use MSCI weight scores by industry, while there are a variety of sources to measure performance. Some studies use KLD, Bloomberg, Reuters, MSCI. More in-depth studies should analyze the difference between these scores. Regarding the CARs method, as already mentioned several times, ESG reports are very unstructured, it is difficult to get the dates of the releases and they do not all arrive at the same time of the year which makes it more difficult to research for comparability reasons. Some of them are announced by means of the press release while others, the only source we found are

the meta data of the pdf. Finally, the CARs themselves are not the most accurate, and additional analysis would be needed to calculate the market reaction like using cumulative abnormal trading volume or CAR adjusted as done by X. Du, (2015) and S. Du et al, (2017).

7. Conclusion

There were two objectives of this thesis:

1. To measure greenwashing through a large sample of ESG reports.
2. To analyze whether and how greenwashing affects firm value through market reactions around the release date of the report and performance.

To achieve these objectives, we started with an overview of the context of ESG issues, how ESG reporting works and the challenges that are related to it. We outlined the lack of regulation and structure which open doors for companies to mis-disclose. These mi-disclosures that we called greenwashing are made by companies in part to improve their reputation and to build their legitimacy to the stakeholders.

We then explained our methodology based on the wording keeping only the words that referred to environmental issues. For the rest of our model, we selected independent strong variables in order to isolate the effect of greenwashing on our two dependent variables, CARs representing the market reactions around the date of the reports and Tobin's Q, the performance ratio.

When we analyzed the results of our sample, we did not find significant results for the short-term market reaction. Thus, we cannot conclude that greenwashing influenced investors in the short term. This is not surprising given that investors do not know the difference between reports that are greenwashing and those that are not in the short run. The market is in fact composed of a number of companies that do not greenwash and can have a similar report that companies that greenwash.

For the medium and long-term stock market, we subsampled our sample into two groups, companies that engaged in greenwashing and companies that did not. We found that the markets reacted positively in the medium term to the companies that greenwash. However, in the long run, it was the opposite, and companies that did not greenwash enjoyed a stronger market reaction. Following previous research, we think that the market is better informed about companies that do not greenwash through the media, ESG rating agencies, and NGOs. It helps

investors to take more informed decisions and it can explain why we have a stronger significant effect at the long term. Last but not least, we point out a positive effect to greenwash on performance. These effects support theories that ESG investing is a cost for companies. Indeed, companies that do not invest as much as they reported benefit from better performance. This last result should be studied further over a longer time horizon, to see if this effect remains the same.

This study provides a better understanding of how markets and performance react to greenwashing. We support the other research on the importance of regulating these reports and improve their accuracy. Therefore, the Securities and Exchange Commission (SEC) should not wait to have a better understanding of how the market use ESG report, but regulate it. Regulating and structuring the ESG reporting will allow to really add value in understanding non-financial company initiatives.

Our analysis is subject to several limitations, as we we only examined greenwashing for environmental issues and our sample is only based on US companies from the SP1500. Future research should examine the mis-disclosures related to social and governance issues. It would be also interesting to extend this research at a larger sample of firms from different countries. Regarding the methodology used, we created our greenwashing score with the MSCI and Bloomberg performance scores, therefore other studies should consider comparing to other ESG ratings.

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9. Appendices

9.1 Appendix A

```
import pandas as pd
import os
import csv
import logging

filenames = os.listdir('/Users/Maud/Documents/pythonProject2/Thesis/data/Text_files')

total_score = []
qualitative_sentences = []
quantitative_sentences = []
currency_sentences = []
percentage_qualitative_sentences = []
percentage_quantitative_sentences = []
percentage_currency_sentences = []
sentences_count = []
final_percentages = []

words = ['material', 'materials', 'energy', 'energies', 'water', 'waters', 'biodiversity', '
emission', 'emissions',
'effluent', 'waste', 'wastage', 'climate', 'climates', 'compliance',
'transport', 'transportation', 'environment', 'environments', 'environmental',
environment_initiatives',
'environmental_assessment', 'recycling', 'recycle']

counter = 1
for file in filenames:
    logging.warning('Reading_file_{}'.format(counter))
    df = pd.read_csv('./data/Text_files/{}'.format(file), sep='\t', lineterminator='\n',
                    header=None,
                    encoding='unicode_escape', names=['Sentences'], quoting=csv.QUOTE_NONE)
    df['Sentences'] = df['Sentences'].str.lower()
    df2 = df[df["Sentences"].str.contains('|'.join(words), regex=True)]
    df3 = df2.copy()
    df3['Score'] = df2["Sentences"].map(lambda x:
                                        3 if "$" in x else
                                        3 if "dollar" in x else
                                        3 if "dollars" in x else
                                        3 if "_{euro}_-" in x else
                                        3 if "euro" in x else
                                        3 if "euros" in x else
                                        2 if "0" in x else
                                        2 if "1" in x else
                                        2 if "2" in x else
                                        2 if "3" in x else
                                        2 if "4" in x else
                                        2 if "5" in x else
                                        2 if "6" in x else
                                        2 if "7" in x else
                                        2 if "8" in x else
                                        2 if "9" in x else
                                        1)

    total_score.append(df3['Score'].sum())
    qualitative_sentence = (df3.Score.values == 1).sum()
    quantitative_sentence = (df3.Score.values == 2).sum()
    currency_sentence = (df3.Score.values == 3).sum()
    count = len(df3.index)
    qualitative_sentences.append(qualitative_sentence)
    quantitative_sentences.append(quantitative_sentence)
    currency_sentences.append(currency_sentence)
    sentences_count.append(count)
    percentage_qualitative_sentences.append(qualitative_sentence/count)
    percentage_quantitative_sentences.append(quantitative_sentence/count)
    percentage_currency_sentences.append(currency_sentence/count)
```

```

final_percentage = 0
try:
    final_percentage = (qualitative_sentence+quantitative_sentences*2+currency_sentence
                       *3)/(count*3)
except ZeroDivisionError:
    final_percentage = 0
final_percentages.append(final_percentage)
counter += 1
filename = file[:-4]
df3.to_csv('./Maud_files/{}.csv'.format(filename), index=False)

master_df = pd.DataFrame({'File_name': filenames,
                          'Total_Score': total_score,
                          'Sentences_Count': sentences_count,
                          'Qualitative_Sentences': qualitative_sentences,
                          'Quantitative_Sentences': quantitative_sentences,
                          'Currency_Sentences': currency_sentences,
                          '%Qualitative_Sentences': percentage_qualitative_sentences,
                          '%Quantitative_Sentences': percentage_quantitative_sentences,
                          '%Currency_Sentences': percentage_currency_sentences,
                          'Final_Percentage': final_percentages
                          })

print(master_df.info())
print(master_df.describe())
print(master_df.head())

master_df.to_csv('master_file.csv', index=False)

```

9.2 APPENDIX B

Table 4.2.1 Sample distribution by industry (1)

Industries	Numbers	%	Average score of GW
1. Aerospace components and Automobile components	22	4,3	0,3133
2. Chemicals	36	7,08	-0,1,6
3. Construction and Mining	44	8,67	-0,007
4. Energy, Utilities, oil and gas	95	18,7	-0,5672
5. Engineering (semi conductor)	27	5,31	-0,07
6. Health Care Equipment and Supplies	22	4,33	1,16
7. Industrial products and Consumer Discretionary	39	7,68	0,5334
8. Real state and Financial services	52	10,24	0,5367
9. Retail, Food and consumer staples	83	16,34	0,6327
10. Software and Services	20	3,94	1,19
11. Technology Hardware, Storage and Peripherals	20	3,94	1,035
12. Telecommunication services	8	1,57	1,756
13. Transportation	28	5,5	0,47
14. Wastes and Packaging	12	2,4	-0,49
15. Total	508	100	-

Table 4.2.1 Sample distribution by year (2)

Years	Numbers	%	Average score of GW
2015	67	13.18	-0,2506
2016	120	23.62	-0,44033
2017	115	22.63	0,0933
2018	123	24.21	0,06873
2019	75	14.76	0,05579
2020	8	1.6	0,1280
Total	508	100	-

9.3 Appendix C

Table 4.3.3 Summary Statistics Regression 1 (1)

Statistic	N	Mean	St. Dev.	Min	Max
Dependent variables					
Car - 1, +1	217	0.017	0.016	0.0001	0.107
Car - 3, +3	217	0.026	0.025	0.0002	0.174
Car - 5, +5	217	0.030	0.030	0.00001	0.183
Independent variables					
Size	217	8.409	0.516	7.184	9.742
ROA%	217	4.4	1.68	-2.14	5.819
MTB	217	8.218	44.808	0	446.498
Lev %	217	15.97	4.154	0	40.847
volatility%	217	2.9	3.2	0.007	3.6
R.D intensity%	217	2.2	1.6	0	30.5
INST%	217	52.33	20.676	0	99.990
Global ESG score	217	4.3	2.4	0.2	9.7
Weight ESG score	217	4.2	1.2	0.3	10.000

Table 4.3.3 Summary Statistics Regression 2a (2)

Statistic	N	Mean	St. Dev.	Min	Max
Dependent variables					
Car + 1, +60	130	0.098	0.090	0.001	0.450
Car + 1, +180	130	0.221	0.209	0.001	1.036
Independent variables					
Size	130	8.462	0.517	7.319	9.742
ROA%	130	0.075	0.063	-0.138	0.219
MTB	130	11.372	57.661	0	446.498
Lev%	130	1.722	5.227	0	40.847
volatility%	130	0.029	0.028	0.009	0.191
R.D Intensity%	130	0.024	0.043	0	0.257
INST%	130	0.424	0.209	0.000	0.920
Global ESG score	130	5.341	2.350	0.2	10.000
Weight ESG score	130	1.089	0.798	0.3	3.941

Table 4.3.3 : Summary Statistics Regression 2b (3)

Statistic	N	Mean	St. Dev.	Min	Max
Dependent variables					
Car + 1, +60	86	0.121	0.108	0.005	0.455
Car + 1, +180	86	0.248	0.213	0.002	0.881
Independent variables					
Size	86	8.334	0.509	7.184	9.415
ROA%	86	0.040	0.069	-0.214	0.207
MTB	86	3.504	4.275	0	25.488
Lev%	86	1.169	1.479	0	7.324
volatility%	86	0.030	0.028	0.007	0.139
R.D Intensity	86	0.019	0.049	0	0.305
INST%	86	0.469	0.192	0	1.000
Global ESG score	86	5.062	1.849	0.300	9.000
Green score	86	1.213	0.795	0.020	2.846

Table 4.3.3 Summary Statistics Regression 3 (4)

Statistic	N	Mean	St. Dev.	Min	Max
Dependent variable					
Tobin.s.q	508	1.493	1.259	0.000	8.901
Independent variables					
Size	508	8.255	0.543	7.108	9.742
ROA%	508	5.5	8.9	-8.46	6.48
MTB	508	5.739	32.662	0	446.498
Lev%	508	19.4	16.185	0	40.847
volatility%	508	3.5	4.4	0.007	3.6
R.D intensity%	508	1.9	3.7	0	30.05
INST%	508	44.09	23.33	0	99.990
Global ESG score	508	4.9	2.28	0.2	9.7
Weight ESG score	508	4.595	1.314	0.3	10.000

9.4 Appendix D

Table 4.3.4 Pearson's Correlation Matrix (1)

CORR	Size	ROA	MTB	Lev	volatility	R&D	INST	ES perf score	GW	Car -1, +1	Car -3, +3	Car -5, +5	Car +1, +60	Car +1, +180
Size	1	0,1303	0,1192	0,1126	-0,0859	-0,1524	-0,0642	0,0875	0,0932	-0,1361	-0,1614	-0,1673	-0,1443	-0,1249
ROA	0,1303	1	0,0972	0,0423	-0,1751	-0,1566	-0,0445	0,0325	0,2207	-0,2662	-0,1140	-0,1385	-0,2182	-0,2507
MTB	0,1192	0,0972	1	0,3974	-0,0629	0,0076	0,0147	0,0282	0,0511	0,0147	0,0214	0,0320	0,0287	-0,0099
Lev	0,1126	0,0423	0,3974	1	-0,1214	-0,0742	0,0118	0,0454	0,0242	0,0131	0,0285	-0,0083	0,0363	-0,0189
volatility	-0,0859	-0,1751	-0,0629	-0,1214	1	0,3439	0,0172	-0,0329	0,0807	0,1755	0,0876	0,2224	0,1374	0,1335
R&D	-0,1524	-0,1566	0,0076	-0,0742	0,3439	1	0,0213	0,0702	0,0801	0,0977	0,0264	0,2512	0,1009	0,1298
INST	-0,0642	-0,0445	0,0147	0,0118	0,0172	0,0213	1	-0,0056	-0,1607	-0,0081	0,0606	0,0619	0,0662	0,0228
ESG perf sc	0,0875	0,0325	0,0282	0,0454	-0,0329	0,0702	-0,0056	1	-0,0719	-0,0410	-0,0947	-0,1045	-0,0375	-0,0208
GW	0,0932	0,2207	0,0511	0,0242	0,0807	0,0801	-0,1607	-0,0719	1	-0,0538	-0,0593	0,0184	0,0115	-0,0318
Car -1, +1	-0,1361	-0,2662	0,0147	0,0131	0,1755	0,0977	-0,0081	-0,0410	-0,0538	1				
Car -3, +3	-0,1614	-0,1140	0,0214	0,0285	0,0876	0,0264	0,0606	-0,0947	-0,0593		1			
Car -5, +5	-0,1673	-0,1385	0,0320	-0,0083	0,2224	0,2512	0,0619	-0,1045	0,0184			1		
Car +1, +60	-0,1443	-0,2182	0,0287	0,0363	0,1374	0,1009	0,0662	-0,0375	0,0115				1	
Car +1, +180	-0,1249	-0,2507	-0,0099	-0,0189	0,1335	0,1298	0,0228	-0,0208	-0,0318					1

Table 4.3.4 Pearson's Correlation Matrix (2)

CORR	tobin's q	Size	ROA	MTB	Lev	volatility	R&D	INST	ESG Perf sc	GW
tobin's q	1	-0,1581	0,4267	0,0849	0,0124	0,041	0,3302	-0,14	0,2232	0,3277
Size	-0,1581	1	0,0195	0,0686	0,0641	-0,1667	-0,0967	0,0987	0,1501	0,0877
ROA	0,4267	0,0195	1	0,0884	0,0727	-0,03	0,0261	-0,0734	0,1338	0,211
MTB	0,0849	0,0686	0,0884	1	0,3859	-0,0684	0,0027	-0,0417	0,0765	0,0658
Lev	0,0124	0,0641	0,0727	0,3859	1	-0,0885	-0,0833	-0,0311	0,0596	0,0363
volatility	0,041	-0,1667	-0,03	-0,0684	-0,0885	1	0,3832	-0,0043	-0,1599	-0,04235
R&D	0,3302	-0,0967	0,0261	0,0027	-0,0833	0,3832	1	-0,0123	0,1391	0,0769
INST	-0,14	0,0987	-0,0734	-0,0417	-0,0311	-0,0043	-0,0123	1	-0,0877	-0,07689
ESG perf sc	0,2232	0,1501	0,1338	0,0765	0,0596	-0,1599	0,1391	-0,0877	1	-0,078965
GW	0,3277	0,0877	0,211	0,0658	0,0363	-0,04235	0,0769	-0,07689	-0,078965	1