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Is greenwashing relevant information for investors?

An event study of corporate greenwashing and stock market reactions

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This thesis marks the conclusion of the Master of Science in Economics and Business Administration at the Norwegian School of Economics (NHH). It is written by two students majoring in Financial Economics, both of whom have an interest in green finance, ESG and related topics. Greenwashing is as such an area we wanted to explore in this thesis, and more specifically how it is incorporated into financial markets and asset pricing.

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Abstract

The understandings and frequencies of climate change adversities have increased dramatically in the last decades. As a result, firms are under pressure from stakeholders to improve their environmental performance. However, some firms are opting to take shortcuts in the form of corporate greenwashing. This thesis investigates whether the exposure of corporate greenwashing leads to abnormal stock returns, and studies relationships between the abnormal returns and firm characteristics. We also discuss the concept of greenwashing, specifically its definitions, history, drivers, and future.

Using an event study methodology, we define the events to be the day of publication for an article in a major news outlet that exposes firms for greenwashing. From a sample of 44 greenwashing firms from 2015-2022, we find that the exposure of greenwashing is associated with significant negative abnormal returns for some event windows. In particular, the event window [0,2] shows abnormal returns of -1.376% and is significant at the 1% level. The evidence shows that investors react negatively to the exposure of greenwashing. We argue that the reactions might come from the notion that environmental performance is regarded as valuable, or that investors have a disregard for cheaters. We also apply OLS regressions on the cumulative abnormal returns (CAR) and firm characteristics, to find that CAR is significantly related to firm size, industry, and environmental score. The results for the cross-sectional regressions are subject to model specifications and varies across event windows.

Keywords – Greenwashing, ESG, Climate Change, Financial Markets, Stock Returns, Event Study

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1 Introduction

As companies around the world commit to being carbon-neutral, some are struggling to follow up on their commitments. Whether their struggles are deliberate or not can in some cases be difficult to assess, but the rising cases of corporate greenwashing has raised concerns in regards to the sincerity of these commitments. The lack of harmony between pledges and actions is creating difficult environments for stakeholders to navigate, including investors. Simultaneously, the investing environment is shifting, reflected through the sustainable investing trend in the last decade (Blackrock, 2021). The trend could be described as investing in businesses that perform well, or are expected to perform well along some sustainable dimension. In some ways it reflects sustainability becoming a more integral part of the decision-making of financial players, and consequently increased attentiveness towards environmental disclosure. Indeed, the investors are also dependent on the disclosure being accurate, in order to make well-informed decisions. How, then, do investors react when it becomes evident that the public discourse from companies does not match their underlying operations and efforts with regards to the environment? Do they even react at all?

This thesis aims to examine the effects of greenwashing on stock prices. The relationship is studied through the event study methodology using a sample of 44 greenwashing events spanning from 2015-2022. From our analysis, we find that the exposure of greenwashing is associated with negative market reactions. We argue that investors' negative reactions could come from expectations that environmental initiatives lead to better handling of risks or cost reductions. Further, we suggest that it could represent a drop in demand due to sustainable funds having to exclude the stocks from their portfolios, or that investors value cheating negatively. Through OLS regressions, we also provide weak evidence of relationships between particular firm characteristics and the cumulative abnormal returns, namely the environmental scores, sizes and industries of firms. As we point out, the results are sensitive to model specifications, only valid in certain event windows and to a degree driven by one influential observation.

The thesis is structured as follows: Section 2 covers the concept of greenwashing. Section 3 reviews relevant literature before these are used to formulate our hypotheses in Section

4. How we select and handle our data is found in Section 5, while the methodology of our study is explained in Section 6. Then, we present our results in Section 7, before discussing potential limitations and offer suggestions for future research in Section 8. Lastly, we give our concluding remarks in Section 9.

2 Background

This section presents background information on topics that are relevant to the thesis. First, we briefly cover climate change and the subsequent emergence of ESG[1] in business. Second, we cover corporate greenwashing in Section 2.2.

2.1 Climate Change and ESG

"We've been warning about climate change[2] for 50 years or so" stated Klaus Hasselmann in a response interview for his Nobel Prize in Physics (Nobel Prize, 2022). The German physicist received the award for his work on the physical modelling of the Earth's climate, quantifying variability and reliably predicting global warming. Despite continuous warnings from climate scientists like Hasselmann, efforts to combat climate change remained low for decades.

According to IPCC[3], human activities dating back to the 18th century's industrial revolution have accelerated climate changes and increased the average global temperatures (Pachauri et al., 2014). This issue was recognized at the First World Climate Conference (FWCC) in 1979, where they encouraged nations to (a) take full advantage of man's present knowledge of climate, (b) take steps to improve significantly that knowledge and (c) to foresee and prevent man-made changes in climate that might be adverse to the well-being of humanity (John W. Zillman, 2009). Since then, the adversities from climate change have been studied, and one of the most prominent discoveries is the increased frequency of extreme weather events. In 2012 the IPCC wrote: "A changing climate leads to changes in the frequency, intensity, spatial extent, duration, and timing of extreme weather and climate events, and can result in unprecedented extreme weather and climate events". The frequencies of global natural disasters between 1970-2014 are displayed in Figure 2.1, and events like these are not without socioeconomic costs. The EM-DAT[4] shows that in the period from 2000-2015, over a million people have died due to natural

[1] ESG stands for Environmental, Social and Governance.

[2] Climate change refers to long-term shifts in temperatures and weather patterns (United Nations, nd).

[3] IPCC stands for Intergovernmental Panel on Climate Change.

[4] EM-DAT is the Emergency Event Database of the Center for Research on the Epidemiology of Disasters.

disasters, and the costs of those disasters to be $1.7 trillion (Thomas, 2017). Still, it was not until 2015 that climate change reached the top of the political agenda with the signing of the Paris Agreement. Here, countries committed to limit global warming to below 2, preferably to 1.5 degrees Celsius (UNFCCC, nd). One can only speculate as to why it has not been done sooner, given that the FWCC was held in 1979, but Figure 2.1 might provide some insight. Indeed, there has been significant development in explaining climate change and potential risks related to that since 1979, but the extreme weather events have also been brought to places where they perhaps previously have been deemed insignificant. Floods in Germany, forest fires in the United States and heatwaves across central Europe to name a few[5]. Again, it calls for speculation, but it seems as though a global issue is not really an issue until it becomes local. Incidentally, the Paris Agreement (and climate change in general) also has implications for business, but what exactly is the role of businesses when it comes to climate change?

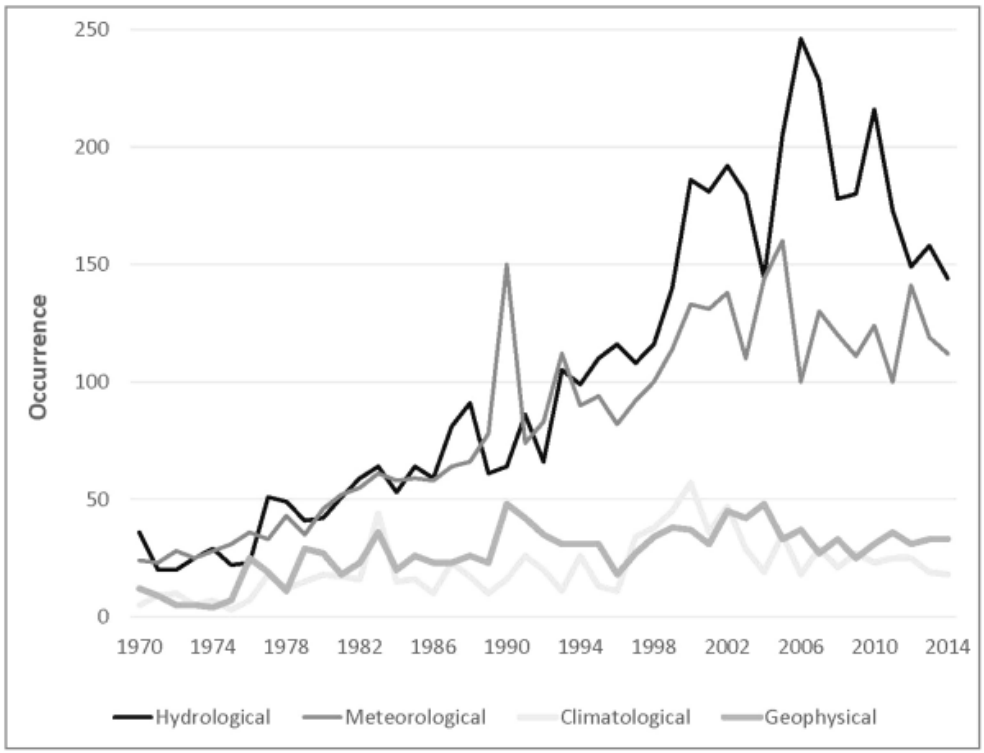

Figure 2.1: Global Frequency of Natural Disasters by Type, 1970-2014
Source: (Thomas, 2017)

[5]As Friederike Otto, the associate director of the Environmental Change Institute at the University of Oxford stated: "These floods have shown us that even developed countries are not safe from severe impacts of extreme weather that we have seen and known to get worse with climate change (Angela Dewan, 2021).

The American economist Milton Friedman famously stated that "the social responsibility of business is to increase its profits", arguing that businesses should have no social responsibility other than delivering profits to their shareholders (Milton Friedman, 1970). Driven by the increased attention towards climate change, the consensus on the matter has progressed from Friedman's doctrine, and the term Corporate Social Responsibility (CSR) has largely been substituted by Environmental, Social and Governance (ESG). Incorporating ESG into business is the exact opposite of what Friedman advocated; namely to have a more holistic approach to business that extends beyond the profits of shareholders. With regards to the environment, businesses are increasingly committing to reaching net zero[6] by 2050 and expanding their environmental initiatives (Andrew Winston, 2021). In some cases the initiatives are voluntary, and in others they are forced by regulators. The European Trading System (ETS) scheme is an example of the latter, where certain firms[7] are required to cover their greenhouse gas emissions through emission contracts. Compulsory initiatives are in some instances necessary as it partly addresses the free-rider problem. The problem often occurs when dealing with a public good similar to the environment; that some agents are unwilling to contribute to improvements, as they can still enjoy the full benefits of the improvements delivered by other agents. However, in the spirit of Adam Smith, doing environmental initiatives might be more in businesses' self-interest now than ever due to green consumerism. In 2021, GreenPrint found that 75% of millennials are willing to pay a premium for environmentally friendly products (Business Wire, 2021). Thus, if long term demands are governed by environmental friendliness, profits may be synonymous with ESG, and followers of Friedman's doctrine would have to consider ESG in order to deliver profits.

2.2 Greenwashing

When companies are committing to environmental initiatives, be they voluntary or involuntary, they can sometimes fall short of their ambitions. Their shortcomings could be intentional or unintentional, but either way, the firms could be accused of greenwashing.

[6]To achieve a state where the business does not add incremental greenhouse gases to the atmosphere.
[7]The system covers around 40 percent of emissions in the EU (The European Commission, 2021).

2.2.1 Definitions and History

The term greenwashing was first introduced in 1986 by environmentalist Jay Westerwelt. He used the term in his essay on promoting towel reuse in the hospitality industry (Pearson, 2010), claiming that it was not an environmental measure, but rather a cost-saving strategy. Therefore, he pointed out, customers were mislead by inaccurate advertising and promoting.

Greenwashing is a broad and nuanced term that encompasses a variety of subsets, and hence the concept is defined differently by various sources. Webster´s New Millenium Dictionary of English defines greenwashing as: "Expressions of environmentalist concerns especially as a cover for products, policies or activities" (Merriam-Webster, 2022) while the Concise Oxford English Dictionary defines it as: "Disinformation disseminated by an organization so as to present an environmentally responsible public image; a public image of environmental responsibility promulgated by or for an organization, etc., but perceived as being unfounded or intentionally misleading" (Oxford English Dictionary, 2022).

Several studies considers greenwashing as a form of selective disclosure. Delmas and Burbano (2011) define greenwashing as: "Poor environmental performance and positive communication about environmental performance". The authors describe the two main behaviours that greenwashing firms do simultaneously: they retain the disclosure of bad information that is tied to the firm's environmental performance and they publish positive information about the environmental performance (Netto et al., 2020). Another definition was offered by the former leading North American environmental marketing company, TerraChoice: "The act of misleading consumers regarding the environmental practises of a company or the environmental performance and positive communication about environmental performance" (TerraChoice, 2010). Although the definitions are widespread and numerous, there are some reoccurring themes. Specifically, that firms are (1) trying to give a wrongful impression of their environmental activities (a form of deception), and that they are (2) doing so with intent. Naturally, proving that information is wrong is far less problematic than proving intent, which is why the former is the main focus when claiming greenwashing in practice. It should be noted that the responsibility of firms to provide accurate information should outweigh any reason as to why they fail to do so. One could therefore argue that greenwashing as a concept exists regardless of how it is performed; whether it is with intent, ignorance or some other measure.

Delmas and Burbano (2011) categorize firms into four different categories based on their environmental performance and how the firms communicate about the performance. The four categories are: vocal brown firms, vocal green firms, silent brown firms and silent green firms. It is when the brown firms (poor environmental performers) are vocal, and positively communicate about their performance, that they can be classified as "greenwashing" firms. A matrix showing the typology is presented in Figure 2.2.

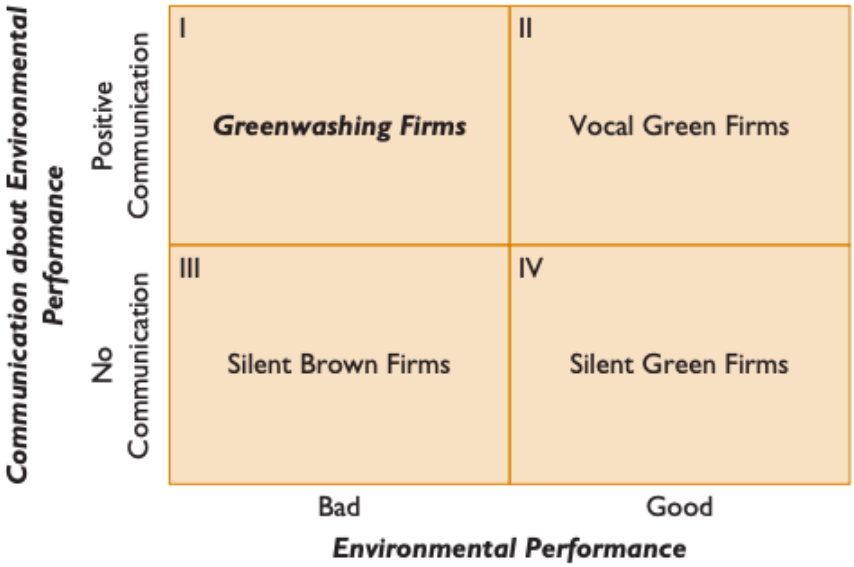

Figure 2.2: Firm Typology Based on Environmental Performance and Communication
Source: (Delmas and Burbano, 2011)

Firms can move across quadrants by either changing their environmental performance or their communication of said performance. A vocal green firm can for instance alter their performance (negatively) and thus become a greenwashing firm.

2.2.2 Forms of Corporate Greenwashing

As previously mentioned, greenwashing exists in many different forms, and Netto et al. (2020) find two major classifications of greenwashing: Claim greenwashing and Executional greenwashing. Both of the classifications can be done at either the firm- or product/service-level. It happens at the firm-level when firms mislead consumers regarding the environmental practices of the firm, and at the product-level when consumers are mislead regarding the environmental benefits of a product. Studies on the topic of greenwashing mainly focus on Claim greenwashing at the firm- and product/service-level, as it is the most common form of greenwashing. Figure 2.3 illustrates the two major

classifications of greenwashing.

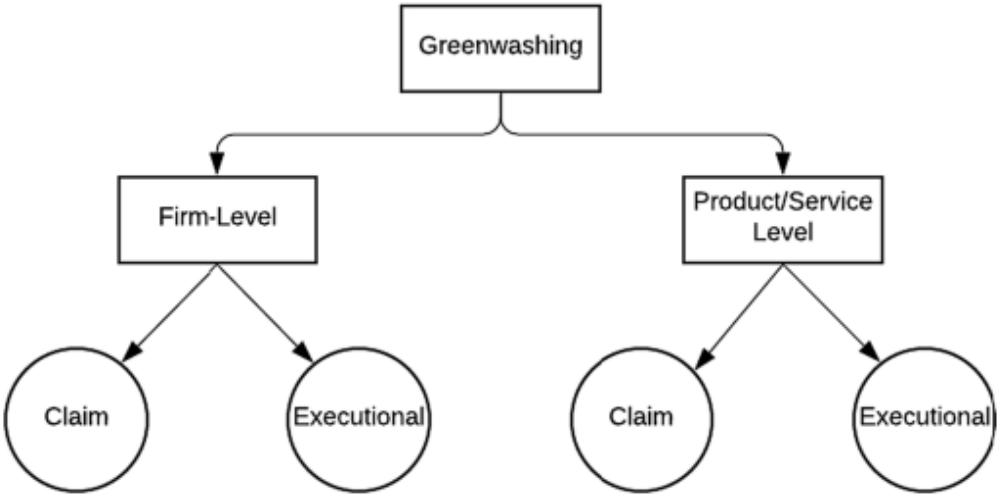

Figure 2.3: Major Classifications of Greenwashing
Source: (Netto et al., 2020)

Claim greenwashing is when firms use textual arguments to create a misleading environmental claim (Netto et al., 2020). They include making false statements, omitting clarifying information or using vague language. One could argue that generic statements like "Environmentally friendly" are vague and misleading when given in isolation. Consumers, then, risk accepting statements such as these as facts, without recognizing how the firms/products are (or are not) environmentally friendly. To help mitigate these risks, TerraChoice, an environmental firm, created a classification called "The seven sins of Greenwashing". The classification helps consumers identify common ways in which companies can mislead them with regards to environmental claims. According to Delmas and Burbano (2011), the seven sins are examples of Claim greenwashing at the product-level. They consist of:

1. The sin of hidden trade-off:

   A claim suggesting that a product or service is environmentally friendly based on a very narrow set of attributes, while neglecting other environmental issues related to the product or service. An example could be building new facilities for hydropower. While hydropower is considered environmentally friendly relative to for instance oil, building the damns and reservoirs can have profound negative effects on the

environment[8].

2. The sin of no proof:

   An environmental claim that can not be backed up by evidence or a third-party. In our sample (that we will discuss further in Section 5), we included an instance of when Ryanair was exposed for claiming that they had the lowest CO_2 pollution of any major airline (Mark Sweney, 2020). The Advertising Standards Authority, however, found the evidence provided by Ryanair lacking and inconclusive.

3. The sin of vagueness:

   Environmental claims that are poorly defined and lacking in specifics. Consider for example the concept of "biodegradable" products. Many products might be biodegradable, suggesting that they have little to no environmental impact. However, the time it takes for products to break down in nature varies significantly, and it does not guarantee that the product will not harm the environment either.

4. The sin of worshipping false labels:

   Creation of false certification processes or labels to mislead consumers into thinking a product or service is green. Typically, environmental certifications for products (e.g. The Nordic Swan Ecolabel) is given by a third-party. When companies create their own, however, the criteria used for the labels might be obscure or not expressed clearly.

5. The sin of irrelevance:

   Environmental claims that are unimportant, unhelpful or emphasizes unrelated environmental issues. TerraChoice (2010) gives the example of companies claiming that their products are "CFC-free[9]", even though they are illegal.

6. The sin of lesser of two evils:

   Environmental claims that may be true within a product category, but distracts the consumer from environmental issues concerning the whole category. Again, using an example from our sample, the Italian energy company Eni was exposed for claiming that their Diesel+ fuel significantly contributed to reducing greenhouse gas emissions (Petroni, Giulia, 2020). While this might be true when compared to other diesel

[8]E.g. emissions related to manufacturing and changes in the ecosystem (EIA, 2021).
[9]CFC stands for chlorofluorocarbons.

fuels, diesel in itself is not environmentally friendly.

7. The sin of fibbing:
   Environmental claims that simply are false. The Volkswagen case in 2015 is a fitting example of fibbing. While running a marketing campaign claiming environmental benefits, their vehicles had installed software that allowed for cheating emission tests (Rupert Neate, 2015). It turned out that the environmental benefits were in fact not present when the vehicles were rolled out to customers.

Parguel et al. (2015) introduces a new classification of greenwashing, namely Executional Greenwashing. Contrary to Claim greenwashing, this form does not use any textual arguments and claims in order to mislead consumers. Executional greenwashing instead uses nature-evoking elements like pictures combined with special colours and sounds. Examples of Executional greenwashing is the use of backgrounds such as natural landscapes, pictures of endangered animals and renewable energy sources (Netto et al., 2020). While it may seem innocent, the usage of nature-evoking elements in adverts may mislead consumers in regards to their impressions of firms' environmental friendliness.

2.2.3 Drivers

Understanding why firms resort to greenwashing can aid stakeholders in creating an environment in which greenwashing becomes less desirable. The underlying drivers of greenwashing can, according to Delmas and Burbano (2011), be categorized as follows: Non-market external drivers, Market external drivers, Organizational drivers and Individual psychological drivers.

Non-market external drivers of greenwashing consist of "Lax and uncertain regulatory environment" and "Activists, NGO´s and media monitoring" (Delmas and Burbano, 2011). Regulation of environmental claims by the government is very limited in several countries, and the enforcement of these regulations is inconsistent, making firms uncertain whether their environmental claims will result in charges (Delmas and Burbano, 2011). The uncertainty of regulation is especially complicated for multinational corporations. These firms experience variations in regulation across countries and complexity relating to which practices are legal for different countries' regulations. With limited regulation of

greenwashing and uncertainty about enforcement, activist groups, and NGO´s have an important role together with the media to put pressure on and expose greenwashing firms. We will elaborate further on the governing role of media in Section 5.1.

Market external drivers are factors that affect the way firms communicate about their environmental performance, and consist of consumer demand, investor demand and competitive pressure (Delmas and Burbano, 2011). Indeed, such demands can guide and force the behaviour of firms, and especially brown firms experience pressure from these sources to become environmentally friendly. One could also argue that the communication given from brown firms is tied to the level of pressure exerted by stakeholders, that high pressure levels increases the probability of greenwashing, and vice versa. In addition to pressure from stakeholders, Delmas and Burbano (2011) argues that the competition in the market could affect how firms communicate about their environmental performance. Firms tend to imitate the practices of more successful and legitimate firms in the same industry; "industry leaders", per se. Research shows that this is true for green practices as well (Delmas and Toffel, 2008). Thus, brown firms might communicate positively about their environmental practices in order to keep up with competitors that already have started implementing green practices.

Organizational drivers consist of firm characteristics, incentive structures and corporate culture (Delmas and Burbano, 2011). Firm characteristics like profitability and size can influence whether firms greenwash or not. Large firms for instance, naturally receive more media attention, pressure from investors/consumers and scrutiny from regulators than smaller firms. Thus, the characteristics of firms might provide insight into the level of pressure experienced from external market drivers. How firm characteristics and greenwashing can relate will further be discussed in 6.3.1. Similar to external pressure, internal pressure created from incentive structures can also have an impact on the greenwashing "decision". The goals of firms, such as financial goals and marketing goals, could result in greenwashing if greenwashing can contribute to reaching those goals. Lastly, the corporate culture can influence the action of greenwashing. For instance, having decent standards of conduct and ethics codes can help prevent greenwashing (Delmas and Burbano, 2011).

Individual psychological drivers are linked to the individuals in firms, and consist of narrow

decision framing and optimistic bias (Delmas and Burbano, 2011). They describe ways in which leaders and individuals can shape firm behaviour. Narrow decision framing speaks to the tendency of making decisions while losing sight of the bigger picture. It can happen when a firm (by the power of an individual) focuses on the potential short-term gains of greenwashing, but forget to factor in potential long-term effects such as reputational damage. Optimistic bias, on the other hand, is the tendency of overestimating the probability of positive events and underestimating the probability of negative events. Firms may overestimate the probability of good results from greenwashing, such as increased capital from green investors. Conversely, they might underestimate the probability of bad results such as being caught by government regulations, negative media attention, and litigation from consumers (Delmas and Burbano, 2011).

Ultimately, the drivers mentioned are important individually, but they are also highly intertwined. For instance, laxity in regulation can breed laxity in corporate cultures, and cause firms and decision-makers to greenwash. While most of the discussions above have covered how firms might be tempted or driven to greenwash, neither of the drivers should be viewed as having a one-way effect. For instance, firm characteristics such as being a large-sized firm, are given as examples of factors that can influence a firm to greenwash. However, being a large firm can also help prevent greenwashing, if one assumes larger firms to have stricter ethical codes and are more worried about scrutiny from stakeholders than smaller firms.

2.2.4 Future

As Mark Twain once put it: "Prediction is difficult - particularly when it involves the future", which is why we will be brief when discussing it. When it comes to greenwashing, predicting how it will develop is difficult, but there are some trends worth noting. The trends of sustainable investing and green consumerism mentioned previously are factors that can influence firms and their decisions with regards to the environment, both in terms of performance and communication. Several measures have also been implemented from a regulatory standpoint, like the Green Claims Code from The Competition and Markets Authority (CMA) implemented in 2021 (Competition and Markets Authority, 2021). The code helps businesses understand how to communicate their green claims without misleading consumers, and the CMA also communicated that they are increasing

regulations of misleading environmental claims in 2022. In the US, the Securities and Exchange Commission (SEC) has prepared rules that would require investment funds to explain the ESG standards used to classify funds and products. The SEC is also moving towards imposing rules that will require companies to reveal their direct greenhouse gas emissions and have them verified by a third party (Temple-West, Patrick and Palma, Stefania, 2022). Lastly, it is reasonable to expect that environmental disclosure and reporting will develop in a similar fashion to what financial data has done in the last 50 years. This includes more transparency, more available data and better standards for reporting. As a result, firms might find it harder to perform greenwashing in the future. When approaching 2050, the target year for reaching net zero global emissions, it would be reasonable to assume that trends like the ones mentioned will continue to grow.

3 Literature Review

In this section we present relevant literature and theories. Our thesis aims to find a relationship between the exposure of greenwashing and stock returns. Existing literature on this topic is therefore highly relevant. However, little research has been done to study this relationship, so we also include literature covering other ESG related research that we deem relevant. Lastly, the efficient market hypothesis is included as we are examining whether or not the exposure of greenwashing contains new and relevant information for investors. The literature presented serves as a foundation for our hypotheses, as described in Section 4.

3.1 Environmental Announcements

Du (2015) is a study examining the Chinese market's reaction to greenwashing. In his study, Du uses an event study methodology to study the effect on cumulative abnormal returns (CAR) for 14 Chinese listed firms that were exposed for greenwashing. He finds that greenwashing has a negative effect on CAR that is statistically significant. Further, he finds that certain firm characteristics have significant impact on CAR. One such characteristic is the environmental score, which has a significantly positive effect on CAR. As such, he finds that the Chinese market disfavors greenwashing, and leads to lower valuations for firms that are exposed for doing so. This is congruent with the arguments given by Flammer (2013). Given that Du hand-collected events from the *South Weekend* newspaper, it also indicates that the media plays an important role in exposing such firms, and subsequently affecting investor behavior.

Jacobs et al. (2010) investigates the effects of announcements of environmental perfomance on stock market reactions. The study is conducted on announcements from 2004-2006 and is divided into two subcategories. The first of which is Corporate Environmental Initiatives (CEIs) and includes 417 announcements. The CEIs are efforts to mitigate, avoid or offset the environmental footprint of a company's activities. These efforts are self-reported, as opposed to the second category of announcements, which is Environmental Awards and Certifications (EACs) given by third-parties for environmental performance. The category consists of 363 EACs. The authors does not find significant market reactions when looking

at the aggregated CEI and EAC announcements, but only for certain subcategories. The subcategories with significant market reactions include voluntary emission reductions (negative), ISO14001 certifications[10] (positive) and philanthropic gifts for environmental causes (positive).

Flammer (2013) studies whether shareholders are sensitive to the environmental footprint of corporations. She performs an event study on environmental corporate news announcements for US listed firms from 1980 to 2009. In the study she finds that environmentally responsible companies have a significant stock price increase, while firms reported to behave irresponsibly towards the environment experience a significant decrease. In addition, she argues that due to the increase in external pressure to behave towards the environment, environmental wrongdoers are more heavily punished in the stock market than environmental- friendly initiatives are rewarded.

Krüger (2015) examines how stock markets react to positive and negative news concerned with the CSR of firms. In his event study, he uses 2116 corporate events with either positive or negative implications for stakeholders. The main finding is that investors react strongly negative to negative events and weakly negative to positive events. He concludes that the findings points to CSR being in the shareholders' best interest. However, it does not account for the costs of policies that would have prevented the events to occur in the first place.

In an event study, Laplante and Lanoie (1994) analyse the stock price reactions of 47 Canadian firms between 1982 and 1991 to environmental news. Their results showed no abnormal returns the day after the announcements of negative environmental incidents. They point out that firms with suit settlements related to environmental incidents suffer significant abnormal losses of -2.7%, but also that returns of -1.2% were observed the day after firms announced they would invest in anti-pollution equipment.

Another type of environmental event, is a firms' inclusion in a sustainability index. Roca et al. (2013) studied stocks in the Asia Pacific market and the impact on returns from being added to the Dow Jones Sustainability World Index (DJSWI). Their main finding is that being included in the index, results in significant negative returns. Thus, investors

[10]The ISO14001 certification is a highly regarded standard for environmental management systems, and involves implementing an EMS that is audited by an ISO-approved auditor (Gregory Barnes, nd).

in the Asia Pacific markets view sustainability as costly, and not something that adds value to the firm. A more detailed explanation is given by the authors through their "sustainability redundancy hypothesis", which argues that selecting stocks on the basis of corporate sustainability imposes constraints on portfolios[11].

3.2 ESG and Firm Performance

Bragdon and Marlin (1972) studied the relationship between environmental performance and the financial performance of firms. More specifically they examined whether the profitability of a firm was tied to its pollution. The focus of the paper was the pulp and paper industry in the US, an industry known for vast amounts of water and air pollution. Bragdon and Marlin found that firms with lower pollution also had higher profitability. They concluded that abatement could lead to lower labour costs, specifically from reducing health insurance premiums for their employees.

Ambec and Lanoie (2008) investigate the relationship between a company's environmental performance and its economic or financial performance. They review empirical evidence to analyze the mechanisms involved in potential revenue increases and cost reductions which can be achieved by better environmental practices. They find that the costs of pollution control can be offset by gains elsewhere (e.g. by better access to markets or differentiated products). Increased environmental perfomance is therefore associated with gains in a firms' financial performance according to the authors.

Friede et al. (2015) performs a meta-analysis on around 2200 empirical studies relating to ESG and financial performance. Their results show that ESG investing is empirically well founded, with approximately 90% of the studies finding a non-negative relationship between ESG and corporate financial performance. They also find the majority (however not all) to report positive findings.

From the literature review, there seems to be contradicting evidence and inconclusive results regarding the relationship between ESG and firm performance. This thesis contributes by examining the effects of greenwashing, a relatively under-focused environmental event in the existing literature.

[11] Constraints that are sub-optimal as they are not risk minimizing or return maximizing.

3.3 Efficient Markets

In Fama (1970), Eugene Fama presented the efficient market hypothesis (EMH), stating that stock markets were efficient when prices reflect all price-relevant information. The main implication is that when information is fully reflected in prices at all times, investors can not earn excess returns. He further proposed three levels of the efficient market hypothesis, namely (1) the weak, (2) semi-strong and (3) strong efficiencies. The weak degree is built on the notion that all historical price information is incorporated into today's prices. An investor could as such, not expect abnormal returns by using historical information. The semi-strong degree adds to the first by also assuming that all publicly available information to be reflected in market prices. Finally, the strong degree of market efficiency is present when all information, including insider information, is incorporated into market prices.

4 Hypotheses

In this section, we define hypotheses that provide the basis for our analysis. We are examining whether or not the exposure of greenwashing is considered new information for investors, and the correlation between stock price reactions and firm characteristics. With the exposure of greenwashing being public information, the semi-strong form of market efficiency expects this information to be immediately incorporated into prices. If this does not happen, either the news is not price-relevant for investors, or the market is not efficient. Congruent with the semi-strong EMH, we develop the following hypothesis:

Hypothesis 1. Exposure of greenwashing is associated with abnormal stock price returns.

While greenwashing is deemed as a negative practice, the literature review reached no consensus on the effects of ESG events on financial performance or firm value. Thus, we hypothesize only that the returns will be abnormal, and not the direction of those returns.

Hypothesis 2. The cumulative abnormal returns around the exposure of greenwashing are correlated with certain firm characteristics.

Firm characteristics are important in understanding the abilities and incentives of a firm to do environmental initiatives. We expect that certain characteristics are linked to the cumulative abnormal returns around the exposure of greenwashing. These characteristics will be elaborated on in Section 6.3.1.

5 Data

The following section presents the data used in our study. We discuss how the data sample is constructed and the steps we implement in order to collect and clean the data.

5.1 Event Criteria

The first step in an event study is to define the events of interest. Miller (2006) argues that nongovernment-owned media can be described as special market participants with interests that are often aligned with investors and the market. As "watchdogs" for the public, they thus have a governing function, exercised through independent investigations (Djankov et al., 2003). The investigations can uncover and expose cases of corporate misconduct, including greenwashing, and ultimately help reduce information asymmetries[12] in markets. Thus, we define our event(s) to be the day(s) of publication for an article in mainstream media that exposes firms for different types and varying degrees of greenwashing[13]. An important criterion is that the companies are mentioned by name by a major news outlet. Examples of news outlets used in our sample are Reuters, Financial Times and The Wall Street Journal among others[14]. We believe that news providers such as these are likely to be available for and followed by investors, and we are thus more likely to observe effects. Another reason is the integrity of these outlets. We do not want claims of greenwashing by outlets that might have other interests or incentives for publishing than providing truthful and accurate information. Conversely, this means that we are dependent on that not being the case for the outlets we have chosen, but we are not aware of any conflicts of interests for the media outlets we use[15]. For some events we also include reports by large and reputable NGOs [16] that received traction in media. Further, we do not exclude events based on region or industry.

[12]Information asymmetry pertains to individuals or institutions having different levels of knowledge. Investors are likely to have less information about a business than for instance business operators.

[13]We include all greenwashing events, whether they be claim or executional and on firm or product-level.

[14]A full overview can be found for the reader in Appendix A5.1.

[15]The media outlets in our sample are independent and not government owned.

[16]NGO stands for Non-Governmental Organization.

5.2 Data Collection

The stock returns of greenwashing firms are retrieved from the Thomson Reuters Refinitiv Database. We hand-collect daily stock returns of greenwashing firms using the event criteria made in Section 5.1. From this, we end up with a greenwashing sample consisting of 39 unique firms and 44 events spanning from 2015-2022. Our data sample consist of firms and events from multiple countries. One issue that occurs in multi-country event studies is that countries have different national holidays, which results in missing values because the market is closed for the respective country. In order to deal with this issue we remove missing returns from days where markets are closed, so that all companies have the same estimation window length.

In order to calculate the normal returns in Section 6.1.3 we collect index return data on The Morgan Stanley Capital International (MSCI) World Index. The data is retrieved from the Thomson Reuters Refinitiv Database.

For our cross-sectional regression we collect a data set from the Thomson Reuters Refinitiv Database consisting of firm characteristics data for the greenwashing firms. The data included are the *Environmental Pillar Score*, *Market Cap*, *Total Assets*, *Return on Assets (ROA)*, *Leverage Ratio* and *Independent Board Percentage*. This data is used as independent variables in the cross-sectional regression. In order to limit the effect of outliers we winsorize the data at the 1% level (Tukey et al., 1977).

The Environmental Pillar Score gives an indication of the environmental performance of firms. Thomson Reuters explain that: "*The environmental pillar measures a company's impact on living and non-living natural systems, including the air, land and water, as well as complete ecosystems. It reflects how well a company uses best management practices to avoid environmental risks and capitalize on environmental opportunities in order to generate long term shareholder value.*"

In order to calculate the *Return on Assets* we first retrieve the "Net Income Reported - Actual" variable from the Thomson Reuters Refinitiv Database. Thomson Reuters define the variable as : "*The company's actual value normalized to reflect the I/B/E/S default currency and corporate actions (e.g. stock splits). Net Income Reported is the net income earned after deducting all expenses including operating and non operating, interest expense*

and income and taxation. It is inclusive of all amortization and one-time charges.". We then divide the Net Income variable by the Total Assets of the firm in order to find the Return on Assets.

The *Leverage Ratio* variable is calculated by taking the "Total Liabilites" variable from Refinitiv and divide it by the Total Assets. Thomson Reuters define Total Liabilities as: "*Represents the sum of: Total Current Liabilities, Total Long-Term Debt, Deferred Income Tax, Minority Interest and Other Liabilities, Total.*"

5.3 Descriptive Statistics

Summary statistics for the greenwashing firms are presented in Table 5.1.

Table 5.1: Summary Statistics for Greenwashing Firms

Statistic	N	Mean	St. Dev.	Min	Max
Environmental Pillar Score	44	75.48	18.15	14.32	97.95
Market Cap (billions)	44	237.13	450.59	2.12	1 858.76
Total Assets (billions)	44	113.65	125.19	1.14	414.99
ROA	44	0.04	0.07	−0.08	0.18
Leverage Ratio	44	0.64	0.15	0.22	0.88
Independent Board	44	71.05	16.93	23.02	92.60

Note: Table 5.1 presents the summary statistics for the greenwashing sample. N: Number of observations, Mean: The observation average, St. Dev: Standard deviation of the observations. Min: Lowest observation, Max: Highest observation.

The average Environmental Pillar Score for the greenwashing sample is 75.48. An environmental score of 75 corresponds to the grade A which means that on average, the greenwashing sample consist of firms with excellent environmental performance and high degree of transparency[17]. It is curious, as one would think that firms with lower environmental performance would have higher risk of greenwashing. On the other hand, firms with high environmental performance are more ambitious when it comes to the environment and often have more elaborated reporting on the subject than worse performing firms. Unsurprisingly, it should therefore be harder for high performance firms to reach their ambitious goals, as opposed to firms that might not have any environmental

[17]Grade descriptions can be found in Appendix A1.1.

ambitions at all. As a result, high performing firms might be easier to identify as greenwashers by the media due to increased scrutiny.

In terms of market cap, there is quite a substantial gap between the minimum ($2.12b) and maximum ($1858.76b) observation. The average market capitalization is $237.13 billion, meaning that the firms are large-cap[18] on average. Similar to the environmental score, large firms might be subject to more attention from regulators, investors and media, and are therefore more easily identified as greenwashers than smaller firms. The average market cap, however, does not give an accurate reflection of the market cap distribution. Figure 5.1 displays that the sample distribution is concentrated around the lower end of the market cap, and that some outliers are responsible for pulling up the average.

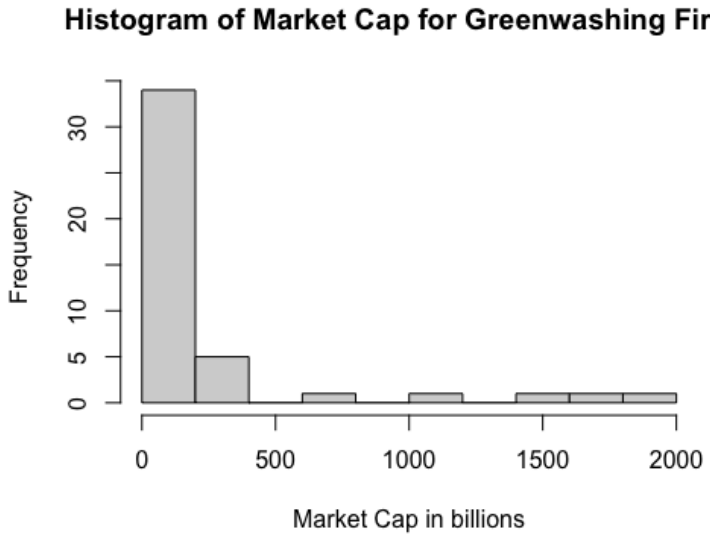

Figure 5.1: Histogram of Market Cap for Greenwashing Firms

Table 5.1 further reveals that the greenwashing firms are on average moderately profitable and indebted. They also have a substantial share of independent directors on average.

Table 5.2 illustrates the industry segmentation for the greenwashing sample, and follows the Thomson Reuters standards. Our greenwashing sample consist of firms from a broad range of industries, and there are a total of 18 industries represented in the data sample. The three biggest industries are *Integrated Oil and Gas*, *Apparel Retail* and *Advertising*, all with 7 greenwashing firms. Especially the Oil & Gas industry has contributed significantly to greenhouse gas emissions and global warming in the last century (Li et al., 2022).

[18]Large-caps are usually defined as firms with a market value of $10 billion or more (Fidelity, nd).

They therefore receive a lot of media attention and are under heavy pressure from non-governmental organizations, activist groups and investors. This may help explain why the industry is heavily represented in our sample. The two others might be more obscure, but we note that some of the greenwashing claims towards advertising companies are linked to the oil and gas industry. In other words, some advertising companies have been exposed for claiming good environmental performance, while helping oil and gas companies with "green" advertising. Obviously, the communication and performance is not closely aligned.

Table 5.2: Industry Segmentation For Greenwashing Firms

GICS Sub-Industry Name	N
Integrated Oil & Gas	7
Apparel Retail	7
Advertising	7
Internet & Direct Marketing Retail	5
Apparel, Accessories & Luxury Goods	3
Interactive Media & Services	2
Soft Drinks	2
Multi-Utilities	1
Independent Power Producers & Energy Traders	1
Food Retail	1
Hypermarkets & Super Centers	1
Airlines	1
Footwear	1
Packaged Foods & Meats	1
Automobile Manufacturers	1
Technology Hardware, Storage & Peripherals	1
Systems Software	1
Asset Management & Custody Banks	1
Total	**44**

Table 5.3 illustrates the country segmentation for the greenwashing sample, and there are a total of 44 observations from 11 countries. The United States of America is over-represented in our sample, accounting for 15 of 44 total observations. It could be linked to the fact that many of the news outlets used are based in America, and are therefore focused on American stocks. Alternatively, the size of the American market also governs that the pool of stocks is larger, meaning that the potential for investigations and discoveries is larger than for smaller markets.

Table 5.3: Country Segmentation for Greenwashing Firms

Country	N
Unites States of America	15
United Kingdom	9
France	5
Germany	4
Sweden	3
Spain	2
Japan	2
Norway	1
Italy	1
Ireland	1
Switzerland	1
Total	**44**

6 Methodology

In this section we describe the methodologies we use in order to investigate the hypotheses defined in Section 4.

6.1 Event Study

To study the effects of the exposure of greenwashing on stock returns, we employ the event study methodology. It is a widely used method to measure the effects of events on firm value (MacKinlay, 1997). One of the first event studies published is Dolley (1933) in which he investigates the price effects of stock splits. He finds that from 95 stock splits, the stock price increased in 57 cases and declined in 26. Since then, there has been a number of revisions and modifications to the techniques used. MacKinlay (1997) offers a review and summary of event study methods, and will be the basis for the procedure in our study. The procedure is structured as follows:

1. Defining events
2. Selecting the event window(s)
3. Choosing estimation window
4. Estimate normal returns
5. Estimate abnormal returns
6. Examine if abnormal returns are significant through statistical testing

First, we define the events we wish to investigate. Second, we select appropriate event windows. Third, we choose the estimation window used to estimate normal returns. Fourth, we estimate the stocks' normal returns. Fifth, abnormal returns are calculated before they are tested in statistical tests. The figure below illustrates the timeline of an event study:

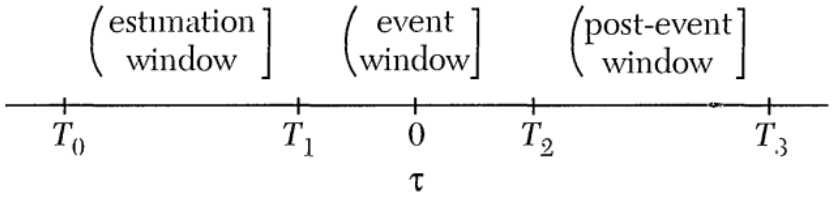

Figure 6.1: Event Study Timeline
Source: (MacKinlay, 1997)

6.1.1 Event Windows

After defining the events in Section 5.1, the next step is to define the corresponding event window. MacKinlay (1997) proposes that the event window should at least include the day of the event and the day after. If there is suspicion of leakage, one could include days prior to the event and similarly one could include days after the event to capture delayed reactions (MacKinlay, 1997). To capture both effects, we want to use multiple event windows. The length of the windows depends on how fast we expect the market to react to news of greenwashing. The semi-strong form of market efficiency is one of the underlying assumptions for hypothesis 1, and can also assist in determining the event window length. According to Fama (1970), the period of which prices are "updated" by the semi-efficient market should be short in order to limit arbitrage. When selecting event windows to analyze, we datamine based on the cumulative average abnormal returns, the development of which can be seen in Figure 7.1 in Section 7.

From the figure, it seems that most of the abnormal returns happen around the event date, and in particular in window [0,2]. Thus, windows [0,2], [0,3] and [0,5] are selected to measure the peri-post-event effects, [-5,0] and [-3,0] the pre-peri-event effects, and [-5,5], [-4,4], [-3,3], [-2,2], [-1,1] the combined effects. Observing pre-event effects depends on whether or not investors to some degree are able to receive the information pre event-date. If indeed non-public information is priced into stocks, it supports the strong form of market efficiency. From the figure, however, we do not view it as likely that significant returns will be observed in pre-peri-event windows. The post-event effects are more linked to the semi-strong form, and we use multiple windows to measure these effects as investors' perspective on greenwashing firms might not change instantaneously.

6.1.2 Estimation Window

Next in the event study methodology is the estimation window. The purpose of the window is to define a period in which normal returns are estimated. These are then used to estimate normal returns in the event windows. According to MacKinlay (1997), biased normal returns could occur if the event window is included in the estimation window. The separation of the event window and estimation window is therefore important, and we end the estimation window the day prior to the event window starting date.

We also have to clarify what length to use for the estimation window. The literature typically estimates normal returns in windows that are -250 to -30 days relative to the event date (Aktas et al., 2007). Choosing a window in that range becomes a balancing act between excluding unrelated events and increasing the accuracy of the normal returns. Although important to be aware of, excluding unrelated events might be hard to do in practice. It requires one to know which events are related and unrelated to exclude them, not to mention that this must be done for all stocks (events) in the study. Trying to leave out certain events could therefore cause unanticipated effects, and thus our estimation window is set more arbitrarily. For our estimation, we use a window of 250 days, meaning that for each event, the 250 trading days prior to the start of the event window is used[19].

6.1.3 Estimating Normal Returns

Before estimating normal returns, an appropriate benchmark return model must be chosen. There exists a number of different models, including single- and multi-factor models MacKinlay (1997). Single-factor models like the market-model aim to explain normal returns by regressing the returns of a stock on the market return in the estimation window. Multi-factor models like the three-factor model proposed by Fama and French (1993), adds factors to that are likely to explain the returns of financial securities. In the three-factor model suggested by Fama and French, premiums for size[20] and value[21] are added to the excess return on the market.

[19]For an event window starting on day -5, this translates to an estimation window of [-256, -6].

[20]Small minus big (SMB) accounts for small firms outperforming big firms.

[21]High minus low (HML) accounts for firms with high book-to-market (BTM) ratios outperforming firms with low BTM-ratios.

MacKinlay (1997) argues that the gains from using multi-factor models are limited, as the explanatory power of additional factors is small. It should, however, be considered in instances where the sample have a common characteristic, e.g. when they are all part of one industry. As seen from Section 5, our sample consists of firms from different industries, countries and sizes. Thus, we prefer the market-model to estimate our normal returns. The market model for any security i is given by

$$R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it} \tag{6.1}$$

$$E(\varepsilon_{it} = 0) \qquad\qquad var(\varepsilon_{it}) = \sigma^2_{\varepsilon_i}$$

where R_{it} and R_{mt} are the returns of security i and the market portfolio for period t, respectively. The error term is given by ε_{it} while the parameters of the market model are α_i, β_i and $\sigma^2_{\varepsilon_i}$. The parameters are estimated over the estimation window using OLS[22] regression, where β_i denotes a stock's sensitivity to the market return. The most popular representations used for the market portfolio are broad based stock indices similar to the S&P 500 (MacKinlay, 1997). An alternative could be to use national indices. However, the findings of Park (2004) suggest that using a country market model in a multi-country event study likely leads to an overestimation of changes in firm value. Consistent with MacKinlay (1997) and Park (2004), we choose a broad global index, namely the MSCI World Index[23], to use for our multi-country study.

For the normal returns to be reliable, the assumptions for OLS needs to hold. According to MacKinlay (1997), it is fair to assume that they do. Nevertheless, they are checked and can be read in Appendix A2.

6.1.4 Estimating Abnormal Returns

The abnormal returns refers to the difference between actual returns that can be observed in markets and the estimated normal return. For each security i, abnormal returns at time τ are calculated as

[22]OLS stands for Ordinary Least Squares.

[23]The Morgan Stanley Capital International (MSCI) World Index comprises of large and mid-cap companies in 23 Developed Market countries (MSCI, 2022) . All of the countries in our study are defined as developed countries.

$$AR_{i_\tau} = R_{i_\tau} - E(R_{i_\tau}|X_\tau) \tag{6.2}$$

In order to test the overall effect of greenwashing exposure, we need to aggregate the abnormal returns along two dimensions - through time and across securities. This is done to limit misinterpretation for specific securities by the market, in addition to reducing systematic errors (MacKinlay, 1997). For each event, we aggregate returns per event window, yielding the cumulative abnormal returns:

$$CAR_{iL} = \sum_{i=1}^{L} AR_{it} \tag{6.3}$$

where AR_{it} denotes the abnormal returns at time t for security i. The length of the event window is given by L.

Lastly, the number of events are aggregated, giving the average cumulative abnormal return:

$$\overline{CAR}_{NL} = \frac{1}{N} \sum_{i=1}^{N} CAR_{iL}. \tag{6.4}$$

with N denoting the number of events.

6.2 Statistical Tests for Abnormal Returns

This subsection will present the tests that are used to examine the statistical significance of the abnormal returns. We will also discuss potential problems with our data sample and how these are accounted for.

6.2.1 The T-Test

We follow the event study methodology of MacKinlay (1997) and test whether cumulative abnormal returns are present or not using the standard t-test. The t-statistic as defined by MacKinlay is:

$$t = \frac{\overline{CAR}(t_1, t_2)}{\sqrt{var(\overline{CAR}(t_1, t_2))}}, \tag{6.5}$$

where $\overline{CAR}(t_1, t_2)$ denotes the average cumulative abnormal return during the event window. The first and the last day of the event window are defined as t_1 and t_2, and $var(\overline{CAR}(t_1, t_2))$ denotes the variance. The variance of the cumulative abnormal returns is given by:

$$var(\overline{CAR}(t_1, t_2)) = \frac{1}{N^2} \sum_{i=1}^{N} \sigma_i^2(t_1, t_2), \tag{6.6}$$

where $\sigma_i^2(t_1, t_2)$ for each security i is given by:

$$\sigma_i^2(t_1, t_2) = (t_1 - t_2 + 1)\sigma_{\epsilon i}^2, \tag{6.7}$$

and $\sigma_{\epsilon i}^2$ denotes the variance of the estimation window residuals for security i.

The t-test is a simple test that is easy to interpret, but the simplicity of the test has some downsides. The methodology of MacKinlay (1997) and the t-test assumes that the event windows of the securities do not overlap and that there is zero cross-correlation between the returns. The weakness of the t-test is that the test is sensitive to volatility changes and cross-sectional correlation, this is something we will discuss in the following sections.

6.2.2 Event Induced Variance

Event induced variance occurs when the variance of firms returns increases accompanying an event. Boehmer and Poulsen (1991) investigates how event induced variance affects the power of event study tests and their ability to detect whether abnormal returns are present or not. Brown and Warner (1985) argues that event studies work well when the effect of the event is the same for all firms. But when the effect of the event is different for firms, the variance of returns will increase and the power of the tests will decrease. The

study of Brown and Warner (1985) presents evidence that many events cause different reactions in risk and returns for individual firms securities.

Event induced variance will cause highly volatile returns during the event window to have a bigger impact than they truly have when compared to the variance of estimation window returns. This leads to Type 1 errors, which is when you falsely reject the null hypothesis. Patell (1976) proposed a solution to event induced variance by standardizing the abnormal returns. By standardizing the abnormal returns you limit the impact of highly volatile securities. Boehmer and Poulsen (1991) further developed the key insights from the study of Patell (1976), resulting in the creation of the BMP test which is robust against event induced variance.

However, the literature mentioned above does not take into account the issue of mixing the variance effect and information effect of the events. One could argue that these two effects are the same. When trying to account for event induced variance there is a possibility that you are removing the effect of interest, namely the information effect of the event. One could say that the increased variance on the event day is just the market processing the information. Because of the possibility of the variance effect and the information effect being the same, it is not given that one should correct the increased variance.

6.2.3 Event Clustering and Cross-Sectional Correlation

Event clustering and cross-sectional correlation is a problem that occurs when the event date are the same for sample firms and the event windows overlap in calendar time. The study of Kolari and Pynnönen (2010) finds that even low levels of cross-correlation between abnormal returns will lead to over-rejection of the null hypothesis when it is true, and causing Type 1 errors.

When ignoring event date clustering, the standard deviation of returns becomes too low because we assume that the cross-correlation between firms are zero. This causes a downward bias of the standard deviations (Kolari and Pynnönen, 2010). The standard deviation is usually found in the denominator when calculating test statistics. Underestimating the standard deviation will result in overestimating the t-statistic, which in return leads to more frequent rejection of the null hypothesis.

Event date clustering is present in our data sample and the level of clustering is illustrated

in Table 6.1 (A more in depth overview of the clustered event dates can be found in Appendix A3.1). In order to prevent over-rejection of the null hypothesis and Type 1 errors, we use the adjusted BMP test developed by Kolari and Pynnönen (2010), which aims to control for cross-sectional correlation. The adjusted BMP test is presented in the next section.

Table 6.1: Clustering of Greenwashing Exposure

Dates with 1 event	Dates with 2-5 events	Dates with >5 events
5	6	2

Table 6.1 illustrates the event dates with multiple events on the same day. The event dates in our sample ranges from 2015 to 2022. 5 dates contains only 1 event, 6 dates contains 2-5 events and 2 dates contains more than 5 events. A full overview of event dates can be found in Appendix A3.1.

Country clustering is also a form of clustering that may lead to biased results in the form of population validity. From Table 5.3 it is evident that our data sample has an overweight of firms from USA. From 44 greenwashing firms, 15 are from the USA. One can thus argue that our data sample has an overweight of observations from USA, and that generalization of the findings may not possible. However, all of our observations are from developed capital markets. The governance structure in the US and Europe are also known for being similar. Meier and Meier (2013) find many similarities between the governance structure in the US and UK, such as the same goals of corporate governance and board structure. We therefore believe that investors in the US and Europe would have similar reactions to the exposure of greenwashing.

6.2.4 The Adjusted BMP Test

In addition to using the event study methodology of MacKinlay (1997), we include the adjusted BMP test. The adjusted BMP test accounts for both cross-sectional correlation and event induced variance. The adjusted BMP test statistic is defined by Kolari and Pynnönen (2010) as:

$$t_{AB} = \frac{\bar{A}}{s_{\bar{A}}} = \frac{\bar{A}\sqrt{n}}{s_A\sqrt{1+(n-1)\bar{r}}}, \tag{6.8}$$

where $\bar{r}$ denotes the average sample cross-correlation of the estimation period residuals, $\bar{A}$ is the average standardized abnormal return and s_A is the standard deviaton defined as:

$$s_A = \sqrt{\frac{s^2}{1-\bar{r}}}. \tag{6.9}$$

Patell (1976) argues that standardized abnormal returns (SAR) should be used for statistical tests. Each abnormal return is standardized by the forecast-error corrected standard deviation. Standardization of the returns implies that more volatile observations are assigned less weight and will have a smaller impact when averaging the abnormal returns than observations that are less volatile. SARs are defined as

$$A_{i_t} = \frac{AR_{i_t}}{s_i\sqrt{1+d_t}}, \tag{6.10}$$

where A_{it} denotes the standardized abnormal return for security i at time t and AR_{it} is the abnormal return for security i at time t. The regression residual standard deviation is given by s_i, and d_t denotes the correction term.

When testing the significance of cumulative abnormal returns (CAR), equation 6.8 is modified by changing the average standardized abnormal return ($\bar{A}$) with the average standardized cumulative abnormal return ($\overline{SCAR}$) in the numerator , and the standard deviation (s_A) with the cross-sectional standard deviation of SCARs (s_{SCAR}) in the denominator. The equation is written as:

$$t_{AB} = \frac{\overline{SCAR}\sqrt{n}}{s_{SCAR}}\sqrt{1+(n-1)\bar{r}}. \tag{6.11}$$

The adjusted BMP test was developed by modifying the original BMP t-statistic of Boehmer and Poulsen (1991) which only controls for event induced variance. The original BMP t-statistic (Boehmer and Poulsen, 1991) is defined as

$$t_B = \frac{\bar{A}\sqrt{n}}{s}, \tag{6.12}$$

where $\bar{A}$ is the average standardized abnormal return, n is the sample size and s is the cross-sectional standard deviation of the event day standardized abnormal returns, given by:

$$s^2 = \frac{1}{n-1}\sum_{i=1}^{n}(A_i - \bar{A})^2. \tag{6.13}$$

The original BMP test assumes that firms' abnormal returns are uncorrelated (Boehmer and Poulsen, 1991). When there is event date clustering present, this assumption leads to over-rejection of the null hypothesis, which causes Type 1 errors.

We can also write the adjusted BMP t-statistic as a function of the original BMP t-statistic:

$$t_{AB} = t_B\sqrt{\frac{1-\bar{r}}{1+(n-1)\bar{r}}}, \tag{6.14}$$

where t_B denotes the original BMP t-statistic. If the average sample cross-correlation of the estimation period residuals ($\bar{r}$) equals zero, the adjusted BMP test and the original BMP test will be the same.

Something to note is that when correcting for event induced variance and cross-sectional correlation we use the estimated variance and correlation. The estimated variance and correlation are estimated with errors, and a potential issue when correcting for event induced variance and cross-sectional correlation is that we introduce more errors instead of correcting them.

6.3 Cross-Sectional Regression

In our study, we also aim to find firm characteristics that can help explain the cumulative abnormal returns. When investigating such relationships between the magnitude of returns and firm characteristics, a cross-sectional regression model can be an appropriate tool.

The approach, as described by MacKinlay (1997), regresses the abnormal returns on the characteristics of interest. Generally, with N abnormal return observations and M characteristics, the regression model can be written as:

$$AR_j = \delta_0 + \delta_1 x_{lj} + ... + +\delta_M x_{Mj} + \eta_j \tag{6.15}$$

where AR_j denotes the j^{th} observation of abnormal returns, M is the characteristic for observation j and η_j is the zero mean disturbance term. For our firm characteristics, j represents the value at the end of the last fiscal year. In other words, for an abnormal return observed in 2021, we use the firm characteristics from the end of 2020.

The regression model is estimated using OLS, meaning that we assume the η_j's to be cross-sectionally uncorrelated and homoskedastic. However, plot 3 in Figure A2.1 in the Appendix suggests that heteroskedasticity might be present, as the variance of the residuals is decreasing with the fitted value of the outcome variable. This phenomenon causes inefficient parameter estimates and could lead to faulty inferences when testing for statistical hypotheses (White, 1980). To account for this, we use heteroskedasticity robust standard errors as advised by White (1980). The heteroskedasticity robust standard errors are obtained by estimating a new covariance matrix. It replaces the diagonal elements in the matrix, and the new diagonals are calculated by:

$$\omega_i = \frac{\hat{u}_i^2}{(1 - h_i)^2} \tag{6.16}$$

where h_i are the diagonal elements of the hat matrix (MacKinnon and White, 1985) and $\hat{u}$ denotes the residuals. The method was introduced as an improvement to White (1980) for the performance in small samples, and was further recommended by Long and Ervin (2000).

6.3.1 Firm Characteristics

When choosing firm characteristics to examine, we refer to extant studies. The main independent variable is the Environmental Pillar Score, and we control for fossil fuels, firm

size, leverage, profitability and independent board members. As previously mentioned, we use the value from the year prior to the event for each characteristic.

Environmental Pillar Score: Du (2015) investigates the effect of environmental score on returns in China, and finds a significant positive relationship. Thus, our main independent variable is the Environmental Pillar Score in the last year as provided by Refinitiv, Thomson Reuters. The Environmental Pillar Score represents firms' environmental performance reflected through their emissions, resource use and innovation (Refinitiv, 2022)[24]. Companies are graded from D- to A+, with scores ranging from 0 to 100, where 100 represents the top mark[25].

Fossil Fuels: Our second variable is one related to industry, with the rationale being that Oil & Gas companies are inherently not environmentally friendly. Furthermore, these play a major role in reaching net zero, one of the premises for why greenwashing as a concept exists in the first place. The dummy variable takes the value 1 if firms operate within fossil fuels, and 0 if they do not.

Firm Size: Another variable of interest is firm size. Fama and French (1993) linked it to stock returns, arguing that small firms outperformed large firms. Another argument is tied to information asymmetry. Brammer and Pavelin (2008) state that larger firms are better at environmental disclosure and are more socially responsible. Lang and Lundholm (1993) also argues this to be the case, but by suggesting that there are economies of scale with regards to information production costs. Larger firms are thus more likely to report more accurately on their environmental initiatives, and investors might react with more surprise to news of greenwashing from large firms than small firms.

To account for size, we use two proxies, namely market capitalization and total assets. This is consistent with the recommendations of Dang et al. (2018), who argues that there are advantages and disadvantages to the different measures. For instance, the measurement of assets could vary across countries and industries, while investor expectations could over- or understate the size of a firm through the market capitalization. From the Pearson correlation matrix in Appendix A4.1, it can be viewed that the correlation between the

[24]The score is calculated by taking the relative sum of the category weights (Emissions, Resource use and Innovation)(Refinitiv, 2022).

[25]Grade A (or a score between 75-100), indicates excellent relative performance and high degree of transparency in reporting material environmental data publicly.

two variables is high (over 0,75). To avoid problems of multicollinearity[26], the variables are included in two separate regression models. As both proxies are likely to be right-skewed[27], they are log transformed to normalize the distribution.

Leverage: The leverage ratio for a firm, measured as leverage divided by total assets, is included to control for the capital structure's effect on CAR. Debt is of interest as it can speak to the abilities and incentives for firms to do environmental initiatives. For instance, Frankel et al. (1995) argues that firms with external financing needs have higher propensities to do disclosures in voluntary channels. Also, numerous studies[28] have argued that creditor power and resource constraints tied to leverage can affect corporate environmental responsibility. Lastly, Fama and French (1992) find that leverage and stock returns have a negative relationship.

Profitability (ROA): Similar to leverage, profitability can influence a firm's ability to do environmental initiatives if we assume them to incur some costs. It is also reasonable to assume that companies with low financial performance will prioritize operations as opposed to enfironmental initiatives. Conversely, well performing firms would have more leeway to focus on their environmental initiatives. To measure profitability we use return on assets (ROA) as it is widely used as a proxy for financial performance (Hult et al., 2008). We measure ROA as net income divided by total assets.

Independent Board: Governance mechanisms and structures can also exert impact on environmental initiatives. However, the effects of independent board members on firm performance are dubious. Among others, Bhagat and Black (1999) find no evidence that greater board independence correlates with firm profitability. Another perspective that can be captured through the independent board variable is one regarding moral hazard[29] in management. Sun (2014) find a positive correlation between manipulation through earnings management and incentive pay. This is consistent with the findings of Bergstresser and Philippon (2006), who find that firms with more earnings management (manipulation) are firms with more incentivized CEOs - i.e. where compensation is more

[26]Having multicollinearity present could undermine the statistical significance of the independent variable (Allen, 2004).

[27]There are more large firms than small firms, when compared to the lower bound of 0.

[28]See Roberts (1992), Hossain et al. (1994) and Huang and Kung (2010).

[29]Moral hazard can be defined as "actions of economic agents in maximizing their own utility to the detriment of others, in situations where they do not bear the full consequences, or equivalently, do not enjoy the full benefits of their actions" (Kotowitz, 1989).

sensitive to the firm's share price. Additionally, Wang et al. (2015) find that a higher presence of independent directors reduces excess compensation for the chief executive officer. Thus, if greenwashing is of importance to investors, CEOs with compensation tied to the share price might manipulate environmental disclosure data. Having independent board members could help negate this problem by reducing CEOs excess pay.

From the above variables and discussions, we end up with the following models:

$$CAR = \alpha + \beta_1 ENV.SCORE + \beta_2 FOSSIL + \beta_3 LN(MCAP) + \beta_4 LEVERAGE + \beta_5 ROA + \beta_6 IND.BOARD \quad (6.17)$$

$$CAR = \alpha + \beta_1 ENV.SCORE + \beta_2 FOSSIL + \beta_3 LN(ASSETS) + \beta_4 LEVERAGE + \beta_5 ROA + \beta_6 IND.BOARD \quad (6.18)$$

7 Results

In this section we will present our results from the empirical analysis and discuss them in the context of the hypotheses, literature review, and methodology sections.

7.1 Results T-Test

The results are shown in Table 7.1 and Figure 7.1. There are 44 total events and the null hypothesis for each event window is that the cumulative average abnormal return (CAAR) is zero.

Table 7.1: Results T-Test

Event window	N	CAAR	Min	Max	T-Test
CAR [-5,5]	44	−0.871	−31.377	11.349	−0.886
CAR [-4,4]	44	−0.862	−27.443	11.718	−0.970
CAR [-3,3]	44	−1.011	−27.998	11.401	−1.291
CAR [-2,2]	44	−1.504	−35.248	8.142	−2.271**
CAR [-1,1]	44	−0.600	−19.169	8.576	−1.173
CAR [-5,0]	44	−0.036	−5.134	9.076	−0.054
CAR [-3,0]	44	−0.354	−5.598	10.566	−0.690
CAR [0,2]	44	−1.376	−33.927	4.016	−2.689***
CAR [0,3]	44	−1.088	−26.520	5.562	−2.126**
CAR [0,5]	44	−1.313	−29.246	7.272	−1.987**

Note: Table 7.1 presents the results for the t-test. The null hypothesis is that CAAR = 0. N: Number of events, CAAR: Cumulative average abnormal return, Min: Lowest CAR observed, Max: Highest CAR observed, T-Test: The t-statistic. The 10%, 5% and 1% significance levels are denoted by *, ** and ***, respectively.

Our event windows are segmented into three categories, namely pre-peri-event, peri-post-event and combined windows. Pre-peri-event windows include the event date and days prior to the event. Peri-post-event windows include the event date and days after the event. And lastly the combined windows includes the event date and days prior and after the event.

For our five combined windows, only window [-2,2] shows evidence of CAAR being statistically different from zero. The window has a CAAR of -1.504% and is significant at the 5% level. We do not find evidence in pre-peri-event windows, an indication that there

is little information leakage prior to the events. However, all peri-post-event windows ([0,2], [0,3], [0,5]) provide evidence that CAAR is different from zero. Event window [0,2] is significant at the 1% level, with a CAAR of -1.376%, while windows [0,3] and [0,5] have CAARs of -1.088% and -1.313% respectively. They are also both significant at the 5% level. Thus, with the absence of significance in pre-peri-event windows, it is likely that the peri-post-event windows are driving the results for the combined windows. Another thing to note is that the CAARs for all event windows are negative, suggesting that investors react negatively to the exposure of greenwashing. However, due to the fact that not all of these CAARs are significant, we only have evidence that this might be the case for the aforementioned windows ([-2,2], [0,2], [0,3], [0,5]).

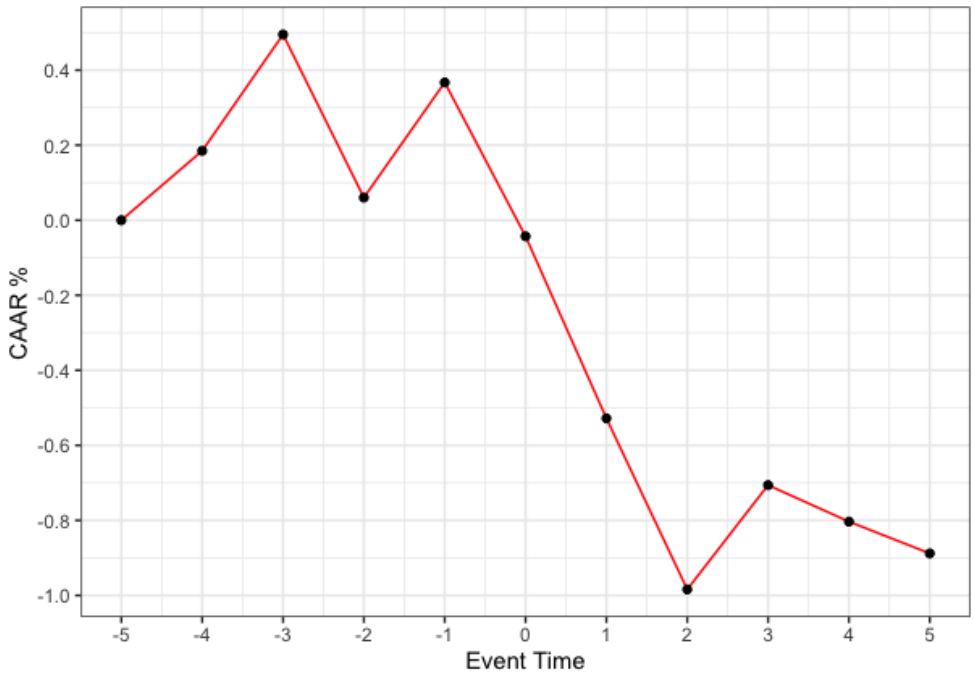

Figure 7.1: Cumulative Average Abnormal Returns From Day -5 to Day 5

Figure 7.1 illustrates the CAAR from day -5 to day 5. It shows a drastic decrease in CAAR from day -1 to day 2. The illustration, however, could be somewhat misleading when interpreting which event window has the biggest effect on CAAR. It looks like the event window [-1,2] should have the biggest impact, but this is not accurate. From day -2 to -1 the graph increases, coming from the positive returns on day -1. From day -1 to 0 the graph turns downwards, a result of the negative returns on day 0. Hence the big decrease in CAAR that is illustrated comes from the negative returns on day 0, day 1 and

day 2. Therefore, the effect depicted is from event window [0,2].

Hypothesis 1 states that the exposure of greenwashing should be followed by abnormal stock price returns. The results from the t-test gives preliminary support to hypothesis 1 for some event windows, primarily the peri-post-event windows. This corroborates the findings of Du (2015), stating that investors react to greenwashing news, and similar to Du, we find that they do so in a negative way. The negative reaction represents a direct link between investors' view of greenwashing and their stock portfolios. The sustainability redundancy hypothesis proposed by Roca et al. (2013), suggesting that sustainability is costly and does not add to firm value, is thus contradicted. Instead, the results indirectly suggest that the opposite might be true, that sustainability is deemed as value creating or serve some other utility[30] for investors. When cheaters[31] then are exposed, investors lose that additional utility and subsequently punish the stock. The results might also indicate that investors are opposed to the concept of cheating in general, and that they are not willing to invest in companies where cheating is evident. Further, negative reactions might also come from the expectations that environmental initiatives could lead to lower costs, similar to the findings of Bragdon and Marlin (1972), or that it could lead to better handling and prediction of risks (Giese et al., 2019).

That ESG is regarded as valuable by investors, can also partly be reflected through the recent years' inflows into sustainable funds. According to Morningstar[32], global ESG fund assets climbed to $3.9 trillion in September 2021 (Patturaja Murugaboopathy, Anurag Maan, 2021). The funds are subject to the Sustainable Finance Disclosure Regulation (SFDR)[33] and quarterly net inflows have almost tripled from Q1 2020 to Q3 2021. When companies are exposed for greenwashing, they may be excluded from such funds, which in turn lowers demand for the stocks in question.

With hypothesis 1, we are also testing the semi-strong form of the efficient market hypothesis (Fama, 1970). If indeed the exposure of greenwashing is new and relevant

[30]Examples of utility could be institutional investors with mandates to invest in environmentally friendly businesses or wanting to invest in environmentally friendly businesses for personal or social reasons.

[31]If the optimal strategy for firms is to do environmental initiatives due to some increase in firm performance/firm value, firms that only reap the benefits without actually performing the initiatives could be labelled as "cheaters".

[32]Morningstar is a financial services company, whose services include providing fund ratings.

[33]The SFDR sets standards for minimum disclosure to prevent greenwashing (Morningstar, 2021).

information for investors, prices should "update" within a short period of time to make arbitrage difficult. Congruent with the EMH[34], the peri-post-event windows in particular have significant abnormal returns. From the t-test, then, it seems plausible that the market is efficient in a semi-strong manner with regards to the exposure of greenwashing.

7.2 Results Adjusted BMP Test

The results for the original BMP test and the adjusted BMP test are presented in Table 7.2. We test the null hypothesis of $SCAAR$ being equal to zero for each event window.

Table 7.2: Results Adjusted BMP Test

Event window	N	SCAAR	Min	Max	BMP	Adj.BMP
SCAR [-2,2]	44	−1.069	−22.506	2.750	−1.763*	−1.295
SCAR [0,2]	44	−0.949	−21.639	1.590	−1.667*	−1.238
SCAR [0,3]	44	−0.812	−16.898	2.840	−1.664*	−1.236
SCAR [0,5]	44	−0.961	−18.643	2.802	−1.811*	−1.345

Note: Table 7.2 presents the results for the original and the adjusted BMP test. The null hypothesis is that SCAAR = 0. N: Number of events, SCAAR: Standardized cumulative average abnormal return, Min: Lowest SCAR observed, Max: Highest SCAR observed, BMP: t-statistic, Adj.BMP: t-statistic. The 10%, 5% and 1% significance levels are denoted by *, ** and ***, respectively.

We choose the event windows from Table 7.1 that has the biggest impact on CAR and test whether these abnormal returns are equal to zero when accounting for event induced volatility and cross-sectional correlation. We find that the standardized cumulative average abnormal return (SCAAR) is negative for all event windows. The results from the original BMP test show that SCAAR is statistically significant for all event windows at the 10 percent level.

When additionally accounting for cross-sectional correlation through the adjusted BMP test, we fail to reject the null hypothesis. But, failure to reject does not mean that we can accept the alternative hypothesis. The results from the adjusted BMP test does not support Hypothesis 1, however, we are not able to evaluate the power of the adjusted BMP test without doing a simulation ourselves. Therefore, we are reluctant to conclude

[34]The EMH usually requires that the effects are concentrated on the event date, but even under EMH there can in some cases be a lag in effects.

based on the results from the test. Still, we appreciate that our results might not be robust to cross-sectional correlation or event induced volatility.

7.3 Results Cross-Sectional Regression

When assessing which event windows are most suited for further analysis, we refer to Section 7.1. The most significant peri-post-event window was [0,2] while the most significant combined window was [-2,2], hence these are selected. No pre-peri-event window is examined as none were statistically significant. In the selected windows, we investigate the effects of firm characteristics on CAR. The results from the cross-sectional regressions can be viewed in Table 7.3. As mentioned in Section 6.3.1, two models are used in each window to address multicollinearity concerns caused from the market cap and asset variables.

The environmental score coefficient is positive in all four models, but only significant at the 10% level in model (1). Firms with higher scores are thus more likely to experience positive abnormal returns. This may be counter intuitive, as one would expect firms with perceived high environmental performance to be punished harder when exposed to greenwashing, than firms with low environmental performance. Granted that the results do not account for the degree or type of greenwashing, we cannot rule out that this has an effect on stock market reactions. For instance, that firms with high environmental performance are exposed for less serious misrepresentations of green initiatives than those with low environmental performance, leading to a positive relationship between environmental score and CAR. It might also be the case that when firms are exposed for greenwashing, investors are executing a long/short-strategy[35], in other words buying stocks with high environmental performance and selling stocks with low environmental performance, regardless if those firms have been exposed or not.

Model (3) seems to provide evidence that there is a negative relationship between being a fossil fuel firm and cumulative abnormal returns. A possible explanation could be that fossil fuel firms are more easily identified as greenwashers by investors, given the direct link between fossil fuels and the environment. Fossil fuel firms face greater challenges than

[35]A long/short-strategy means buying stocks expected to go up in value, and selling short in securities expected to go down in value.

Table 7.3: Cross-Sectional Regression Results

	Dependent variable:			
	CAR			
	Event window [0,2]		Event window [-2,2]	
	(1)	(2)	(3)	(4)
Environmental Pillar Score	0.087*	0.081	0.064	0.063
	(0.052)	(0.050)	(0.055)	(0.048)
Fossil fuels	-2.785	-0.668	-4.097*	-0.992
	(2.323)	(1.851)	(2.322)	(1.794)
Ln(M.Cap)	-1.023		-1.134	
	(0.684)		(0.857)	
Ln(Total Assets)		-1.626		-2.099*
		(1.139)		(1.206)
Leverage	-2.039	0.502	0.461	4.070
	(9.639)	(8.240)	(10.552)	(8.879)
ROA	1.339	-4.238	5.067	1.731
	(14.821)	(12.317)	(15.322)	(11.310)
Independent Board	0.252	0.245	0.239	0.232
	(0.158)	(0.150)	(0.173)	(0.159)
Constant	1.187	15.077	4.890	26.344
	(13.114)	(20.744)	(16.021)	(21.618)
Observations	44	44	44	44
R^2	0.396	0.465	0.342	0.460
Adjusted R^2	0.298	0.379	0.235	0.372

Note: Table 7.3 presents the results for the cross-sectional regression. Dependent variable: CAR from the respective event windows. Models (1) and (3) excludes total assets, while (3) and (4) excludes market capitalization. Environmental Pillar Score: Refinitiv's Environmental Score. Fossil fuels: A dummy equal to 1 if the firm is in the oil and gas industry. Ln(M.Cap): The natural logarithm of market capitalization at the end of the fiscal year. Ln(Total Assets): The natural logarithm of total assets at the end of the fiscal year. Leverage: Leverage ratio, calculated as. ROA: Return on assets, calculated as net income divided by total assets. Independent Board: Percentage share of independent board members. Constant: Value of the dependent variable when independent variables = 0. Observations: Number of observations. R^2: The fit measure for the model. Adjusted R^2: R^2 adjusted for number of predictors. Heteroskedasticity robust standard errors are displayed in parentheses, while the 10%, 5% and 1% significance levels are denoted by *, ** and ***, respectively.

those of other industries in terms of the environment, investors may boycott this industry when it becomes evident[36] that they struggle to resolve those challenges. Worth noting is also the coefficient sizes of the fossil fuels variable, especially in model (3). Significant at the 10% level, the coefficient is around -4%, meaning that being a fossil fuel firm leads to around -4% lower CAR relative to other industries around the exposure of greenwashing.

When it comes to the our size proxies, both market cap and total assets have negative coefficients in all models. Thus, smaller firms are more likely to experience positive abnormal stock returns at the exposure of greenwashing. As mentioned in Section 5.1, information asymmetries are likely to exist in markets, and this understanding can assist in explaining the relationship between firm size and CAR. As discussed in Section 6.3.1, larger firms are better at disclosing environmental information than smaller firms, meaning that the level of information asymmetry between large firms and investors is likely lower than that of smaller firms. Hence, smaller firms might be "rewarded" compared to their larger counterparts for bridging the asymmetry gap. Lastly, the proxies' significance is only evident in event window [-2,2], suggesting that investors only factor firm size into investment decisions pre-event[37].

From the regressions, we do not find evidence that leverage ratio nor ROA has an effect on CAR. Coefficients vary from negative to positive, and are in no circumstance significant. Investors are thus not concerned with indebtedness or profitability when making investment decisions around the exposure of greenwashing.

The percentage share of independent board members evidently does not have an effect on CAR around the exposure of greenwashing. Either, investors are not confident that independent boards will address greenwashing, or the variable is not a good proxy for the governance mechanisms that could affect CAR. Conversely, it could also mean that governance mechanisms are not valued by investors around the exposure of greenwashing. Thus, independent boards' effect on firm performance remains uncertain, and our study does not offer any updates from the findings of Bhagat and Black (1999) in this regard.

[36]Evident through the exposure of greenwashing.

[37]If the effects are not significant in peri-post windows, but significant in combined windows, the effects should be from the pre-event period.

7.4 Overall Results

The results from the t-test provide evidence that there exists a negative relationship between the exposure of greenwashing and CAAR. The price reactions are significant for the combined event window [-2,2] and the peri-post event windows [0,2],[0,3] and [0,5]. However, when testing for robustness through the adjusted BMP test, we fail to reject the null hypothesis. But without testing the power of the adjusted BMP test through a simulation, we are reluctant to base our findings on the results from this test.

We also find evidence of relationships between some firm characteristics and CAR. Specifically, we find relationships between environmental score and CAR (positive), fossil fuel industry and CAR (negative) and firm size and CAR (negative). These results however, are subject to model specification and are only valid in certain event windows.

8 Discussion

The following section discusses limitations present in our study, as well as offer suggestions for future research within the topic of greenwashing.

8.1 Limitations and Suggestions for Future Research

The first potential limitation is the sample size of our study. In statistics, having larger sample sizes is usually considered necessary to obtain unbiased results. It increases the probability of observing sample means that are close to the population mean, and hence increases the power of the study. Naturally, our sample size is also related to our sample selection process, and the media coverage of greenwashing. An inherent restriction as such, is the limited reach of media. Therefore, we cannot rule out that some firms escape media coverage for the exposure of greenwashing, thus limiting our sample. However, due to climate change, it is reasonable to assume that environmental considerations for firms will increase in the years to come, and media's attention towards it as well. This could enable future researchers to still use media for sample selection, but obtain a larger sample than our study. An alternative of course would be to use another source (if such exists) for data sampling.

Another potential issue in using different media sources is the divergence in quality and outreach of those outlets. While we have been selective in our choice of outlets, we acknowledge that there is likely to be disparities we have not accounted for. This could lead to similar events having different effects on markets solely based on the news outlets they were mentioned in. Ideally, we would want to have publications from only one source, for instance Reuters. But again, due to sample size concerns, we deemed it rational to include more sources.

Another concern is related to the events themselves. In our study, we have aggregated events based on a broad definition of greenwashing, and not segmented based on various subcategories of the concept. Thus, we appreciate the argument that some events might drive the results of our study. And indeed, from plot four in Figure A2.1 in the Appendix, we see that point 35 exceeds 4 standard deviations and is outside the Cook's distance, meaning it has leverage on the regression results. Outliers can arise from errors in

measurement or they may have been recorded in extraordinary circumstances (Rousseeuw and Hubert, 2011). The observation in question is the Volkswagen scandal in 2015, where the company used software to cheat emission tests, so that their cars could produce 40 percent more pollution than allowed (Rupert Neate, 2015). From our specifications, we could not conclude that the observation was erroneous, and we therefore left the outlier in our sample. By leaving it in the sample, we recognize that the event to a certain degree is influencing the results and the subsequent inferences drawn from them. Had we instead excluded the observation, the results might have been altered. Whether this alteration is good or bad depends on the effects we are trying to observe. As stated, we are not segmenting events into categories of greenwashing, and thus it is plausible that some events does not fit the model as well as others. In the case of Volkswagen, it stands out from the rest of the sample across multiple dimensions: (1) the devices installed were outright illegal, (2) the scale of the scandal and potential repercussions[38], and (3) the serious lack of ethical understanding[39]. In addition, the timing of the scandal could help explain why investors reacted so negatively, as it was uncovered only months before the COP21 and signing of the Paris Agreement. Investors might have anticipated tightening of environmental regulation prior to the conference, and this could have exacerbated their reactions. It might therefore not be abnormal that investors react more negatively to greenwashing news of this fashion, than for instance to a company using "green symbols" in their advertising. This could just be an accurate representation of what happens in reality. For future research then, we recommend to do a thorough segmentation of greenwashing events, in terms of classification and perhaps time variability. In other words, identifying what types of greenwashing events and under what circumstances drive market reactions would make for an interesting analysis.

Particularly with one influential observation, we cannot evaluate whether the adjusted BMP test removes the variance effect or the information effect. Indeed, the Volkswagen scandal seem to offer insight into why some events have larger effects on returns than others. Potentially removing this effect through the standardized returns of the adjusted BMP test might not be of interest. We therefore conclude our study based on the methodology of MacKinlay (1997), and are open to the results potentially not being robust to event

[38]Ca 482.000 vehicles with potential fines of $18bn.

[39]Cheating tests to improve profitability to the detriment (nitrogen oxides are linked to asthma attacks and respiratory illnesses (Rupert Neate, 2015)) of citizens is highly unethical.

induced variance or cross-sectional correlation.

As greenwashing is a relatively diffuse concept, knowing how to factor these events into investment decisions might not yet be clear. For the same reason, it might also be difficult for investors to analyze the information in the short windows that we have defined. Studying the long-term effects of greenwashing could therefore be interesting. And not only on stock prices, but for instance effects on reputation, access to financing or revenues.

With the knowledge of our sample being concentrated around a few industries and countries, we should be hesitant to claim that our study has external validity. The fact that we have one influential observation also argues against the study having external validity. Furthermore, we cannot ignore the possibility of exogenous variables explaining the results of our cross-sectional analysis. The covariates in our study are not randomly chosen, and could be correlated with some unobserved factor(s) (Gerber and Green, 2012). The risk then, is that the unobserved variable(s) is in fact responsible for the effects observed in the study, and not the variable(s) that we have included.

9 Conclusion

This thesis studies the relationship between the exposure of greenwashing and stock returns, and which (if any) firm characteristics are correlated with those returns. We hypothesized that (1) the exposure of greenwashing was linked to abnormal stock returns and (2) that certain firm characteristics were correlated with the cumulative abnormal returns. The hypotheses were developed based on existing literature and to investigate them we used the event study and cross-sectional regression methodologies, respectively. Events were set to be the days of publication for articles in major news outlets that exposed firms for greenwashing. From the event study we found that the exposure of greenwashing was linked with abnormal returns. The evidence suggests that there is a negative relationship between greenwashing firms and the cumulative abnormal returns. In other words, investors reacted negatively to the news of greenwashing, which indirectly suggests that they viewed corporate environmental performance as important, and/or that they disfavour cheating firms. However, the results were only valid in certain event windows and most notably in window [0,2], where the CAAR was significant at the one percent level. It indicated that investor reactions were concentrated around the event date and the following two days. As our sample had some event date clustering, we used the adjusted BMP test which indicated that the results might not be robust to cross-sectional correlation and event-induced variance. But without testing the power of the adjusted BMP test, and that failure to reject does not mean to accept the alternative hypothesis, we conclude based on the methodology of MacKinlay (1997) that the relationship between greenwashing and CAR is present in our sample.

Further, we found weak[40] evidence of a positive relationship between a firm's environmental score and cumulative abnormal returns. We argued that the results could indicate that firms with higher environmental performance were exposed for less severe types of greenwashing, and hence punished less by investors. Contrary to the environmental score, we found a negative relationship between being a fossil fuel firm and CAR. We argued that the direct link between the fossil fuel industry and the environment could offer insights into why this relationship exists. Lastly, we found a negative relationship between firm size and CAR. Large firms are better at disclosing environmental data (Brammer and

[40]Weak as it is only significant at the 10% level.

Pavelin, 2008), and investors might therefore be more surprised at large firms getting exposed for greenwashing, as opposed to smaller firms. It should be noted that the results from the cross-sectional regressions were sensitive to model specifications and only valid in some windows.

We also addressed some of the potential limitations of our study. Among them was the fact that we have one influential observation, which to a degree was likely to drive the results. However, due to the nature of the event in question, it could provide insight into why some greenwashing events received more attention from investors than others. Other limitations included the size and other traits of our sample that potentially prevent the study from having external validity.

The thesis adds to a relatively thin body of literature on the topic of greenwashing. As we approach the year 2050, the target year for net zero global emissions, stakeholders are likely to increase scrutiny with regards to environmental performance in business. With increased pressure from policymakers, regulators, investors and consumers, an increasing number of firms could find themselves in situations where they over-promise and under-deliver in terms of their environmental commitments. As greenwashing then matures as a concept and data availability increases as a result of more events, so will the body of literature on the topic. We recommend that future studies test further the relationships that we have presented in our study, but also examine other potential connections within greenwashing. With the above-mentioned changes in stakeholder and business environments, investigating what types of greenwashing and under what conditions draw the most attention from investors, would be of particular interest.

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Appendix

A1 ESG Scoring

Score range	Grade	Description
0.0 <= score <= 0.083333	D -	'D' score indicates poor relative ESG performance and insufficient degree of transparency in reporting material ESG data publicly.
0.083333 < score <= 0.166666	D	
0.166666 < score <= 0.250000	D +	
0.250000 < score <= 0.333333	C -	'C' score indicates satisfactory relative ESG performance and moderate degree of transparency in reporting material ESG data publicly.
0.333333 < score <= 0.416666	C	
0.416666 < score <= 0.500000	C +	
0.500000 < score <= 0.583333	B -	'B' score indicates good relative ESG performance and above-average degree of transparency in reporting material ESG data publicly.
0.583333 < score <= 0.666666	B	
0.666666 < score <= 0.750000	B +	
0.750000 < score <= 0.833333	A -	'A' score indicates excellent relative ESG performance and high degree of transparency in reporting material ESG data publicly.
0.833333 < score <= 0.916666	A	
0.916666 < score <= 1	A +	

Figure A1.1: ESG Score Description
Source: (Refinitiv, 2022)

Figure A1.1 illustrates Refinitiv's grading system when it comes to ESG scores. The same grades are given for the individual pillars, such as the environmental pillar.

A2 OLS Assumptions

In order to check the OLS assumptions of our linear regression model, we create the diagnostic plots below:

The "Residuals vs Fitted" plot shows the linear relationship between the the residuals and the fitted model, and the plot is used to test the linearity assumption. We see from the plot that the we do not have any distinct patterns in the residual plot. This indicates that the linearity assumptions holds.

The "Normal Q-Q" plot is used to check the distribution of the residuals. The residuals should ideally follow the dashed line. From the plot we see that our residual points follow the dashed line and we assume that the residuals are normal distributed.

The "Scale-Location" plot is used to check the homogeneity of the residuals variance. The homoskedasticity assumption holds when the residuals have a constant variance. The plot

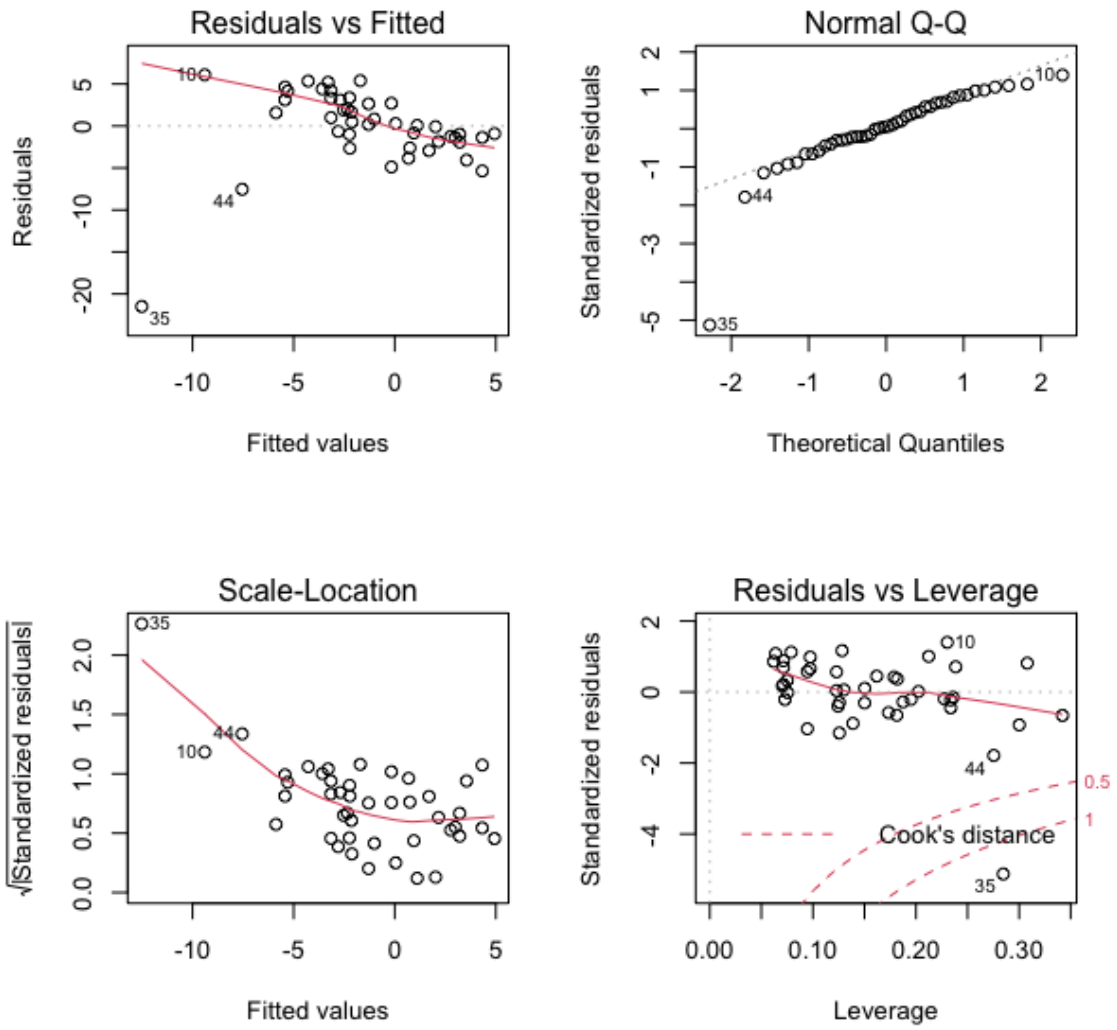

Figure A2.1: Testing OLS Assumptions

indicates that there might be heteroskedasticity present in our sample, as the variance is non-constant. To deal with this potential problem, we use heteroskedasticity robust standard errors.

The "Residuals vs Leverage" plot is used to check for extreme values that might influence the regression model. The plot shows that we have some observations with high leverage and one significant outlier. Observation 35 (Volkswagen scandal 2015) lies outside of Cook's distance and hence classified as an influential value. We do not believe that the observation occurred because of errors in measurements or in the data collection. By leaving it in the sample, we recognize that the event to a certain degree is influencing the results and the subsequent inferences drawn from them.

A3 Clustering

Table A3.1: Event Date Clustering

Event date	N	Reference
30.06.2021	10	(Changing Markets Foundation, 2021b)
19.04.2021	7	(ClientEarth Communications, 2021)
20.09.2021	5	(Paddison, Laura, 2021)
21.09.2021	5	(Clean Creatives, 2021)
03.02.2021	4	(Changing Markets Foundation, 2021a)
14.01.2022	3	(Butler, Sarah, 2022)
17.09.2020	3	(Chapman, Ben, 2020)
19.01.2022	2	(Volcovici, Valerie, 2022)
15.01.2020	1	(Petroni, Giulia, 2020)
03.12.2019	1	(Dempsey, H. and Raval, A., 2019)
05.02.2020	1	(Sweney, Mark, 2020)
18.09.2015	1	(Neate, Rupert, 2015)
25.08.2021	1	(Kowsmann, P. and Ramey, C. and Micheals, D., 2021)

The reports by NGOs received attention in mainstream media on the day of publication and the day after.

A4 OLS Regression Correlation

Table A4.1: Pearson Correlation Matrix of Independent Variables for OLS Regression

Variables	ENV.Score	Fossilfuel	LogM.Cap	Log.Ass	Leverage	ROA	Ind.Board
ENV.Score	1.000						
Fossilfuel	0.203	1.000					
LogM.Cap	0.300	0.160	1.000				
Log.Ass	0.262	0.450	0.816	1.000			
Leverage	-0.040	-0.147	-0.205	0.002	1.000		
ROA	-0.085	-0.444	0.477	0.015	-0.398	1.000	
Ind.Board	-0.208	0.276	0.238	0.235	0.118	0.043	1.000

A5 Media Outlets

Table A5.1: List of Media Outlets

Media Outlet
The Guardian
The Wall Street Journal
The Independent
Financial Times
The New York Times
Reuters
Client Earth Communications
CleanCreatives