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Greenwashing: when climate talk does not meet the climate walk

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Abstract

Sustainability and green-thinking are increasingly popular buzzwords, as companies try to create a more environmentally friendly image to appeal to consumers, employees and investors. However, not all companies are able to present actions taken to tackle climate change; therefore some companies draw to greenwashing. The aim of this study is to understand whether investors are able to recognise and punish greenwashing behaviour. We use calendar time regressions on the company portfolios with data from STOXX 600 index companies and determine that greenwashers have significantly lower abnormal returns than non-greenwashing companies during 2015-2020, with the effect diminishing over time. This result suggests that as regulations imposed by governments around the globe to tackle climate change are getting tighter, companies are performing more similarly to each other in terms of sustainability and additional abnormal returns enjoyed by non-greenwashing companies are decreasing over time.

Keywords: Greenwashing, peer-relative score, ESG, Abnormal returns.

JEL Classification: Q50, Q54, Q56.

1. Introduction

Global warming is threatening every single aspect of human life (*What Is Climate Change? A Really Simple Guide*, 2021). Since the beginning of the environmental movements in the 1960s concerns about global pollution and warming have continued to rise (Szabo & Webster, 2021). For example, products marked as sustainable grew 5.6 times faster than other products (Whelan & Krothal-Sacco, 2019). Similarly, investors indicate increased interest in sustainable investments by investing in real estate projects with a smaller carbon footprint or by investing in companies that minimise their climate impact (de la Merced, 2020; Sisson, 2021). The permanent negligence of the unsustainable use of human and environmental resources has raised awareness at many levels and has encouraged discussion through diverse channels (Coqueret, 2021). The increased attention from society has affected companies around the globe through more severe regulations and increased investor attention to investment sustainability (Sautner et al., 2020).

Governments are implementing diverse regulation frameworks to tackle climate change. In the European Union, discussions were triggered by Intergovernmental Panel on Climate Change in 1990 and the EU has actively participated in this process starting from the late 1990s when the first Kyoto protocol was signed (European Commission, 2004) and the first European Climate Change program was approved (European Commission, n.d.-b). The next step taken by the EU was implementing the EU Emission trading system in 2005 (European Commission, n.d.-a) and signing the Paris agreement (European Commission, n.d.-c). Most recently the EU has taken one step forward and specified how its commitments in the Paris agreement will be achieved through the "Green deal" implying that the European Union commits to become carbon neutral by 2050 (McGrath, 2021). To make commitments binding, the EU adopted new European Climate law (Climate Action Tracker, 2021).

The increased attention to companies' ESG performance comes not only from the tighter regulations implemented by the governments but also from an increased investor, employee and customer attention. In the last 5 years, 85% of customers have shifted their buying habits so that they would become more environmentally friendly while 34% are willing to pay a premium for sustainable goods (Pope, 2021). A similar increase can be observed in investor attention to sustainable stocks. As Hartzmark & Sussman (2019) find, being categorised as a low

sustainability fund leads to net outflow while high sustainability funds saw an increase in investor attention and a net inflow of funds. This attention has encouraged companies to engage in green marketing, occasionally leading to greenwashing. In this paper, we attempt to analyse whether investors are able to recognize greenwashing and state the following research question: **Do greenwashing company stocks have lower abnormal returns compared to the companies that do not overestimate their sustainability efforts from 2015-2020?**

Green marketing is a strategy executed by companies in order to create a more environmentally friendly image of the product and the whole company to compete in the global market. However, when this strategy is misused, a company starts to mislead the stakeholders and engages in greenwashing (Agarwal & Kadyan, 2014). In 2021, the European Commission for the first time did a website "sweep" focused on greenwashing, investigating 344 EU trader sustainability claims and identified that in 42% of cases the claims were exaggerated without sufficient information and in 37% of cases vague statements were used to provide a positive impression to consumers (European Commission, 2021). Several large corporations have been accused of greenwashing – Ryanair ads were banned by the ASA ruling in 2020 (ASA, 2020), Innisfree, a popular South Korean beauty brand, publicly apologised for the misleading information displayed on the packaging of its products (BBC News, 2021) and many other adverts published by ExxonMobil, Aramco, Chevron, Shell, Equinor companies have been identified as greenwashing (Carrington, 2021).

While in academic literature there is a consensus that greenwashing affects stakeholders (Gatti et al., 2021) only a few empirical studies have focused on understanding how greenwashing affects shareholders (Friede et al., 2015) and whether they recognize it despite the lack of regulation leading to the ambiguity of interpreting the law (de Freitas Netto et al., 2020). Greenwashing has been widely analysed in terms of consumer perception and buying decisions focused on marketing style, as well as how it affects the key values of the company (sales, profitability, debt etc.), however, research that focuses on the impact of greenwashing on company's abnormal returns is scarce (Lyon & Montgomery, 2015).

Previously Du (2015) has identified that greenwashing companies after being revealed to the public experience negative abnormal returns, however, Du (2015) did not focus on defining companies as greenwashers and relied on the list published by South Weekend, one of the largest China's papers. Du (2015) emphasises that the market reacts negatively to the exposure of

greenwashing (media coverage plays an important role in affecting investor behaviour), ESG score is positively related to returns around the exposure of greenwashing and the market can identify the environmental wrongdoers through ESG scores and punish them quite severely.

Yu et al. (2020) developed a methodology on how to define the greenwasher firms but focused their research on which firm-level governance factors are the most effective to attenuate firms misleading disclosure. In this paper, we use the methodology developed by Yu et al. (2020) to create a peer relative greenwashing score as a divergence between ESG performance and disclosure scores and examine if the STOXX 600 companies from 2015-2020 that have been identified as greenwashers show inferior stock returns compared to non-greenwashing companies.

This paper is structured as follows: Section 2 reviews previous literature on ESG and abnormal return connection, defines and categorises greenwashing and provides an overview of the previous research regarding greenwashing and abnormal return connection. Section 3 describes the data and methodology used in the paper, further sections present our results, discussion and conclusions.

2. Literature review

2.1. ESG and financial performance

In the last 2 decades, investors have seen a rapidly increasing number of companies that report and measure their environmental performance (e.g., water usage, carbon emissions), social data (e.g., employee engagement, labour standards), and governance practices (e.g., board composition and political contribution data). Together that forms ESG data that attracts increasing investor attention and serves as a meaningful deciding point while evaluating potential future investment companies (Amel-Zadeh & Serafeim, 2018).

With the increase in ESG data disclosure researchers have tried to establish a relationship between the financial performance of the stock and companies' ESG performance. The first understanding of this relationship was based on neoclassical theory and implied a negative association between ESG and financial performance. This theory was based on Friedman's (1970) argument that companies' main target is to earn profits for shareholders. Since then several studies have found either a negative (Fisher-Vanden & Thorburn, 2011; Brammer, Brooks, & Pavelin, 2006) or a nonsignificant (Landi & Sciarelli 2019, Revelli & Viviani, 2015) or positive (Fatemi, Fooladi & Teheanian, 2015) relationship between ESG performance and companies' financial performance. Considering this uncertainty, Friede, Busch and Bassen (2015) analysed more than 2000 academic studies covering ESG and financial performance relationship and authors concluded that approximately 90% of analysed studies found a nonnegative relationship between the two variables and the majority of the papers reported a positive relationship. Furthermore, the authors emphasise that this relationship has been stable over time since the 1990s.

2.2. Greenwashing

As a response to ever-increasing investor attention to ESG data reported by companies, a new alarming, investor misleading practice has evolved – greenwashing. Some recent examples of greenwashing include, but are not limited to, BP misleading society with advertisements focusing on low-carbon energy products without specifying the proportional amount of those products respective to the total BP production (Carrington, 2021), Coca-Cola positioning the company as eco-friendly while being ranked as the world's number 1 plastic polluter and announcing that the company will not abandon plastic bottles (Joe, 2021) and IKEA

sustainability claims took a hit when furniture seller was connected to illegal logging link in Ukraine (Thomson Reuter, 2020).

The term is extensively used not only in the scholarly press but also in the popular press, however, one clear definition of the term still is lacking due to the multifaceted nature of greenwashing (Lyon & Montgomery, 2015). Delmas and Burbano (2011) offer a simple definition: “Poor environmental performance and positive communication about environmental performance" (p. 65). However, as Lyon and Montgomery (2015) emphasise this definition lacks a clear explanation of how environmental performance and communication made about it can be divided as either positive or negative. Further Lyon and Maxwell (2011) attempt to define greenwashing as “Selective disclosure of positive information about a company’s environmental or social performance, without full disclosure of negative information on these dimensions, so as to create an overly positive corporate image” (p. 9). This definition is based on the fact that greenwashing mainly implies disclosure of “hard” data and disregards vague claims made by greenwashers to improve their image (Lyon & Montgomery, 2015). Bowen (2014) extensively expands on the topic by highlighting assumptions that limit academic literature while defining greenwashing – (1) greenwashing is exclusively about information disclosure, (2) greenwashing is intended action, (3) greenwashing as a practice is implemented only by corporate companies and (4) greenwashing is profitable for companies at the expense of the society. Considering misconceptions emphasised by Bowen (2014), Lyon and Montgomery (2015) explain greenwashing as “any communication that misleads people into adopting overly positive beliefs about an organisation’s environmental performance, practices, or products” (p. 226).

2.3. Greenwashing motives

With the increased attention to greenwashing in the academic literature, an increasing number of papers explore the drivers and circumstances of greenwashing (Lyon & Montgomery, 2015). The most common theory used by researchers (Aggarwal & Kadyan, 2014; Lyon & Montgomery, 2015) was developed by Delmas and Burbano (2011) that divides greenwashing into three driver levels: external, organisational, and individual.

The external level of drivers includes reasons that are caused by market and non-market actors such as NGOs, consumers, competitors and investors. As highlighted by researchers, lack of regulatory environment (Delmas & Burbano, 2011), weak political and environmental agency pressure (Delmas & Montes-Sancho, 2010; Kim & Lyon 2011, Marquis & Toffel, 2013), as well

as the threat to regulation (Kim & Lyon, 2011), can be drivers of greenwashing. Marquis and Toffel (2013) in their empirical research find that firms with headquarters in countries with undeveloped activist organisations and weak connections to the global economy are more likely to engage in greenwashing activities. Some of the external drivers extensively discussed in media and academic literature are the lack of regulation and a clear definition of sustainability and sustainable actions (de Ferrer, 2020; Lyon & Montgomery, 2015). As pointed out by Lyon and Montgomery (2015) all firms would prefer to engage in greenwashing activities as long as the threat of punishment is negligible from both governmental as well as activist sides.

The organisational level drivers developed by Delmas and Burbano (2011) include low visibility of actions (Delmas & Montes-Sancho, 2010), large company size (Kim & Lyon, 2011), and the image of being "relatively green" (Marquis & Toffel, 2013). Ramus and Montiel (2005) conclude that the implementation of environmental policies is more successful in manufacturing companies compared to service companies. The organisational level drivers are based on firm incentive structure and ethical climate as well as on the effectiveness of the communication within the firms (Lyon & Montgomery, 2015).

The individual-level drivers are rarely discussed in the literature, but it implies psychological drivers of a person such as optimistic bias or narrow decision framing (Delmas & Burbano, 2011).

Overall, previous literature has predominantly focused on external factors encouraging greenwashing, thus suggesting that it is a reactive response. However, there is also an alternative view that greenwashing can be a proactive action meant to influence field or political changes as well as actions used by organisations to preserve existing power positions.

2.4. Classification of greenwashing

Greenwashing is not only defined differently throughout the literature but is also classified in several ways. In their paper Yu, Luu and Chen (2020) distinguish three types of greenwashing. The first one is the manipulation of disclosure. Meaning that companies overstate their actual performance in the sustainability area (Lyon & Maxwell, 2011) and those companies tend to disclose a huge amount of data thus misleading investors (Yu, Luu & Chen, 2020). The next greenwashing type is selective disclosure. Companies using this approach rely on presenting only positively associated data and creating an overly positive image (Yu, Luu & Chen, 2020). However, Marquis et al. (2016) found that with stricter regulations and more public attention

firms are less likely to adopt this greenwashing tactic. The third type of greenwashing in the Yu, Luu and Chen (2020) classification is the product and firm-level discrepancies meaning that the company focuses on delivering a positive image based on one sustainable product.

The greenwashing classification offered by de Freitas Netto et al. (2020) is based on the difference between claim greenwashing and executional greenwashing. First implies a greenwashing method that relies on making misleading claims while executional greenwashing suggests nature-evoking elements (usage of green colour, picture of endangered species, backgrounds with natural landscapes etc.) (de Freitas Netto et al, 2020). Authors also distinguish between firm-level and product-level greenwashing similarly to Yu, Luu and Chen (2020) in the third type of greenwashing.

Further, Gatti, Pizzetti and Seele (2021) present greenwashing typology based on the type of deception (active vs passive) and level of greenwashing (action vs communication). Active deception is explained as the creation of false information while passive deception is misleading through lack of full disclosure. Active greenwashing implies the presentation of false information to stakeholders while communication greenwashing implies only information selection in order to create a more positive picture of the company.

2.5. Regulation of greenwashing

Considering the lack of common greenwashing definition and aligned taxonomy in the academic world, there is a lack of regulation when it comes to green marketing. Further, every country has developed its marketing and advertising laws that should govern green marketing as well (Agarwal & Kadyan, 2014). Although, as Agarwal and Kadyan (2014) point out, there have been several attempts from different governments to impose regulation to ensure the legitimacy of environmental claims, the scope of those regulations vary significantly.

To improve CSR research and practice, Kurpierz and Smith (2020) explore the similarities between fraud and greenwashing. The researchers' highlight that fraud is a legal affair with clearly defined punishment however neither the USA nor Canada has a clear legal definition of fraud because clearly defining fraud would encourage individuals to find a way to work around the definition. The authors claim that greenwashing could be perceived as a fraud as it entails the seven-step fraud process as defined by Albrecht et al. (2011) and has a similar structure as fraud, thus is consistent with the fraud triangle (Kurpierz & Smith, 2020). The fraud triangle defines that all fraudulent activities should have 3 traits: pressure to get money, an

opportunity to do that and admission of such behaviour as aligned with the individual's self-image. Kurpierz and Smith (2020) emphasise that the comprehension of the similarities between fraud and greenwashing could be meaningful for further research, understanding of greenwashing and development of new policies to address the issue.

2.6. Greenwashing and CSR reporting

In order to inform the stakeholders about the company's compliance with social and environmental activities, companies are increasingly issuing CSR reports (Kolk, 2003). Investors, governments, NGOs, insurers, underwriters and other stakeholders also increasingly rely on the information in CSR reports to make their investments decisions, analyse possible risks and safety measures, compare the ESG performance between the firms and determine the company's proactiveness in the stated activities (Tate et al., 2010). Communication of ESG practices can help companies to gain a competitive advantage, show the importance of CSR issues within it, strengthen relations with the stakeholders and improve reputation and corporate image (Uyar et al., 2020).

There are two purposes identified as to why companies might engage in CSR reporting, namely signalling (Spence, 1978) and greenwashing (Guo et al., 2018). Signalling purpose states that more sustainable companies are more likely to publish CSR reports in order to signal their superior commitment to CSR measures and ensure that stakeholders are informed about the "'appropriateness of the firms' actions taken on social and environmental issues" (Mahoney et al., 2013, p. 351). On the other hand, greenwashing suggests that CSR reports are used as a legitimation strategy to create an impression that the firm is socially responsible. Here it relies on the assumption that stakeholders perceive the issuance of CSR reports as a beneficial feature to the company's social performance. This implies that firms with weaker ESG performance would want to influence stakeholders' perceptions more and thus would more actively engage in CSR reporting (Mahoney et al., 2013).

There are several studies done that support either the greenwashing or signalling aspect of CSR reports. For example, Dhandhania and O'Higgins (2021) have highlighted the discrepancy between the CSR reporting and actual performance among Tobacco and Gambling companies, the so-called "sin" companies. Using multiple case study methods combined with content analysis, authors find that sin companies use CSR reporting to gain legitimacy via putting emphasis on positive attributes, for example, actions taken to reduce harmful effects of

tobacco and declaration of CSR values while excluding the negative aspects and directing the focus to other industry companies or regulatory burden (making themselves appear as victims) (Dhandhania & O'Higgins, 2021). On the other hand, Uyar et al. (2020) investigate a sample of logistics sector companies worldwide and find a positive link between CSR performance and reporting, meaning that firms with better CSR performance are more likely to issue CSR reports, thus supporting the signalling purpose highlighted above. Authors find that CSR disclosure coupled with superior performance provides several benefits to the company, such as "reducing information asymmetry between managers and shareholders and lowering the cost of equity" (Uyar et al., 2020, p. 9).

To follow if the companies are taking actions to comply with legislation several countries have implemented mandatory disclosure programs. Empirical studies suggest (Delmas et al., 2010) that mandatory disclosure programs in fact lead to improved environmental performance (Kim & Lyon, 2011). Considering this, companies have implemented voluntary disclosure programs to appeal to society as more environmentally friendly, however, that has an ambiguous effect as distrust in such reports is extremely high due to the possible greenwashing concerns (Kim & Lyon, 2011). Some researchers concluded that disclosure will be positively correlated with firms' performance as more open firms have better results to present (Song Shin, 2003; Sinclair-Desgagne & Gozlan, 2003). On the other hand, some management scholars emphasise that companies tend to increase the disclosure after damaging events to boost their positive image within society (Patten, 1992).

2.7. Greenwashing and financial performance

The overall view of greenwashing companies by stakeholders is negative – they are perceived as manipulative, opportunistic and untrustworthy. The negative association occurs because greenwashing is never done by accident but rather is a "strategic, intentional and voluntary corporate lie and the dissemination of disinformation" (Gatti et al., 2021, p. 229). Once the company engages in communication, in this case, ESG communication, the stakeholders with whom this conversation is held, expect companies to be honest and simultaneously create expectations about the company's ability to follow their claims. If companies break their promises, it affects the stakeholders' opinion about the company reducing attitudes and intentions, thus creating a negative effect (Gatti et al., 2021).

With regards to CSR, manipulative communication is viewed to be coming from corruption and corporate misbehaviour within the company which leads to greenwashing infuriating the misbehaviour-judgements leading to even more severe consequences. Therefore, individuals are less willing to invest in companies accused of greenwashing, which in return means that greenwashing has a negative effect on stock returns. This comes from an observation that investors would be adjusting the projected cash flows for the perceived misbehaviour (Gatti et al., 2021). Other misbehaviour that is not linked with CSR promises may be less influential to the investor decisions than greenwashing simply because there are no expectations from their side – no promises to break by this misbehaviour (Gatti et al., 2021).

In his study Du (2015) analyses 14 Chinese firms that have been listed as greenwashing companies in the *South Weekend* newspaper and finds that identified companies have lower cumulative abnormal returns (CAR) around the exposure of greenwashing which holds also over time, meaning that the market values greenwashing negatively. Additionally, the author finds a significant positive relationship between CAR and corporate environmental performance scores around greenwashing, suggesting that investors can differentiate between environmentally friendly and unfriendly firms through corporate performance scores, meaning that for the companies it is more beneficial to fulfil their environmental duty rather than engage in greenwashing, as the market would punish these firms (Du, 2015).

As raised by Gatti et al. (2021) the perceived negative effect of greenwashing from the investor side also depends on the type of greenwashing. Authors find that investors were less willing to invest in the companies which engaged in active greenwashing compared to passive greenwashing. Additionally, the greenwashing effect depends on the scope of the greenwashing is done – either communication or action-level greenwashing. Authors find that intentions to invest were much lower when the greenwashing was carried out at the action level (Gatti et al., 2021).

While active vs passive and action vs communication level greenwashing can be analysed separately, the interactions between them also provide relevant conclusions. Looking at the interactions between these types of greenwashing authors find active greenwashing on an action level to be the most detrimental one to the intention to invest. Additionally, the negative effect of passive greenwashing on the intention to invest was more accentuated when it happened at action rather than communication level, meaning “when the company diverted attention from

environmental problems with actions, rather than with selected words" (Gatti et al., 2021, p. 234).

2.8. Hypothesis development

Based on the literature review we form two hypotheses.

Potential greenwashing companies might not only perform poorly in the sustainability field but also willingly lie to society and shareholders. Therefore, as indicated by Gatti et al. (2021) greenwashing is overall negatively perceived by all stakeholders and presumed as manipulative communication from the company's side. This further implies that there could be more misbehaviour from the company management side, thus overall implying negative effects and decreased investor willingness to invest in companies engaging in greenwashing activities. Therefore, our first developed hypothesis is as follows:

H1: The abnormal returns for portfolios formed from potential greenwashing companies are negative.

According to Du (2015), greenwashing has negatively affected the abnormal returns of companies in China. This was an event study, but we expect to observe similar relationships over the long run as well.

Further while developing the second hypothesis, we consider research done by Pope (2021). This research indicated increased attention to the sustainability of the products from the customer perspective. Considering potentially increased sales for sustainable companies and research done by Hartzmark & Sussman (2019) that indicates investor willingness to invest in more sustainable companies in the last few years we develop our second hypothesis that focuses on the relationship between greenwashing and abnormal returns over the time.

H2: The negative relationship between relative greenwashing score and abnormal returns is more significant over time.

As pointed out by several researchers (de Freitas Netto et al., 2020; Friede et al., 2015) the number of academic papers on the greenwashing phenomenon has increased over the last decade. Additionally, investors and customers are paying more attention to the sustainability of companies and products in recent years, therefore we developed hypotheses that over time companies with higher peer relative greenwashing scores will present lower abnormal returns in line with the increased attention.

3. Data

3.1. Time horizon and sample

To analyse the effect of greenwashing on stock prices, we use companies that are included in the STOXX 600 Europe index. The index covers 17 countries from Europe, not limited to the Eurozone, and includes 600 companies. The index represents large, mid and small capitalization companies. Considering that the index is reviewed quarterly we use the composition of the STOXX 600 Europe index at the end of December 2021 (Qontigo, 2022). We analyse the companies of this index throughout the last 6-year period from January 2015 to December 2020. This time period is chosen in order to retrieve as many full firm observations as possible. As of the time of this research, the data for the year 2021 is not yet published in a sufficient amount, especially for the measures used to identify greenwashing companies.

3.2. Data on ESG measures

We use two types of company ESG measures - ESG performance score obtained from the Thomson Reuters database and ESG disclosure score from Bloomberg. Bloomberg's ESG disclosure score as a measure of a firm's ESG disclosure has been used in previous studies (Eliwa et al., 2021; Tamimi & Sebastianelli, 2017; Yu et al., 2020; Yu & Luu, 2021). The score reflects the quantity of ESG related information the company chooses to disclose to the public – a summary of mandatory and voluntary disclosures available to all stakeholders. Bloomberg's score ranges from 0.1 for companies that disclose a minimum amount of ESG data, to 100 for companies that disclose every item Bloomberg considers in its score calculation. Altogether 900 key disclosure indicators (e.g., direct CO2 emissions, total energy consumptions, total water use, hazardous waste, minorities in the workforce, community spending, board meeting attendance) are firstly reported separately for each dimension, afterwards weighting the data based on the sector the company operates in to compile the total Bloomberg's ESG disclosure score (Yu et al., 2020; Yu & Luu, 2021).

To represent a company's actual performance based on the ESG pillars we use the Thomson Reuters ESG performance score. This score has been widely used in academic research – as of June 24, 2021, there are more than 1500 articles that have mentioned Refinitiv ESG data usage in empirical tests or as a valuable reference in the research (Berg et al., 2021). Thomson Reuters calculates more than 500 firm-specific ESG measures of which 186 most relevant data

points are selected as the base of the overall company assessment and scoring process. The final ESG score is computed from 10 categories covering the 3 pillars which are weighted based on the industry specifics – Environmental (resource use, emissions, innovation), Governance (management, shareholders, CSR strategy) and Social (workforce, human rights, community, product responsibility) (Refinitiv, 2021). The ESG score reflects the "company's ESG performance based on publicly reported information" (Refinitiv, 2017, p. 6) and is an enhancement and replacement of ASSET4 ratings. Information in databases is updated continuously in line with corporate reporting patterns which, in most cases, leads to data for a specific company being updated once a year (Refinitiv, 2021). The ESG performance score ranges between 0 and 100 where better performance is represented by higher score values (Yu et al., 2020).

The data sources are updated throughout the year based on the company's fiscal year-end; thus we are able to obtain data on a monthly basis from January 2015 till December 2020.

3.3. Data sources

For this research, we retrieve data from 3 sources namely Thomson Reuters, Bloomberg and Kenneth French data library. The company's actual stock returns and ESG performance scores are retrieved from Thomson Reuters, however, the ESG disclosure score is obtained from the Bloomberg database in line with Yu et al. (2020) which is used as the base paper for the methodology part. Factors for the regression are obtained from the French data library (Kenneth R. French Data Library, n.d). The description of each variable and its source can be seen in the table below.

Table 1. Description of variables used in the methodology part.

Variable	Description	Source
$\mathbf{R_{it}}$	Excess returns for company i, calculated as $Actual\_Returns_{it} - R_{ft}$	Calculated
$\mathbf{Actual\_Returns_{it}}$	Actual monthly excess returns for company i	Thomson Reuter
$\mathbf{RF_t}$	Market risk free rate	Kenneth French's website
$\mathbf{RM_t}$	Monthly market return (return on Europe's value weighted portfolio minus the U.S. one month T-bill rate)	Kenneth French's website
$\mathbf{SMB_t}$	Historical excess returns between small-cap and large-cap companies (Fama & French, 1995)	Kenneth French's website
$\mathbf{HML_t}$	Historical excess returns of value stocks (high P/B ratio) over the growth stocks (low P/B ratio) (Fama & French, 1995)	Kenneth French's website
$\mathbf{RMW_t}$	The average form two robust operating profitability portfolio minus two weak operating profitability portfolios (Fama & French, 1995)	Kenneth French's website
$\mathbf{CMA_t}$	The average return on two conservative investment portfolios minus the average return on the two aggressive investment portfolios (Fama & French, 1995)	Kenneth French's website
$\mathbf{GS_{it}}$	Peer relative ESG score calculated as normalized $Performance_{it}$ - normalized $Disclosure_{it.}$ Normalized score is obtained based on industry relative performance	Calculated
$\mathbf{Performance_{it}}$	ESG Performance score as the ASSET 4 score	Thomson Reuter
$\mathbf{Disclosure_{it}}$	Bloomberg ESG Disclosure score	Bloomberg
$\mathbf{Industry_i}$	Set of dummies identifying GICS industry sectors	Thomson Reuter

4. Methodology

Since the data for greenwashing estimation is available with monthly frequency, the use of conventional event study methodology does not apply in this case, thus we use the calendar-time portfolio approach as in Jaffe (1974) and Mitchell and Stafford (2000) research papers. Lyon et al. (1999) analyse two approaches used by academics for tests of long-run abnormal returns – the first approach is based on the event study method and buy-and-hold abnormal returns, however, the second is based on calendar-time portfolios as discussed by Fama (1998). Authors find that the calendar-time portfolio method eliminates the problem of cross-sectional dependence among firms, yields more robust test statistics in non-random samples and is less

sensitive to a poorly specified asset pricing model compared to methods based on buy-and-hold abnormal returns. Although this model does not precisely measure investor experience, the benefits seem to outweigh its costs (Lyon et al., 1999). This methodology has been previously applied to ESG rating changes (Shanaev & Ghimire, 2021), mergers and acquisitions (André et al., 2004; Dutta & Jog, 2009; Bessembinder & Zhang, 2013), CEO turnover (Demirtas & Simsir, 2016) and confidential short-sales disclosure (Galema & Gerritsen, 2019).

4.1. Abnormal returns

We estimate monthly abnormal stock returns for each STOXX 600 Europe company in the chosen period (January 2015 – December 2020). Abnormal stock returns are defined as a difference between the actual and expected stock returns calculated using an asset pricing model. In order to assess the most applicable model to our case, we analyse the most widely used empirical asset pricing models, namely, Capital Asset Pricing Model (CAPM), the three-factor model, the four-factor model, and the five-factor model.

One of the key problems when applying the calendar-time portfolio approach to long-run horizons is the possibility of miss-specifying the asset pricing model. Borup (2019) analyses the performance of conventional asset pricing models for assessing abnormal returns using calendar-time portfolio methodology and finds that CAPM, Fama-French (FF) three-factor, Carhart's four-factor and FF five-factor models suffer from omitted variable bias in a time period of 1980-2015. Authors argue that the recent time period is associated with eight-nine factors explaining expected returns which are out of the scope of any conventional asset pricing model (Borup, 2019). Bello (2008) finds that in terms of statistical goodness of fit, there are no significant differences between CAPM, FF three-factor and Carhart's four-factor model, however, in terms of quality of prediction, the FF three-factor model is a significant improvement over CAPM, and Carhart's four-factor model is a significant upgrade over the FF three-factor model (Bello, 2008). In our research, however, we choose to adopt the Fama-French five-factor model which adds profitability and investment effects to the three-factor model. These two factors, as argued by (Fama & French, 2016), are important over the long run which makes this model more appropriate when analysing long horizons. Carhart's four-factor model compared to FF five-factor model includes the momentum factor, however, this factor is believed to be more significant over the short-term, rather than in the long-term horizons, which is the case in this study.

FF five-factor model uses firm excess returns as the response variable for the regression, thus for each firm, we calculate the excess returns on monthly basis following the equation:

$$R_{it} = Actual\_Returns_{it} - RF_t \qquad (Eq. 1)$$

where R_{it} is the excess return for the company i at time t, $Actual\_Returns_{it}$ is the company's i monthly return during the month of time t and RF_t is the risk-free rate of return at time t.

4.2. Greenwashing

To identify greenwashing companies, in previous research academics have used content analysis of ESG disclosure reports, advertisements and company websites (Agarwal & Kadyan, 2014; Clarkson et al., 2008; Dhandhania & O'Higgins, 2021), the list compiled by the newspaper (Du, 2015), rating disagreements between agencies (Yang, 2020), the discrepancy between CSR rating and communication efforts made based on the number of reports per year and number of report pages (Bazillier, 2009), employee surveys (Ramus & Montiel, 2005; Szabo & Webster, 2021), participation in the green-watch program (Miller et al., 2020) and interviews (Olatubosun & Nyazenga, 2019; Szabo & Webster, 2021).

The timeframe and available data sources of this research do not allow us to perform content analysis of reports, analyse conference calls or rely on a compiled greenwashing-company list. In order to keep the intention of analysing several companies rather than focusing on a few specific cases, we choose to identify greenwashers as the firms which disclose a large amount of data on their ESG pillars but perform poorly on their ESG performance aspect. Thus, to identify greenwashing companies, we adopt a methodology used by Yu et al. (2020), while other academics have adopted a similar idea of quantifying greenwashing (In & Schumacher, 2021; Kim et al., 2021; Mahoney et al., 2013), particularly this methodology matches our available data sources. As seen from the literature review, recently ESG data has been an important decision factor for investors when searching for prospective investments. However, it has also experienced increased attention from the company side which try to use ESG data for their benefit (Amel-Zadeh & Serafeim, 2018). Due to the complex nature of greenwashing, there is no clear definition in scholarly or popular press (Lyon & Montgomery, 2015), however, several attempts have been made to describe it. In the previous literature greenwashing is considered in varying scopes – only in environmental terms (Delmas & Burbano, 2011), in environmental and social aspects (Lyon & Maxwell, 2011) and as any misleading communication of ESG practices (Bowen, 2014; Lyon & Montgomery, 2015). Based on these

previous academic works and the increased attention towards ESG data, we choose to adopt the methodology which looks at greenwashing behaviour as misleading communication across all ESG pillars, considering them as interconnected (Yu et al., 2020).

As of now, there is no commonly acknowledged greenwashing score, thus the calculated numbers, in this case, cannot be used in absolute measures, however, creating a peer-relative score allows to set boundaries to which companies can be identified as engaging in greenwashing. The authors quantify greenwashing using a peer-relative greenwashing score:

$$GS_{it} = Disclosure_{it} - Performance_{it} \qquad (Eq. 2)$$

where $Disclosure_{it}$ is the normalised measure representing the firm's relative position to its peers in the distribution of the Bloomberg ESG disclosure score and $Performance_{it}$ is the normalised measure of the firm's relative position to its peers in the distribution of ASSET4 ESG performance score and later Thomson Reuters ESG performance score as the ASSET4 score was modified in 2020 (Yu et al., 2020). Initial scores obtained from Bloomberg and Thomson Reuters databases accordingly are transformed into ratios in a way that the maximum value for them is 1 and normalised by subtracting the industry mean and dividing by industry-standard deviation. Here, 3 discrete situations can be identified – company (1) discloses a lot of ESG data such that it over exaggerates its achievements in ESG performance and thus its peer-relative greenwashing score is positive, (2) discloses all its ESG information so that it matches the reflection of firm's actual ESG performance and thus its peer-relative score is 0 or (3) discloses less ESG information than is reflected by its ESG performance and thus its peer-relative greenwashing score is negative (Yu et al., 2020).

4.3. Portfolio formation

According to the methodology used by Yu et al. (2020), the firms with a positive peer-relative greenwashing score can be identified as greenwashers, and those with a negative one as non-greenwashers meaning that the authors use a hard cut-off at point 0 for greenwashing score (GS_{it}). In our case, instead of using a cutoff point at 0, we divide the companies into terciles for each month based on their greenwashing score and identify the first-tercile as non-greenwashing companies and the third-tercile as the greenwashing ones. We exclude the second-tercile from any further calculation and identify the companies in it as neutral in terms of greenwashing. The division into terciles rather than using the positive/negative approach by Yu et al. (2020) allows us to separate more extreme cases on the positive and negative greenwashing score spectrum.

Further, we construct the calendar-time portfolio method by creating three equally weighted portfolios - (1) firms within the third-tercile or the greenwashers, (2) firms within the first-tercile or the non-greenwashers and (3) a market-neutral portfolio that is long in first-tercile firms (non-greenwashers) and short in third-tercile firms (greenwashers). Portfolio rebalancing happens monthly, as the ESG performance data is updated throughout the year based on when the fiscal year for the specific company ends. The performance of the portfolio thus can be measured as:

$$R_{pt,t} = \frac{\sum_{i=1}^{S} R_{it}}{S} \qquad (Eq. 3)$$

where $R_{pt,t}$ are the excess returns of portfolio pt in month t, R_{it} is the excess returns of the company i of portfolio pt in month t and S is the number of securities included in the portfolio (Jaffe, 1974). Portfolio composition depends on the tercile for which it is being formed (greenwasher, non-greenwashers) and the specific companies within that tercile at month t. Each month, each company can be present in a maximum of 1 portfolio, depending on its greenwashing-score tercile.

The portfolio excess returns are further regressed using the five-factor Fama and French model:

$$R_{pt} = a_{pt} + b_1(RM_t - RF_t) + b_2 SMB_t + b_3 HML_t + b_4 RMW_t + b_5 CMA_t + e_{pt} \quad (Eq. 4)$$

where R_{pt} is the return on the portfolio, RF_t is the risk-free return, RM_t is the return on the value-weight market portfolio, SMB_t is the return on a diversified portfolio of small stocks minus big stocks, HML_t is the difference between the returns on diversified portfolios of high and low B/M stocks, RMW_t – the difference between the returns on diversified portfolios of stocks with robust and weak profitability, CMA_t is the difference between the returns on diversified portfolios of the stocks of low and high investments (conservative vs. aggressive) and e_{pt} is a zero-mean residual (Fama & French, 2015). For each month-observation, we have 3 separate regressions for each portfolio respectively - (1) greenwashing, (2) non-greenwashing and (3) market neutral.

The intercept alfa a_{pt} thus measures the average monthly abnormal return on the portfolio of firms identified as greenwashers or non-greenwashers which is equal to 0 if no abnormal returns are identified. However, here intercept may also represent the combined effects of mispricing and model misspecification which is referred to as a "joint-test problem" – such a case occurs when the used model provides an imperfect description of expected returns.

5. Results

5.1. Descriptive statistics

The descriptive statistics of our initial data set can be seen in Appendix A. The initial data set has 43 272 observations – 72 observations for each of 600 companies and the stock index itself together. Further, we filter out data with missing observations for ESG performance and ESG disclosure scores and in the final data set used for this research, we have 31 514 observations across in total of 541 companies. To limit extreme values and reduce the possibility of spurious outliers we winsorize outliers to the 1st and 99th percentile for company actual stock returns. The summary of the main variables of the final data set that is used for further calculations can be seen in Table 2.

Table 2. Summary of the main variables from the dataset used in this research.

Variable	Actual returns	ESG Performance	ESG Disclosure
Maximum	0.2287	93.5719	73.5537
Minimum	-0.2035	3.2480	2.0661
Mean	0.0092	58.2647	44.9934
Median	0.0076	59.8293	46.6942
Observations	31514	31514	31514

After winsorizing monthly stock returns, this data falls within the interval of -20.35% and +22.87% with mean monthly stock returns being only 0.92%. ESG performance score, in Thomson Reuters database given as a number from 0 to 100, in our data set falls within 3.25 and 93.57 implying that no companies are doing completely nothing in either of ESG pillars as well as no companies are reaching a maximum score of 100. The mean ESG performance score in this data set is 58.27. ESG disclosure scores retrieved from the Bloomberg database can reach values from 0 to up to 100. Similarly, as for the ESG performance score, there are no companies at both ends of this scale with the minimum score being 2.07 and the maximum score being 73.55, however, the mean score is meaningfully lower – only 45.

The companies are classified based on Global Industry Classification Standard (GICS), thus divided into 11 separate sectors. After creating an industry-based peer relative score we obtained the following (Table 3) greenwashing score statistics for different industries. To ensure the trustworthiness of the results the count of firms in each industry was checked and the smallest number of firms was 14 for the Energy sector which is sufficient to obtain reliable

results. The mean of greenwashing score for the Health Care industry is the smallest and slightly negative while the Consumer Staples industry has the largest mean across the industry, however, means of greenwashing scores from 2015 to 2020 are close to zero while the minimum and maximum ESG score values differ across industries.

For all of the GICS sectors, there are company observations at both ends of the greenwashing score distribution (positive and negative) meaning that in all of the industries we are able to identify potential greenwashers (positive greenwashing score) and potential non-greenwashers (negative greenwashing score). Among all sectors, Industrials has the highest greenwashing score of 4.43 while the lowest value of -5.12 is in the Materials sector. The mean of all greenwashing scores in our sample is 0 while the median is slightly negative at -0.0530. The distribution of greenwashing scores across our sample firm observations (2015 - 2020) can be seen in Appendix B.

Table 3. Summary statistics of greenwashing scores for GICS industries of STOXX 600 Europe companies between January 2015 and December 2020.

GICS sector	Maximum	Minimum	Mean	Count of firms	Percentage of all firms
Communication Services	2.48	-3.46	-6.29e-17	33	6.10%
Consumer Discretionary	3.47	-3.60	1.42e-16	61	11.28%
Consumer Staples	3.03	-3.84	4.84e-16	39	7.21%
Energy	2.24	-2.36	-8.00e-17	14	2.59%
Financials	2.90	-3.68	3.02e-16	93	17.19%
Health Care	3.87	-2.66	-3.67e-16	51	9.43%
Industrials	4.43	-3.99	-1.32e-16	107	19.78%
Information Technology	3.42	-3.06	-1.18e-16	30	5.55%
Materials	3.00	-5.12	3.55e-16	48	8.87%
Real Estate	2.70	-3.60	2.81e-16	35	6.47%
Utilities	2.39	-3.70	-2.99e-16	30	5.55%

The table demonstrates summary statistics of greenwashing scores for GICS industries, the respective count of the firms and the percentage of all firms used in the research. The count of firms is taken as all unique tickers available in the dataset, however, not all firms have every monthly observation available. It can be observed that the majority of the analysed firms operate in Industrials, Financials and Consumer Discretionary sectors. The greenwashing scores for each industry are both on a positive and negative spectrum.

5.2. Excess returns for greenwashing and non-greenwashing portfolios

In this section, we present the main results of the potential greenwashing and non-greenwashing behaviour on portfolio performance between January 2015 and December 2020.

Firstly, as shown in equation (1), we calculate the excess returns over the risk-free rate for each of the company observations (in total 72 for each). Further, we calculate the peer-relative greenwashing score for each company at the specific month (Eq. 2) and divide the companies into terciles for each monthly observation. Next, we drop the second tercile and divide the first and third tercile into non-greenwashing and greenwashing company portfolios for the specific month accordingly. Portfolios are equally weighted, thus for each of the portfolios, we calculate the monthly return in line with equation 3. The market-neutral portfolio returns for each month are calculated as non-greenwashing portfolio returns minus greenwashing portfolio returns. We regress the obtained portfolio excess returns using the FF five-factor model (Eq. 4) creating separate regressions for greenwashing (third-tercile), non-greenwashing (first-tercile) portfolios and market-neutral portfolios.

Table 4. Regression analysis of non-greenwashing company portfolios.

Variables	Estimate	Std. Error	t value	p-value	
Alpha	0.0048	0.0022	2.1530	0.0350	**
RM - RF	0.7724	0.0602	12.8390	<2e-16	***
SMB	-0.0532	0.1412	-0.3770	0.7080	
HML	0.1110	0.1893	0.5860	0.5600	
RMW	0.3592	0.2284	1.5730	0.1210	
CMA	-0.2654	0.2820	-0.9410	0.3500	
Observations	72				
R-squared	0.8074				

This table presents the results of the linear regression of non-greenwashing company portfolios from January 2015 to December 2020. The regression was performed using the five-factor Fama French model which includes market excess returns, size, value, profitability and investment patterns factors. Returns of non-greenwashing portfolios are used as the dependent variable. Portfolio returns are calculated as the average of monthly excess returns of companies included in the portfolio in the respective month. *p < 0.1; **p < 0.05; ***p < 0.01.

From the regression results above it can be seen that portfolios consisting of non-greenwashing companies have a positive and statistically significant alpha coefficient at a 5% level showing that the monthly alpha for this portfolio is 0.48%. The market premium has a positive and statistically significant coefficient, while SMB and CMA factors show an insignificant negative relation with portfolio returns. The effect of HML and RMW factors is positive but also statistically insignificant. Adjusted R-squared for non-greenwashing company portfolios regression is 80.74%.

Table 5. Regression analysis of greenwashing company portfolio.

Variables	Estimate	Std. Error	t value	p-value	
Alpha	0.0026	0.0218	1.1980	0.2351	
RM - RF	0.7783	0.0584	13.3190	<2e-16	***
SMB	-0.3105	0.1372	-2.2640	0.0269	**
HML	0.1726	0.1839	0.9390	0.3514	
RMW	0.2854	0.2219	1.2870	0.2027	
CMA	-0.2335	0.2739	-0.8520	0.3971	
Observations	72				
R-squared	0.8167				

This table presents the results of the linear regression of greenwashing company portfolios from January 2015 to December 2020. The regression was performed using the five-factor Fama French model which includes market excess returns, size, value, profitability and investment patterns factors. Returns of greenwashing portfolios are used as the dependent variable. Portfolio returns are calculated as the average of monthly excess returns of companies included in the portfolio in the respective month. *p < 0.1; **p < 0.05; ***p < 0.01.

Greenwashing portfolio regression, similarly to a non-greenwashing company portfolio, has a positive alpha coefficient, however, the coefficient is relatively smaller - only 0.26% compared to the non-greenwashing portfolio intercept of 0.48%. However, this alpha coefficient is statistically insignificant. Market premium is statistically significant and positive, while the SMB factor is significant at a 5% level and is negative. HML and RMW factors are positive and statistically insignificant, while the CMA factor is negative and not statistically significant. The adjusted R-squared for greenwashing company portfolio is 81.67% and it is larger than for the non-greenwashing portfolio.

5.3. Excess returns of market-neutral portfolio

Table 6. Regression analysis of market neutral portfolio where the greenwashing portfolio is in a short position and non-greenwashing portfolio is in a long position.

Variables	Estimate	Std. Error	t value	p-value	
Alpha	0.0022	0.0011	1.9480	0.0557	*
RM - RF	-0.0059	0.0305	-0.1940	0.8471	
SMB	0.2573	0.0717	3.5880	0.0006	***
HML	-0.0616	0.0961	-0.6400	0.5241	
RMW	0.0737	0.1160	0.6360	0.5271	
CMA	-0.0319	0.1432	-0.2230	0.8424	
Observations	72				
R-squared	0.2072				

This table presents the results of the linear regression of market neutral portfolios from January 2015 to December 2020. The regression was performed using the five-factor Fama French model which includes market excess returns, size, value, profitability and investment patterns factors. The difference between non-greenwashing and greenwashing portfolio returns in each month is used as the dependent variable. Portfolio returns are calculated as the average of monthly excess returns of companies included in the portfolio in the respective month. *p < 0.1; **p < 0.05; ***p < 0.01.

Market neutral portfolio alpha coefficient is positive and statistically significant at a 10% significance level. Considering that for greenwashing and non-greenwashing portfolios alphas were positive, this indicates that alphas for both portfolios are not cancelling out. The alpha of the market-neutral portfolio is 0.22% per month and shows that the alpha from regression represented in Table 4 and the alpha from regression in Table 5 are significantly different from each other. The non-greenwashing portfolio alpha is significantly larger compared to the alpha of greenwashing companies. For a market-neutral portfolio, the SMB factor is positive and statistically significant, while other factors are not. The market premium has a slightly negative coefficient, the same as HML and CMA factors, while RMW has a slightly positive coefficient. The adjusted R-squared has meaningfully decreased compared to greenwashing and non-greenwashing portfolios and now is 20.72%.

5.4. Excess returns effect over time

To assess the effect that greenwashing portfolios have over alpha over time we divided our time frame into two separate time periods and compared the results for non-greenwashing and greenwashing portfolios from 2015 to 2017 and from 2018 to 2020.

Table 7. Results of regression analysis for the non-greenwashing portfolio (on the top) and greenwashing portfolio (on the bottom) for the time period from 2015 to 2017.

Non-greenwashing portfolio

Variables	Estimate	Std. Error	t value	p-value	
Alpha	0.0161	0.0036	4.5210	8.98e-05	***
RM - RF	0.4966	0.1087	4.5700	7.82e-05	***
SMB	-0.7816	0.2414	-3.2380	0.0029	***
HML	-0.4609	0.3525	-1.3080	0.2009	
RMW	-0.7478	0.3854	-1.9400	0.0618	*
CMA	-0.9192	0.4282	-2.1470	0.0400	**
Observations	36				
R-squared	0.7161				

Greenwashing portfolio

Variables	Estimate	Std. Error	t value	p-value	
Alpha	0.0160	0.0038	4.1730	0.0002	***
RM - RF	0.5367	0.1171	4.5840	7.52e-05	***
SMB	-1.1559	0.2601	-4.4440	0.0001	***
HML	-0.6184	0.3798	-1.6280	0.1139	
RMW	-1.0312	0.4153	-2.4830	0.0188	**
CMA	-0.9658	0.4613	-2.0940	0.0449	**
Observations	36				
R-squared	0.7420				

This table presents the results of the linear regression of non-greenwashing and greenwashing company portfolios from January 2015 to December 2017. The regression was performed using the five-factor Fama French model which includes market excess returns, size, value, profitability and investment patterns factors. Returns of non-greenwashing and greenwashing portfolios are used as dependent variables depending on the analysed case. Portfolio returns are calculated as the average of monthly excess returns of companies included in the portfolio in the respective month. *p < 0.1; **p < 0.05; ***p < 0.01.

The alphas for both portfolios are significant and positive: 1.61% for non-greenwashing portfolios and 1.60% for greenwashing portfolios monthly. Both regressions have positive and significant coefficients for the market premium while all other factors have negative coefficients. For non-greenwashing and greenwashing portfolios from 2015 to 2017, all coefficients except HML are statistically significant at different significance levels. Adjusted R squared is 74.20% for the greenwashing portfolio and 71.61% for the non-greenwashing portfolio.

Table 8. Results of regression analysis for the non-greenwashing portfolio (on the top) and greenwashing portfolio (on the bottom) for the time period from 2018 to 2020.

Non-greeenwashing portfolio					
Variables	Estimate	Std. Error	t value	p-value	
Alpha	0.0018	0.0035	0.5260	0.6030	
RM - RF	0.8040	0.0730	11.0140	4.61e-12	***
SMB	-0.0325	0.1968	-0.1650	0.8700	
HML	0.1965	0.2180	0.9020	0.3740	
RMW	0.4702	0.3774	1.2460	0.2220	
CMA	-0.4399	0.4362	-1.0080	0.3210	
Observations	36				
R-squared	0.8787				

Greenwashing portfolio					
Variables	Estimate	Std. Error	t value	p-value	
Alpha	-0.0010	0.0027	-0.3740	0.7112	
RM - RF	0.7691	0.0557	13.8170	1.52e-14	***
SMB	-0.2132	0.1501	-1.4210	0.1657	
HML	0.2852	0.1662	1.7160	0.0965	*
RMW	0.2894	0.2877	1.0060	0.3225	
CMA	-0.4246	0.3326	-1.2770	0.2115	
Observations	36				
R-squared	0.9208				

This table presents the results of the linear regression of non-greenwashing and greenwashing company portfolios from January 2018 to December 2020. The regression was performed using the five-factor Fama French model which includes market excess returns, size, value, profitability and investment patterns factors. Returns of non-greenwashing and greenwashing portfolios are used as dependent variables depending on the analysed case. Portfolio returns are calculated as the average of monthly excess returns of companies included in the portfolio in the respective month. *p < 0.1; **p < 0.05; ***p < 0.01.

The alpha for the non-greenwashing portfolio for the last 3 years (2018-2020) has been a slightly positive while for greenwashing portfolio slightly negative however both coefficients are insignificant, thus we cannot reject the null hypothesis that they are zero. For this time period for both portfolios, only the market premium is statistically significant and it has a positive coefficient. For greenwashing, the portfolio HML coefficient is significant at a 10% significance level. The adjusted R-square is 92.08% for the greenwashing portfolio and 87.87% for the non-greenwashing portfolio. It is important to note that when comparing the alpha coefficients for

two periods for both greenwashing and non-greenwashing portfolios the coefficients have become smaller and less significant.

5.5. Robustness checks

As a robustness test, we checked whether the results hold for a different threshold of the greenwashing score which determines the division of potential non-greenwashing and greenwashing companies. For this, we divide the companies into two groups based on the median greenwashing score in the specific month. Companies above the median score are identified as greenwashers, but those below as non-greenwashers. The abnormal returns for the market-neutral portfolio for this case are 0.17% per month and the result is significant at a 5% significance level (Appendix C). The reflected alpha has decreased in absolute values from 0.22% to 0.17% per month, however, it has increased in significance - from a 10% significance level to 5%. Similar results are also depicted in a case where we use the originally proposed methodology by Yu et al. (2020) and select the cutoff between potential greenwashers and non-greenwashers at 0. Thus, we conclude that the overall relationship between the greenwashing score and company abnormal returns holds for different greenwashing thresholds. The depicted difference in the abnormal returns, however, seems to come from the fact that choosing lower values of greenwashing scores allows us to identify less severe potential greenwashing behaviour and thus also the difference in the abnormal returns is lower. By choosing the median of greenwashing scores as the cutoff value we allow more errors in the company specification as potential greenwashers and non-greenwashers. Compared to using terciles, we do not have any zone of companies that are identified as neutral in terms of greenwashing behaviour.

Additionally, we checked whether there is any difference between non-greenwashing and greenwashing companies in their accounting performance. We perform Welch Two-Sample t-test to check whether there is a difference between the mean of Return on Assets (ROA) for the two samples (greenwashers and non-greenwashers). We obtain that by taking the whole sample (2015-2020) there is a significant difference at a 1% level between the mean ROA measure with a 95% confidence interval of [0.0133, Inf] with non-greenwashers having by 1.49 percentage points (pp) larger mean value of ROA (Appendix D). This holds also for all the single years, except the year 2015 when the ROA for non-greenwashers is higher by 0.48pp but significant only at a 5% level. This could be either because of the comparingly lower sample size, the fact that attention to the company sustainability was not yet so pronounced or perhaps could reflect

that different regulations for encouraging sustainability came after the year 2015 which decreased the greenwashing company ROA in further years, thus generating this difference in sample means.

6. Analysis and discussion of results

In this research, our main aim is to explore the effect of greenwashing on company stock performance during the last 6-year period (2015-2020). Our intention is to identify whether there is an effect associated with potential greenwashing on company stock performance, whether this effect is positive or negative and whether it varies over time.

Our main findings indicate that portfolios consisting of greenwashing companies are associated with lower abnormal returns compared to portfolios consisting of non-greenwashing companies. Separately monthly alphas obtained from greenwashing and non-greenwashing portfolio regressions are both positive (0.26% and 0.48% respectively) suggesting that abnormal returns for both portfolios are positive. The abnormal returns for the greenwashing portfolio are still positive but lower than for the non-greenwashing portfolio. For the non-greenwashing portfolio, the alpha was statistically significant at the 1% level indicating that the obtained abnormal returns (alpha coefficient) are likely different from 0 while for the greenwashing portfolio the alpha was not significant thus the null hypothesis that this coefficient might be zero cannot be rejected. These results come in line with the economic theory as the second tercile portfolio (that we did not identify as either greenwashers or non-greenwashers) had a smaller alpha coefficient compared to the non-greenwashing portfolio but a larger alpha coefficient than greenwashing portfolio (Appendix E).

Further by creating a market-neutral portfolio, we check whether the greenwashing company portfolio's abnormal returns are statistically different from the non-greenwashing company portfolio's abnormal returns. Our main results in Table 6 indicate that the abnormal returns for greenwashers and non-greenwashers are statistically different from each other at the 10% level and the abnormal returns of the market-neutral portfolio are positive. This indicates that in the sample period it was possible to obtain positive abnormal returns via constructing an investment strategy that shorts greenwashing companies and buys non-greenwashing ones according to the peer-relative greenwashing score. This also reflects that abnormal returns of the greenwashing companies are significantly lower than for the non-greenwashers.

To address our second hypothesis about the time effects on portfolio alphas, we divide the previously analysed set into two parts. Unexpectedly, over time alphas seem to decrease and become less significant, indicating that since 2015 smaller part of abnormal returns was affected by the company being a greenwasher or not. When analysing the effect in two time periods we were able to conclude that in the first time period (2015-2017) the alpha was positive and statistically significant for both portfolios, however, for the second time period (2018-2020) the alpha was slightly positive for non-greenwashing portfolio and slightly negative for greenwashing portfolio but overall both alphas were statistically insignificant.

The other part of the discussion is whether this effect of larger alphas for non-greenwashing companies can be expected to diminish over time. From regressions which test the time effect, we could conclude that in the two periods that we analysed separately, namely the period from 2015 to 2017 and the period from 2018 to 2020, the effect of positive and larger alphas was more pronounced in the earlier period, thus indicating that in the future these findings could become less relevant. In the first sample with the earliest data (2015-2017), there is little difference between greenwashing and non-greenwashing portfolio alphas even though they are both significant. However, in the latest sample, the difference between alphas has become bigger and also is in line with what we found when analysing the market-neutral portfolio - that greenwashing companies are punished with lower returns. The intercepts from this regression (Table 8), however, both are insignificant, meaning that possibly there is no difference between the alphas of the greenwashing and non-greenwashing portfolios.

7. Limitations

7.1. Regarding the ESG scores

ESG scores retrieved from Bloomberg and Thomson Reuter databases are a vital part of our research, however, there are some limitations arising from the decision to choose those particular scores.

While calculating the peer-relative greenwashing score we use data from two separate databases that internally calculate ESG disclosure and performance score and both databases internally decide what weights will be given to different metrics in E, S and G parts. These relative weights for the Bloomberg database are not disclosed to the public, therefore we were unable to reweight Thomson Reuters scores in a way that would match the weights used by the

Bloomberg database. This issue might create some inaccuracy for greenwashing scores, however, considering that for all scores this inaccuracy would be the same as they are weighted in the same way for all companies, we believe that this does not affect companies' position in peer-relative scores.

In our research we perform monthly regressions, however, ESG performance and disclosure data is available only once a year, therefore we assume that the performance for the companies does not change over the year, applying the same score for the past 12 months since it has been published. We believe that it is a probable assumption as companies' ESG performance is not very volatile. Meaning that companies are consistently greenwashers or non-greenwashers over the years, therefore we can claim that over months companies are also consistently either greenwashers or non-greenwashers.

7.2. Regarding the time effect analysis of greenwashing score on abnormal returns

Considering that ESG disclosure and ESG performance score we attribute to the company 12 months back from the moment the score has been published then for the most recent data we lack information. This is due to the fact that the Bloomberg database publishes data in the spring of each year and for the year 2021 this data has not been published yet, therefore we decided to interpolate data and assume that in case of lack of data, companies ESG performance in 2020 did not differ from performance in 2019. In this case, we might lose some accuracy of our results but gain a possibility to answer our second hypothesis more precisely as it evaluates the effect that peer-relative greenwashing score has on abnormal returns over time.

In total, interpolation adds 116 companies and 2038 company month-observations to the dataset for the year 2020 (Appendix F). After running the regressions for the two datasets again (2015-2017 and 2018-2020), we expect changes in the latest dataset as the observation as well as the company count has increased for the year 2020. Appendix G in comparison with Table 8 indicates that there are no major differences in the alpha coefficients after interpolation. The p-value in absolute number has increased for both non-greenwashing and greenwashing portfolios, while the coefficients have changed very little keeping the same sign - positive alpha coefficient for non-greenwashing portfolio and negative for greenwashing. Overall, we do not observe any significant differences in our results after the interpolation.

The second limitation for time effect analysis is the small sample size when analysing data in two subsamples. This is due to the fact that for each month we create two separate

portfolios - greenwashers and non-greenwashers and further we work with the data gained from this portfolio. Therefore, when dividing the sample into two subsamples to evaluate data we are left with 36 observations for each sample. The small sample size might affect the accuracy but to increase it we would have to extend the overall time frame of this research which might be difficult due to the lack of data for years prior to 2015.

7.3. Greenwashing score's applicability for measuring greenwashing activity

Another possible limitation could be the descriptive power of the greenwashing score to reflect the company's greenwashing behaviour. Greenwashing oftentimes is thought of as reflecting the company's overstatements of only its environmental aspect which could be better described not by the total ESG score, as used in this research, but only by the Environmental factor of this ESG score. However, as there is no certain definition in the literature of what is a greenwashing company, we follow the methodology developed by Yu et al. (2020) which characterises greenwashers as "firms which seek to create a very transparent public image by revealing large quantities of ESG data but perform poorly in ESG aspects" (Yu et al., 2020, p. 5). From this it can be seen that the way of quantifying greenwashing depends on the definition of greenwashing, thus in our case, we choose to apply the greenwashing to all three ESG score pillars - Environmental, Social and Governance - following the methodology of Yu et al. (2020). We do not necessarily see this as a major limitation of our research, but we acknowledge that our results might not be applicable to the situation when greenwashing is defined differently.

8. Conclusions

The main aim of this research was to analyse whether greenwashing is reflected in stock returns during the time period 2015-2020. Using STOXX 600 Europe companies, we examine if greenwashing company stocks have lower abnormal returns compared to the companies that do not overestimate their sustainability efforts during 2015-2020. We find that, in the sample period, portfolios consisting of greenwashing companies perform significantly worse in terms of abnormal returns compared to the non-greenwashing companies. Greenwashing portfolios earn 0.22% lower monthly abnormal returns than their non-greenwashing counterparts. Annually this would mean 2.67% lower abnormal returns for greenwashing companies. Additionally, we find that the abnormal returns have decreased over time for both greenwashing and non-greenwashing companies. In the earliest years (2015-2017), greenwashing companies earn abnormal returns of 1.60% per month while non-greenwashing companies have abnormal returns of 1.61%. For the latest years, both alphas obtained from the portfolio regressions are not significant, thus we can conclude that the abnormal returns are likely 0% for greenwashing and non-greenwashing companies.

We interpret our findings as follows. For the companies it pays off to be sustainable and report their green efforts truthfully, as investors seem to be able to identify potential greenwashing companies. However, the peer-relative greenwashing score becomes a less significant factor to explain abnormal returns of the company over time.

For further research, we would suggest focusing on other greenwashing definitions that highlight specifically the environmental performance of companies. Consequently, conduct similar research by constructing peer-relative greenwashing scores based on the Environmental (E) factor of ESG scores, thus evaluating the specific effect that environmental score has on abnormal returns of the company. Additionally, considering that the EU has actively taken action to encourage sustainable behaviour from companies, we would suggest researching whether the relationship between peer-relative greenwashing scores and abnormal returns exhibited in this research holds in other markets, for example, USA or China.

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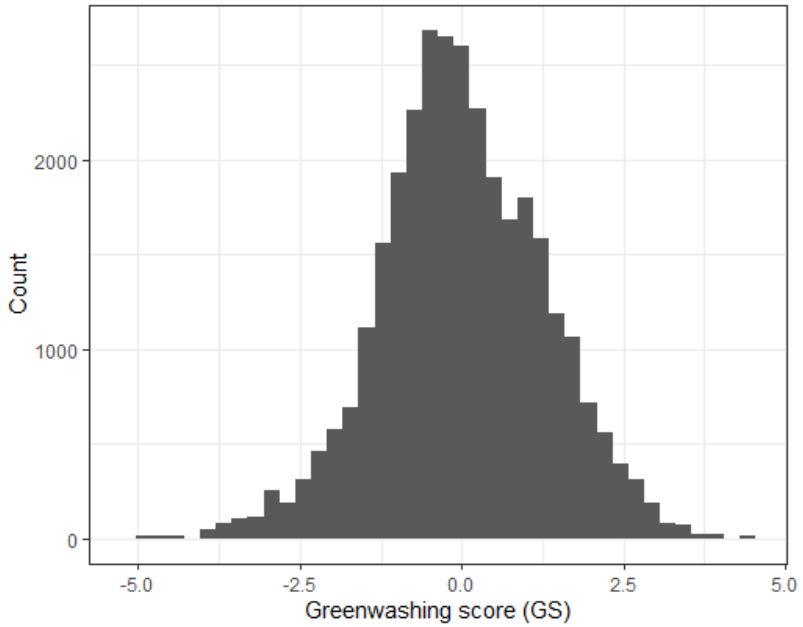
Appendices

Appendix A. Summary statistics of the initial dataset.

Variable	$Actual\_Returns_{it}$	$RM_t - RF_t$	SMB_t	HML_t	RMW_t	CMA_t	R_{ft}	$Performance_{it}$	$Disclosure_{it}$
Minimum	-0.7142	15.4400	-5.0700	-11.3000	-3.8500	-4.3900	0.0000	3.2480	2.0660
1st Quarter	-0.0319	-2.5000	0.7600	-1.7600	-0.5250	-1.2800	0.0100	46.7800	35.5260
Median	0.0041	0.0680	0.5300	-0.7100	0.3300	-0.2500	0.0400	59.9010	46.2810
Mean	0.0101	0.5983	0.3594	-0.5316	0.3383	-0.3944	0.0746	58.4840	44.3060
3rd Quarter	0.0527	4.0550	1.4900	0.7250	1.3800	0.3850	0.1400	70.6880	54.1320
Maximum	1.1010	16.6200	4.7200	10.7600	3.2500	2.9600	0.2100	93.5720	73.5540

This table presents the summary statistics of the initial dataset before any transformations.

Appendix B. Distribution of greenwashing scores across all sample firms throughout the years 2015-2020.



This graph shows the distribution of the calculated greenwashing scores across all sample firms for the years 2015-2020. The score is normalised by the industry thus having a mean score around 0. The data used in the calculation is extracted from Bloomberg and Thomson Reuters databases. The graph is created by the authors.

Appendix C. Regression analysis of market neutral portfolio where the greenwashing portfolio is in a short position and the non-greenwashing portfolio is in a long position.

Variables	Estimate	Std. Error	t value	p-value	
Alpha	0.0017	0.0008	2.0790	0.0415	**
RM - RF	-0.0013	0.0215	-0.0600	0.9524	
SMB	0.2400	0.0504	4.7590	1.1e-0.5	***
HML	-0.1219	0.0676	-1.8040	0.0759	
RMW	-0.0227	0.0816	-0.2790	0.7815	
CMA	0.0863	0.1007	0.8570	0.3948	
Observations	72				
R-squared	0.2719				

This table presents the results of the linear regression of market neutral portfolios from January 2015 to December 2020. The regression was performed using the five-factor Fama French model which includes market excess returns, size, value, profitability and investment patterns factors. The median of the greenwashing score in each month is used as a threshold between potential non-greenwashers and greenwashers. The companies above-median are identified as greenwashers while companies below as non-greenwashers. The difference between non-greenwashing and greenwashing portfolio returns in each month are used as the dependent variable. Portfolio returns are calculated as the average of monthly excess returns of companies included in the portfolio in the respective month. *p < 0.1; **p < 0.05; ***p < 0.01.

Appendix D. Mean value of return on assets (ROA) for non-greenwashing and greenwashing companies throughout years 2015-2020.

	Non-greenwashers	*Greenwashers*		
Variable	Mean ROA	Mean ROA	p-value	
2015	0.0679	0.0630	0.02049	**
2016	0.0699	0.0545	2.115e-12	***
2017	0.0846	0.0633	<2.2e-16	***
2018	0.0754	0.0621	1.099e-08	***
2019	0.0679	0.0519	1.285e-14	***
2020	0.0625	0.0435	4.25e-11	***
All	0.0716	0.0567	<2.2e-16	***

This table presents the mean value of returns on assets (ROA) for non-greenwashing and greenwashing companies through the sample period (2015-2020). Welch Two Sample t-test is used to obtain the p-values. The test is run for every year to check whether the average ROA for non-greenwashing companies is higher than for greenwashing ones. The test is statistically significant at a 1% level for all years except 2015, when the results are significant at a 5% level. For the analysed sample, non-greenwashing companies have a higher ROA than greenwashing companies. *p < 0.1; **p < 0.05; ***p < 0.01.

Appendix E. Results for the regression analysis of the companies identified as neutral (second tercile) in terms of greenwashing behaviour.

Variables	Estimate	Std. Error	t value	p-value	
Alpha	0.0034	0.0021	1.5760	0.1199	
RM - RF	0.7528	0.0572	13.1610	<2e-16	***
SMB	-0.2765	0.1342	-2.0510	0.0442	**
HML	0.1804	0.1800	1.0020	0.3199	
RMW	0.4238	0.2172	1.9520	0.0552	*
CMA	-0.2120	0.2614	-0.7910	0.4320	
Observations	72				
R-squared	0.8127				

This table presents the results of the linear regression of neutral (second tercile) company portfolios from January 2015 to December 2020. The regression was performed using the five-factor Fama French model which includes market excess returns, size, value, profitability and investment patterns factors. Returns of portfolios are used as the dependent variable. Portfolio returns are calculated as the average of monthly excess returns of companies included in the portfolio in the respective month. We observe that the alpha of the neutral portfolio is lower than for non-greenwashing portfolios but higher than for greenwashing portfolios. *p < 0.1; **p < 0.05; ***p < 0.01.

Appendix F. Summary statistics of the interpolation effect on company and observation count.

	Before interpolation		*After interpolation*	
Year	Companies	Observations	Companies	Observations
2020	423	4395	539	6433
2019	510	6045	510	6045
2018	510	5652	510	5652
2017	466	5250	466	5250
2016	437	5145	437	5145
2015	429	5027	429	5027
Total		31514		33552

This table shows the impact of interpolating the ESG performance and ESG disclosure data for the year 2020. Interpolation was done by assigning 2019 data for the missing observations for the year 2020. Interpolation adds 116 companies and 2038 observations to the dataset.

Appendix G. Results of regression analysis for non-greenwashing portfolio and greenwashing portfolio for the time period from 2018 to 2020 after interpolation.

Non-greeenwashing portfolio					
Variables	Estimate	Std. Error	t value	p-value	
Alpha	0.0017	0.0034	0.5060	0.6170	
RM - RF	0.8036	0.0703	11.4300	1.86e-12	***
SMB	0.0751	0.1895	0.3960	0.6950	
HML	0.1429	0.2100	0.6810	0.5010	
RMW	0.4939	0.3635	1.3590	0.1840	
CMA	-0.3233	0.4201	-0.7700	0.4480	
Observations	36				
R-squared	0.8874				

Greenwashing portfolio					
Variables	Estimate	Std. Error	t value	p-value	
Alpha	-0.0009	0.0026	-0.3280	0.7453	
RM - RF	0.7864	0.0548	14.3610	5.54e-15	***
SMB	-0.2137	0.1476	-1.4480	0.1580	
HML	0.3692	0.1635	2.2580	0.0314	*
RMW	0.2967	0.2831	1.0480	0.3030	
CMA	-0.4577	0.3272	-1.3990	0.1721	
Observations	36				
R-squared	0.9301				

This table presents the results of the linear regression of non-greenwashing and greenwashing company portfolios from January 2018 to December 2020 after the interpolation of data for the year 2020. The regression was performed using the five-factor Fama French model which includes market excess returns, size, value, profitability and investment patterns factors. Returns of non-greenwashing and greenwashing portfolios are used as dependent variables depending on the analysed case. Portfolio returns are calculated as the average of monthly excess returns of companies included in the portfolio in the respective month. The interpolation does not add significance to the portfolio alphas. *p < 0.1; **p < 0.05; ***p < 0.01.