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ESG and Stock Prices

A quantitative study on ESG score and its immediate effects on stock prices of mid -and large cap companies within the EU market

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Abstract

This paper examines the relationship between positive change in ESG scores and instantaneous stock price volatility as well as the direction of price change. For this purpose, a sample of 536 large- and medium cap companies within the EU market were selected and classified into three groups of excellent, good and poor-satisfactory performance based on their ESG scores. The change in the companies' stock prices were studied within an event period of three days around the time when the ESG score was released by Reuters Refinitiv, which was compared to the estimated period of 100 days. Furthermore, the data was studied against the efficient-market hypothesis and signalling theory as the main theoretical framework and tested in SPSS through contingency tables, ordinary least square regression and chi-square. Even though the final results did not indicate significant associations between the respective variables, slight differences in prediction lines for the categories were observed and further assessed. The study concluded that although some reactions to the signals were observed, they were considered minor; therefore, a short-term perspective on this topic would not capture the whole value investing in CSR could provide the company, such as decrease in volatility. That could benefit the company in terms of mitigating the risks arising from volatile business environments, hence a reason for why investing in CSR has far more benefits for the company than only a better reputation.

Keywords: Corporate Social Responsibility, ESG, Volatility, Efficient-Market Hypothesis, Stock Valuation

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1 Introduction

1.1 Background

Corporate social responsibility (CSR) is a broad concept with many definitions. An early definition of CSR (at the time referred to as social responsibility) was given by Bowen (1953 cited in Carroll, 2008) as "the obligations of businessmen to pursue those policies, to make decisions, or to follow those lines of action which are desirable in terms of the objectives and values of our society" (p.6). A later, more specific definition suggests that "[t]he social responsibility of business encompasses the economic, legal, ethical, and discretionary expectations that society has of organizations at a given point in time" (Caroll, 1979, p.500). In more recent times, international organizations have made attempts to establish a generic definition of CSR. The European Union (EU) and the United Nations (UN) define CSR respectively as,

> … a concept whereby companies integrate social and environmental concerns in their business operations and in their interaction with their stakeholders on a voluntary basis. It is about enterprises deciding to go beyond minimum legal requirements and obligations stemming from collective agreements in order to address societal needs. (European Commission, 2006)

> ... a management concept whereby companies integrate social and environmental concerns in their business operations and interactions with their stakeholders. CSR is generally understood as being the way through which a company achieves a balance of economic, environmental and social imperatives ("Triple-Bottom-Line-Approach"), while at the same time addressing the expectations of shareholders and stakeholders. (United Nations, n.d.)

While there are minor distinctions between the definitions, the core idea is that corporations have a responsibility to act ethically for a greater purpose than solely in the interest of shareholders.

Over the years, interest in CSR has increased substantially. In 2019, 90% of the S&P 500 companies published a CSR report, which was a significant increase compared to the 20% in 2011 (Stobierski, 2021). In the light of consumer awareness, the pressure on companies to act as corporate citizens has increased and they are expected to go beyond the financial value creation of a business. While pressure from consumers may not be mandatory, policy makers

are increasingly legally regulating firm's engagement in CSR. While the Council Directive 2014/95/EU currently regulates the reporting by large companies on matters including respect for human rights and environmental matters, the EU is overseeing further regulations in a new proposal (European Council, 2021). India has gone even further by implementing clause 135 of The Company Act, 2013, which enforces larger companies to spend a minimum of two per cent of the net profit on CSR activities. On the contrary, the United States of America (U.S.) lacks similar regulations. However, American companies still have to fulfill minimum standards on responsible business conduct as the U.S. is a member of the Organization for Economic Co-operation and Development (OECD) (Bureau of Economic and Business Affairs, n.d.).

The preoccupation with the topic has also changed the way equity investments take shape. In recent years, so-called, sustainable investment has become increasingly popular, and is based upon investing in highly ESG rated firms (Boffo & Palano, 2020). As of 2020, 20% of all professionally US managed assets were ESG investments with a total worth of over 11 trUSD, and the European ESG investments were even higher, amounting to 17 trUSD (Boffo & Palano, 2020). ESG is an acronym for three pillars - Environmental, Social and Governance - each of which encompasses fields of CSR activities subject to a score. ESG scores provide a method to measure to which extent firms are occupied with CSR activities. One can argue that such measurements cannot convey all of what is incorporated in the term CSR due to the vagueness in its definition. Nevertheless, ESG scores provide a quantification of the CSR concept, which enables comparison among different firms over time.

Each ESG pillar has its own underlying indicators for quantifying how a company scores in that field. Neisen, Bruhn and Lienland (2022) identify that the most common indicators for environmental risks include pollution, waste and natural resources. Moreover, they find that social risks oftentimes include measures on human capital, labor rights and health and safety, and that governance risks usually include business ethics and legal, governance structure and IT and data security (Neisen, Bruhn & Lienland, 2022). For this study, the score of each respective ESG pillar is not considered but rather the overall score is taken into account.

Connecting back to the increasing popularity of ESG investing on the equity markets, theorists suggest that the price of a stock reflects underlying information to it (Akerlof, 1970; Crocker, 1986; Spence, 1977). As more stocks are being traded on the basis of their ESG rankings, this would suggest that the information behind an ESG score would be incorporated into the equity markets as the stock price is a reflection of the value of the company. According to the efficient-market hypothesis, when markets are efficient all stocks are correctly priced, thus, reflecting the actual value of the firm (Fama, 1965). Moreover, behavioral finance acknowledges that irrational behavior among market participants plays the risk of disturbing the accuracy to which a stock price reflects the value of the firm (Shefrin &

Statman, 1994). Nevertheless, the stock price is still assumed to incorporate information about the profitability of the firm influenced by external factors, thus macro-trends are of relevance when discussing factors that influence stock prices (Huang, Capretz & Ho, 2022).

For this paper, the focus will be on listed companies within the EU market. The overall ESG score for companies and their effects on stock prices will be assessed through a period of three days. The market immediate reaction and the stock prices' volatility throughout the mentioned time period will subsequently provide a foundation as to what degree the change in ESG scores affect the stock price volatility.

1.2 Aim and Objectives

This paper aims to identify whether a market reaction can be observed when ESG scores are released. The main objective is to assess whether there is a correlation between the degree to which the ESG score changes and the degree to which volatility changes in relation to this event. Based on existing research, the expectations are that the results, the degree to which the stock prices are affected, will vary depending on how active the firms are in terms of CSR activities. The study will primarily be based on ESG scores and stock price volatility. Moreover, the aim is to identify whether CSR activities, reflected in ESG scores, have different impacts on highly or low ESG rated companies. Based on these aims and objectives, the research question can be broadly stated as follows.

RQ: *What is the immediate market reaction to changes in ESG scores?*

1.3 Research Purpose

The insights provided by the results of this study will be of interest in future studies on CSR activities and its effects on market capitalization. It will also be of relevance to news-traders as the study mainly focuses on how signals, in the form of change in ESG scores, instantly affect the market prices. In addition, while it will be helpful to both investors, analysts and practitioners to understand the market effects of CSR activities.This study provides additional insights into the limited research there is on the topic, and contributes to a more complete understanding of the effects on a company's stock price when engaging in CSR activities.

1.4 Delimitations

Various limitations have restricted the scope of this research. Firstly, a limited time frame has meant that it was not possible to exhaust all available options for statistical analysis, thus there is a risk or concern that more appropriate approaches were not identified.

Secondly, due to differences in market conditions around the world, the scope of markets had to be limited to the EU as a homogenous sample where companies operate under similar CSR regulations was optimal. The complications are therefore that the conclusions from the study may interfere with conclusions on more liberal, or less liberal markets than the EU. It might, therefore, be difficult to apply the findings in a more general setting as both market regulations and CSR regulations vary among jurisdictions.

Thirdly, while ESG scores and stock price changes were studied, it was not possible to isolate ESG as the only factor affecting the stock price during the event period. However, attempts to regulate, to some extent, were made by including an estimation period in the statistical analysis. Attempts to isolate the effect of ESG score were made even further by setting the event period as shortly as possible. However, other factors affecting the stock prices still remained. Therefore, in the case of significant findings, it is not possible to conclude that it is only due to changes in ESG scores and that stock prices are accurate but mere a coincidence. However, the results are therefore to some extent ambiguous.

1.5 Outline of the Thesis

In the following sections of the paper, a review on previous studies in the field of CSR and its effects on stock prices and empirical findings is presented in the next chapter. In addition, the theoretical framework will be established on how stocks are valued. In order to discuss the market reactions, the efficient-market hypothesis and signalling theory will be introduced. The chapter ends with hypothesis development, where literature review and theoretical framework are combined to form the hypotheses. Chapter three presents the methodology, which together with chapter two lay the groundwork for chapter four where the results of the research are analyzed. In chapter five, the results are discussed using the theories and literature presented earlier. Finally, chapter six concludes the research, discusses potential limitations of the thesis, and suggests future research topics.

2 Literature -and Theoretical Review

This section builds a foundation for how the research question was identified and which findings lay the ground for the hypothesis development. The section explores CSR and the effect of such activities on the financial and stock performance of companies. It starts with an overview of the available research within the field of CSR with a focus on how companies' involvement in the respective activities impact different aspects of their performance. The second part of this chapter presents a theoretical backbone with theories explaining the stock valuation method and stock market's reaction to new information. Lastly, the empirical evidence of the impact of CSR activities on firm performance is merged with the theoretical foundation to develop the hypotheses which will be tested in this research study.

2.1 CSR and ESG

Friedman and Freeman (1984 cited in Zhang, 2011) argue for whether it is the firm's responsibility to go beyond profits and conduct business with a greater purpose in society. In this regard, Friedman (1962) claims in the shareholder theory that the main responsibility of the companies is to increase the profit. He believed enhancing the profit is the only social responsibility of the firms, which he established in his doctrine, first published in the New York Times (Friedman, 1970, cited in Zhang, 2011). In line with Friedman's statement, Posner (1972 cited in Krier, 1974) mentioned that the cost of involvement in CSR activities will be passed on to the customers, potentially questioning how responsible it is towards the customers as a stakeholder group. He thought of CSR activities not part of the business operations but rather an initiative taken by the shareholders to utilize their wealth in the interest of the society as a result of growing wealth.

Many accept Friedman's take on the purpose of businesses, while also acknowledging the importance for firms to conduct CSR activities. However, Freeman brought into light the matter of incorporating the interests of those other than shareholders into consideration- the stakeholders. Freeman (2010) defined them as those who "can affect or is affected by the achievement of the organization's objectives" (p.46). Donna Wood (2008 cited in Agle, Donaldson, Freeman, Jensen, Mitchell & Wood, 2008) at the symposium on the future of stakeholder theory in business, emphasizes the institutional role of the businesses in the society pointing to both positive and negative consequences for the firms only pursuing their interests. Micheal Jensen (2008 cited in Agle, Donaldson, Freeman, Jensen, Mitchell & Wood, 2008) further adds to the debate by stressing that equity value maximization would not result in higher value for the firm nor would it create value for the society in which the company operates within. However, he also questions a part of Friedman's statement regarding "rules of the game" (p. 165), raising the question as to whether there is a certain

way to recognize what is best for the society (Agle, Donaldson, Freeman, Jensen, Mitchell & Wood, 2008).

As for the relationship between CSR activities and financial performance of firms, Vogel (2005) discusses that although there exists a business case for CSR, there is lack of strong empirical evidence showing a link between CSR and financial performance. Duque-Grisales and Aguilera-Caracuel (2019), and Shahbaz, Karaman, Kilic and Uyar (2020) support the findings of a negative relationship between CSR and financial performance. In contrast, other research has found a positive, or at least non-negative, relationship between CSR and financial performance (Cornett, Erhemjamts & Tehranian, 2016; Friede, Busch & Bassen, 2015; Margolis, Elfenbein & Walsh, 2009; Shakil, Mahmood, Tasnia, & Munim, 2019). For example, Margoli, Elfenbein and Walsh (2009) have indicated the positive effect of CSR activities on the financial performance of the companies, emphasizing the relevance of protecting the stakeholders' interests for the enterprises.

Moreover, Cho, Chung and Young (2019) stress that there is a positive correlation between CSR activities and financial performance of the firms with them positively affecting the companies' reputation as well. They detected that effects are both short- and long-term. However, while both Behl, Kumari, Makhija and Sharma (2021) found that CSR does in fact affect the financial performance of the firm, this would only be a short-term effect. With their findings they concluded that CSR would be of most interest for long-term shareholders, as these are the ones experiencing the effects of CSR. They found that short-term investors withdraw investment and reallocate elsewhere, in order to realize short-term profits.

Extending the effect of CSR activities from financial performance to stock market reaction, Tasnia, Habshi & Rosman, (2020) found that investors tend to react to both negative and positive ESG news, thus implying that stock price volatility increases in both cases. According to Cornelissen, Haslam and Balmer (2007), firms with high CSR ratings do not often encounter significant negative effects in case of negative news. However, Janny and Gove (2011, cited in Yasar, Martin & Kiessling, 2020) elaborate further that a high CSR rating could be in the company's disadvantage in case of governance wrongdoings. Tasnia, Habshi and Rosman (2020) concluded that positive news attracts investors supporting socially responsible firms, while investors withdraw investments from firms exposed to negative ESG news as a way to penalize such firm-behavior. Two other studies, whereas one is a replication of the other one, have found that CSR has little impact on stock prices, but a possible change in the trend was detected in both (Durand, Paugam & Stolowy, 2019; Hawn, Chatterji & Mitchell, 2018).

On the other hand, studies have found that CSR activities decrease a firm's stock price volatility (Benkraiem, Boubaker & Saeed, 2021; Deng, Liao, Luo, Sun & Xu, 2021), which suggest that while CSR active firms tend to experience some stock price volatility, it is lower

than for firms that do not engage in CSR. The main explanation for this seems to be the reduction in information asymmetry as CSR increases corporate transparency, which contributes to the efficient market where as much information as possible is already priced into the stock (Benkraiem, Boubaker & Saeed, 2021; Deng et al. 2021; Wong & Zhang, 2022).

In regard to the effect of ESG signals on different industries, there has been a clear distinction between traditional and sensitive industries, such as tobacco, energy and gambling. Wong and Zhang (2022) unravel that sensitive industries are normally subject to less analyst coverage due to investment risks. The respective companies tend to be undervalued due to certain expectations of negative ESG news coverage (Wong & Zhang, 2022) given that investors are concerned about the environmental effects of these companies (Miralles-Quirós, Miralles-Quirós & Gonçalves, 2018). Moreover, Cherkasova and Nenuzhenko (2022) found that sensitive industries disclose better performance and demonstrate high ESG indicators as their reputation hangs on the thread of CSR activities. However, there have been contradictory results on the effect of CSR on stock prices of environmentally sensitive companies. While Miralles-Quirós, Miralles-Quirós and Gonçalves (2018) found that firms in sensitive industries listed on the Brazilian stock exchange explore positive value creation from social and corporate governance activities, Yoon, Lee and Byun (2018) found that to be less value creating for firms in non-sensitive industries listed on the Korean stock exchange as managerial ability in implementing CSR is found to be the main reason to the created value, and not the activities per se.

2.2 The Stock Market

2.2.1 Stock Prices: A micro perspective

As firms are traded on stock exchanges, their shares are subject to valuation by the market. Such valuations can take different forms and have priorly been reviewed as there lacks consensus on the most accurate valuation model (Huang, Capretz & Ho, 2022). A commonly adopted stock valuation method is the one built upon a discounted cash flow technique (O'Loughlin & O'Brien, 2019). However, the cash flows from stocks are uncertain, and the future income stream has to be estimated. According to O'Loughlin and O'Brien (2019), this estimation requires an analysis of the fundamentals of the firm and the firm environment.

According to Huang, Capretz and Ho (2022) fundamental traders make use of firm fundamentals in trading based on differences between the current trading price and the stock price based on estimations of the firm value. While Nti, Adekoya and Weyori (2020) suggest that the unstructured nature of the fundamental data could be problematic for the individual investor, Zhang, Fuehres and Gloor (2011) conclude that it is still a good predictor of excessive returns over the long-term.

Nichols, Wahlen and Wieland (2017) primarily suggest that company fundamentals relating to book value, earnings, dividends and operating-income growth are the main predictors of the long term stock price. Nti, Adekoya and Weyori (2020) refer to assessing the company in regards to financial ratios. Yang (2010 cited in Christie & Isidore, 2018) suggests that the most essential ratios for fundamental analysis are, among others, earnings per share, return on assets, return on equity, price-to-earnings, market capitalization and debt-to-equity. While the four former strictly concern income and earnings, market capitalization concerns the total value being traded on a stock exchange, and debt-to-equity concerns utilized credit (Yang, 2010 cited in Christie & Isidore, 2018). When looking at it from a firm perspective, Zhu, Hu, Che and Yang (2020) claim that as the stock price increases, the equity of the firm increases as well which can be used for financial purposes of future investments. Besides the content of the company reports, the fundamental analysis is also focused on the composition of the board and the company employees (Tsai & Hsiao, 2010) as well as macroeconomic- and industry-wide conditions (Nti, Adekoya & Weyori, 2020).

According to Aspris, Finch, Foley, and Meyer (2013), utilizing accounting-based fundamental analysis strategies could possibly result in excess returns. Nichols, Wahlen and Wieland (2017) found that the nature of the business activities affect how well accounting fundamentals determine stock value. They claim that for firms relying on intangible assets, the lack of recognition of such assets on the balance sheet means that the value of such assets is not reflected in the fundamental value of the stock price of these firms. In other words, a firm heavily relying on unrecorded intangible assets (e.g. brand image) would have its fundamental valuation based on factors excluding those assets, suggesting a mispricing of the firm's stock. Moreover, in their research Damayanty and Mulyadi (2020) incorporated the impact of CSR into fundamental analysis. They found that CSR can have a positive effect on a company's brand image, for example resulting in increased sales. While the brand image as an intangible asset could be neglected by the fundamental analysis (Nichols, Wahlen & Wieland, 2017), Damayanty and Mulyadi (2020) found that the long-term effects are reflected in the accounting-based fundamentals priorly discussed in this section.

Furthermore, Nichols, Wahlen and Wieland (2017) suggest unpredictable accounting information contributes to the mispricing of a stock as it causes information asymmetry. Bernard and Thomas (1990) suggest unexpected earnings as one reason, Weber (2009) suggest book-tax differences as another, and an unforeseen change in R&D expenditure is suggested by Lev, Sarath and Sougiannis (2009). To address the issue of unpredictable accounting information Barth, Konchitchki and Landsman (2013) identified earnings transparency as a way for firms to mitigate shocks in the market as it would lead to less information asymmetry. Besides, Moreira Marques, Henrique Ogasavara and Araujo Turolla (2022) found that opportunistic behavior of managers concerning concealing accounting information on unprofitable investments could spur the information asymmetry further.

Moreover, Zhu et al. (2020) found this to be especially problematic in volatile markets as a poor investment decision can be blamed on overall market sentiment and trends, rather than the fundamental decision itself.

While fundamental analysis is concerned with the underlying company, sentiment analysts claim the stock is not isolated from the overall market perception of it, nor isolated from effects of the overall market trends (Huang, Capretz & Ho, 2022). Besides accounting-based fundamentals, Benjamin, Biswas, Marathamuthu and Arunachalam (2022) found evidence that positive social media sentiment increases firm value, thus reflecting the added firm value of positive investor sentiment. According to Baker and Wurgler (2007) the stocks most sensitive to investor sentiment are those of companies that are "younger, smaller, more volatile, unprofitable, non-dividend paying, distressed, or with extreme growth potential" (p.132), contrary to bond-like stocks. This suggests that stocks that are more risky and more prone to speculation are to a greater extent affected by market sentiment.

2.2.2 The Stock Market: A macro perspective

The efficient-market hypothesis (EMH) suggests that investors react immediately to new information, and when all information is available to the market, the intrinsic value of the stock will be reflected in the stock price (Fama, 1965; Fama, Fisher, Jensen & Roll, 1969). Ausloos and Furtuna defined the movements in the stock prices, volatility, as price dispersion. Yadav (1992) further explained volatility as caused by variations in trading volumes on buy -and sell sides. He states that as sell volume increases, the price is driven down, while it is driven up as buy volume increases. Therefore, companies listed on a stock exchange would be subject to volatility. Bhowmik and Wang (2020) also explained volatility as the change in stock prices in an unpredictable manner. However, the stock price predictability is a debatable topic among investors and academics.

According to EMH, in an efficient market where the stock prices are adjusted to the available market information, mispricings, suggested by Nichols, Wahlen and Wieland (2017), would not occur and the earnings transparency would contribute to accurate fundamental valuation as the market would have access to accurate information (Barth, Konchitchki & Landsman, 2013). However, technical analysis suggests the stock price can be predicted beforehand by studying trading patterns (Huang, Capretz & Ho, 2022). The mathematician and polymath Benoît Mandelbrot (1997) also suggested that historical trading data can be fragmented to identify patterns and indicate that the stock market has a long-term memory regardless of fundamental factors. On another hand, Read (2013) suggests an investor with insider information on an equity could use that to its advantage by investing before the information reaches the market. Consequently, beating the market by using this information would mean that the information that was not yet incorporated in the stock price is incorporated once that information is used for trading.

Fama (1965) strived to prove such suggestions otherwise by claiming that in an efficient market, information is freely available to market participants. He claimed that the goal for an investor in efficient markets would therefore be to predict the future value of the security based on available information. In order to acknowledge claims about the markets not being efficient, Fama (1965) categorized the markets into strongly efficient, semi-strong and weak, each indicating different characteristics. According to Fama (1965), the strong form of the efficient market is one that has fully incorporated all the available information, public and private; whereas in a semi-strong efficient market, only the publicly available information is reflected in the prices. In a weakly efficient market; however, the prices are argued to incorporate the technical measures (Fama, 1965).

Building upon Fama's claims on the efficient market, Read (2013), adds that in order for the prices to properly incorporate all the information, it requires a period of time. Thus, he suggests the markets are only efficient in the long-run. It is further suggested by him that markets in the short-run are not efficient as over- and underreactions to new information occur, thus violating the fundamental value of the stock prices. This is further supported by Akerlof (1970) who developed what came to be known as the signalling theory.

Akerlof (1970) initially studied information asymmetry and developed the Lemon Theory which concluded that adverse selection occurs when one party of a sales situation has more information than the other. He claims that the lack of knowledge of the product quality drives buyers to value the product as if it is of bad quality, which puts the sellers of good quality products at a disadvantage. Spence (1977) looked further into this and tried to explicitly contribute to the definition of the signalling theory. He concluded that consumers view warranties as pre-purchase guarantees for the product possessing a certain quality. However, he also found that consumers neglect reading the warranties despite knowing the coverage differed. Crocker (1986) further claimed information asymmetry is caused by the complexity of warranties, leading to consumers not reading them before a purchase. The consumer would therefore not be aware of the quality signals the terms of a warranty reflects.

Crocker (1986) would therefore make three conclusions about information asymmetry in the markets. Firstly, neglecting reading a warranty means no quality signals, thus are information asymmetrical markets doomed to failure (Crocker, 1986). Secondly, Crocker (1986) concludes that so long the marginal customer reads the warranty, market failure can be eliminated. However, he identifies the free-rider dilemma as a counter-problem - in the case everyone assumes someone else will read the warranty, no one will. Thirdly, he finds that markets do not necessarily need to fail due to information asymmetry as customers will often view the product quality of each seller as the market average. While the findings of Spence (1977) and Crocker (1986) are made with the reference to the effects of warranties, they state that these findings may very well reflect on other markets as well due to similar natures of the functions. Therefore, the findings will be applied somewhat interchangeably when studying

the financial markets referring to company reports and other public information. Additionally, Wong and Zhang (2022) that markets of firms with larger market capitalization tend to have less information asymmetry as these firms have more analyst coverage.

The application on financial markets concerns how companies convey a message through publicly sharing information to influence their stakeholders' perceptions of them (Amaya, López-Santamaría, Acosta & Hinestroza, 2021). Yasar, Martin and Kiessling (2020) claim that the signals could either be negative, positive or neutral, and they are either about the signaler or add new information to the stakeholders' knowledge of the matter. Each signal affects the market volatility in a different way, for which the reputation of the publishing agency/company is an influential factor (Kreps & Wilson, 1982; Certo, 2003).

Furthermore, De Bondt and Thaler (1985) studied investor's reactions to unexpected and dramatic news events and found that in the short-run investors tend to have exaggerated reactions. They also found that negative news tends to be exposed to bigger reactions than positive news. On the other hand, as previously mentioned, positive signals are also proved to affect the market; however, the extent to which they affect the market volatility is relatively lower than the negative signals' impact (De Bondt and Thaler, 1985).

As for the signals affecting the change in stock prices, Shefrin and Statman (1994) claim that in an efficient market, it is only new information that drives price movements. However, they suggest that in reality certain investors, such as noise traders, trade based on cognitive errors. Noise is defined as when non-fundamental reactions are occuring in the market, whereas the opposite, price shocks, concern fundamental reactions (Dessaint, Foucault, Frésard & Matray, 2019). Shefrin and Statman (1994) explained that among such errors is the belief that good stocks are stocks of good companies, and expectations about the term structure. They claim that trading based on cognitive errors, rather than solely trading on information, causes distortions that drive prices away from equilibrium and generate excess volatility in the risk premium. In other words, market signals go beyond information specifically concerning the company, as suggested by Yasar, Martin and Kiessling (2020).

Moreover, Dessaint et al. (2019) looked into the effects of noise from the management perspective and found that managers in general have a tendency to confuse noise with price shocks. Based on the findings of Stein (1988), they concluded that volatility in general causes inefficient corporate investments. By wanting to boost current profits, managers can act upon high stock prices caused by noise, rather than fundamental values, and invest rather on quantity than quality due to increased equity (Stein, 1988). Consequently, in times of low prices caused by noise, managers rather face the challenge of funding investment, which potentially results in missing out on profitable investments (Stein, 1988).

2.3 Hypotheses Development

De Bondt and Thaler (1985) and Yasar, Martin and Kiessling (2020) identified a relationship between the signals in the efficient market and market psychology. They found that while signals are valuable, they have different impacts on stock price volatility. Investors are in general more or less risk-averse, and their findings concluded that negative signals bring stronger reactions from the market participants, compared to positive signals. Additionally, market signals have been found to affect firms of different characteristics, differently. For instance, Boldeanu, Clemente-Almendros, Tache and Seguí-Amortegui (2022) found that companies with a good reputation are more negatively affected by negative ESG news compared to firms with not as good reputation. Moreover, De Bondt and Thaler (1985) suggest that a positive change in ESG score would increase the volatility, but not as much as a negative change would do. Benkraiem, Boubaker and Saeed (2021) and Deng et al. (2021) also found that there is a relation between CSR activities and stock price volatility. When comparing highly CSR active companies to less CSR active firms, they found that the ones with a higher CSR activity had lower volatility.

In this research, the focus is on examining market reactions to the positive signal reflected by an increase in ESG score. The choice to focus on positive signals is motivated by the gap identified in the literature. In specific, Boldeanu, Clemente-Almendros, Tache and Seguí-Amortegui (2022) examined the effect of the negative signal, while less focus has been on positive signals and their impact for different firms.

For the purpose of this research, ESG score is viewed as an equivalent of the degree to which a firm engages in CSR activities. Given that previous studies have found evidence that there are distinct market reactions for different firms based on their reputation and level of CSR activities, this research will consider this comparison to examine whether distinctions can be identified across categories of firms based on the degree to which they engage in CSR. In other words, these considerations lead to the following hypotheses:

> *H_0: As ESG scores increase, the change in stock price volatility does not differ between firms with higher and lower ESG scores.*
>
> *H_1: As ESG scores increase, the stock price volatility of firms with higher ESG scores, compared to firms with lower scores, will be lower in the event period.*
>
> *H_2: As ESG scores increase, the stock price volatility of firms with higher ESG scores, compared to firms with lower scores, will be higher in the event period.*

2.4 Chapter Summary

This chapter has discussed the development of the hypotheses starting from a general approach on what CSR means and how it is quantified using ESG scores. There has been different research on the effect of CSR on both financial performance and stock performance of a company. From the literature review, relevant theories have been selected which will lay the foundation for the discussion and interpretation of the results later on in the research paper. Different stock valuation methods with a focus on fundamental analysis laid the foundation for what is incorporated into the stock price and how. In addition to that, the EMH and signalling theory establish that reactions to new information will be instantaneous in an efficient market causing stock price volatility. Combining the established theories and empirical findings, hypotheses were developed. The main take of these hypotheses were that there is an expected change in volatility when there is a positive change in ESG scores from one year to another. However, the extent to which volatility changed would vary among firms depending on the ESG score range the firm belongs to.

3 Methodology

3.1 Research Approach

The following sections establish the research approach for conducting the study. The development of the research strategy has been primarily based on the nature of the studied topic in relation to prior research and literature.

3.1.1 Deductive Research Approach

The basis of the research approach was to formulate hypotheses based on what was already known about market reactions to CSR and ESG scores. Bell, Bryman and Harley (2019) define this approach as deductive where the researcher studies a domain and relevant theories in order to deduct hypotheses for further research. The domain in this study concerned the effects of ESG/CSR on stock prices, and the theory concerned market reactions to information. Therefore, the developed hypotheses relied on both established theories (signalling theory and the EMH), and empirical findings (for example see Miralles-Quirós, Miralles-Quirós & Gonçalves, 2018; Wong & Zhang, 2022). The opposite to the deductive approach is the inductive where researchers start from specific observations and then infer an explanation or theory that seems appropriate based on the conclusions of the findings (Bryman & Bell, 2011). Considering the broad access to stock market theory an inductive approach was not applicable as the studied topic would not generate a new theory, rather complements to existing theories.

Furthermore, the conductance of this study was of a linear approach, as described by Bell, Bryman and Harley (2019), where relevant theory and research was studied and connected for hypotheses development. At the end of the linear design the hypotheses were tested and either confirmed or rejected. The criteria for rejection or confirmation was set up by testing the significance of the multivariate regression analysis.

3.1.2 Quantitative Research

The objective was to study the relationship between data points on market reactions and ESG score changes to test the relationship between the EMH and ESG scores, thus a quantitative approach was adopted for this research. Quantitative research can be used both for testing and constructing theories, while the opposite, a qualitative approach, is normally applied to construct rather than test theories (Bryman & Bell, 2011; Roni, Mega & Morris, 2020).

Moreover, Mertler (2015) explains that the methodology should be explicitly defined as the research should be replicable for other researchers, as well as the data results should be completely statistical and not be up for different interpretation by different researchers. Therefore, the methodology section of this paper will explicitly state how the data collection and analysis was conducted.

The opposite approach would be qualitative, which Bryman and Bell (2011) describe as incorporating interpretative measurements and quantification in the data collection and analysis process that tries to explain social phenomena. A qualitative approach would therefore have been optimal if the aim was to study the reasons behind the market reactions, as done by Hawn, Chatterji and Mitchell (2018). As the aim was to establish a relationship and test existing research and theory, the quantitative approach was appropriate as it is described to identify trends or relationships between different variables (Mertler, 2015; Roni, Mega & Morris, 2020).

3.2 Research Design

Following section describes the design of the study and how the way of conducting it was attributable to the aims of the research questions.

3.2.1 Comparative Design

The research question embodies a comparison between companies based on the ESG score of each respective company. A division of the companies has been based on the Thomson Reuters (2017) ESG Score Grades, ranging within four quartiles. Generally there is a perception that a score below 50 tends to be considered bad (for example see Cowen, 2021; Legal & General Investment Management, 2019; Sustainalytics, 2019). Thus, were the two first quartiles including up to 50 score points included in the group categorized as poor-satisfactory (Thomson Reuters, 2017). The third quartile was classified as good and included scores above 50 but less than 75 (Thomson Reuters, 2017). Lastly, the fourth quartile included scores between 75-100 and was classified as excellent (Thomson Reuters, 2017). The companies were divided into sample groups based on their respective scores in 2018 in order for the data analysis to reflect the reaction to the change from one score to another.

The hypotheses also embody a logic of comparison as they suggest variations in volatility between the divisions of companies as they face changes in their ESG scores. Such logic is described by Bryman and Bell (2011) to be the backbone of choosing a comparative research design. The approach in this study was to compare the volatility between the three different sample sets based on ESG scores. Adopting a comparative design has been common for other research studying volatility between sample groups (for example see Mugoto & Muzindutsi, 2022; Sun, Xiang & Shen, 2020). The comparison of volatility between the three sample sets

was done in both a contingency table analysis and ordinary least squares linear regression analysis with the absolute change in ESG score as independent variable, and percentile change in volatility as the dependent variable. The stock return of the event period was included in the contingency table to make a deeper analysis as volatility does not show the direction of the stock price movement. As the aim was not to study if there is an effect on the volatility for the same sample throughout time, a linear regression model was used rather than panel data regression.

3.2.2 Event Study

When studying market efficiency, the event study methodology has been commonly adopted (Henderson, 1990; Peterson, 1989; Yadav, 1992). An event study often studies the time effect on a dependent variable (Henderson, 1990), however this research studied the market efficiency by analyzing changes in stock volatility when new ESG scores are released. Therefore, the change in ESG score was defined as the independent variable. The reason to study volatility rather than stock returns is motivated by Yadav (1992) to examine to what percentile extent the new information affects the market. He describes it as identifying to which degree the stock price changes instead of studying it in absolute terms.

The first steps in this study was to define the event period range and the estimation period range. The former defines the days during which the information of the event affects the market, and the latter estimates the expected stock volatility during no information influences (Henderson, 1990). The event period volatility was then subtracted from the expected volatility to calculate the abnormal volatility. Lastly, the event study design includes a significance test to examine whether there is a statistical association between the studied variables (Henderson, 1990).

The observational data laying the groundwork for the statistical analysis of the event study was collected by adopting a cross-sectional research design. The combination of the event study methodology and cross-sectional design has been widely used in finance research (for example see Eckbo, Maksimovic & Williams, 1990; Kolari & Pynnönen, 2010). Bell, Bryman and Harley (2019) emphasize the importance of having a large sample size, the data being quantitative or quantifiable and collecting all data at the same point in time. An alternative to cross-sectional design is the longitudinal design, which collects data over time of the sample set (Bell, Bryman & Harley, 2019). This design approach would have been attributable to the panel data regression if studying the time effect would have been the aim of the study.

3.3 Data Collection Method

The first section describes the data sources used for obtaining the ESG scores and trading data. This is followed by a step-by-step description of how the companies were sampled and on what criteria.

3.3.1 Data Sources

Thomson Reuters' ESG score database was chosen based on the review on ESG score providers by Christensen, Serafeim and Sikochi (2022), and based on our limited access to ESG databases. Thomson Reuters (2017) releases yearly ESG scores based on publicly reported company information. As they base it on company reported information, they also assess the transparency of the information. They calculate each ESG pillar separately and benchmark country-wise and within the same industries. The overall ESG score for respective companies is the result of the pillar scores, weighed against each other based on the materiality of the underlying components (Thomson Reuters, 2017).

As the aim of this study was to study positive changes in ESG scores from one year to another and as recent scores as possible, scores between 01.01.2018 to 31.12.2019 were retrieved. Durand, Paugam and Stolowy (2019) have shown that the investor perception of sustainable investing, and focus on ESG scores, has changed significantly in recent years, thus the objective was to study as relevant market reactions as possible. The ending point of the data collection was due to substantial macroeconomic disturbances after 2019, including the Covid-19 pandemic and the war in Ukraine.

Trading data for calculating the volatility and changes in stock prices was collected using Bloomberg. As volatility was to be calculated using the drift-independent volatility estimator by Yang and Zhang (2000) daily data for daily open -and closing stock prices and open -and closing stock prices was collected. The trading data was then collected by selecting 'Historical Data Table' in the spreadsheet builder from 01.01.2018 to 30.01.2020.

3.3.2 Sampling

The companies which were to be used for the data analysis were sampled by using the Refinitiv Eikon add-in in Microsoft Excel. The first step was to filter for companies in the formula builder using the advanced filter. The 'Country of issuer' filter was applied to include only companies with stocks issued by with stocks issued by EU member states between 01.12.2018 to 30.01.2020. This included all member states as of 22.04.2022 (European Union, n.d.a) and the United Kingdom (European Union, n.d.b.). Next step was to filter for companies with a minimum of 500 employees as only those companies are affected by the mandatory non-financial reporting Council Directive 2014/95/EU.

The companies were then sampled based on market capitalization since it has been discussed by Doukas, Kim and Pantzalis (2005) that the larger market capitalization of a firm generates more analyst coverage. Relating this to the EMH could imply that firms of smaller market capitalization would have more hidden information due to the lack of analyst coverage, and therefore experience stronger market reactions to new information. To reach a large sample size, both large cap firms (market capitalization >10 bnUSD) and mid cap firms (market capitalization >2 bnUSD) were sampled for. The trade-off was between a large sample size or only including large cap firms and assuming they would have similar analyst coverage. However, as quantitative and cross-sectional research requires a large sample size the choice was to include mid cap companies as well.

Furthermore, companies were sampled by only including 'Active only', thus eliminating current delisted companies. Dual-listed shares were also excluded to only include the 'Primary issues only'. Any others except for 'Ordinary shares' were also excluded in order to only retrieve trading data from shares trading on public exchanges.

Lastly, companies with available ESG scores from 01.12.2018 to 31.12.2019 were filtered for by choosing 'Last 12 FY' using the 'Parameters and Quick Functions'. As the objective was to study the positive change in scores between 2018 and 2019, a sampling criteria was for a company to have ESG scores for both years. Companies were also sampled based on the access to complete trading data in Bloomberg between 01.01.2018 to 30.01.2020. One month was added in order to be able to estimate event reactions, as many of the ESG scores were released on 31.12.2019. This left us with a sample of 622 companies. However, in the process of manipulating the data, the sample was further reduced due to errors with certain data points. The final number of observations in the sample totalled 536. Once companies were sampled by a positive change in ESG score from 2018 to 2019, a sample of 350 companies was the end result, which was divided into respective score groups described in chapter 3.2.1.

3.4 Data Analysis

This section discusses the approach taken to manipulate the data according to certain criteria. It further defines the periods for which volatility was defined and the methodological approach for calculating the volatility. Lastly, the methodology for the statistical analysis is defined.

3.4.1 Data Manipulation

In order to conduct the data analysis it was essential to manipulate the data so that it would be possible to examine the research question. This was done using Python and Excel. First step was to remove missing data points. In specific cases where there was no data for ESG score in 2018 or 2019, companies would be excluded from the sample. Once these data points were excluded the data manipulation proceeded to merge the individual excel sheets, non-trading days were excluded by identifying dates for missing data in the S&P 350 Europe Index. These dates included holidays (New Year's Day, Easter Friday, Easter Monday, Christmas Day and Boxing Day) common for all sampled countries. The calculations were then proceeded with, and the bases for the calculations are defined below in 3.4.2 and 3.4.3. The final output from data manipulation and calculations was a summary data set, including absolute change in ESG score, percentile change in volatility between event and estimation period, and both categorical change in ESG scores and price movement in event period. Specifically, the summary data set included all variables needed for analysis for each respective company and the respective event- and estimation period. An overview of the logic is illustrated in Appendix A.

3.4.2 The Event -and Estimation Period

With reference to the EMH in chapter 2, it was assumed the reactions to the ESG scores would be instantaneous. However, as isolating the reactions to ESG scores was not practically possible, the event period was defined to be as short as possible, which the research by Brown and Warner (1980) suggests. Additionally, Peterson (1989) explained that it is common to choose a range similar to prior studies. As many studies ranged from one to five days before and after the event (for example, see Durand, Paugam & Stolowy, 2019; Ender & Brinckmann, 2019; Hawn, Chatterji & Mitchell, 2018; Wu & Hu, 2019) the event period was defined to include the day of the release of the score and two trading days after (see figure 3.1). It was assumed the days before would not reflect the actual market reactions to the scores. The reason for it to not be shorter was due to the stocks being traded in European time zones, which consequently meant investors in other time zones reacted to the news at different times.

The estimation period range is described by Henderson (1990) to be most commonly defined before the actual event takes place and Peterson (1989) states that the typical length of it usually varies between 100 to 300 days. This would mean that the longer the period, the less risk of having the estimation period concentrated around another event impacting the stock price. An estimation period of 100 trading days before the event period was chosen (see figure 3.1) as similar researches adopted the same range (for example see Durand, Paugam & Stolowy, 2019; Hawn, Chatterji & Mitchell, 2018).

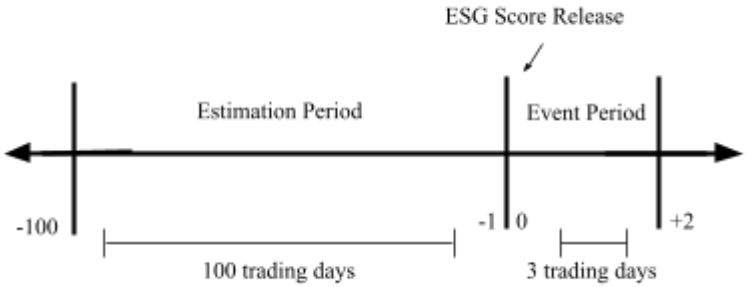

Figure 3.1. The event period range and the estimation period range.

3.4.3 Measuring Market Reaction through Abnormalities in Volatility

Volatility is described as the price dispersion of an instrument throughout time and is based on the historical trading data (Vinte, Ausloos & Furtuna, 2022). While the close-to-close method has been the most commonly used estimator for estimating historical volatility it has been criticized for only including snapshots of the market and thus misses out on trading throughout the day (Vinte, Ausloos & Furtuna, 2022; Yadav, 1992; Yang & Zhang, 2000). Instead the volatility estimator based on open, high, low and close prices (OHLC) developed by Yang and Zhang (2000) was used to calculate the stock volatility. Their volatility estimator is the result of addressing the problems with the ones of Parkinson (1980), Garman and Klass (1980) and Rogers-Satchell (1991). The Parkinson estimator includes only high and low prices, which the method of Garman and Klass (1980) addresses by incorporating OHLC prices, but fails to consider potential jumps in the open prices (Vinte, Ausloos & Furtuna, 2022). As a response to this problem, Rogers-Satchell (1991) normalized the closing price to account for the price movement, however, Yang and Zhang (2000) found that both the opening and closing price had to be normalized. Therefore, the following formula (presented on next page) was developed (Yang & Zhang, 2000) and will be used for calculating the daily volatility for respective companies:

$$\sigma_{YZ} = \sqrt{\sigma_O^2 + k\sigma_C^2 + (1 - k)\sigma_{RS}^2}$$

where

$\sigma_O^2 = \frac{1}{N-1}\sum_{n=1}^{N}\left[ln\left(\frac{O_n}{C_{n-1}}\right) - m_1\right]^2$ = Overnight variance;

$\sigma_C^2 = \frac{1}{N-1}\sum_{n=1}^{N}\left[ln\left(\frac{C_n}{O_n}\right) - m_2\right]^2$ = Open-to-Close variance;

$k = \frac{0.34}{1.34+\frac{N+1}{N-1}}$;

$m_1 = \frac{1}{N-1}\sum_{n=1}^{N}\left[ln\left(\frac{O_n}{C_{n-1}}\right)\right]$;

$m_2 = \frac{1}{N-1}\sum_{n=1}^{N}\left[ln\left(\frac{C_n}{O_n}\right)\right]$;

$\sigma_{RS} = \sqrt{\frac{1}{N}\sum_{n=1}^{N}\left[ln\left(\frac{H_n}{C_n}\right)ln\left(\frac{H_n}{O_n}\right) + ln\left(\frac{L_n}{C_n}\right)ln\left(\frac{L_n}{O_n}\right)\right]}$ = Rogers-Satchell Volatility;

N= Number of days in the sample period;

O_n = Open price on day n;

H_n = High price on day n;

L_n = Low price on day n; and

C_n = Close price on day n.

As it regards the abnormal volatility, Peterson (1989) defined abnormal stock activity as the difference between the event period and the estimation period. However, while she used the methodology for calculating excess stock returns, we applied it on our calculations for volatility but changed formulas accordingly as Yadav (1992) studied the methodology in relation to both stock returns and volatility. As the percentile difference was of interest the abnormal volatility was divided by the volatility in the estimation period. Thus, following formula was used for calculating the abnormal volatility for security *i* in event period *t*:

$$\%\Delta\sigma_i = \frac{(\sigma_{iN} - \sigma_{iN}^*)}{\sigma_{iN}^*} * 100$$

where

σ_{iN}= YZ daily volatility (σ_{YZ}) for security *i* in event period *N*; and

σ_{iN} * = YZ daily volatility (σ_{YZ}) for security *i* in estimation period *N*.

While standard deviation is a measure of the range of movement, it does not tell the direction of the movement. It was of interest to analyze whether the volatility of a stock was caused by a negative or positive change in the stock price throughout the event period. Thus was the following formula adopted:

$$r_i = C_{in-1} - C_{in}$$

where

C_{in-1}= The closing price for security *i* on the day *n-1*;

C_{in+2}= The closing price for security *i* on day *n+2*; and

n = The release date of the new ESG score.

3.4.4 Data Analysis

The data analysis consists of two steps. First, the data was analyzed by examining contingency tables, which Berenson, Levine and Szabat (2015) explain as an examination of potential patterns between categorical variables by studying the occurrence of the variables. The contingency tables in this study examined the correlation between ESG score and volatility, volatility and price movement, and ESG score and price movement. These are further presented in sections 4.1.1 and 4.1.2.

In addition to the tables, Pearson's chi-square distribution, X^2 was used to examine whether there is a significant association between the categorical variables. The chi-square distribution calculates the estimated frequencies of observations for each cell, in relation to the actual observations (Berenson, Levine & Szabat, 2015). When the expected count in a cell is less than five, the chi-square distribution is not appropriate, but rather Fisher's exact test (Kanji, 2006). Moreover, Berenson, Levine and Szabat (2015) state that a null hypothesis is defined as where the column variable is independent upon the row variable. Null hypotheses were defined for each contingency table and for each assessed category of ESG performers. The null hypotheses were rejected when the p-value <0.05. Both tests were automatically run in SPSS.

Ordinary least squares (OLS) linear regression analysis was thereafter applied in order to advance the analysis to study the relationship between positive changes in ESG scores and stock price volatility. Berenson, Levine and Szabat (2015) describe a linear regression model as defining a prediction line that expects the change in the dependent variable for each unit change in the independent variable. The power of this relationship can be told from the coefficient of determination, R^2 where a value close to 1 would indicate that most of the data points are captured by the model. An important notation by Berenson, Levine and Szabat (2015) is to only predict values of the dependent variable where the independent variable falls within the studied range, also known as interpolation. The formula was defined as follows:

$$Y_i = \beta_0 + \beta_1 X_i + \varepsilon_i$$

where

β_0 = Y intercept for the population;

β_1 = Slope for the population;

ε_i = Random error in Y for observation *i*;

Y_i = Dependent variable for observation *i*; and

X_i = Independent variable for observation *i*.

There are four assumptions which had to be tested for the linear regression to be applicable and Berenson, Levine and Szabat (2015) refer to these as linearity, independence of errors, normality of error and homoscedasticity. They state that linearity is often assessed by plotting the dependent variable against the independent variable in a scatter plot and assessing whether it is linear or nonlinear. As this study was of a cross-sectional nature, the independence of

error was not necessary to test, as opposed to for a longitudinal research (Berenson, Levine & Szabat, 2015). The normality of error and homoscedasticity were tested in SPSS, and the fulfillment of the homoscedasticity assumption is plotted in figures B1-B4 in Appendix B.

Moreover, when running a regression, Berenson, Levine and Szabat (2015) define so-called outliers as values that deviate from the rest of the values. In the case of an ordinary least squares regression, the regression is sensitive to outliers (Bashiri & Amir, 2013). Such reviews can be conducted using the Cook's distance statistics, D_i, which gives each variable a *D*-value (Berenson, Levine & Szabat, 2015). A common criteria for removing outliers is if the *D*-value exceeds the mean of all *D*-values times three (Cooks, 1977 cited in Jingang, Lu, Zhongya & Jiaguo, 2017). Another test to identify outliers was the hat matrix element, H_i, which finds the data points which have an unproportionate influence on the prediction line (Berenson, Levine & Szabat, 2015). Therefore, in order to optimize the regression, outliers were removed from the data set if the *H*-value exceeded the mean of all *H*-values times two (Fox, 2005). Both these tests were run in SPSS.

The normality of error was tested for the residuals of the dependent variable once outliers had been excluded, and tested against the Kolmogorv-Smirnov test, which is appropriate for sample sizes > 50 (Kanji, 2006). The sample is considered normally distributed when the p-value > 0.05 (Kanji, 2006). For the excellent ESG performance companies and when all categories were tested altogether, the normality of error test failed. However, as Cooks (1977 cited in Jingang et al., 2017) states that three times the mean for the Cook's distance test is only commonly adopted and not an obligation, an exception was made for these categories. In order to reach a normal distribution, the exclusion criteria was lowered to two times the mean. This is further demonstrated in Table B in Appendix B.

Lastly, and as defined in the event study methodology, the significance of the regression was tested using the calculated p-value in SPSS. A p-value < 0.05 indicates the null hypothesis, where the X and Y variables are independent of each other, should be rejected (Berenson, Levine & Szabat, 2015).

3.5 Validity and Reliability

The reliability of this study refers to the historical data being unconditional to future events, i.e. the studied data encompasses past events which cannot change. Another researcher could therefore at any time in the future retrieve the same data and content, and perform the same study. Moreover, given the quantitative nature of this study, the results are independent of the authors' subjective interpretations, which would be the case for a qualitative study. The reliability is further strengthened by the data analysis being conducted in SPSS which reduces the risks of errors by manually analyzing the data. The standardized data analysis also allows for a replication under the same conditions of the study. Considering criteria for excluding outliers, without subjective decisions by the authors, the replicability is strengthened as any researcher applying the same methodology would retrieve the same results. The approach of relying on p-values in order to reject or accept the null hypotheses further strengthens the research as these as well are unconditional upon the subjective assessment of the authors.

Furthermore, the aim of this research paper was to identify the effects of CSR activities on stock prices of listed companies on the markets in the EU. The objective was to study the stock price effects in terms of volatility in order to identify the range of movement of the stock in relation to the CSR activities in terms of ESG scores. More specifically, the aim was to identify whether ESG scores have different impacts on different companies depending on how highly rated they are. The ESG scores were extracted from the Refinitiv Database, which is one of the highest ranked ESG providers (Christensen, Serafeim & Sikochi, 2022). Considering these are based on a company's CSR activities, the aim of measuring ESG scores is considered to be satisfied. However, as Christensen, Serafeim and Sikochi (2022) criticize in their review, there is a rather significant discrepancy between the ESG scores provided by different agencies. Thus, the validity of this study is relatively tied to market reactions happening in relation to the releases of ESG scores by Reuters.

Furthermore, while the aim was to study the effect of ESG scores, it was not practically possible to isolate the individual effect of the variable. Rather, all market influences during the studied periods were included. Testing the volatility against a market index (e.g. S&P 350 Europe) would have been optimal. A large proportion of the ESG scores were released at the same date, which made it difficult to identify patterns of volatility in relation to the market as well. Consequently affecting the validity of the study as other aspects were studied as well when analyzing the volatility.

3.6 Limitations

The limitations of this study concern mainly the data collection. When extracting the data from Bloomberg, not all non-trading days were automatically removed. In specific, weekends were automatically removed, but not the non-trading holidays. Instead the prices on these days were the same as the price on the trading day before. Therefore, if not removing those data points, a volatility of zero would have been calculated between those days and lowered the average volatility for the period. Thus, these days had to be identified manually. It is expected that there were additional discrepancies in the data that were not identified, referring to national-specific holidays such as national days. It is important for the reader to be aware of the issues with the data.

Besides, the criteria applied to the sampling was limited by the database used to sample companies. In this research Refinitiv Eikon's database was used to determine which stocks to examine in this research. One limitation is that Refinitiv Eikon's database may not include all stocks in its database. For instance, Bloomberg may have provided a larger number of stocks with ESG scores when applying the same filters. Another limitation is that the criteria for sampling was true for the company on the date of which the data was extracted from the database, but may not have been true for the time period the study examined. For example, the filter of 500+ employees, applied to the day the data was extracted, and not the ending point of the sample time period between 01.12.2018 to 30.01.2020. Thus, the company sample could include companies fulfilling the sampling criteria as of 10.05.2022, but not during the sampling period.

Lastly, the construction of the methodology has brought limitations to the study as well. The geographical scope was limited to the EU, potentially resulting in data results limited to markets with similar liberal extent of regulations. I.e. markets with stricter or looser regulation on non-financial reporting, and stricter or looser controls on financial markets could potentially show other patterns in market reactions. The limitations are tied to the studied ESG scores. As Berenson, Levine and Szabat (2015) state, the findings are only applicable to the same range of ESG scores as the range of this study includes. Whether other patterns occur with higher or lower scores has therefore not been studied.

3.7 Chapter Summary

This chapter has established the methodology for which laid the foundation for the data analysis. A deductive approach was adopted and the research question embodied a comparative analysis of quantitative data and influences from the event study methodology were adopted. This meant the volatility during periods of no information influences (100 days) was compared to the period surrounding the release of the ESG score (3 days). As for the data collection, ESG scores by Thomson Reuters were used and the trading data was extracted from the Bloomberg Terminal. The sampling of the companies was based on set criteria, among others including only companies with 500+ employees and including only shares listed by EU member states. The data analysis then took the shape of a contingency table analysis and an ordinary least squares linear regression. The assumptions of such regressions were tested and the sample was adjusted accordingly when necessary. The data results are further presented in the next chapter.

4 Data Results and Analysis

4.1 Volatility and ESG Score

The following section in chapter 4 will in detail analyze the data results focusing on ESG scores and the associated market reaction in the form of changes in volatility. An analysis of the contingency table was first conducted in combination with results from Pearson's chi-square test and Fisher's Exact test. The analysis was then further advanced with a regression analysis.

4.1.1 Contingency Table Results

Table 4.1 presents the frequency to which there was a negative and positive change in volatility and the frequency to which there was a negative or positive change of ESG score for each of the ESG performance categories. A combination of all the categories opened for a general idea about the data results. It can be observed that 445 out of 536 total observations had a negative change in volatility, while 91 out of 536 observations had a positive change in volatility. Moreover, it can be observed that the proportion of decrease in volatility, relative to increase in volatility, appeared to be similar regardless of whether the observation was associated with a reduction or improvement in ESG score.

For observations within the poor-satisfactory ESG performance category, it can be observed in Table 4.1 that 81% of observations with a decrease in ESG score (13 out of 16) experienced a decrease in volatility, while the remaining experienced an increase in volatility during the event period. Similarly, 78% of observations (66 out of 85) with an increase in ESG score experienced a decrease in volatility.

For observations within the good ESG performance category, 89% of observations associated with a decrease in ESG score (68 out of 76) experienced a decrease in volatility during the event period relative to the estimation period. 84% observations with an increase in ESG score (164 out of 195) experienced a decrease in volatility.

Lastly, observations within the excellent ESG performance category, showed similar tendencies. 80% of observations that experienced a decrease in the ESG score (76 out of 94) experienced a decrease in volatility, and 83% of observations that experienced an increase in the ESG score (58 out of 70) experienced a decrease in volatility in the event period relative to the estimation period.

Bringing all these observations together it could be concluded that no substantial difference was observed among neither of the categories, and that the direction of change in volatility did not seem to differ no matter whether there was an increase or decrease in ESG score since previous ESG score release. Moreover, Pearson's chi-square test of independence (see Appendix C) showed that there was not sufficient evidence to reject the null hypothesis - change in volatility and change in ESG score were independent variables - for neither of the categories of ESG performance. Nevertheless, the p-value for good companies was 0.258, indicating a 25.8% likelihood that the null hypothesis was correct, therefore indicating a larger likelihood of an association between the variables.

Table 4.1 Two by two contingency table of observations between the change in the volatility and the change in ESG scores.

			Change in Volatility		
ESG Performance Category			Negative	Positive	*Total*
Poor-Satisfactory	Change in ESG Scores	Negative	13	3	*16*
		Positive	66	19	*85*
	Total		*79*	*22*	*101*
Good	Change in ESG Scores	Negative	68	8	*76*
		Positive	164	31	*195*
	Total		*232*	*39*	*271*
Excellent	Change in ESG Scores	Negative	76	18	*94*
		Positive	58	12	*70*
	Total		*134*	*30*	*165*
All	Change in ESG Scores	Negative	157	29	*186*
		Positive	288	62	*350*
	Total		*445*	*91*	*536*

4.1.2 OLS Regression Results for Positive ESG Score Change

An ordinary least squares regression was performed to further analyze the relationship between the variables. Specifically, the regression examined whether the volatility would change differently, based on the degree to which the ESG score changed. The regression only examined the behavior of observations associated with a positive change in ESG score.

For two out of four regressions (excellent ESG performance and poor-Satisfactory performance) the linearity assumption, stating that the data should be linear for it to be used in a linear regression model, was violated. Therefore, it was clear that a model solely based on

ESG score change could not predict the change in volatility for these categories. This was illustrated in Figure D1 and D3 in Appendix D, where the data points appear as randomly spread out. One could also argue that this random spread could be due to less data points for poor-satisfactory performance (85 observations) and excellent performance (70 observations), compared to good performance (195 observations) and all companies altogether (350 observations). Nevertheless, R^2 is rather low for all models. The highest R^2 value was reported for observations categorized as good, where R^2 was equal to 0.02, indicating that only 2% of the data points from the sample were explained by the regression model (see Table 4.2).

While these models do not serve for prediction purposes, it allows further analysis by bringing forth the possibility to discuss variations in volatility based on the extent to which ESG score changes. Nevertheless, as the models were rather weak, strong conclusions could not be derived from the results. For companies categorized as poor-satisfactory and excellent, (see Table 4.2) the p-value was significantly greater than 0.05, the threshold for accepting/rejecting the null hypothesis for the greater population. Nevertheless, for good and all companies altogether, the p-values were within the range of 0.06 to 0.08, indicating that the slope suggested by the respective models was likely to apply for observations beyond the sample.

Table 4.2. Summary of coefficients from running OLS regressions on the entire data set and the subsets of the data, where one subset was created for each company category.

ESG Performance Category	Intercept	Slope	R^2	p-Value (slope)
Poor-Satisfactory	-20.194	-0.319	0.003	0.652
Good	-29.574	1.186	0.020	0.069
Excellent	-27.032	0.983	0.005	0.590
All	-27.471	0.709	0.011	0.073

A common feature across the linear regression models was a negative intercept value zero. This indicates that overall, the volatility decreases around the time the ESG score was released, which was coherent with what was described in Table 4.1. For excellent ESG performance companies, the model suggested an intercept equal to -27.03 (see Table 4.2), indicating that no change in ESG score was associated with a reduction in volatility. A positive slope of 0.71, meant that per percentage unit change in ESG score, the volatility change would increase by 0.71 percentage unit per unit increase in ESG score. For good ESG performing companies, the intercept equaled -29.57, while it had a positive slope of 1.18, slightly higher than what it was for excellent companies. This would suggest that the change in ESG score was associated with a higher increase in volatility relative to observations within the excellent category. Lastly, the model for poor-satisfactory ESG performance stocks had an

intercept equal to -20.19 change in volatility, with a slope of -0.31. These results differ from that of the other two groups, and indicate that an increase in ESG score for these companies was usually associated with a decrease in volatility. However, the slope was relatively flat, and there was only very weak evidence for this statement as p-value was 0.652 (see Table 4.2).

4.2 Additional Data Analysis

Additional data analysis was done in order to advance the discussion and detect possible associations between volatility and the direction of the price, and ESG score and the direction of the price. This section also aimed for detecting whether the abnormal volatility was mainly caused by positive or negative returns in the event period.

4.2.1 Volatility and Price

Table 4.3 builds upon the previous analysis, but brings focus to whether the direction of the volatility was associated with a specific price movement. Moreover, it gives an idea about which price direction was most common for the different ESG Performance Categories. The table shows that among all the ESG performance categories, the overall tendency was that the price decreases after the release of ESG scores. 57% of all observations (304 out of 536) indicate a decrease in stock price during the event period.

For observations within the poor-satisfactory ESG performance category, it could be observed in Table 4.3 that 49% of observations where volatility decreased (39 out of 59) were associated with a decrease in prices, and an equivalent proportion of observations with a decrease in volatility experienced an increase in prices during the event period. Similarly, 91% of observations with an increase in volatility (20 out of 22) experienced an increase in prices.

For observations within the good ESG performance category, 57% of observations that experienced a negative change in volatility (132 out of 232) were associated with a decrease in prices, and 84% of observations with an increase in volatility (30 out of 39) were associated with lower prices, while 31% of observations with an increase in volatility (12 out of 39) were associated with higher prices in the event period.

Lastly, for observations within the excellent ESG performance category, approximately an equal proportion of observations associated with a decrease in volatility were associated with an increase (49%) and a decrease (51%) in prices during the event period. Among the observations associated with an increase in volatility during the event period, 67% of observations (20 out of 30) were associated with a decrease in prices, while the remaining was associated with an increase in prices.

Overall the numbers in Table 4.3 show that regardless of whether the volatility increased or decreased in the event period, the price tends to decrease. Contrary to the independence test of volatility and ESG score, Fisher's exact test for the independence of price direction during the event period and the direction of the change in volatility, exhibited less evidence of the null hypothesis being true. In particular, the poor-satisfactory and all companies altogether seemed to exhibit a significant dependence between volatility and price movement, where p-values were <0.001 and 0.004 respectively (see Appendix C). For the poor-satisfactory category an increase in volatility reported more cases where there was a negative movement in prices. Specifically, the proportion of negative to positive price movement was 20 to 2 when there was an increase in volatility contrary to 39 out to 39 when there was a decrease in volatility. The same tendency was observed for all companies altogether.

Table 4.3. Two by two contingency table of observations between the change in the volatility and the direction of price movement.

			Change in Volatility		
ESG Performance Category			Negative	Positive	*Total*
Poor-Satisfactory	Direction of Price Change	Negative	39	20	*59*
		Positive	39	2	*41*
		No change	1	0	*1*
	Total		*79*	*22*	*101*
Good	Direction of Price Change	Negative	132	30	*164*
		Positive	94	12	*106*
		No Change	6	2	*8*
	Total		*232*	*39*	*271*
Excellent	Direction of Price Change	Negative	68	20	*88*
		Positive	65	10	*75*
		No Change	1	0	*1*
	Total		*134*	*30*	*164*
All	Direction of Price Change	Negative	239	65	*304*
		Positive	198	24	*222*
		No Change	8	2	*10*
	Total		*445*	*91*	*536*

4.2.2 ESG Score and Price

Table 4.4 examines the correlation between direction of ESG score change and price movement during the event period. As established in the previous section, most observations were associated with a decrease in prices during the event period, implying that the volatility was associated with a fall in prices. However, Table 4.4 adds information about the price movements depending on the direction of the ESG score change. Overall a decrease in ESG score was associated with a decrease in prices, as 106 out of 186 observations (57%) where there was a decrease in ESG score exhibited negative returns during the event period.

Among the observations within the poor-satisfactory category that were associated with a decrease in ESG score, 10 out of 16 observations (63%) were also associated with an increase in prices during the event period. Among the observations within the same category that were associated with an increase in ESG score, 53 out of 85 observations (62%) were associated with a decrease in prices and 31 out of 85 (36%) were associated with an increase in prices.

For stocks within the good category that experienced a decrease in ESG score, 44 out of 76 observations (58%) were associated with a negative price movement, while 41% were associated with a positive price movement during the event period. Among the stocks that experienced an increase in ESG score, 113 out of 195 observations (58%) experienced a negative price movement, while 75 out of 195 observations (38%) experienced positive price movement during the event period.

Lastly, within the excellent category, 56 out of 94 observations that were associated with an increase in ESG score experienced a drop in prices during the event period, while 37 out of 94 observations with an increase in ESG score experienced an increase in prices during the same period. In contrast, among the observations that were associated with a decrease in ESG score within the same category, 32 out of 70 observations (46%) were also associated with a decrease in prices, while the remaining were associated with an increase in prices.

Overall, the numbers in Table 4.4 showed varying results. An improvement in ESG score was more frequently associated with a decrease in prices during the event period for poor-satisfactory and good ESG performance stocks, while it was associated with an increase in stock prices during the event period for excellent ESG performance stocks, although it was a rather minor difference. With regards to poorer ESG score rating, it was more frequently associated with a decrease in stock prices during the event period for good and excellent ESG performance stocks, while it was associated with an increase in stock prices for poor-satisfactory ESG performance stocks. Thus, good ESG performance stocks seemed to have the same reaction regardless of the direction of ESG score change. In contrast, the stocks of poor-satisfactory rated companies had a positive stock price reaction to a decrease in ESG score, and a negative stock price reaction to an increase in ESG score. Nevertheless, quite the

contrary appeared to be true for the stocks of excellent companies, where it was more frequently reported an increase in stock prices after the release of higher ESG scores than previous year and a decrease in ESG score was associated with a decrease in stock prices.

While certain differences were identified in Table 4.4, the independence test did not report significant dependence between ESG score change and price movement during the event period for stocks in the good ESG performance category and for companies altogether. However, poor-satisfactory and excellent companies' stocks reported p-values of 0.202 and 0.095 respectively (see Appendix C). Therefore, as discussed above, these categories seemed to exhibit stronger relation between change in ESG score and direction of price movement during the event period.

Table 4.4. Two by two contingency table of observations between the change in the ESG scores and the direction of price movement.

			Change in ESG Scores		
ESG Performance Category			Negative	Positive	*Total*
Poor-Satisfactory	Direction of Price Change	Negative	6	53	*59*
		Positive	10	31	*41*
		No change	0	1	*1*
	Total		*16*	*85*	*101*
Good	Direction of Price Change	Negative	44	113	*157*
		Positive	31	75	*106*
		No Change	1	7	*8*
	Total		*76*	*195*	*271*
Excellent	Direction of Price Change	Negative	56	32	*88*
		Positive	37	38	*75*
		No Change	1	0	*1*
	Total		*94*	*70*	*164*
All	Direction of Price Change	Negative	106	198	*304*
		Positive	78	144	*222*
		No Change	2	8	*10*
	Total		*186*	*350*	*536*

4.3 Chapter Summary

The results from the data analysis provided information for further discussion. Among the most prominent results was that overall volatility appears to be lower during the event period relative to the estimation period. However, no substantial difference was observed among the categories of ESG Performance and the direction of change in volatility did not seem to vary based on the change in ESG score. Nevertheless, the OLS regression discovered a distinction between the categories, where stocks within the poor-satisfactory category were the only stocks with a negative slope, indicating that contrary to the good and excellent groups, these stocks would have a decreasing volatility associated with an increase in ESG score. Nevertheless, these results lacked significant evidence.

The final sections of the data analysis reported that the price during the event period decreased for most observations. The most significant correlation between price change and volatility change was observed for the poor-satisfactory and all companies, where an increase in volatility was most frequently associated with a negative price movement during the event period. With regards to price movement and change in ESG score, interesting differences were discovered between the poor-satisfactory and the excellent groups, where poor-satisfactory rated companies appeared to have a negative correlation between stock price movement and ESG score change, while excellent companies, a positive correlation appeared to be true.

5 Discussion and Interpretation

5.1 Differences Across the Firms

Based on the outcome of the data analysis it was not possible to find strong evidence to reject the null hypothesis. Figures 4.1, 4.2 and 4.3, show no statistical significance for this. Nevertheless, while not statistically significant, a comparison among the three firm categories identified slightly different characteristics of the prediction line that is of interest to assess further.

5.1.1 Instant Market Reactions

The basis for the discussion lies in the assumption that the market considers ESG scores as an influential factor when pricing the stocks. Referring to Table 4.2, the stock volatility of poor-satisfactory ESG performers indicated a negative slope (-0.319) compared to the other company groups. While the absolute number is insignificant, the negative slope would translate into a greater decrease in volatility for a greater increase in the ESG scores of the respective companies. According to Benkraiem, Boubaker and Saeed (2021) corporate transparency increases as engagement in CSR activities increases. Additionally, Thomson Reuters (2017) ESG scores are partially based on transparency. As argued, poor-satisfactory ESG performance companies show less transparency and in the case of positive signals, they encounter less volatility in their stock prices. However, our results show certain inconsistency with prior research as it has been found that this would apply for highly rated companies as well (Benkraiem, Boubaker & Saeed, 2021; Deng et al. 2021). Also, one could argue that more CSR active firms could potentially possess better reputation, and thus, be less prone to immediate market reactions in the event of the ESG score release due to already incorporated information in the stock prices.

Moreover, Behl et al. (2021) argued that increased CSR engagement could reduce financial performance in the short-run, which would lower the perception of short-term stock return among the investors. It could be argued that the investors of poor-satisfactory ESG rated companies have less expectations on the companies engaging in CSR activities. As these companies incrementally increase their CSR engagement, investors may channelize their investments elsewhere as the initial phase of CSR investments lower financial performance (Behl et al., 2021). Considering this research studied mid -and large cap companies, it was assumed they have a relatively high analyst coverage (Doukas, Kim & Pantzalis, 2005). Additionally, the Reuters ESG scores are based on company fundamentals. As analysts tend to

cover the company fundamentals, but on a more frequent basis than the scores are updated, one could argue that the analyst coverage has already made the investors aware of the increased CSR expenditure among the companies that had a positive change in ESG score. It is therefore possible that the investors, who are not willing to sacrifice short-term returns in the initial phase of CSR engagement, have rechannelized their investments elsewhere prior to the release of the ESG scores.

Furthermore, Tasnia, Habshi and Rosman (2020) argued that environmentally sensitive stocks tend to be less held by institutional investors, such as pension funds. Wong and Zhang (2020) further stated that these stocks tend to bring investment risks. This would suggest that institutional investors would invest in higher ranked stocks to reduce the risk associated with ESG factors. Durand, Paugam and Stolowy (2019) also mention that the sell-side analysis perception of CSR has changed and switched focus towards a more positive view on such stocks. Together with the growing segment of sustainable -and ESG investing, it could be argued that stocks of lower ESG scores are of less interest as they do not fulfill certain ESG criteria. Therefore, suggesting stocks within the poor-satisfactory category are less held by the respective investors. As other categories exhibit positive slopes, it could be questioned if the decrease in volatility in the event period was due to lower ESG analyst coverage as these possibly are of less interest for institutional and ESG investors. As Yadav (1992) claims, higher buy -and sell side trading volume tends to cause increases in volatility as the demand for the stock increases. Referring to table 4.2 it is apparent that in absolute terms, the slope for good and excellent ESG performance companies is steeper compared to bad ESG performance companies. Connecting this to trading volume, the lower change in volatility in terms of absolute numbers could indicate lower trading volume for bad ESG performance companies. Ultimately, potentially suggesting the market interest for these stock around ESG score releases is smaller than for good and excellent ESG performance companies.

When looking at the good and excellent categories, they experienced an overall decrease in volatility in the event period. However, contrary to poor-satisfactory stocks the slope was positive, indicating that a greater increase in ESG score would translate to a greater increase in volatility - in other words, a less negative change in volatility. This could suggest that the stock prices react based on the degree to which the ESG score changes. However, as the association between ESG scores and volatility was not proven significant, it would be reasonable to take into account other influential factors on the prices, which Hawn, Chatterji and Mitchell (2018) also concluded in their study. Sentiment analysis as an explanation for this event, assumes that the stock price is affected by the overall market trends (Huang, Capretz & Ho, 2022). However, it could also be argued that the findings are aligned with Bhowmik and Wang (2020) that the volatility is not predictable and it is not possible to beat the market.

Nti, Adekoya and Weyori (2020) suggest that the fundamental information is often unstructured and could be difficult to comprehend for the average investor. ESG scores can therefore be argued to comprise fundamental company information to the average investors and signal an investment decision relating to CSR. This could suggest that the data results would reflect an association between ESG scores and volatility. However, this would potentially go against the EMH and signalling theory that once information has been traded on, that information is incorporated into the market. Wong and Zhang (2022) claims larger market capitalization increases analyst coverage and reduces information asymmetry. Which in relation to the fundamental information basis behind ESG scores, would suggest that the information behind the ESG scores are already being traded when the scores are released. This could thus suggest short-term trading on ESG scores for the studied companies would be abundant.

5.1.2 Firms and Market Environment

The implications of the results for the poor-satisfactory ESG performance companies could potentially be in line with the findings of Durand, Paugam and Stolowy (2019) that increases in CSR in the long-run increase analyst coverage. Taking on the long-run effect of CSR on stock prices, it has been found that CSR reduces long-term volatility (Benkraiem, Boubaker & Saeed, 2021; Deng et al. 2021). Hence, one approach can be to look beyond the abnormal volatility. For both good and excellent ESG performance companies it was identified in the regression that a greater increase in the ESG score would be associated with a greater positive change in volatility during the event period. In turn the intercept for these categories was lower, while it was higher (although still negative) for the poor-satisfactory ESG performance companies. This could be in line with findings on CSR reducing long-term volatility. As for the detected short-term volatility, considering that we found no significant correlation between positive changes in ESG scores and volatility, the short-term volatility of stocks within the good and excellent category experienced, was probably caused by other factors.

As Stein (1988) claims, it is in the interest of managers to keep the volatility of the stock at rather stable levels in order to mitigate the risks of inefficient investments. They refer to it as missing opportunities of investing in times of low prices because there is a hesitation to extra expenditure in unstable times, as well as overinvesting in good times. The latter resulted in negative effects on the quality of the investments. Furthermore, when looking at a volatile business environment in general, Dessaint et al. (2019) found that managers have problems sorting out noise in the market, meaning they would adapt their investment strategies based on the overall market sentiment. I.e., if the stocks of the peers reacted to non-fundamental information, the managers of a company would adapt investments accordingly, either start overinvesting or underinvesting. It is suggested though, that these scenarios are only relevant for longer periods of time, and not as short as the event period was defined in this research. This could also suggest that the noise is only reduced as a larger proportion of the market

invests in CSR, thus reducing the overall market volatility. At least within a certain business segment. However, it could therefore be in the interest of a company to invest in CSR to improve brand image and steal market shares of other firms. This can be implied as firms tend to adopt successful strategies. Resulting in CSR engagements increase within the segment, and reduce market volatility, and noise as well.

However, as discussed above, the negative slope for poor-satisfactory ESG performance companies could suggest that they operate in a more volatile environment compared to good and excellent ESG performance companies. Thus, could the inefficient investment problem be of relevance to address for these companies. This is further problematized by the findings of Zhu et al. (2020) on opportunistic behavior of managers in volatile markets. For example, the managers of the poor-satisfactory category could take advantage of a generally more volatile market as investments turn out to be unprofitable; therefore, mitigating the risks of themselves being blamed. Based on this, one could argue that it could be in the interest of the shareholders that the company invests more in CSR activities. This argument is mainly based on the findings of Benkraiem, Boubaker and Saeed (2021) that increased engagement in CSR leads to more transparent reporting, which Moreira Marques, Henrique Ogasavara and Araujo Turolla (2022) conclude is in favor for shareholders when there occurs opportunistic behavior among managers of a company. Additionally, lower long-term volatility could be associated with less information asymmetry as a result of improving transparency as the market is subject to less shocks due to unpredictable fundamental information (Barth, Konchitchki & Landsman, 2013; Nichols, Wahlen & Wieland, 2017).

Moreover, as it regards the financial performance, which according to fundamental pricing is the determinant of the stock price, especially referring to the ratios presented by Yang (2010 in Christie & Isidore, 2018). Zhu et al (2020) state that a high stock price increases the equity of a company, which becomes a financing tool for investments. Hence, managers taking advantage of times of non-fundamentally high stock prices could also jeopardize the overall finances of the company in cases of overinvesting based on temporary equity increases. Connecting back to the fundamental analysis, the debt-to-equity ratio is one of the most commonly used ratios for firm valuation and would therefore be impacted as equity fluctuates and companies increase their debt as overinvestment occurs. Consequently, the fundamental value of the company could be negatively affected. In situations of a significantly low fundamental value, the company could potentially risk being acquired or liquidated. Once again, it could be argued that it would be in the interest of the shareholders for a firm to engage in CSR activities as it has been found the overall volatility has a tendency to be lower for CSR active firms in the long run.

5.1.3 ESG Pillars and Stakeholders

Our lack of results could also be discussed from the perspective of dividing ESG into its three pillars. While the governance risk concerns the relationship towards shareholders, both social and environmental factors concern the stakeholders of a company. In the light of the stakeholder theory, firms have experienced pressure from stakeholders to adapt their operations to include corporate social responsibilities in their agendas. This could suggest that the power of the shareholders in relation to CSR activities has been slightly put out of play; therefore, not affecting the stock price significantly when ESG scores are released. This could be further emphasized by the fundamental valuation presented in 2.2.1 where it is suggested that CSR activities increase brand image, which often is an unrecorded intangible asset, which is not reflected in the company fundamentals. Consequently, an increase in ESG score, could in fact also mean higher valued intangible assets. However, as they often are unrecorded, it is possible that our data analysis is based on a lack of recognition of such assets as they would be mispriced according to Nichols, Wahlen and Wieland (2017). That being the case, for the fundamental trader, recognizing such mispricings among stocks with unrecorded intangible assets in terms of CSR could lead to excess returns as the, for example, increased brand image suggested by Nichols, Wahlen and Wieland (2017) generates increased sales and affects the fundamentals of the company positively in the long-run.

5.2 Validity, Reliability and Limitations

As it concerns the reliability of the data results (see chapter 4), it is apparent that the data results do not align with prior research as similarly as possible to this study. While De Bondt and Thaler (1985) looked into both negative and positive changes in ESG scores, this study limited the scope of negative scores to contingency table analysis. However, the research results did not identify a significant association similar to the one by De Bondt and Thaler (1985). Boldeanu et al. (2022) found that companies with good reputations are more affected by negative ESG news. When studying the data results of this study, no significant association similar to theirs was apparent. When studying the regression analysis, while it was not significant, there was an indication that poor-satisfactory ESG performance companies experienced a negative change in volatility as the ESG score increased. There was an opposite case for excellent ESG performance companies. This would not be in accordance with the study of Benkraiem, Boubaker and Saeed (2021) and Deng et al. (2021). These discrepancies can indicate a violation of the reliability of the data results of this study.

5.3 Chapter Summary

This chapter was mainly concerned with discussing the findings in the paper based on the main theories introduced in chapter 2. ESG scores and their connection to stock prices, volatility and shareholders were the primary focus of the chapter. It was argued that although there is no immediate market reaction detected, the effect of investing in CSR and consequently better ESG scores become apparent in the long-run. Moreover, it was discussed potential benefits on the brand image from increase in ESG scores, hence, adding value to the companies' intangible assets that could potentially cause mispricing. Later in the chapter, the validity and reliability of the research was also explored.

6 Conclusion

In this section, an ending note to the study will be provided concluding the results and observations. The research objectives will be examined in order to determine to what extent the research results addressed the aim of the paper. The chapter will end with practical implications and suggestions for potential future research.

6.1 Research Aims and objectives

The main purpose of this study was to determine whether there is any immediate market reaction to a positive change in the ESG score. The main conclusion concerned that there was an overall decrease in daily volatility at the time of ESG score releases for most observations, regardless of the change in ESG score. Thus, in cases where there was an improvement in ESG score, a positive signal, stock price volatility would be lower than the estimated normal volatility.

Moreover, the hypotheses embodied an assumption that there would be a relationship between volatility and releases of ESG scores, and that the overall volatility level would differ for firms in different categories of ESG score performance. As the data analysis demonstrated no significant association between the variables, H_0 could not be rejected. However, the OLS linear regression did, while not significant, indicate different results when comparing poor-satisfactory ESG performance companies to good and excellent ESG performance companies. If these results would have been significant, H_2 would have been accepted, indicated by a lower intercept for the poor-satisfactory category relative to the other categories combined with a positive slope for observations in the categories good and excellent. As for H_1, the data results and discussion embody that the hypothesis would potentially have been accepted if studying long-term volatility in relation to CSR activities. It was argued that firms with better ESG scores experience less volatile business environments as the market encounters less shocks as they tend to be corporate transparent. However, as it concerns this study, no significant data results support acceptance of either H_1 or H_2. Thus H_0 is not rejected.

Additionally, this study concluded that given the effect of volatility on stock prices, mainly in the long run, it could be implied that it is to the benefit of companies to invest in CSR activities in order to mitigate potential risks and losses rising in uncertain business environments. However, short-term volatility was not implied to be affected.

6.2 Practical Implications

This section discusses potential practical implications of our findings from our discussion where prior research is connected to our data analysis.

6.2.1 Equity Investing Implications

The findings in this study suggested no significant changes in stock price volatility around the times of ESG scores releases. It was therefore suggested that short-term trading on ESG scores would not generate excess returns and may not contribute significantly to the field of technical trading. However, it was discussed that the long-term volatility among good and excellent ESG performance companies tend to be more stable in the long-run. While this was not tested, the data analysis suggested it could be the case. This would also be in accordance with prior research studying the specific topic. It is therefore argued that ESG scores could be an indicator of improved long-term stock performance, which would be of interest for long-term investors. As for long-term investors, the discussion also landed in that with CSR comes transparent corporate governance, which reduces volatility and mitigates risks of information shocks.

6.2.2 Managerial Implications

The results were also discussed from the perspective of managerial implications. While the discussion for the most part was focused on the implications for poor-satisfactory performance companies, the discussion could also argue for CSR active firms to engage even further in CSR activities. A reduced long-term volatility is claimed by prior research to mitigate the risks of inefficient and unprofitable corporate investments. It is also suggested that the demand for investing in CSR active firms is increasing and has increased in recent years. Another connection to the low ESG scores was a probable mitigation strategy of good financial liquidity as a company in a volatile environment could risk an unstable debt-to-equity ratio.

6.3 Future Research

The limitations in our study open up several opportunities for future research. Among these limitations it would be possible for future research to address the limitations caused by geographical constraints, limited time-span, and the focus on large and medium capitalized companies. Future research could add to our research by examining other companies in other regions over a different and longer time period. It could also be of interest to compare whether there are differences in market reactions between different years. Moreover, examining the effect of change in ESG scores over a longer time could provide valuable insights in order to

investigate the effect of CSR activities on the companies' financial and stock performance in the long-run.

Besides researching market reactions overall, the study focused on examining differences among clusters created based on ESG score levels. It could be of interest to advance these clusters to identify potential differences in market reactions for different types of firms. For instance by examining the differences across firms in different industries and countries, as well as differences across firms of different sizes.

Adjustments could also be made to the method of examining the research question. For instance, one could aim to examine market reactions by further assessing the change in market prices and the excess returns in the two periods rather than volatility. One could also aim to use another form of news rather than ESG score releases to examine market reaction to news related to CSR activities.

6.4 Chapter Summary

This chapter has concluded the findings of this study and its contribution to the overall discussion on how CSR activities of a firm affect its stock price. While the aim of the study was of a short-term focus, the findings rather concluded long-term effects of CSR. The practical implications were elaborated on and suggested that while the findings may not be of relevance for technical traders, more substance was found towards long-term investors and managers of firms to engage in CSR activities. It was further suggested that future research on the topic could be interesting and contribute further to the field. Main suggestions for future research were adaptations to the methodology in order to study another scope of companies, the time-effect of CSR and other geographical areas. Lastly, it was further suggested that other studies look into other variables than volatility, such as excess returns, and instead of ESG scores study how companies' stock prices react to ESG news in the media.

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Appendix A

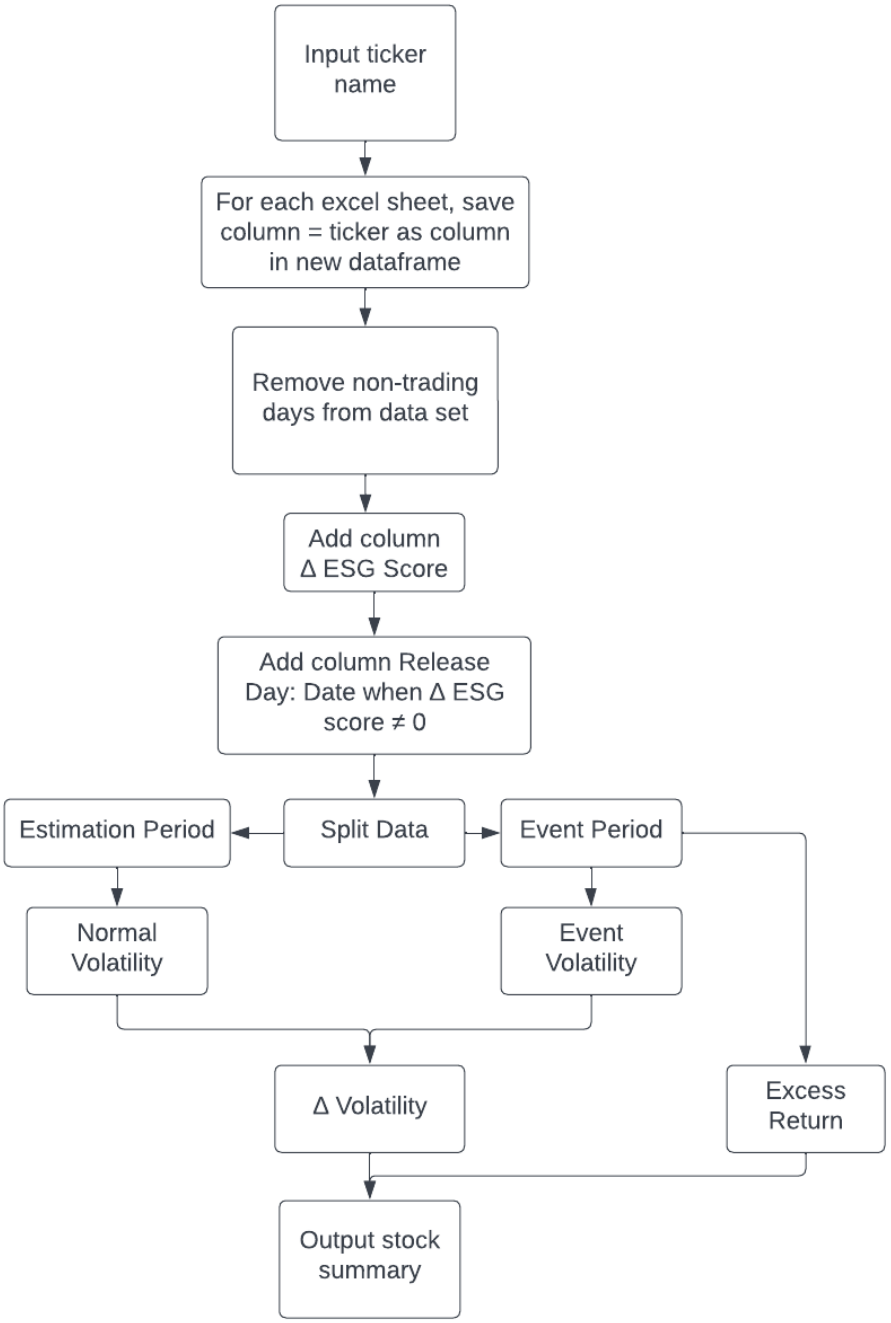

Figure A. Flowchart of the logic behind the data manipulation process.

Appendix B

The following figures illustrate residual plots used for testing the assumptions of equal variance (homoscedasticity). Residual plots were run in SPSS and the results in figures B1-B4 suggest no violation of the homoscedasticity assumption. The standardized residuals were plotted against the dependent variable (percentile change in volatility). Following the residuals plots is table B which presents the acceptance of the normal distribution of errors assumption for a linear regression.

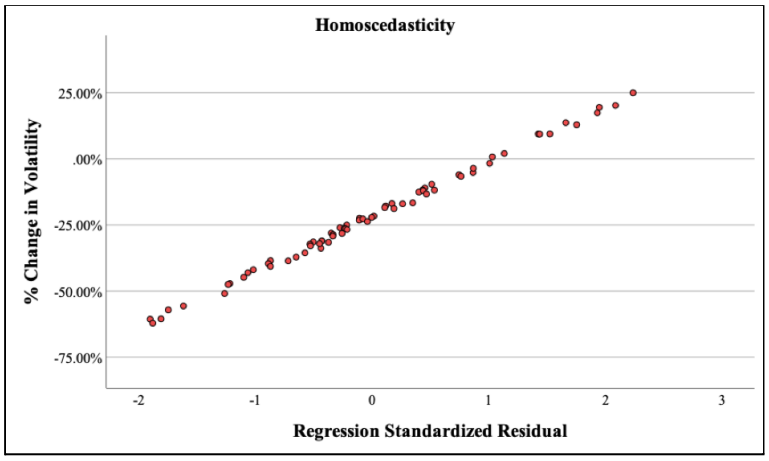

Figure B1. Residual plot of poor-satisfactory ESG performance companies.

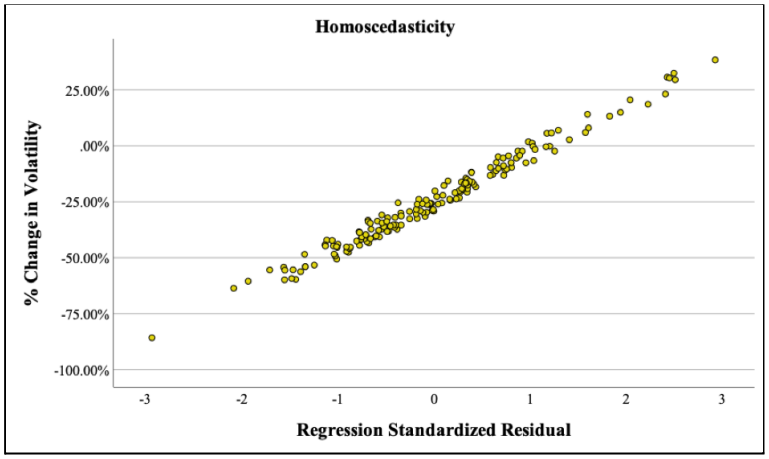

Figure B2. Residual plot of good ESG performance companies.

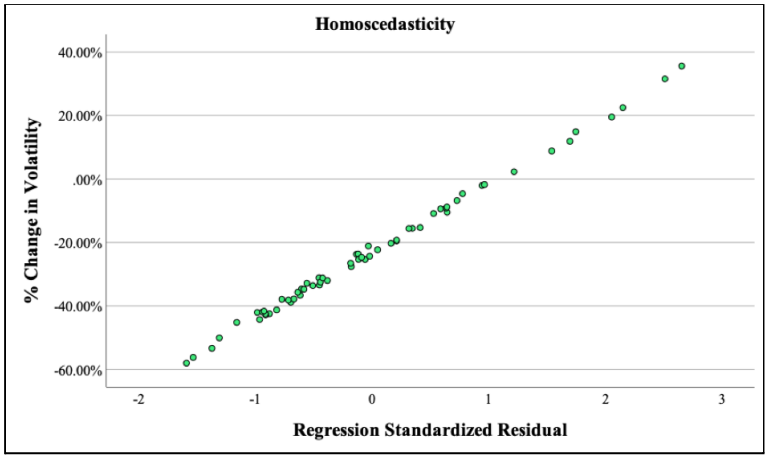

Figure B3. Residual plot of excellent ESG performance companies.

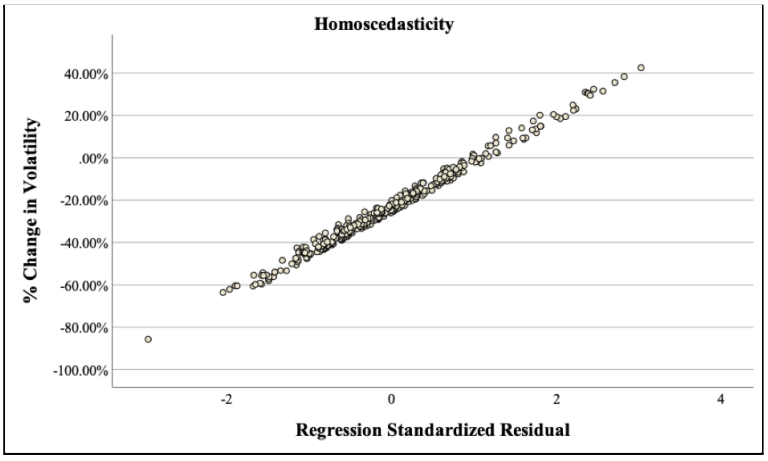

Figure B4. Residual plot of all studied companies.

The normal distribution of residuals was table B where the Cook's distance test and leverage values identified outliers. The normal distribution was tested with the Kolmogorov-Smirnov test. The normal distribution was proven when the significance level was > 0.05. The second trial of tests is presented in parentheses.

Table B. Cook's distance test, leverage values, and the Kolmogorov-Smirnov test.

ESG Performance Category		**Poor- Satisfactory**	**Good**	**Excellent**	**All**
No. of Companies Removed	Cook's Distance Test	8	15	5 (3)	29 (15)
	Hat Matrix Element	8	13	4	17
Significant Value	Kolmogorov-Smirnov	0.200	0.200	0.045 (0.183)	0.014 (0.054)
Final Sample Size of Companies		69	167	58	289

Appendix C

The table in Appendix C presents the results of the chi-square distribution and Fisher's exact test. Price included a category of no change, which had cell counts of less than 5. Similarly, poor-satisfactory ESG performance companies had too few observations to apply Pearson's chi-square test. Therefore, this row and the columns "Price-Volatility" and "Price-ESG" applied Fisher's exact test rather than Pearson's chi square test, resulting in "Value" and "df" (degrees of freedom) returning empty cells.

Table C. Significance test of contingency tables.

	ESG - Volatility			**Price - Volatility**			**Price-ESG**		
	Pearson's Chi-square (Fisher's Exact Test)								
ESG Performance Category	Value	df	2-tailed p-Value	Value	df	2-tailed p-Value	Value	df	2-tailed p-Value
Poor-Satisfactory	–	–	(1.000)	–	–	(<0.001)	–	–	(0.202)
Good	1.281	1	0.258	–	–	(0.299)	–	–	(0.688)
Excellent	0.108	1	0.742	–	–	(0.311)	–	–	(0.095)
All	0.388	1	0.533			(0.004)			(0.719)

Appendix D

The following figures illustrate scatter plots with the prediction line from the OLS linear regression where the percentile change in volatility has been plotted against the change in ESG scores. Each regression was run independently for each ESG performance category, and then once for all categories all together.

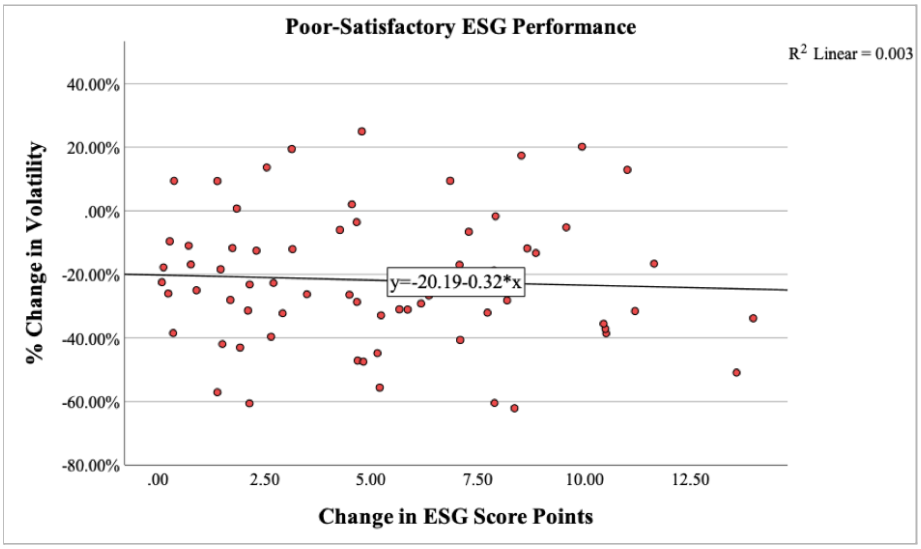

Figure D1. Scatter plot with the OLS linear regression on poor-satisfactory ESG performers.

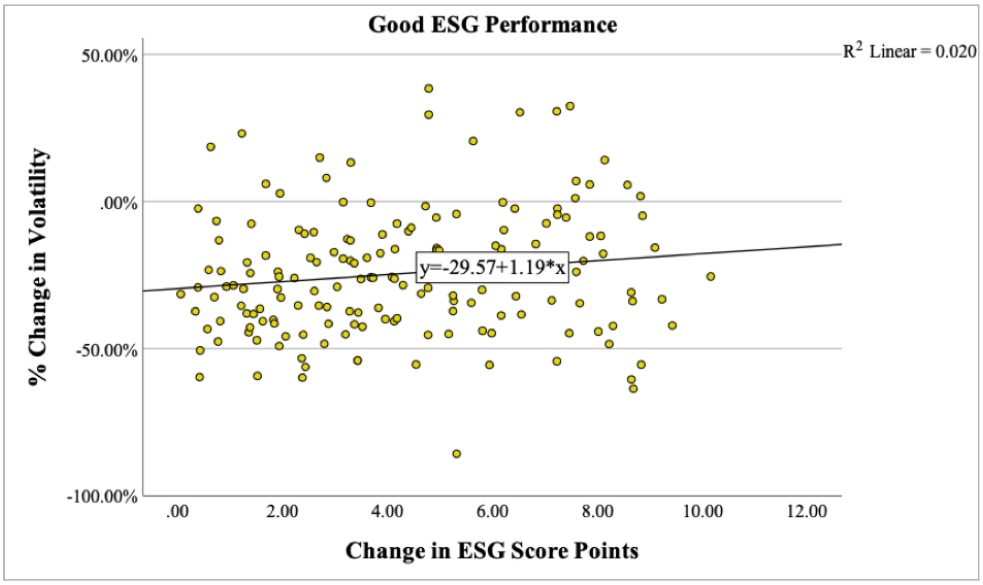

Figure D2. Scatter plot with the OLS linear regression on good ESG performers.

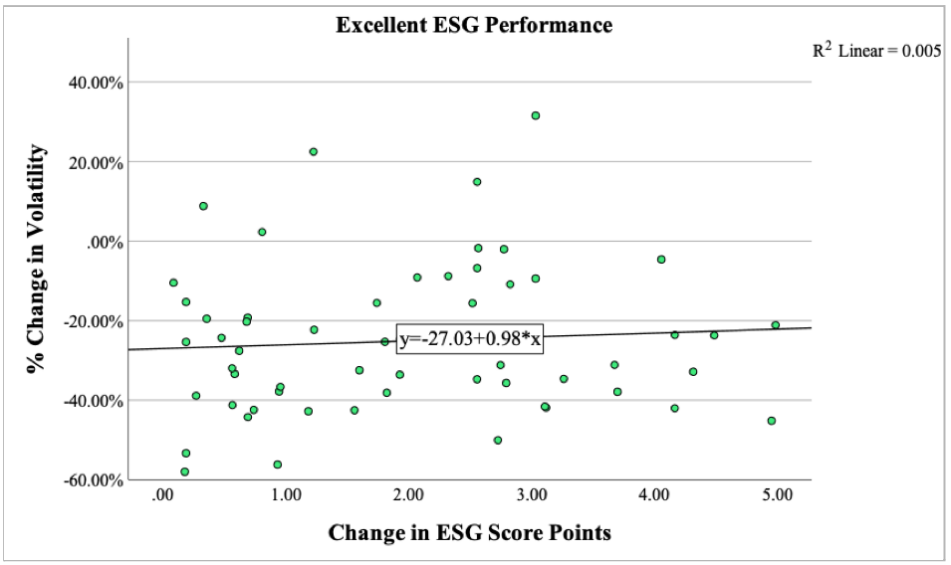

Figure D3. Scatter plot with the OLS linear regression on excellent ESG performers.

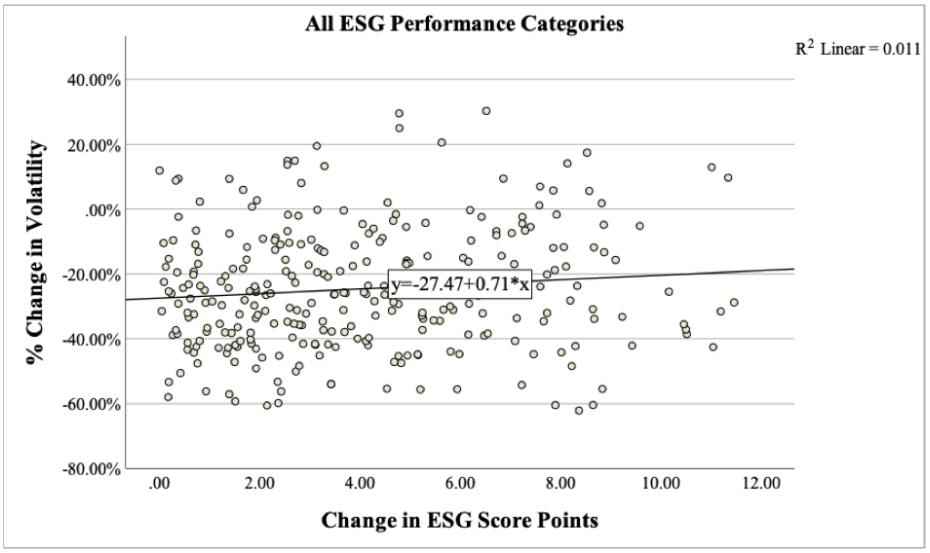

Figure D4. Scatter plot with the OLS linear regression on all observed companies.