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E, S, or G? Pillar-specific rating changes and their respective impacts on Stock Price Performance.

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Contents

1	Introduction.....	3
2.	Literature Review.....	6
2.1.	ESG ratings and financial performance.....	6
2.1.1.	Neutrality	6
2.1.2.	Underperformance	7
2.1.3.	Overperformance	7
2.2.	Individual Pillars.....	8
2.2.3.	(E) - Environmental Pillar	8
2.2.4.	(S) - Social Pillar	9
2.2.5.	(G) - Governance Pillar	9
2.3.	ESG rating changes and financial performance.....	10
3.	Research Problem & Hypothesis development.....	12
4.	Methodology	15
4.2.	Overall approach	15
4.3.	Variables.....	19
5.	Results.....	22
1.1	5.1. Descriptive Statistics	22
1.2	5.2. Results of Overall ESG Rating Changes	24
1.3	5.3. Environmental Pillar Rating Changes	Error! Bookmark not defined.
7.	References.....	35
8.	Appendix	38

1 Introduction

Over the past few years, Environmental, Social, and Governance (ESG) considerations in investing has been an increasingly important topic in the financial world, gaining traction in all sorts of economic actors ranging from ordinary investors up to major fund managers. As sustainability concerns worldwide are growing and stakeholder expectations are evolving, understanding the complex nature between ESG performance and their related financial consequences are more and more essential. ESG considerations have become such a big topic in the recent past that there is no way around it, and it will most likely be – if not already the case - the future of investing and/or the financial environment as a whole.

ESG scores measure a company's performance and risks related to Environmental, Social, and Governance factors, the goal of the ESG framework is to promote sustainable and ethical business practices, encourage transparency, and drive long-term value for all stakeholders. These scores are constructed by 'rating agencies' like MSCI, Sustainalytics, S&P, and Refinitiv, to transparently and objectively measure a company's ESG performance. Rating agencies collect and analyse vast amounts of data from various sources, including company disclosures, regulatory filings, and public records. ESG ratings provide a quantitative measure of a company's sustainability practices and societal impact, and are structured revolving around categories within their respective pillars (E, S, and G) such as carbon emissions (E), labour practices (S), and board diversity (G), with corresponding indicators ranging from greenhouse gas emissions intensity to board independence ratios which collectively form the aggregated scores. These ratings enable investors to differentiate between different firms based on their sustainability practices, facilitating the allocation of capital towards more responsible destinations aligning ethical and sustainable goals with capital gains as investors desire (La Torre, Mango, Cafaro & Leo, 2020).

Due to its swiftly growing importance and impact on the financial world, the body of research surrounding ESG considerations is rapidly increasing as well. As the overall goal of the ESG framework is to integrate non-financial sustainable factors into investment decisions, their implications on firms' value and stock prices are studied extensively. However, there appears to be an apparent gap in the research field of ESG ratings and its effects on stock price performance,

as existing conducted research is predominantly concerned with nominal ESG rating levels and how the market reacts to them; little research studies the effects of ESG rating *changes* over different periods of time, as observed by Shanaev & Ghimire (2022), and Glück, Hübel & Scholz (2022). While nominal ESG ratings offer valuable insights into a company's ESG performance, ESG rating *changes* reflect improvements or deteriorations in a company's sustainability trajectory, which can have significant signalling effects on financial markets, influencing investor perceptions and stock price performance. Therefore, solely focusing on the nominal level of ESG ratings does not do justice to the implications of an increasingly relevant topic in financial markets. Capturing the effects of ESG rating changes over time captures the dynamic nature of ESG ratings over time and how this is reflected into investor sentiment as both investors and firms try to align financial goals with sustainable practices and initiatives. Better insight in this relationship allows firms to adopt ESG strategies to gain competitive advantage and enhance long-term value creation, allows investors' to more efficiently align their goal of returns on investment with their ethical and sustainable values, and to assess whether or not the market deems ESG ratings as carrying value-relevant information which would result in significant reactions in the financial market in the first place.

For this reason, this study aims to answer the following research question:

What is the relationship between a firm's ESG rating change (individual pillar and overall level) and its stock price in European stock markets?

I perform event-study analysis using a 200-day estimation window and 17-day [-6, 11] event window for time period 2018-2023 over 15 European countries. The sample includes constituent stocks to the countries' main large, mid, and small cap index, trying to analyse how ESG rating changes affect stock price performance, offering a different perspective to look at ESG scores within European stock markets in comparison with existing literature. I check whether or not increases, decreases, or small/no changes in ESG ratings ultimately result into significant deviations from expected returns (CAPM benchmark) over the event periods, which are later

also analysed using regression analysis, and controlling for other variables like dividend yield and market capitalization.

This thesis fails to find significant Cumulative Abnormal Returns following from ESG rating events, which leads us to not be able to reject the null hypothesis of no significant relationship between a firm's ESG rating change and stock market. Over all subsamples, the only significant observation was the group portraying increases in Environment scores, whereas all others fail to deliver significant CARs, these results are robust over different estimation and event windows.

These results can also help inform policymakers and/or regulators about the effectiveness of ESG disclosure frameworks and how these mechanisms encourage or discourage companies in terms of improving their sustainability practices, in order to adjust regulations and policies to more effectively incentivize sustainability increasements in the future.

2. Literature Review

2.1. ESG ratings and financial performance.

Even though ESG investing is a fairly novel phenomenon, research is already conducted so much that there have already been multiple meta analyses published. This existing research is not necessarily conclusive, as literature finds positive, slightly negative, and non-existent relationships between financial performance and ESG scores, although the majority of studies seems to point at a positive correlation between the two (Friede et al., 2015; Giese et al., 2019). It should be noted that the negative studies are a very small minority, but the main “disadvantage” of ESG investing seems to be that it not necessarily translates into negative returns, but that they relatively underperform to their non-ESG counterparts. Cornell (2021) states that the ambiguity stemming from the varieties and differences in ESG ratings between vast amounts of rating agencies, along with the relatively short time interval over which these ratings have been available, makes it difficult to properly analyse the relationship between ESG ratings, financial returns and the associated risks. Below I will briefly summarize literature supporting different relationships between ESG and stock price performance.

2.1.1. Neutrality

The main argument of studies corroborating the ‘neutrality’ argument, is the notion that markets are informationally efficient, hence it is not possible to achieve superior risk-adjusted returns. Results from (Naffa & Fain, 2022) supports this statement, as their research points out that ESG portfolios did not generate significant alphas. Outperforming the market is not a prerequisite for being a good place to allocate funds to, as there are more ways through which ESG convey value. Hartzmark & Sussman (2019) also fail to find evidence supporting the rational belief that sustainable funds perform better than non-sustainable ones. However they do find that investors value sustainability for which they explore three hypotheses: institutional investors value sustainability due to institutional constraints (1), it is a signal of higher future returns (supported by Torre et al. (2020))(2), and altruism reasons (3).

2.1.2. Underperformance

ESG investments are a subset of the market, hence have lower diversification capability and therefore negatively impact the risk-return trade-off. As ESG criteria are hard, these constraints must have a downward impact on financial performance in comparison to normal unconstrained portfolios (Cornell, 2021). These results are corroborated by Matos (2020), which states that the binding constraint on portfolio optimization should result in an expected performance cost, however that ESG advocates claim that ESG related information is being underpriced. (Cornell, 2021) also finds a paper, following Fama-French (2007) theory which ultimately states that holders of 'sin stocks' require a premium on their returns due to reputational losses; and that the reverse is true for holders of high ESG stocks, and ultimately concludes that high ESG ratings go hand in hand with lower *expected* returns for investors. Other study also finds that more sustainable funds underperform in comparison to less sustainable funds, but also that due to increased fund inflows into sustainable funds, and decreases in fund inflows regarding unsustainable funds to be in line with a more altruistic motive (Hartzmark & Sussman, 2019). However, it is also the case that there is also evidence for that high ESG funds may underperform to benchmark models like the FF3F (or Carhartt-4, etc), but that also is often the case with their lower ESG counterparts and they do not find evidence of a significant difference in fund performance relative to the expected benchmark outcomes (Renneboog et al., 2008).

2.1.3. Overperformance

Clark, Feiner & Viehs (2014) explicitly finds evidence of outperformance of each individual pillar. They argue that a portfolio which shorts poorly governed firms and long well-governed firms historically has created an alpha between 10-15% (Governance pillar), that more environmentally friendly/efficient firms significantly outperform firms that are perform worse on this pillar (Environment pillar), and quotes research from Edmans (2012) which found that a constructed portfolio of the "100 best companies to work for" has earned an excess annual alpha of 3.5% above the risk free rate; and 2.1% above industry benchmarks (Social pillar). Another study also provides evidence for higher excess returns and lower volatilities for high-ESG score stock indexes, however this was the case for only a small amount of the stocks when analysed individually (Torre et al., 2020).

Research also points out that higher sustainability/ESG rated firms are “more likely to have established processes for stakeholder engagement, to be more long-term oriented, and to exhibit higher measurement and disclosure of nonfinancial information” (Eccles et al., 2014), and also significantly outperform their counterparts over the longer term in both accounting as stock market performance spheres.

To summarize, often the main takeaway of these study results is that high ESG performance does not necessarily translates into abnormally positive stock price performance and more often than not results in only a slight overperformance which mostly stems from the notion that high ESG conveys high value to investors, in terms of business practices, norms and values, and governance.

2.2. Individual Pillars

2.2.3. (E) - Environmental Pillar

A company’s Environmental (E) score is based on different criteria concerning their relative performance in terms of sustainability around the environment. It considers a company’s energy use, waste management, emissions, pollutions, overall resource use, etc. While the literature is not always in consensus, it seems to generally support the notion that better environmental practices are associated with good stock performance (Friede et al., 2015). This does not necessarily imply that they outperform peers, as many but that there is a general positive relationship between E scores and stock prices. However, underperformance relative to their low-E peers is found to be true more often in the short run, as there is also evidence for that high-E stocks outperform their peers over a longer timeframe, in both stock market and accounting measures (Eccles et al., 2014). Agliardi et al. (2023) Find that stocks with high Environmental (‘High-E’ stocks) to be the risk-averted option for investors as they show to be more resilient after economic shocks, and find an overall positive relationship between E levels and financial performance; however they also find that they underperform relative to their low-E counterparts. Multiple meta-studies report that good environmental practices and performance will ultimately transfer into a more competitive advantageous position in their respective markets and hence increase corporate performance, which is also reflected in stock prices. There is also found to be

a significant causal relationship between environmental performance and financial performance, which is dependent on the time horizon. In the short run, this effect is slightly less prominent, but over the long run the causality gets more significant, corroborating the notions that environmental practices ultimately cause better stock price performance (Clark et al., 2014; Hang et al., 2019).

2.2.4. (S) - Social Pillar

The social pillar focuses primarily on a company's relationships with its overall stakeholders, like employees, customers, suppliers, broader community, etc. The main research paper regarding the effects of the Social pillar on stock prices stems from Alex Edmans (2012), which finds that firms with "high levels of job satisfaction generate high long-run stock returns" (Edmans, 2012, p. 16), and that they also systemically beat analysts' earnings estimates. Edmans states that this implies that certain of these social governance "intangibles", like increased productivity and reducing turnover/recruitment costs due to employee satisfaction/morale, can improve stock performance and therefore bear value-relevant information.

High social scores can enhance a company's reputation, which leads to increased customer loyalty and employee satisfaction, which are critical drivers of long-term financial performance (Illuzzi & Inguanta, 2021). However, Krüger (2015) stated that markets also often react negatively to incurred costs associated with implementing and maintaining high social initiative standards, possibly reflecting the market's concern about short-term profitability.

The overall literature consensus regarding the Social pillar suggests a positive relationship between the scores and stock price performance, due to increased employee satisfaction and productivity and enhanced reputation.

2.2.5. (G) - Governance Pillar

The governance pillar of the ESG framework assesses the quality how the company operates internally, and contains factors like a company's leadership, executive compensation, audit practices, board structure, and shareholder rights.

It is found that effective governance is crucial for sustainable business performance, as it enhances oversight and accountability within firms, and that this strongly enhances investor confidence and reduces perceived risk which drives funds into these firms. Well-governed companies are also more likely to make better strategic decisions that align with shareholder interests and are less likely to engage in activities that could lead to financial distress (Bebchuk et al., 2004) and cause declines in stock prices. Higher governance scores are also found to be more transparent and providing more reliable financial information, which also increases investor trust by reducing information asymmetry. This transparency can also lead to a lower cost of capital and higher stock valuations (Larcker et al., 2007). In conclusion, the literature regarding the governance pillar suggests a positive relationship between stock price performance and ESG governance scores, primarily driven by investor confidence, risk management, and more effective decision-making processes.

2.3. ESG rating changes and financial performance.

As initially stated, the vast majority of ESG research surrounding stock prices and financial performance of firms considers nominal ESG levels, instead of the changes in ratings over time. This gap in research results in a smaller literature field capturing the dynamic nature of financial markets, investor sentiment, and sustainability initiatives over time. This section discusses existing literature and aims to answer the question how sustainable initiatives or sustainable deteriorations are rewarded by market participants. This section will provide the primary basis from which I derive my hypotheses later on.

All of the relevant literature surrounding rating change effects which are discussed below, employ some form of event-study methodology to assess the effects of these 'events' on the stock market from some predetermined benchmark. Event study methodology involves analysing the impact of a specific event on stock prices. This is done by examining stock price behaviour during a defined 'event window' surrounding the event, the ESG (and individual pillar) rating change in this context, and comparing it to the expected stock price values determined by an asset pricing model using historical values over a defined 'estimation window'. The difference between actual and expected stock returns, known as *abnormal returns* are calculated and

statistical tests are used to assess whether or not these are significant. Abnormal returns, which are usually indicated by *Cumulative* abnormal returns (CAR), which is defined as the sum of abnormal returns of the stock over the event window. If CAR's are significant, this indicates the presence of a significant market reaction to in the defined event window.

Shanaev & Ghimire (2022) find that while ESG rating upgrades ultimately lead to relatively small and often insignificant abnormal returns, the case for ESG rating downgrades is much stringent. ESG rating downgrades are “consistently detrimental for stock performance, leading to statistically and economically significant negative abnormal returns” (Shanaev & Ghimire, 2022, p. 5) which are found to be robust across multiple model specifications. Glück et al. (2022) corroborate these findings, and find that particularly downgrades in the environmental (E) and social (S) scores will ultimately lead to significantly negative cumulative average abnormal returns within eleven days following rating ‘events’ (e.g. rating updates by rating agencies), but they do not find a same significant market reaction for rating upgrades in the short-term.

The way in which ESG rating changes convey value-relevant information to the market can also be seen in how the market reacts to ESG related *news* more broadly, apart from just the rating changes events. Capelle-Blancard & Petit (2019) analyse stock market reactions to positive and negative news items regarding ESG performance, with positive news including launch of “new-eco innovative products”, green awards, etc; and negative news including stories about bad labour practices in factories, toxic release disclosures, negative rumours, etc. Their results also point out that shareholders mainly react to negative ESG news expressions, finding significant drops in market value in a 3 day event around the announcement. They also find that on the contrary, firms experiencing positive ESG expressions in the news do not experience any significant change in their market value. Krüger (2015) performs a similar type of analysis to Capelle-Blancard & Petit, however assesses effects of Corporate Social Responsibility, which more broadly regards the impact of a firm’s business operations on stakeholders like employees, society and the environment. The findings of this study also point out that there is a difference in how positive and negative events are treated differently by the market. Investors react strongly negatively to negative CSR news, but yields way less pronounced effects for positive CSR news events.

There seems to be a consensus amongst the vast majority of studies that indicate that predicting the market reaction in context of ESG ratings (changes), primarily upgrades, is not straightforward. The difference between how negative events and positive events are treated could potentially be explained by the following. Loss aversion been a well-documented phenomenon that refers to the fact that losses are psychologically more impactful than equal gains in our minds (Kahneman & Tversky, 1979). In this context, this means that investors react more strongly to potential losses than to gains, and this consequently causes negative news about a stock to have a bigger downward impact on prices, than 'equally positive' news would increase stock prices. As stated by Glück et al. (2022), an improvement of a company's overall ESG score might not be rewarded with positive price reactions as the costs associated with said improvement might outweigh the potential expected benefits, which would in fact lead to negative net present value (NPV) of these efforts, whereas the decrease of a company's ESG score(s) seem to be weighted more heavily by investors and therefore carry more value-relevant information about a subsequent decrease in firm value.

3. Research Problem & Hypothesis development

Despite the increasing integration of environmental, social, and governance (ESG) considerations into investment decisions, a significant research gap exists regarding the precise impact of ESG rating changes on stock price performance. While previous studies have explored the relationship between overall ESG performance and financial outcomes, relatively little attention has been given to the nuanced effects of individual E, S, and G pillar rating changes on stock prices. Therefore, the central research problem of this study is to empirically investigate how changes in overall ESG ratings, as well as changes in the environmental (E), social (S), and governance (G) pillar ratings individually, affect the stock price performance of European firms. By addressing this research problem, this study aims to provide valuable insights into the mechanisms through which ESG factors influence investor perceptions and asset valuations, thereby informing investment decisions and contributing to the broader understanding of sustainable investing practices in the European context. The main research problem is as follows:

What is the relationship between a firm's ESG rating change (individual pillar and overall level) and its stock price in European stock markets?

3.1. Main Hypotheses ESG

When looking at the literature studying how ESG related news affects their stock prices in the market, whether it be in announcements, news outlets, rumours, or the overall ESG ratings, it seems that ESG performance of firms are a valuable information-carrying indicator in the financial world. Firms suffering from ESG rating downgrades truly seem to be punished, in the sense that they yield significant negative returns. This indicates that investors portray some form of loss aversion and/or are actively negatively screening bad performing firms in portfolio selection (Krüger, 2015). For ESG rating increases, the effects on stock prices are a bit less evident and seem to yield small to no significant returns, not really rewarding firms' ESG initiatives. Nevertheless, returns show to be positive. Following this, I yield the following hypotheses:

H0: There is no relationship between a firm's ESG rating change and its stock price in European stock markets.

H1: There is a positive relationship between a firm's ESG rating change and its stock price in European stock markets.

Where the positive relationship entails that an increase (decrease) ultimately results in positive (negative) significant cumulative abnormal returns, which are also actually attributable to the rating change as impactful event in the regression analysis.

3.2. Hypotheses development individual pillars

Logically, the same structure of research question and hypotheses follow for the sub-analyses regarding the individual pillars. **There is almost no specific information regarding the individual pillars and if the markets react differently to them to base the particular hypotheses on.** To my knowledge, the only study which also assesses the individual pillars' changes as opposed to solely the combined ESG score is from Glück et al. (2019), which finds no significant CAR's in any of the

individual pillars' subgroups if they increase in rating in both a 1-factor and a 6-factor model. However, there nearly all subsamples indicating decreases in the pillars yield significant negative CARs over the two models. This leads to no difference in the direction of the hypotheses, only that we should expect the negative change group to be statistically significant and the increase group to not show significant results. The research question and hypotheses of the individual pillars' are as follows:

3.2.1. Research question and hypotheses - Environment

What is the relationship between a firm's E rating change and its stock price in European stock markets?

With,

H0: There is no relationship between a firm's E rating change and its stock price in European stock markets.

H1: There is a positive relationship between a firm's E rating change and its stock price in European stock markets.

Where, again, the positive relationship entails that an increase (decrease) ultimately results in positive (negative) significant cumulative abnormal returns, which are also actually attributable to the rating change as impactful event in the regression analysis.

3.2.2. Research question and hypotheses - Social

What is the relationship between a firm's S rating change and its stock price in European stock markets?

With,

H0: There is no relationship between a firm's S rating change and its stock price in European stock markets.

H1: There is a positive relationship between a firm's S rating change and its stock price in European stock markets.

3.2.3. Research question and hypotheses - Governance

What is the relationship between a firm's G rating change and its stock price in European stock markets?

With,

H0: There is no relationship between a firm's G rating change and its stock price in European stock markets.

H1: There is a positive relationship between a firm's G rating change and its stock price in European stock markets.

4. Methodology

4.2. Overall approach

Event study methodology enables me to isolate and quantify the impact of potential valued information of the news on the stock market by comparing market movements surrounding ESG related events to what stock price models expect them to do. Relevant previous literature aiming to answer similar research questions to mine also use similar event-study approaches; Shanaev & Ghimire (2022) and Glück et al. (2022) use rating changes as the event, whereas Capelle-Blanchard & Petit (2019) and (Krüger, 2015) adopt ESG news more generally as events.

In my main analysis, I perform an event study on the effects of ESG rating changes on European companies' stock prices, analysing the statistical significance of Cumulative Abnormal Returns, the sum of deviations of actual returns to expected returns, calculated from the Capital Asset Pricing Model benchmark. I distinguishing between a positive change group (increases), negative change group (decreases), and an 'unchanged' rating group, containing observations with ESG rating changes between or equal to -1.5 and +1.5. This 'unchanged' group follows from Glück et al (2019). and allows for distinguishing between minor changes in ESG ratings and more 'real' changes in ratings. With 'real' changes meaning better capturing the effects of 'serious' increases like ones resulting from a new renewable energy project, diversity/inclusivity plan, or improved reporting/disclosure; and 'serious' decreases like ones resulting from increased carbon emissions and labour rights violations.

The sample stocks analysed are the stocks that make up their respective countries' main Large, Mid, and Small cap stock indices, as this gives a relatively broad insight into the various European

stock markets when compared to only the constituents of the largest ‘main’ index of European countries. This way, my sample aims to provide a holistic view of how ESG rating changes affect stock markets all over Europe. Included stock indices can be found in **Table A1: Stock indices used for analysis** in the appendix. The selection of included European countries are based on the fact that these are the biggest (total capitalization) and most developed countries in terms of stock market, which goes hand in hand with the amount of data available for research.

The main analysis’ event & estimation windows will follow the same lengths as used in Glück et al. (2022), as this research lies the closest to that I am aiming to perform, as well as the reasoning behind it is well-founded in event study literature and methodology. They use a 200-day estimation window to acquire coefficients from a 1-factor (US market factor) and a Fama-French 6-Factor Model, applied over this window, whereas I will be using them for the Capital Asset Pricing Model. 200 days is long enough to capture a representative sample of historical returns for each stock¹, whilst also excluding data that may be influenced by the event itself. Another study adopts a much shorter estimation window of only 30 days, with an event window of just 12 days, starting from 2 days before the event [-2, 10] (Illuzzi & Inguanta, 2021). That study argues that ESG rating publications’ effects will show immediately after the fact, which is in line with a semi-strong form of EMH (Fama, 1970). There is a case to be made for the shorter event window, and I will also use a shorter event window for robustness checks, but I believe the 30 day estimation period to be too short, as it allows for estimates to be influenced greatly by short-term shocks in prices, whereas longer ones like Glück et al (2022) are not at that risk to such an extent. Glück et al (2022) calculate Cumulative *Average* Abnormal Returns (CAAR) separately for upgrades, downgrades, and unchanged ratings for each of the respective ESG dimensions. CAAR here is the average of the calculated abnormal returns over the event period. The respective event period used by Glück et al. is 16 trading days around the rating event. Their event window is split into two: first one being five days prior to the rating event to account for the “potential leakage of information or anticipation effects with regard to the rating event” (Glück et al., 2022, p. 19).

¹ Glück et al. (2022) also used 250 trading days as an estimation window for robustness, however these results are similar to 200 trading days. This study will also use 150 days as an estimation window for robustness in the Appendix.

The second component of the event window considers eleven days including the rating date, to capture the short-term reactions to the respective event. This way, the event window allows for capturing the immediate market reaction to the rating change, including any pre-announcement leaks or anticipation to the event, as well as assessing the persistence of the market response in the days following the announcement. Depending on data availability, the amount of years analysed per firm differs, however I perform analysis over all the available data regarding a 5 year period (between 2018 and 2023 – as the final ratings for 2024 are not yet published and/or finalized by the LSEG Database).

For robustness, I check for correlation between variables and will analyse the results over two alternative specifications of estimation & event windows:

- Alternative 1: 150 day estimation period, 25 day event window [-2,23]
- Alternative 2: 200 day estimation period, 7 day event window [-2,5]

This will provide a clearer picture of the impact of ESG rating changes on stock prices, also accounting for market-wide movements and systemic risk factors. It also allows for comparability across different stocks and time periods. It is desirable that these correlations are low; so that each pillar effectively covers different issues and therefore makes potential overlapping of information across pillars insignificant; and makes for better analysis. Fortunately, previous studies typically do not find correlation between pillars and their respective underlying 'Key Issue' scores. Glück et al. (2022) finds weak to no correlation between the three pillars, which allows them to examine the pillar scores separately. Another study conducted by research of MSCI ESG Research does extensive analysis regarding the correlations between Key Indicators Key Issues that make up the individual pillar aggregated scores. They find such low and irrelevant correlations (near 0) that they conclude that key issue and indicators really measure different issues within firms (Giese et al., 2020). This may however not be the case with LSEG ESG data, despite those chances being small.

Resulting CARs and corresponding p-values indicating statistical significance will be calculated separately for 12 subsamples:

ESG (overall score) – Increase, unchanged, decrease.

E (environment) - Increase, unchanged, decrease.

S (social) - Increase, unchanged, decrease.

G (governance) - Increase, unchanged, decrease.

The main goal here is to find whether these CARs are statistically different from zero, which would indicate a significant relationship between the event date and stock price performance. CAR is defined as the sum of AR's of a stock over the length of the event window.

Aiding in the Cumulative Abnormal Return calculations, I will be making use of the RStudio package provided by eventstudytools.com, which presents a solution in performing event studies with multiple features like their abnormal return calculator which allows me to study large number of events at different dates, and cluster them by sub-groups. These sub-groups in my case are industry, market capitalization (small, mid, or large) and country. Test statistics are also included in the list of tools, along with p-values to assess significance levels which I will deem the predominant factor to assess significance of potential event window CAR's (*Apps For Event Studies And News Analytics | EST, 2022*).

The second part of my analysis will consist of random-effects panel data regression analyses, to test whether or not abnormal stock market reactions are indeed attributable to the change in ESG ratings, and not related to some (event-specific) firm fundamentals I will regress the events' CAR's on dummy variables indicating an:

- Increase (*IncreaseDummy*)
- Decrease (*DecreaseDummy*)

Per ESG metric (ESG, E, S, G)

And the following firm-specific value-carrying variables, which are also listed in the "control variables" section in Chapter 4:

Divield stands for *Dividend Yield*

MCAP stands for *Market Capitalization*

Which yields the following panel data regression formula:

$$CAR_{i,t} = \alpha + \beta_1 * IncreaseDummy_{i,t} + \beta_2 * DecreaseDummy_{i,t} + \beta_3 * DivYield_{i,t} + \beta_4 * MCAP_{i,t}$$

Where,

Initially, we expect for a positive β_1 coefficient, indicating that an increase in a respective ESG metric can explain positive cumulative abnormal returns. We expect β_2 to have a negative coefficient, indicating that the presence of a decrease in an ESG metric leads to negative cumulative abnormal returns, which should reflect that investors punish decreases in ratings leading to declines in stock prices. We expect β_3 to be positive, as higher dividend yields signal strong future prospects and indicate high financial health of a firm, which are valued much by investors. We expect β_4 to be negative, as smaller companies are generally perceived as riskier investments as opposed to larger and more established firms, and are deemed as having more potential to growth. Hence, the larger the market capitalization, the lower we expect the cumulative abnormal returns to be.

It must be noted that even if the event study analysis yields insignificant CAR's, this does not necessarily imply that there is no significant relationship between rating changes and stock prices; however it does mean that the deviations from the benchmarks are not significantly different from zero in the event window. It may very well be that ESG rating changes are a good predictor for the CAR's, whether they are significant or not.

If the panel-data regression analysis does not yield significant coefficients for the *Increase & Decrease* dummy variables, I cannot conclude that potential CARs can be attributable to changes in ESG ratings, which will be the main argument in accepting or rejecting my hypotheses.

4.3. Variables

Closing prices

To obtain a holistic overview of the European market, I include all stocks that make up the 15 biggest European stock markets' main large, mid, and small cap indices², which includes over 2000 companies. Think about the CAC 40 Index (large), CAC Mid 60 Index (mid), and CAC Small Index (small) listed on the Euronext Paris, the FTSE 100 Index (large), the FTSE 250 Index (mid), and the FTSE SmallCap Index regarding the London Stock Exchange. Please note that there are some data

² List of indices included can be found in Appendix **Table A1: Stock indices used for analysis**

availability limitations as not all firms' have all their financial data readily available, and therefore cannot be included. Ultimately used in analysis will be the closing prices in the respective eligible stocks in Euro's.

ESG ratings

The ESG rating data that is used in analysis, is gathered through the London Stock Exchange Group (LSEG) ESG database, with access provided by the Radboud Library Team. The LSEG ESG database covers over 90% of the global market cap and involves more than 630 ESG metrics. The metric scores are both available in regular percentages, and in letter grades (from D- to A+), where I will only be using the regular percentages as these allow for more precise estimations and analysis. These ESG scores are based on each firm's ESG factors' relative performance to the firms' sector (for E & S), and country of incorporation for G. While the database is updated weekly; the bigger ESG changes often only change yearly (January 1st) which is in line with companies' own ESG disclosure, however in certain exceptional cases the ratings are updated extra frequently (London Stock Exchange Group, 2023). In order to find a more holistic and complete idea of the relationship between rating changes and future financial performance of the stocks, I will be analysing data from 2018 up until 2023, which is the most recent definite rating available.

Benchmark model variables

To calculate abnormal returns, we need to subtract the *expected returns* from the realized returns. I will use the Capital Asset Pricing Model in order to estimate these expected returns. Expected returns in these models require factors which I will briefly explain.

Capital Asset Pricing Model (CAPM)

$$E(R_i) = R_f + \beta_1 * (E(R_m) - R_f)$$

Risk-free rate, which is proxied by the yield on a short-term government bond of a company's respective country, as these are generally accepted due to minimal default risk by governments, high liquidity and stable returns. For the majority of the countries, I used the 3-month government bond yield; with some exceptions due to data limitations. These exceptions include Norway (where I used the 6-month yield), Poland (2-month yield), Ireland (1-year yield), Finland, and Denmark (both 2-year yields), data was gathered from Investing.com (2024).

Market return, as proxied by a broad market index. Here, the market return is defined as the daily logarithmic return of each respective country's main market index.

Beta, which measures the sensitivity of a stock's returns to changes in the market return. It quantifies the systemic risk of the respective stock relative to the market. In order for Eventtoolsstudy's application to calculate the required (co)variances needed in beta calculation, I needed to provide the closing prices of the market indices corresponding to the firms included in analysis. For simplicity, I only added the main (large) market index closing prices per country over the analysis window.

Control Variables

The following variables are controlled for in the majority of previously mentioned study, to account for potential effects they (potentially) have on stock prices that would have been endogenous, Included control variables are available through the LSEG database.

- *DivYield* stands for *Dividend Yield*, which shows how much is paid out as dividends to its shareholders as a *percentage* of its stock price. Fama & French (Fama & French, 1988) find that there is explaining power (positive relationship) in dividend yields on stock returns, which is increasing over the return horizon. This same relationship is further affirmed by Campbell & Shiller (Campbell & Shiller, 1988). This positive relationship is attributed to that higher dividends signal strong future prospects and indicate financial health, which are attractive features to investors.
- *MCAP* stands for *Market Capitalization*, which is defined as the number of outstanding shares times the stock price, which ultimately is an indicator for how big that firm is in the stock market sphere. There is an apparent negative relationship between size and risk-adjusted returns, which is that it appears that smaller firms generally outperform larger firms in this category. This relationship was first identified and established by Banz (1981), and later further popularized by Fama & French (Fama & French, 1992) as a factor in their 3-factor model. This 'size effect' stems from the fact that smaller companies are generally perceived as riskier investments compared to larger, more established firms, and are seen as having more growth potential. Included MCAP values are in million Euros.

5. Results

This section presents the analysis of the impact of ESG rating changes on stock price performance, measured through Cumulative Abnormal Returns (CARs). The analysis is categorized into overall ESG rating changes and their individual components - Environmental (E), Social (S), and Governance (G). Upgrades, downgrades, and unchanged groups are examined across various event windows to determine their effects on stock prices. Keep in mind that the event window in the main analysis is 17 days (6 before event date, 11 after event date), and has an estimation window of 200 days. At first, we take a look at descriptive statistics and I try to give an overview of how the results are distributed over the sample, then I show a correlation matrix of the different relevant variables, and then I show and analyse the main event-study results over the different ESG metrics and the direction of change they show, and finally I perform regression analysis on the CAR's with different control variables.

5.1. Descriptive Statistics

Variables	Mean	Std. Dev.	Min.	Max.	Obs.
ESG score	58.13	18.13	5.58	95.57	5352
E score	53.61	24.64	6.45	98.56	5352
S score	61.18	21.09	0.25	98.17	5352
G score	57.21	21.88	2.54	98.56	5352
Δ ESG	2.13	6.17	-70.22	73.1	5352
Δ E	3.01	8.67	-63.25	69.77	5352
Δ S	2.03	11.25	-60.26	67.12	5352
Δ G	1.70	7.43	-82.4	79.64	5352
Log ESG	0.05	0.14	-0.72	0.98	5352
Log E	0.07	0.21	-0.97	1	5352
Log S	0.04	0.16	-0.93	0.95	5352
Log G	0.04	0.25	-0.98	1	5352
DivYield	3.39	34.10	0	1677.36	5352
MCap	8700.04	22365.38	0.76	337228.3	5352

TABLE 1: DESCRIPTIVE STATISTICS MAIN VARIABLES. THE ABOVE TABLE SHOWS SOME DESCRIPTIVE STATISTICS FROM THE MAIN VARIABLES USED IN ANALYSIS. 'SCORE' VARIABLES ARE IN ABSOLUTE VALUES, DELTA VALUES ARE ABSOLUTE CHANGES, LOG CHANGES ARE LOGARITHMIC CHANGES, DIVIDEND YIELD IS A PERCENTAGE, AND MARKET CAP IS IN MILLIONS

The table above shows some descriptive statistics from the E, S, G, and combined ESG scores of all included firms in analysis. The four statistics containing deltas show descriptive statistics

absolute changes in their respective scores, and the four statistics including ‘log’, show descriptive statistics of the *logarithmic changes* between ESG metrics between one year and the next. The min. & max. values in the delta variables might seem very high; however they can be viewed as exceptions due to that LSEG sometimes updates their rating changes very drastically; either through that firm being drastically improved or worse from one year to another, or the a ‘mis-rating’ by LSEG in previous year(s) (London Stock Exchange Group, 2023). Fortunately, the mean and standard deviation seem to be reasonable and in order, and as of now do not seem to be affected by these ‘outliers’.

Figure 1 shows the correlation matrix between variables that contain the nominal changes in ESG metric levels. We can see that the individual metrics themselves are pretty highly correlated (0.7, 0.7, 0.59) with the overall combined ESG score, which is nothing but logical as the combined scores is a weighted average of these individual scores. It is more important to make sure that the individual pillars are not highly correlated with each other which causes multicollinearity issues, and we want to make sure that these metrics actually measure different things in the analysis. We see that the individual scores themselves are way less correlated with one another (0.11, 0.15, 0.34), where the normal benchmark of very weak or no correlation is between 0 and 0.3, and weak correlation is between 0.3 and 0.5, which makes the individual pillars for 2/3 have a very weak to no correlation, and only the correlation between Governance score changes and Environmental score changes weakly correlated. This is in line with (Giese et al., 2020), which find that due to the low mutual correlations, this offers no problems for us in the analysis in terms of multicollinearity. Also, we see that the correlations for the firm-specific control variables ‘Divyield’ and ‘MCAP’ portray low correlations to each other and the rest of the variables.

Variables	ΔESG	ΔE	ΔS	ΔG	Divyield	MCAP
ΔESG	1					
ΔE	0.59	1				
ΔS	0.7	0.11	1			
ΔG	0.7	0.34	0.15	1		
Divyield	0.01	0.00	0.01	0.01	1	
MCAP	-0.08	-0.08	-0.04	-0.06	-0.01	1

TABLE 2: CORRELATION TABLE. THIS TABLE SHOWS THE CORRELATIONS BETWEEN THE VARIABLES THAT INDICATE ABSOLUTE CHANGES IN THEIR RESPECTIVE ESG METRIC FROM ONE YEAR TO ANOTHER, AND TWO FIRM-SPECIFIC CONTROL VARIABLES.

5.2. Results of Overall ESG Rating Changes

This section shows an overview of main event study results, analysing the relationship between ESG metric increases, decreases, and 'unchanged' observations and their respective cumulative abnormal return. Figure 2 shows how rating changes are distributed over the sample. It shows

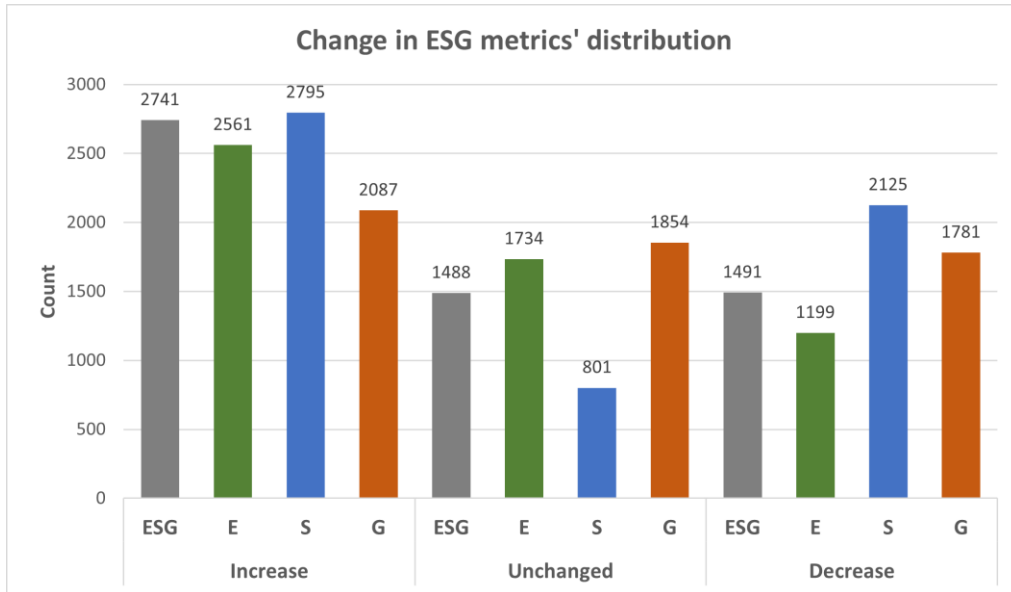


FIGURE 1: DISTRIBUTION OF CHANGES IN ESG METRICS. THE ABOVE FIGURE SHOWS A GRAPHICAL REPRESENTATION OF HOW THE OBSERVATIONS REGARDING RATING CHANGES ARE DISTRIBUTED OVER THE ENTIRE SAMPLE.

that the most amount of observations lies within the increased group, which contains the observations in which the absolute change in the ESG metric are increased by more than 1.5. The unchanged group, which captures the observations where the change of the metrics are between or equal to -1.5 and +1.5. The decrease group portrays the observations in which the ESG metrics decrease by more than -1.5. The figure shows that the most observations lie within the increase group, again indicating that on average ESG metrics are increasing over time. This average increasing trend of ESG scores over time underlines that firms are actively trying to improve and act more ethical and sustainable in their business operations.

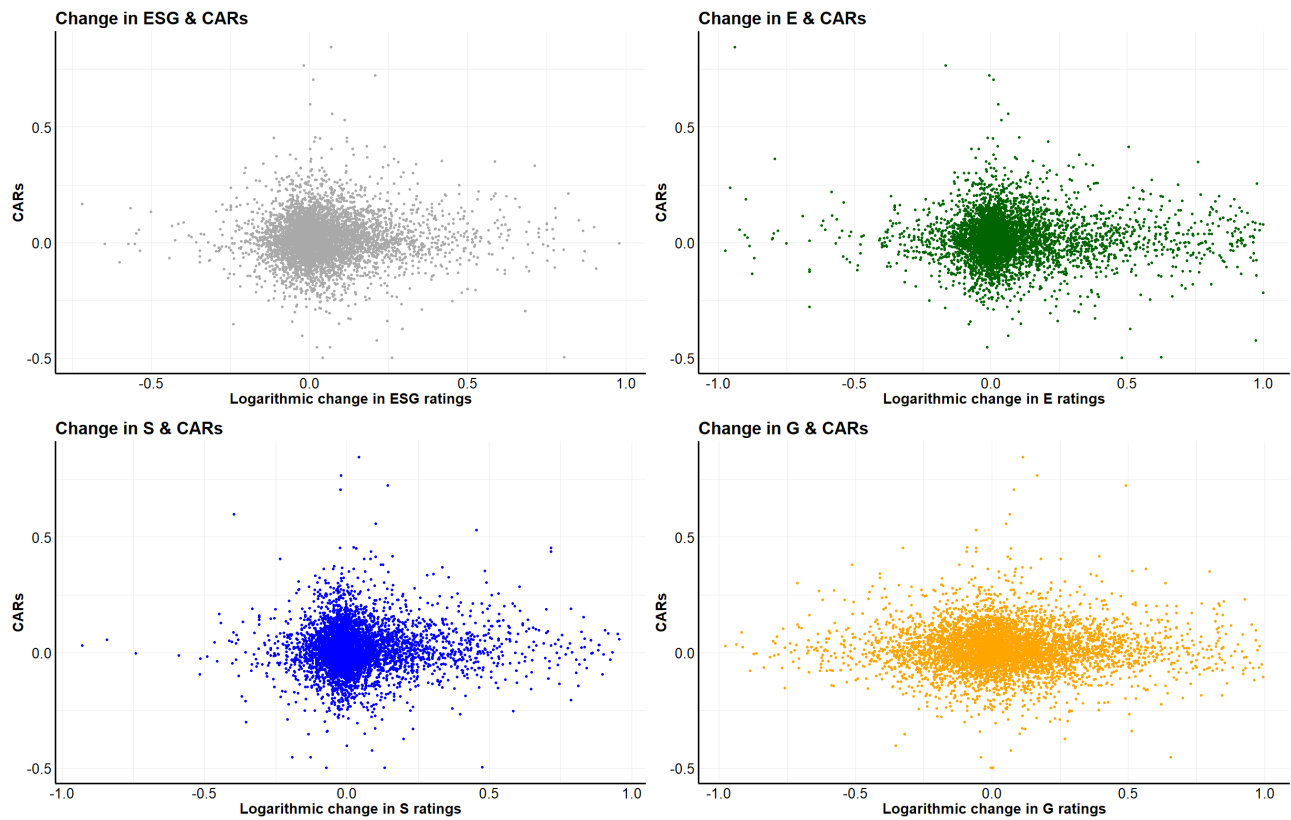


FIGURE 4: SCATTERPLOTS OF CUMULATIVE ABNORMAL RETURNS AND LOGARITHMIC CHANGE IN RESPECTIVE ESG METRICS. THE FIGURE ABOVE SHOWS THE VISUAL RELATIONSHIP BETWEEN LOGARITHMIC CHANGE FROM ONE YEAR TO ANOTHER FOR ALL ESG METRICS WITH THE CORRESPONDING CARs.

Figure 3 shows multiple scatterplots which visualise the relationship between Cumulative Abnormal Returns over the event window $[-5,16]$ and the logarithmic change in ESG, E, S, and G ratings. From these scatterplots we cannot directly observe an obvious strong correlation between the respective variables, which suggests that ESG rating changes do not have a straightforward linear relationship with CARs. We see that the vast majority of data points are densely clustered around the centre (0,0) within every scatterplot, indicating that the most observations portray both small logarithmic changes and small cumulative returns over the event window. What the literature would have expected to see was some indication of a positive relationship between the two, as shown in a scatterplot where the dots would somewhat 'start off' in the left lower corner (indicating that decreases in ESG metrics coincide with negative CARs over the event window), and getting higher up over the length X-axis (indicating a trajectory that as the changes in ESG metrics become 'less negative' or positive, negative CARs also become less negative and ultimately becoming positive if the change in ESG metrics is positive as well). We

would expect this trajectory to be slightly different more steep for decreases in ESG scores than for increases, as literature finds that decreases in ESG scores are punished harder than equal increases are rewarded (Capelle-Blancard & Petit, 2019; Glück et al., 2022).

Variables	<i>ESG</i>	<i>E</i>	<i>S</i>	<i>G</i>
Increase	0.0193% <i>(0.0789)</i>	0.0215% <i>(0.008)***</i>	0.0181% <i>(0.0561)</i>	0.2045% <i>(0.3578)</i>
Unchanged	0.0161% <i>(0.8176)</i>	0.0171% <i>(0.7829)</i>	0.0138% <i>(0.5011)</i>	0.01535% <i>(0.6724)</i>
Decrease	0.0149% <i>(0.1379)</i>	0.0146% <i>(0.1523)</i>	0.0176% <i>(0.0646)</i>	0.0157% <i>(0.1159)</i>

TABLE 3 CAR ANALYSIS FOR DIFFERENT ESG DIMENSIONS. THIS TABLE SHOWS THE SAMPLE CARS FOR DIFFERENT DIMENSIONS OF ESG SCORES AND FOR THE DIRECTIONS IN WHICH THE RATING CHANGE FROM YEAR TO YEAR. MEAN CARS ARE SHOWN IN THE TABLE, WITH P-VALUES IN ITALICS IN THE PARENTHESES. ***, **, AND * INDICATE THE STATISTICAL SIGNIFICANCE AT 0.1%, 1%, AND 5% LEVEL.

Table 3 above shows the main event study results. The main point of this section is to assess if we observe statistically significant CARs within the subsamples, which would indicate that the difference between realized returns and expected returns during the event window are significantly different from zero. The percentages indicate the mean Cumulative Abnormal Returns for the specified subsample, and the p-values to determine the statistical significance of the observations are shown in parentheses. The data shows that there is only one subsample of observations which portrays significant CARs (increases in Environment scores) which indicates that it is very unlikely that there is strong statistical evidence to reject the null hypothesis. In other words, it is unlikely that the rating event has an impact on the abnormal returns of a firm's stock price.

On average, it does show that firms which show increases in their ESG metric scores outperform expectations more than both the unchanged group as the decrease group (0.0193% > 0.0161% & 0.0149%, etc) in every subsample, and the unchanged group and decrease group outperform each other both in 2/4 subsamples. This means that – while not significant – we see that increases in ESG metrics outperform their respective expectations more than groups that do 'not' change

or decrease in rating. The findings are not necessarily in line with previous literature, as these more than often find that ESG rating decreases are punished by investors with declining stock prices (and returns) as a result whereas we do not find evidence of this ‘punishment’ by investors, given that our CAR values are still positive. What is more in line with previous literature is that ESG rating increases do not particularly outperform their expectations significantly. This finding however is of low economic relevance given the fact that these differences are marginal due to their small size. As of right now, the data shows no evidence to reject the null hypothesis of no significant relationship between CARs and ESG rating changes. This is due to the lack of significant CAR’s resulting from the event.

In the Appendix we analyse two other alternative event windows for robustness, the results from the other two window specifications yield similar returns, which is that I find evidence of significant cumulative abnormal returns over the event window over the event periods except one (alternative window 2, E increases).

Regression Analysis

In the previous section, we saw that there is little to no evidence to conclude that ESG rating changes as an event lead to significant CAR’s in the event window. Whilst the previous results aim to shine light on the relationship between CAR’s and ESG rating changes, we may not assume that CAR’s are automatically attributed to these rating changes. CAR’s may very well be caused by endogenous variables’ affecting firms’ stock prices, hence I try to account for this in the next section. This section formally test whether or not deviations from the benchmark are indeed attributable to the change in ESG ratings. I will regress the events’ CAR’s on dummy variables indicating an:

- Increase (*IncreaseDummy*)
- Decrease (*DecreaseDummy*)

Per ESG metric (ESG, E, S, G)

And the following firm-specific value-carrying variables, which are also listed in the “control variables” section in Chapter 4:

Divield stands for *Dividend Yield*

MCAP stands for *Market Capitalization*

Which yields the following panel data regression formula:

$$CAR_{i,t} = \alpha + \beta_1 * IncreaseDummy_{i,t} + \beta_2 * DecreaseDummy_{i,t} + \beta_3 * DivYield_{i,t} + \beta_4 * MCAPI_{i,t}$$

Where,

Initially, we expect for a positive β_1 coefficient, indicating that an Increase in a respective ESG metric can explain positive cumulative abnormal returns. We expect β_2 to have a negative coefficient, indicating that the presence of a decrease in an ESG metric leads to negative cumulative abnormal returns, which should reflect that investors punish decreases in ratings leading to declines in stock prices. We expect β_3 to be positive, as higher dividend yields signal strong future prospects and indicate high financial health of a firm, which are valued much by investors. We expect β_4 to be negative, as smaller companies are generally perceived as riskier investments as opposed to larger and more established firms, and are deemed as having more potential to growth. Hence, the larger the market capitalization, the lower we expect the cumulative abnormal returns to be.

If the panel-data analysis does not yield significant coefficients for the *Increase & Decrease* dummy variables, I cannot conclude that potential CARs can be attributable to changes in ESG ratings, which will be the main argument in accepting or rejecting my hypotheses. Please note that due to the overall lack of evidence that ESG rating changes as an event yield significant CAR's, they may still very well be a significant predictor of the magnitude or direction of CAR's.

At first, I check for cross-sectional dependence and autocorrelation in the data. Cross-sectional dependence occurs when the error terms are correlated across entities at a given point in time. Autocorrelation on the other hand occurs when the error terms are correlated over time within the same entity. Given that I country wide market movements over time this could potentially cause issues. After running both a Durbin-Watson test for autocorrelation and a Pesaran test for cross-sectional dependence, I find my panel data is subject to both these issues. To address both these issues, Odriscoll & Kraay (1998) proposed a new robust standard error measure which are robust to both autocorrelation and cross-sectional dependence by adjusting the standard errors of the estimated coefficients to account for these issues. A Hausman-Wu test revealed that a Random Effects model was most appropriate for this analysis.

ESG In/decreases on CARs				
Independent Variables	Dependent variable: CAR			
	Model 1	Model 2	Model 3	Model 4
ESG Increase	0.042 (0.004)	0.041 (0.004)	0.042 (0.004)	0.42 (0.004)
ESG Decrease	-0.018 (0.002)	-0.01 (0.002)	-0.01 (0.002)	-0.01 (0.002)
Dividend Yield		0.0002*** (0.0001)		0.0002*** (0.0001)
Market Capitalization			-0.00 (0.00)	-0.00 (0.00)
Constant	0.016 (0.014)	0.015 (0.014)	0.017 (0.016)	0.016 (0.015)
R-squared	0.001	0.006	0.001	0.006
Observations	5352	5352	5352	5352
Note:	*p<0.1; **p<0.05; ***p<0.01			

TABLE 4: REGRESSION RESULTS ESG CHANGES ON CARs. SHOWN ARE THE ESTIMATED COEFFICIENTS OVER DIFFERENT SPECIFIED MODELS, WITH THE ROBUST STANDARD ERRORS IN PARENTHESES.

Table 4 shows the regression results of CARs regressed against different model specifications but always including the increase and decrease group dummies of the ESG ratings. Apart from dividend yield, we do not observe any significant coefficients; and the R-squared in each model is really low, indicating that our proposed model does not offer much explaining power regarding Cumulative Abnormal Returns over the event period of our sample. The coefficients however do portray the direction sign which we stated to expect earlier on. Later, we similarly analyse regression results of the individual specific dummies on CARs.

E In/decreases on CARs				
Independent Variables	Dependent variable: CAR			
	Model 1	Model 2	Model 3	Model 4
E Increase	0.013 (0.024)	0.013 (0.024)	0.011 (0.026)	0.011 (0.026)
E Decrease	0.006 (0.030)	0.006 (0.03)	0.005 (0.032)	0.004 (0.032)
Dividend Yield		0.0002*** (0.0003)		0.0002*** (0.0003)
Market Capitalization			-0.00 (0.00)	-0.00 (0.00)
Constant	0.008 (0.043)	0.007 (0.043)	0.01 (0.046)	0.01 (0.046)
R-squared	0.001	0.006	0.001	0.006
Observations	5352	5352	5352	5352
Note:	*p<0.1; **p<0.05; ***p<0.01			

TABLE 5: REGRESSION RESULTS E CHANGES ON CARs. SHOWN ARE THE ESTIMATED COEFFICIENTS OVER DIFFERENT SPECIFIED MODELS, WITH THE ROBUST STANDARD ERRORS IN PARENTHESES.

Similar to the regression results of the overall ESG dummies, we do not find any explaining power and/or significant results when we look at increases or decreases of the environmental scores of the ESG framework. Again, only the dividend yield has some explaining power and is the only factor driving the little explaining power (R-squared) any model specification can offer. The coefficients of decreases in the environmental score however are positive, which is against our expectations specified earlier, but as the coefficients are marginal do not have any statistical weight attached to it.

S In/decreases on CARs				
Independent Variables	Dependent variable: CAR			
	Model 1	Model 2	Model 3	Model 4
S Increase	0.05*** (0.02)	0.004*** (0.02)	0.004*** (0.02)	0.004*** (0.02)
S Decrease	0.004*** (0.030)	0.004*** (0.03)	0.004*** (0.032)	0.004*** (0.032)
Dividend Yield		0.0002*** (0.0003)		0.0002*** (0.0003)
Market Capitalization			-0.00 (0.00)	-0.00 (0.00)
Constant	0.013 (0.018)	0.013 (0.018)	0.014 (0.019)	0.014 (0.019)
R-squared	0.01	0.006	0.01	0.006
Observations	5352	5352	5352	5352
Note:	*p<0.1; **p<0.05; ***p<0.01			

TABLE 6: REGRESSION RESULTS S CHANGES ON CARs. SHOWN ARE THE ESTIMATED COEFFICIENTS OVER DIFFERENT SPECIFIED MODELS, WITH THE ROBUST STANDARD ERRORS IN PARENTHESES.

For some reason, the coefficients of both dummy variables are statistically significant when we look at the regression results of the social score rating changes; which is abnormal in relation to the last two regression tables which has not showed any significant coefficient in the dummy regressors. Given the fact that any of the model specifications have any more explaining power than the preceding regression analyses thus the significant coefficients are more than likely a flaw in my data. However, what does stand out again is that decreases in Social scores again have positive coefficients with respects to CARs, which we do not expect to happen.

G In/decreases on CARs				
Independent Variables	Dependent variable: CAR			
	Model 1	Model 2	Model 3	Model 4
G Increase	0.05*** (0.02)	0.004 (0.02)	0.004 (0.02)	0.004 (0.02)
G Decrease	0.004 (0.030)	0.004 (0.03)	-0.004 (0.032)	-0.005 (0.042)
Dividend Yield		0.0002*** (0.0003)		0.0002*** (0.0003)
Market Capitalization			-0.00 (0.00)	-0.00 (0.00)
Constant	0.013 (0.018)	0.014 (0.018)	0.016 (0.019)	0.015 (0.019)
R-squared	0.04	0.006	0.04	0.006
Observations	5352	5352	5352	5352
Note:	*p<0.1; **p<0.05; ***p<0.01			

TABLE 7: REGRESSION RESULTS G CHANGES ON CARs. SHOWN ARE THE ESTIMATED COEFFICIENTS OVER DIFFERENT SPECIFIED MODELS, WITH THE ROBUST STANDARD ERRORS IN PARENTHESES.

The last regression table considers the regression results of changes in Governance scores and yet again we see only one significant dummy coefficient, which is most likely due a faulty estimate. Explaining power remains extremely low over all models over all analyses.

The regression analysis section showed that due to the lack of explaining power and statistical significance of ESG metric change dummies on the cumulative abnormal returns over the event period, which again underlines that we cannot reject the null hypothesis of no significant relationship in any of the hypotheses, which is against the constructed expectations.

6. Discussion & Conclusion

This Master's thesis examines the effects of ESG rating changes on stock price behaviour in the European stock markets using event-study methodology and regression analysis between 2018 and 2023. This thesis focuses contributing to the field of research considering ESG scores and how the market reacts them, primarily aiming on filling the gap in the literature that fails to consider the implications of ESG rating changes rather than the nominal ESG scores, as these capture the dynamic nature of ESG performance of firms, investor sentiment, and financial markets as a whole over time better due to event-study methodology being better able to isolate and quantify the effects of what effects ESG initiatives or deteriorations have on the stock market in the short run. This thesis aims to fill this gap in the research field to provide regulators, policy makers, investors, and companies themselves better understand the implications of their changes in ESG performance, improving the capability of these actors of aligning sustainability, ethics, with long-term financial growth. I fail to reject any of the null hypotheses specified in the hypothesis development, which means that I cannot reject the null hypotheses that there is no relationship between ESG (ESG, E, S, G) rating changes and stock price performance. This is due to the fact that the main event study fails to find significant cumulative abnormal returns over the event window, which are robust over different estimation and event windows; ultimately implying that there is no evidence to conclude that ESG rating changes make the market react significantly to them, and which is further clarified in the regression analyses. In the second part of the results section, we fail to find a significant relationship between dummies indicating the presence of either an increase, or ones indicating a decrease of each ESG metric, indicating that CAR's, whether they be significant or insignificant, cannot be explained by changes in the ESG metrics. These results are not in line with the existing literature, as they often find that decreases in ESG metrics are punished by the markets by declining stock prices, and that increases in ESG metrics are barely rewarded by them in the form of hardly increasing stock prices. These results do not indicate any form of punishment of ESG rating decreases, as I fail to find negative CAR's in the main event study analysis, but it is the case however that firms which increase their ESG metrics outperform ones that remain the same (up until +1.5 absolute increase in score) and ones that decrease.

The major flaws in my research was that there are more than likely flaws in my data, and on top of that the structure of my dataset allowed for high measures of both cross-sectional dependence and autocorrelation, leaving me obliged to use a measure to account for this and potentially skewing estimates in the process which resulted in weird regression results. Also, due to the structure in which eventstudytools' event study results were provided back to me, structuring my data into a panel dataset in the first place took a lot of work to process.

Therefore, my suggestions for future research is to analyse a more well-structured set of data, preferably over a longer timeframe as five years could be relatively short to derive statistical conclusions from. Maybe in the future it could be investigated how ESG rating changes affect different sectors, or more causal mechanisms underlying the potential relationship between ESG and changes and stock market reactions.

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8. Appendix

Stocks used in analysis come from the following EU market Indices. Keep in mind that not all stocks are included, as for proper analysis also the ESG metrics are required. In the end, of what started out as 2236 firms included, shrunk down to 1494 firms.

Table A1: Stock indices used for analysis

	Index:		
	Large	Mid	Small
Country:			
U.K.	FTSE 100	FTSE 250	FTSE SmallCap
Germany	DAX	MDAX	SDAX
Netherlands	AEX	AMX	AScX
France	CAC 40	CAC mid 60	CAC Small index
Switzerland	SMI Index	SMI Mid Cap Index	Swiss Smaller cap Index
Spain	IBEX 35	IBEX Medium Cap	IBEX Small Cap
Italy	FTSE MIB	FTSE Mid Cap	FTSE Small Cap
Sweden	OMX Stockholm 30	OMX Stockholm Mid Cap	OMX Stockholm Small Cap
Austria	ATX Index		
Denmark	OMX Copenhagen 20	OMX Copenhagen Mid	OMX Copenhagen Small
Ireland	ISEQ Overall Index		ISEQ Small Cap Index
Poland	WIG20	mWIG40	sWIG80
Belgium	BEL 20 Index	BEL Mid Index	BEL Small Index
Norway	OBX Index	Oslo Bors Mid Cap Index	OSSEX Small Cap Index
Finland	OMX Helsinki 25	OMX Helsinki Mid Cap	OMX Helsinki Small Cap

Alternative event windows (CAR analysis)

The first way to check for robustness, is to compare the results across different estimation and event windows. I will perform analysis on two other event study windows.

- Alternate window 1: 150 day estimation window, and a (-2, 23) event window.

This alternate window adopts a smaller estimation window (previously 200 days), but a slightly bigger and shifted event window (previously -6, 11). This way, I aim on focusing less on the potential anticipatory effects of ESG rating changes on stock prices by only incorporating 2 days before the rating event, and making the rest of the event study longer to try and capture potential effects of investor sentiment that comes somewhat later. These lagged effects might not be in line with EMH, but for robustness will be analysed.

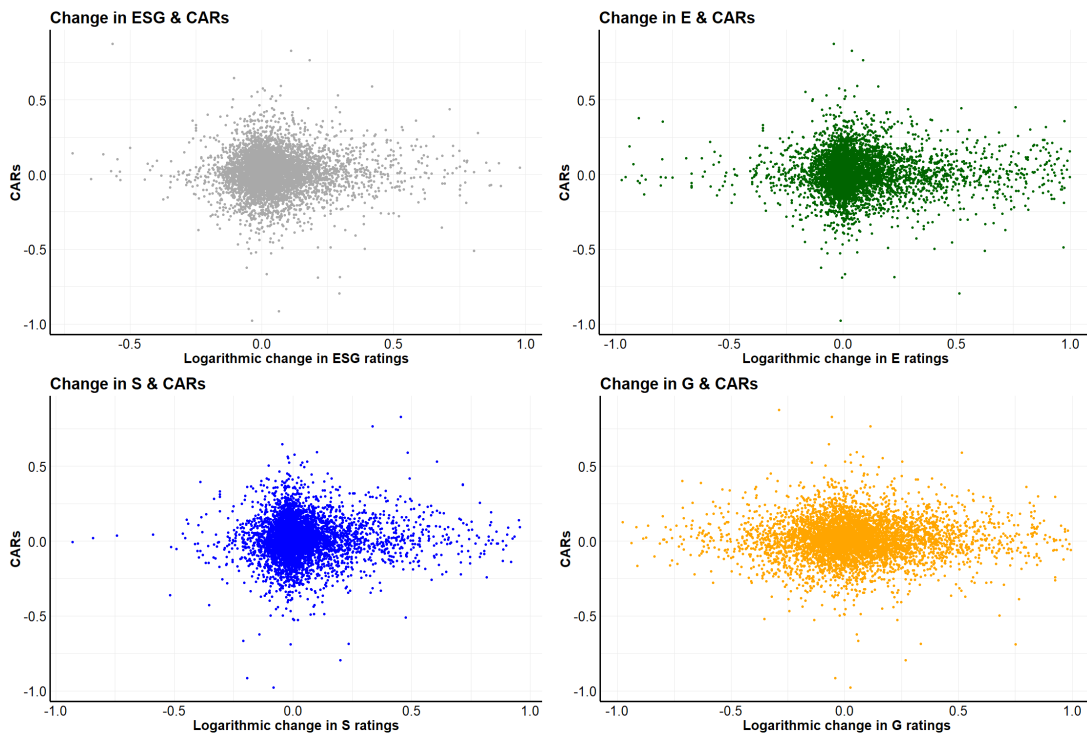


FIGURE 4: SCATTERPLOTS ALTERNATIVE WINDOW 1. THE FIGURE ABOVE SHOWS THE VISUAL RELATIONSHIP BETWEEN LOGARITHMIC CHANGE FROM ONE YEAR TO ANOTHER FOR ALL ESG METRICS WITH THE CORRESPONDING CARs.

Visually there seems to be no difference between results from the main specification and this one, suggesting that the specification does not impact the results specified earlier. We also compare the results from the CAR analysis to check whether there are big differences.

Variables	ESG	E	S	G
Increase	0.0156% <i>(0.0876)</i>	0.0168% <i>(0.0813)</i>	0.0114% <i>(0.0761)</i>	0.0145% <i>(0.1258)</i>
Unchanged	0.0136% <i>(0.0957)</i>	0.0095% <i>(0.7249)</i>	0.0083% <i>(0.4306)</i>	0.0110% <i>(0.3907)</i>
Decrease	0.0103% <i>(0.1349)</i>	0.0064% <i>(0.6491)</i>	0.0121% <i>(0.3045)</i>	0.0077% <i>(0.4061)</i>

TABLE A2: CAR ANALYSIS FOR DIFFERENT ESG DIMENSIONS – ALTERNATIVE EVENT WINDOW 1. THIS TABLE SHOWS THE SAMPLE CARs FOR DIFFERENT DIMENSIONS OF ESG SCORES AND FOR THE DIRECTION IN WHICH RATING CHANGES FROM YEAR TO YEAR. MEAN CARs ARE SHOWN IN THE TABLE, WITH P-VALUES IN ITALICS IN THE PARENTHESES. ***, **, AND * INDICATE THE STATISTICAL SIGNIFICANCE AT 0.1%, 1%, AND 5% LEVEL.

- Alternative window 2: 200 day estimation window, and a (-2, 5) event window.

This alternative window adopts the same initial event window for comparability reasons, and a smaller overall event window (both shorter periods before and after the rating event), aiming to capture the more immediate potential effects of ESG rating events.

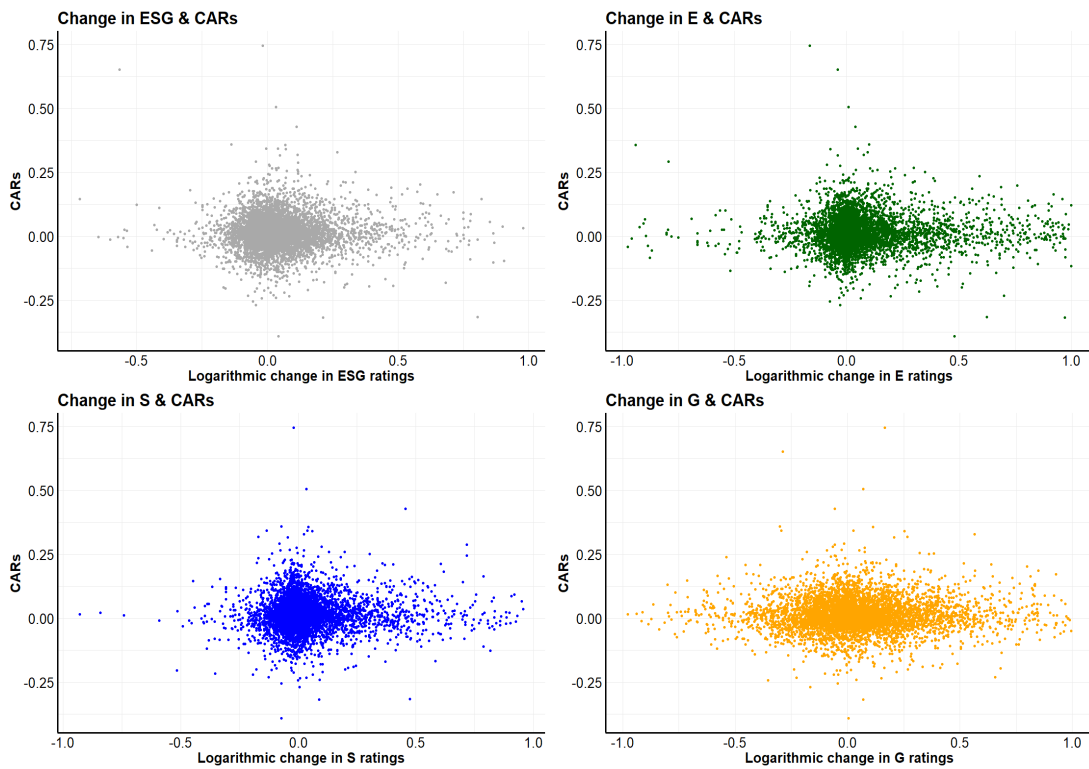


FIGURE 5: SCATTERPLOTS ALTERNATIVE WINDOW 2. THE FIGURE ABOVE SHOWS THE VISUAL RELATIONSHIP BETWEEN LOGARITHMIC CHANGE FROM ONE YEAR TO ANOTHER FOR ALL ESG METRICS WITH THE CORRESPONDING CARs.

Variables	<i>ESG</i>	<i>E</i>	<i>S</i>	<i>G</i>
Increase	0.0166%	0.0181	0.0154	0.0161
	<i>0.0689</i>	<i>0.0473*</i>	<i>0.0597</i>	<i>0.0725</i>
Unchanged	0.0167%	0.0156	0.0162	0.0167
	<i>0.789</i>	<i>0.819</i>	<i>0.801</i>	<i>0.784</i>
Decrease	0.0125%	0.0133	0.0155	0.0137
	<i>0.124</i>	<i>0.104</i>	<i>0.098</i>	<i>0.0114</i>

TABLE A3: CAR ANALYSIS FOR DIFFERENT ESG DIMENSIONS – ALTERNATIVE EVENT WINDOW 2. THIS TABLE SHOWS THE SAMPLE CARS FOR DIFFERENT DIMENSIONS OF ESG SCORES AND FOR THE DIRECTION IN WHICH RATING CHANGES FROM YEAR TO YEAR. MEAN CARS ARE SHOWN IN THE TABLE, WITH P-VALUES IN ITALICS IN THE PARENTHESES. ***, **, AND * INDICATE THE STATISTICAL SIGNIFICANCE AT 0.1%, 1%, AND 5% LEVEL.

Yet again, this alternative window specification yields similar results to the initial setup; making the results robust over different specifications.