Do Natural Disasters Impact Firms' Returns? – An Event Study on Major European Companies

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Abstract

Currently natural disasters are becoming an increasingly global concern across all life aspects affecting the world population. In this research I test whether a natural disaster event causes investors to shift their global market allocations towards greener options and, consequently, if this causes an impact on firms' stock returns thereafter. I decided to focus on major European indexes belonging companies and studied a weather event within Europe between 2015 and 2016. Evidence implies that there is no significant relation between the unfold of an extreme weather phenomenon and an increase of greener corporations' stock returns.

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Resumo

Atualmente, os desastres naturais estão a transformar-se numa preocupação mundial crescente, em todos os aspetos da vida que impactam a população mundial. Nesta pesquisa testei se um evento associado a um desastre natural causa uma mudança nas alocações que os investidores fazem nos mercados financeiros para opções mais verdes e, consequentemente, se tal tem impacto nos retornos das ações depois de acontecer. Decidi focar-me nas principais empresas constituintes dos maiores índices Europeus e estudei um evento climático dentro da Europa entre 2015 e 2016. Os resultados sugerem que não há uma relação significante entre o desenrolar de uma experiência climática extrema e um aumento dos retornos de ações de empresas mais sustentáveis.

Título: Os desastres Naturais Têm Impacto Nos Retornos Das Ações Das Empresas? – Um Estudo De Um Evento Nas Maiores Empresas Europeias

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Palavras-chave: Sustentabilidade; Desastres Naturais; Europa; Rácio de Emissões; Retornos de Ações; Modelos de Regressão Linear Múltipla.

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I – Introduction

Sustainability has become one of the most important factors taken into account by investors when accessing an investment opportunity. Companies continue to increase their efforts in this field in order to maintain their investment attractiveness. It has even been suggested that adopting a sustainable investing approach can be a way to mitigate portfolio risk during crisis periods (Nofsinger & Varma, 2014). One of key factors prompting the shift within investors preferences into an environment conscious strategy is the acceleration of global climate change. According to the United Nations' FAO[1] reports, climate disasters occur nowadays three times more often that what they used to back in the 20th century. This validates investors' escalating concern that environmental conditions and consequential sustainable corporate policies are currently more relevant and impactful than what was the case a few decades ago.

Becoming conscious not only of the afore mentioned growing environmental distress but also of the fact that existing literature enhances that some types of weather events induce several economical consequences across various activity sectors (Panwar & Sen, 2019), global markets investors' most recent preferences have been prioritized, with Bloomberg stating that "trillions of dollars now target socially responsible investments and the integration of environmental, social and governance themes", which applies to both large corporations and minor-called family businesses.

This article's main objective is to provide insights on whether a natural disaster event further shifts investors' behavior into less climate harming corporate strategies and if the consequent stock market's implications are less stringent on greener firms. Several studies explore the relationship between natural disaster shocking events and stock market's returns (e.g., Bourdeau-Brien & Kryzanowski, 2017; Wang & Kutan, 2013), concluding, despite differing geographical time samples and strategies, that these climate episodes affect listed firm's stock returns.

Channeling the event analysis into Europe, the GDFRR[2] organization states that natural disasters within the European continent are exasperated by numerous risk factors, which include the loud climate change. The European Economic Agency also reinforces that the amount of

[1] FAO stands for the Food and Agricultural Organization, a "specialized agency of the United Nations that leads international efforts to defeat hunger.".
[2] GDFRR (Global Facility for Disaster Reduction and Recovery) is an organization whose main goal is to provide climate hazard's risk support to most needed countries.

harming weather events has been increasing in Europe, and consequently so have their negative impacts, which "calls for better integrated risk disaster management across Europe". Several reports highlight the continuous and flagging risk of extreme weather-related disasters and a call for action is becoming increasingly present in everyone's daily actions, which notably applies to global markets' players and their influence on how companies perceive the relevance of their own environmental input.

Inserted in a more regulated situation regarding the European's fight against climate change, companies have been shifting into greener practices with the aim to ensure their market positioning. Firms are, therefore, becoming increasingly aware of the emergent need to change their approach into renewable energies, which has been studied within energy associated firms (Fernandez, 2021).

The database used for this study analysis was mainly retrieved from Refinitiv Eikon, including variables such as major European companies' stock close prices, a proxy used to represent the risk-free rate in the same geographical area, a proxy used to stand as the European market and the industry segmentation for each of these companies. The mentioned data was retrieved for a similar period to the one of the analyzed event (2015-2016) and was used to empirically test results through a Multiple Linear Regression Model (MLRM), which aim was to evaluate the relationship between a natural disaster shock and stock's returns developments.

Furthermore, a "green/brown metric" was created in order to evaluate the firms' position in terms of climate concern/environmental standing. This measure was constituted by two main corporate performance indicators, both also retrieved from Refinitiv Eikon. The first one relates to the sustainable performance of companies – a direct CO_2 and CO_2 equivalent gases emissions measured in tonnes, which represents the greenhouse gas emissions controlled by each company and aim to evaluate the corporate environmental responsibility. The second one was used as a way to control the emissions indicator mentioned above for company's size. Total Assets were then retrieved for each company and the resulting "green/brown" ratio represents the greenhouse gas emissions per companies' asset. A higher ratio therefore means a more polluting firm hence a "browner" firm. The key objective of the creation of this ratio is to serve for the posterior cluster division of firms to test the before mentioned hypothesis.

The link of this study with a natural disaster is made through an event study. The chosen event was an European one which firstly unfolded in Italy with natural and across-sectors economical consequences in the year of 2015. After both an estimation and an event window were defined, we regressed the variables for the specific periods, including an industry and a country controlling scenario.

Our data revealed no significant conclusions. Despite the adoption of two cluster segmentation techniques combined with control variables for the other effects, the obtained coefficients were not overall significant in the various models regressed. In that way, the unwind of a natural catastrophe in numerous European countries was not proved to have directly affected companies' stock returns. Consequently, we were not able to demonstrate our hypothesis that investors shift their investment allocation into greener options when an environmental related disaster takes place.

This analysis was organized in six different sections, them being Section I, the Introduction detailed above. Section II provides a literature review into sustainability investing, natural disasters and their consequences on several aspects, including stock's returns. Section III describes the data used, the variables chosen for the analysis and the main descriptive statistics. Section III also aims at explaining the building of the used variables as well as methodology and the computed regressions. Section IV provides the results achieved from the analysis and, finally, Section V presents the conclusion of this empirical study as well as the inherent limitations.

II – Literature Review

In this section, I present my review of the published literature about preeminent themes around which my research was developed. I start by examining relevant research of sustainable investing in section I. In the subsequent sections I explore the existing contributions to the broad natural disasters theme along with its impacts not only on the economy in general but also in the financial markets in particular. Lastly, I highlight the developments on the event studies methodology.

II.I - Sustainability and Sustainable Investing

The "sustainability era" has come to stay. Not only individuals but also corporate businesses are becoming increasingly aware of how taking sustainability into account may pave the way for future generations and that environmental and social linked concerns have never been more relevant as they are now. Specifically, consumers "increasingly care how companies conduct themselves in these areas and say they are willing to pay more for brands promoting a positive record.".

One of the demonstrations of this growing concerns is the increasing popularity of SRI (Socially Responsible Investment). This type of investment is defined as "an investment that is considered socially responsible due to the nature of the business the company conducts" and may be based on different criteria, including the most recently influential ESG (Environmental, Social and Governance) criteria. Constructing an investment strategy based on ESG criteria means using "set of standards for a company's operations that socially conscious investors use to screen potential investments".

Whether investors choose the ESG criteria or another socially responsible one as a foundation to their investments, sustainable investing nowadays only tends to be gaining a heavier relevance. According to Bloomberg, in 2021 sustainable investing surpassed a new record, with this growth being driven mainly by funds increasing investment. This is, as reported, stimulated by the growing climate change concerns, among other collective social aspects. This tendency is expected to continue its expanding path, with estimates being that assets achieve $50 trillion in the next 3 years from about the current $35 trillion. Reuters also adds to the sustainable investing world data by stating that in 2020 ESG based funds were attracting enormous amounts of capital, with the MSCI World ESG Leaders Index[3] being up 22% in 2021 only. Taking this into account, from newly started to decades performing investors and investing firms, every global market's player is starting to increase the sustainable assets' weight on their portfolios.

In an attempt to respond to the shift in investors' investing criteria, financial institutions also channeled their efforts to start offering a wider and more complete range of products which fit these criteria (GSIA, 2019)[4].

In line with the real-world importance until here described, scholars have also shown an increased interest in sustainable investing and/or its impacts. Pástor, Stambaugh and Taylor (2020) show that this type of investment not only incentives firms to become greener but also makes greener firms to have higher real investment when compared to browner ones. Moreover, Brigham et al. (1999) adds to the topic's literature the question of corporates balancing their fiduciary duty of companies to maximize the value for shareholders with the social responsibilities of the same companies. Brenneis and Herrera (2020) show that there is a higher probability of outperformance when it comes to ESG integration as a mean of sustainable investment, regardless of the investment horizon or investment universe.

II.II – Natural Disasters

II.II.I – Natural Disasters and Overall Consequences

Natural disasters kill, on average, 45,000 people each year, affecting lower to medium income populations the most. According to Baez and Hidalgo (2019), natural disasters are "unexpected predictable and unpredictable events that can have a severe impact in the population, with significant damage to infrastructure and important life and economic losses.". These authors also highlight how these events can have an impact not only on infrastructures but also on the daily life of an entire population. These events can be segmented into different categories according to their main cause of origin, them being: Geophysical, Hydrological, Meteorologic and Climatologic. Sodhi (2016) also emphasizes the exponential growth of the disasters alongside a reinforcing loop. Despite different scenarios of analysis, the existing literature

[3] The MSCI World ESG Leaders Index is defined by the MSCI as "a capitalization weighted index that provides exposure to companies with high Environmental, Social and Governance (ESG) performance relative to their sector peers."

[4] GSIA stands for Global Sustainable Investment Alliance and is an organization which gathers sustainable investment organizations worldwide.

seems to be in accordance with one of its main findings – the need for disaster planning and further management within this cycle.

Despite the existence of several features that can classify natural disasters, the leading cause for these weather events is climate change. In accordance with IPCC[5] (2012), the main prompter of climate change, greenhouse gas emissions, is likely to continue increasing and, as consequence, so will the number of yearly natural disasters, as suggested by climate science theories.

Greenhouse gas emissions are proven to be the main cause of global warming, climate change and, therefore, related natural disasters. NRDC[6] points industrial activity as one of the leading causes for enhanced fossil fuels use and consequently the higher emissions of harmful gases, pointing agricultural and transportation activities as the major contributors to these, alongside the most industrialized countries. Following the previous topic of sustainable investing, companies have been attempting to reduce their gas emissions in order to become more sustainable and be considered among all various sustainable investing strategies.

Diverse studies explore the relationship between climate change and the happening of natural disasters. Francis and Vavrus (2012) demonstrate that the link between extreme weather events in the Arctic is related to high amplitude warming and climate provoked events in the United States. Rahmstorf and Coumou (2011) associate the climate changes with record-breaking achieved temperatures and, consequently, with a high probability of associated climate disasters.

With this topic gaining increased relevance over the modern years, scholars have been keen to study the impact of natural disasters across various aspects and/or geographies. Panwar and Sen (2019), using an OLS methodology, conclude that natural disasters consequences on the macroeconomic environment exist but differ, depending on both the type of natural disaster and each country's development. The authors found stronger evidence of these results in developing countries. Adding to this, the relationship between natural disasters and general health has also been explored by Weilnhammer et al. (2021), stating that natural disasters associated with extreme heat or cold have negative consequences on human health, not only physically but also mentally.

[5] IPCC – Intergovernmental Panel on Climate Change – is a United Nations body whose goal is to increase general awareness on climate change.
[6] NRDC stands for the National Resources Defense Council and its main purpose is to protect all planet's natural systems.

Focusing on macroeconomic aggregated parameters, existing literature does, once again, not seem to agree on the results obtained. Strulik and Trimborn (2019) results' show that macroeconomic performance is impacted by disasters and so is welfare, with the impacts on GDP being positive, negative or even insignificant whilst Hochrainer (2009) states that natural disasters lead to a decline in GDP. Strobl (2011) also assesses the impact of natural disasters on economic growth and concludes that a country's annual growth rate falls after a natural catastrophe.

II.II.I – Natural Disasters and Financial Markets

The occurrence of a natural disaster and its resulting consequences have been of interest among several scholars who have been prompted to study these events and their impacts across various categories, including the effects produced on financial markets. Although existing literature is not in overall agreement, the main findings are presented below.

Koerniadi, Krishnamurti and Tourani-Rad (2016) examined the effect of different types of natural disasters on the stock market to conclude that events like earthquakes, hurricanes and tornadoes have a negative impact on market returns weeks after they unfold, while other types of disasters have a limited impact on the market. Kong et al (2021) study similar events but focus on the effects they have on analysts' market predictions, to conclude that they are indeed affected but for firms closer to the affected area.

The remaining literature does also not completely agree on the results it achieves. Worthington and Valadkhani (2004) found that natural disasters associated shocks have an influence on market returns, finding significant results in the Australian market. Worthington (2008) again focused on studying of the Australian market but to conclude that weather events have no significant impact on market's returns.

While Wang and Kutan (2013) do not find any significant impacts on the U.S. and Japanese markets except for insurance companies, Bourdeau-Brien and Kryzanowski (2017) focus their analysis only on U.S. firms and reported that natural disasters result in abnormal stock returns and returns volatility, specifically in companies located in the affected areas.

Asian's extreme weather events have also been of particular interest in this field's studies. Luo (2012) studied the Japanese earthquake event and although the findings consist of a small negative impact across six different stock markets, these results were not significant. Asongu

(2013) found that the same event does not entail in correlations for any international foreign exchange markets but does result in impacts for some countries' stock markets.

Furthermore, Giraldo (2019) also contributed to this literature topic by finding that natural catastrophes have significant impact on markets' returns, with industrial indexes being the most affected ones.

Seetharam (2017) enlarged his analysis to include more than 100 natural disasters in the United States and showed that the stock market valuations of companies exposed to such kind of events are more negatively affected, when compared to non-exposed companies.

Earlier research also contributed to the literature on the topic by examining United States based natural disasters such as the Florida Hurricane Andrew or the California earthquake. Lamb (1995) concluded that Florida Hurricane Andrew had adverse effects on stock prices of property liability insurers which were precisely exposed to the event. Contrary to this, Shelor et al. (1992) showed that the *Loma Prieta* earthquake's effects were positive in regard to stock prices of insurance companies, supporting their "gaining from loss" hypothesis.

The contradictory results between the existing literature over the past decades has enhanced the need for further studies in this field and the development of additional contributions to the understanding of how the stock market reacts to extreme weather events.

III – Event Studies

The majority of the published analysis concerning natural disasters and their main impact on a very wide range of aspects support their results through an event study methodology (Shelor et al., 1992; Wang & Kutan, 2013; Bourdeau-Brien & Lawrence Kryzanowski, 2017).

Regardless of being used from academics from the 20th century up to the current days, the first contribution to the event study's methodology universe came from Fama, Fisher Jensen and Roll (FFJR) (1969), in which the impact of a stock split in market stock prices is examined.

McWilliams and Siegel (1997) defined an event study as "a powerful tool that can help researchers assess the financial impact of changes in corporate policy". As the authors state, resorting to this method allows researchers to identify whether the unexpected returns related to a stock price move can be attributed to the happening of an unforeseen event or not.

Binder (1998) elaborated a condensed scrutiny over earlier event study used methodologies. One of the main achievements of this study is the fact that the event study's method development has proven the market model to work as a measure of benchmark rate of return and despite the surging issues of the estimated abnormal returns, scholars have found accessible panels of solutions to overcome this.

III – Data and Methodology

Research parameters from the target population, the chosen variables and their proper data sources along with the descriptive statistics and the Multiple Linear Regression Models developed are shown in detail in this section.

III.I – Target Population

The target population of this research is constituted by companies integrated in the three most dominant European financial market indexes: the FTSE 100, the CAC 40 and the DAX, whose origin is England, France and Germany, respectively. Companies with missing data for the concerned period on the used variables were excluded[7] from the scope of this analysis. After applying this methodology, the final sample includes 123 firms.

As further explained below, a proxy for the market was needed. Euro Stoxx 50 index was selected since it represents 50 stocks belonging to several European countries from the most relevant sectors of activity.

In addition to this, the German 10-year bond yield was elected as being representative of the risk-free rate in Europe used for a second-step computations of excess returns.

The database of this study includes several variables related to the above-mentioned companies and was, in its entirety, retrieved from Refinitiv Eikon.

Retrieved data includes daily close prices for all companies for the years of 2015 and 2016, daily close prices of the index Euro Stoxx 50 for the same period, the correspondent yield for the German generic 10-year bond and industry NAICs code for each company. For the "green/brown" created measure further explained below, total assets and scope 1[8] emissions (in tonnes of considered gases) were retrieved on a yearly basis. Its construction will be further detailed in the following sub-section.

[7] A total of 57 companies were excluded from the target population due to missing data in at least one of the variables.

[8] Scope 1 emissions are defined as "direct emissions from sources that are owned or controlled by the company" for which the "following gases are relevant: carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), hydrofluorocarbons (HFCS), perfluorinated compound (PFCS), sulfur hexafluoride (SF6), nitrogen trifluoride (NF3)".

III.II – The Emissions Ratio

With the aim to classify the companies into "greener" or "browner" categories, the first analyzed parameter was the amount of scope 1 gas emissions.

In order to control this evaluation for each company's size, following the rationale that bigger companies would have a higher number of emissions which would not be necessarily related to a lower sustainability profile, total yearly assets for each company were considered and the emissions ratio (ER) was created. It was calculated as follows:

$$ER_{i,t} = \frac{Scope\ 1\ Emissions_{i,t}}{Total\ Assets_{i,t}}$$

, where the $ER_{i,t}$ represents the Scope 1 emissions tonnes per asset for company i in year t. Hence, a higher $ER_{i,t}$ is associated with more polluting companies for each one of their assets while a lower $ER_{i,t}$ is in representation of a less polluting ones or, as an alternative, more sustainable.

The consecutive step of the ER calculation was to divide the companies into a cluster segmentation, with the intention of combining similar sustainability profile companies into the same cluster. Several clusters were created and, consequently, the indexes constituents were grouped with same continent peers, with cluster 1 – correspondent to dummy variable "Polluter 1" being the one associated with companies with the lowest ER up to the highest cluster, containing the most polluting companies.

III.III – The Event Study

As stated in Section II, generally the studies on natural disasters´ impact on the stock market prices are conducted through an event study methodology. This research is no exception and the to be detailed event study concerns floods in Europe starting in 2016.

So as to be relevant in the context of the analysis, the selected event was bound to fulfil a set of pre-defined criteria:

a) To occur in more than one European country;
b) To have a duration longer than one day;
c) To have, as a consequence, at least one human death.

The quoted European Floods started on the 26th of May 2016 and lasted for several days. The weather event quickly spread into different European countries such as France, Germany or the United Kingdom and resulted in at least five human deaths. According to The Guardian, rescue workers had received more than ten thousand help requests a few days after the initial flooding outburst and ended up evacuating a very large number of people.

The reason behind the criteria above stated in a) lies with the fact that prior studies conclusions declared the natural disaster's impact to be significant merely in the affected areas (Bourdeau-Brien and Kryzanowski, 2016; Seetharam, 2017; Kong et al., 2021). In order to overcome this geographic limitation, I decided to choose an event which affected the same countries of origin as the ones of the sample of indexes.

To proceed with the event study, not only an event window but also an estimation window were defined. As for the first, event study's literature suggests that event windows should not be determined for extended periods of time in order to avoid cofounding effects, meaning the stocks' price movement could be due to other factors (McWilliams and Siegel, 1997).

The event window[9] was then defined as [-2, 5] from the 24th of May 2016 to the 2nd of June 2016, with the 26th May 2016 being the day 0. The purpose of selecting a window starting before the event unfolds is to enable the analysis to capture any prior leak of information which could have had impact on investors' behavior before the floods (event) started. In this case, a mere meteorological expectations report could have had this effect.

As for the estimation window[9], the selected period concerned a total of 100 days, from October 29th, 2015, to March 17th, 2016, summarized as [-150, -50]. This window is settled at 50 days prior to the event as its function is to represent a neutral period to the event and, again, information leakage could be bound to happen.

The remaining of the event study procedure partly follows the strategy of McWilliams and Siegel (1997) to achieve the abnormal returns related to the event's shock, which were expected to reflect the incorporation of the new information into investors' sustainable investing preferences.

The authors point out the fact that some corporate performance indicators may be subject to internal manipulation and, therefore, may not reflect the veracity of the company's situation.

[9] Both the event and the estimation window are set in business days due to the fact that stock markets are closed on weekends and/or holidays.

Stock returns, in their turn, are not usually entailed to insider handling and are, thus, considered a more reliable measure to be used in event studies.

The above mentioned daily abnormal returns during the period of the event window were calculated as shown below:

$$AR_{i,t} = R_{i,t} - (a_i + B_i Rm_t) + \varepsilon_{i,t}$$

, for which R_i, t are the excess daily returns for company i in day t. a_i and B_i are parameters estimated through an OLS (Ordinary Least Squares) regression performed for the span of the estimation window. Rm_t stands for the excess daily returns of the used proxy for the market stock's portfolio on day t, also during the estimation window. Finally, $\varepsilon_{i,t}$ is the error term of the regression, for which $E(\varepsilon_{i,t}) = 0$.

The rationale of this method is that the achieved abnormal returns can be, under certain assumptions, attributed to the happening of the specific event. That is the case since they are calculated as the subtraction between the actual observed returns in the market, concerning the event period, $R_{i,t}$, and what can be called of expected returns, the ones obtained from parameters resulting from the estimation window period and which are expected to be neutral to the event's effects.

Further detailing the abnormal returns calculations process, several steps were followed until obtaining the abnormal returns per se:

1. Calculating daily excess returns for both the estimation and the event windows:

   $$R_{i,t} = \frac{P_{i,t} - rf}{P_{i,t-1} - rf}$$

   , where $P_{i,t}$ corresponds to the close stock price of company i on day t, $P_{i,t-1}$ corresponds to the close stock price of company i on day t *-1* and rf stands for the corresponding risk-free rate, obtained through the proxy of the German bond yield.
2. The same rationale was followed into calculating the daily excess returns for the market proxy, Rm_t, again for both periods.
3. Estimating parameters α_i and β_i for each company in our sample. These were estimated through an OLS regression as below (executed for the estimation period):

$$R_{i,t} = \alpha_i + \beta_i Rm_t + \varepsilon_{i,t}$$

All of the obtained α_i and β_i are further detailed in Appendix E, for each of the analyzed companies. In a following step, α_i and β_i observations were then inputted into the main $AR_{i,t}$ regression in order to achieve the abnormal returns observations for each day and for each company.

Having achieved the $AR_{i,t}$ sample, the subsequent step was to be able to condense this time variant results into an aggregated abnormal returns measure, for each of the studied companies. Cumulative Abnormal Returns (CAR_i) were consequently computed, so that the cluster principle adopted in the beginning could take place:

$$CAR_i = \sum_{t=1}^{t} AR_{i,t}$$

, where CAR_i is the sum of all obtained abnormal returns, in the event window period, for each company i. This metric was further used in the chosen Multiple Linear Regression Models (MLRM).

III.IV – Descriptive Statistics

The present section serves to highlight the descriptive statistics of the used variables (and variables' calculation inputs) in this study. These were analyzed not only on a general manner but were also segmented regarding industry and geographical location (the latter can be consulted in Appendix A and B, respectively). Table 1 summarizes the information described below in two categorical panels: Panel A comprehends the information regarding the ER and the variables used in its construction as Panel B enhances the stock's returns related description.

III.IV.I – Emissions Ratio

The sample's average assets quantity is 126.3 million, with a standard deviation of 27.4. Values range from 0.04 million up to 1987.8 million. These figures have the highest average for the financial industry, ranging from 3 to 1988 million, and for France[10], for which asset figures can go from 3 to 1988 million.

Taking into consideration that a company's assets are one of the most common accounting fields used to assess a company's size, this can be considered as a comparable measure between firms. Consequently, one can assume the biggest firms to be in the financial sector and/or in the CAC 40 index.

Regarding the emissions (in tonnes of considered greenhouse gases), the average between the 123 analyzed companies is 7.385 million, with a standard deviation of 2.346 million. The least polluting company has a 177 tonnes yearly emission while the most polluting one contributed with 176 million tonnes of gases emissions in 2015. The most polluting industry, i.e. the one with the highest emissions average is Oil, Gas & Related Services, with an average of yearly emissions of about 38.7 million of tonnes, while the country where the most polluting companies are situated is Germany, with DAX having the highest emissions average among the 3 indexes with 15.7 million of tonnes in 2015.

When it comes to the Emissions Ratio (ER), it varies from 0.0008% to 604%, which represents a range including very low polluting companies up to firms which produce about 6 tonnes of CO_2 related gases per existing asset. The sample's ER average is 1.7%, with a standard deviation of 5%. Between all the sectors, the one presenting the highest average is Metal

[10] For the purpose of this analysis, "country" was defined by the respective index's country of origin. Companies from DAX are considered German, from CAC 40 French and from FTSE100 English.

Producers while the Financial industry is associated with the lowest average. Considering the index segmentation, DAX and FTSE are the highest and lowest average ones, respectively, with corresponding ER averages of 2.4% and 1.5%, respectively.

III.IV.I – Stock Returns

As mentioned in previous sections of the present study, stock returns were calculated for both the estimation and the event window periods. Following the same rationale, descriptive statistics for these figures were also split between the two distinct intervals.

Concerning the estimation window, the average daily excess returns range from -0.08% to 0.0125% (between 29/10/2015 and 17/03/2016). The company with the highest daily returns average is Glencore while the bottom average daily returns company is Deutsche Bank. During the course of the estimation window, the risk-free rate used to calculate the specified excess returns ranged from 0.02% to 0.06%, with an average of 0.04%.

With reference to the event window, the average stock's excess returns were highest for Arcelormittal, at 2.3% and lowest for Evraz, at -1.6%, with standard deviations of 1.3% and 0.09%, respectively and medians of 3.2% and -1.1%, respectively. The risk-free rate proxy ranged from 0.014% and 0.016%, with an average of 0.015%. Additionally, EuroStoxx 50's excess returns (representing the market's excess returns) were comprehended between -1% and 2.5%, averaging at 0.4%.

The computed AR_i, for a total of 924 observations, has a maximum value of 5.5% and a minimum value of -6.1%, during the eight days that constitute the event window. Their average is -0.25% and the standard deviation is around 0.04%.

As for the CAR_i, including all 123 observations, the average CAR_i, is of -2.3%, with a standard deviation of 0.4% and values comprehended in a -16.6% to +3.1% range. Average CAR_i was the highest for the Electrical industry, with an average CAR_i of 1.07% and a standard deviation of 2.76% and lowest for the industry of Oil, Gas & Related Services, with an average CAR_i of -7.35% and a standard deviation of 2.89%. When it comes to the geographical segmentation, the country represented by the highest average CAR_i is DAX, with an average of -1.4% and standard deviation of 0.05%.

Table 1– Descriptive Statistics

Table 1 lists the descriptive statistics in relation to the variables used in the presented research. Yearly variables (displayed in Panel A) concern the year of 2015 while daily variables (illustrated in Panel B) concern two distinguished periods: the Estimation Window, from 29/10/2015 up until 17/03/2016 and the Event Window, which contemplates all business days between 24/5/2016 and 02/06/2016.

A – Assets, Scope 1 Emissions and Emissions Ratio (ER)[11]

Assets represent each company's reported assets at the end of 2015, in millions. Scope 1 Emissions are the correspondent greenhouse gas emissions issued by each company during the same year, in millions of tonnes. Lastly, the Emissions Ratio is the achieved quotient between the two first variables, in tonnes per asset.

	N	Mean	Median	St. Dev.	Min	Max
Assets	123	126.3	27.5	27.4	0.04	1987.8
Scope 1 Emissions	123	7.4	0.1	0.07	0.0002	176
Emissions Ratio (ER)	123	1.7	1	5.8	0.0008	604

B – Stock Returns

All below presented stock returns were calculated on a daily basis and as excess stock returns, meaning that the risk-free rate was deducted from the first computed raw stock returns. Returns are measured in % and are a measure of financial markets performance in this study. They were calculated for two disassociated periods (estimation window, 29/10/2015 - 17/03/2016 and event window, 24/5/2016 - 02/06/2016) and are presented below accordingly.

B1 – Estimation Window

	N	Mean	Median	St. Dev.	Min	Max
Stock Returns	11439	-0.4	-0.5	2.3	-20.1	19.9
Market Returns	96	-0.5	1.6	-0.6	-4.2	3.3
Risk-free Rate	96	0.4	0.5	0.2	0.2	0.6

[11] All figures aimed to be presented with 2 decimal cases and were only shown with more in case of lower values which rounded to 2 decimal cases would appear as 0.

B2 – Event Window

	N	Mean	Median	St. Dev.	Min	Max
Stock Returns	924	0.1	-0.001	0.1	-5.8	6.8
Abnormal Returns	924	0.4	0.1	0.04	-1.0	2.5
Cumulative Abnormal Returns	123	-2.3	0.4	-1.3	-16.6	3.1
Market Returns	8	0.3	0.1	1.2	-1.0	2.5
Risk-free Rate	8	0.1	0.2	0.1	0.01	0.2

III.V – Multiple Linear Regression Models

For this study to take place, several multiple linear regression models were used through the OLS (Ordinary Least Squares) method. The ultimate goal was to understand whether the occurrence of a natural disaster had any impact on companies' stock returns, trying to prove the hypothesis that, due to growing sustainability patterns across investors, greener firms would be less penalized than browner ones, meaning that climate caused events would further shift investors preferences into more environmental friendly investment strategies.

To conduct this analysis, the central regression aimed to model the relationship between CAR_i, which is the cumulative abnormal returns of each company and the dependent variable, and the sustainability profile of each company, measured by the cluster it belongs to. Therefore, ten dummy variables were, as explained before, created with each of them representing one sustainability cluster in a first stage, and twenty Clusters were assumed for the second stage, and are the independent variables in the following model:

$$CAR_i = \alpha + \sum_{n=1}^{n} (\beta_n * Cluster_n) + \varepsilon_i$$

,where α is the constant, i represents the existence of a CAR for each one of the analyzed companies and n stands for the Cluster company i belongs to. The regression shown above was conducted for two single Cluster segmentation strategies. The first including 10 Clusters, for which the dummy Polluter10, represented by the group of companies associated with the highest levels of Emissions Ratio, i.e. the most polluting/least sustainable ones, was the omitted dummy variable. Therefore, all the results in the following section will be interpreted in relation to this variable. β_n, for n = 1 to 9, measures the change in the CAR_i related to the company belonging to Cluster n. An identical reasoning was applied to the 20 Cluster strategy, with Polluter20 being the omitted variable for this regression. The main goal of incorporating two distinct Cluster division strategies was to, with a deeper segmentation in the second case, being able to better capture the expected effects of the shift in investors preferences and, as a consequence, better observe a more severe market penalty in higher Clusters. All the described variables were regressed for the data concerning the event window, in 2016. ε is used to capture the variation in CAR_i which is not explained by all the explanatory variables.

The expectation of this analysis is that lower numbered Clusters, portraying greener gathers of firms, would be associated with a higher β, indicating that being classified within a more sustainable profile would have a positive or less negative impact on the obtained CAR_i, proving that a natural disaster event causes greener corporations' returns to be higher than browner ones. In another sense, this would imply that the shock of a natural disaster would shift investors' preferences into greener firms, causing their returns and, consequently, cumulative abnormal returns to be higher. Browner corporations would, in the other hand, be punished by investors shifting their investments to greener firms and their returns, and hence, β, would be lower after the weather event.

Following existing literature, two other regressions were derived from the one displayed above so as to include control variables. The first was the enclosing of industry dummies into the central regression in order to control for the fact that between the 123 considered companies there are several distinct industries and some could be more penalized by investors than others. Thus, 23 additional dummy variables were included to represent each industry and took the value of 1 if the company *i* belonged to the respective dummy industry and 0 otherwise. In the same procedure as with the Cluster dummies, there was one excluded dummy – the Aerospace industry one – and all results should then be interpreted in relation to this industry.

Finally, and also taking into account the results of previous research, the third-step regression consisted in including country variables, for the sake of introducing geographical control variables. Succeeding this, three supplementary dummy variables were created and took the value of 1 if the considered company belonged to that specific country and 0 if that was not the case. Again, the Germany dummy was omitted and the results obtained should also be interpreted in relation to this location dummy.

IV – Empirical Results

The current segment of this study shows the obtained results, achieved from the regressions explained before. Within this, there are three main segments here included, one for each of the performed regressions. Each of these segments present both a summarized description of the results obtained and a final aggregated table highlighting the realized coefficients results (which can be found graphically in Appendix F), its' standard deviations and significance levels. Geographic and Country related coefficients can be found in Appendix C and D, respectively.

IV.I – Cluster Dummies

When regressing the cumulative abnormal returns with the nine Cluster dummies, little significant results were obtained. Among all the studied independent variables, only Polluter2 and Polluter4 had significant coefficient figures at a 10% significance level.

At this significance level, companies belonging to Polluter2, meaning a level of Emissions Ratio considered sustainable, have, on average, higher CAR_s by 0.021, when compared to companies belonging to Polluter10 and, therefore, the least sustainable one. Following the same reasoning, also all firms which are Polluter4 constituents proved to have around 0.022 higher CAR_s on average, when compared to its Polluter10 peers, again at a 10% significance level.

When analyzing the obtained results through the more segmented 20 Cluster parceling, we achieved not only a higher number of significant dummy's coefficients but also some of them at a higher significance level.

Polluter3, Polluter12 and Polluter15 are all significant for a 5% significance level. In light of interpretation, companies belonging to Polluter3, Polluter12 and Polluter15 clusters have 0.041, 0.038 and 0.037 higher CAR_s, when compared to companies associated with the most polluting figures, respectively. Within this Cluster segmentation process, the decreasing tendency of significant β for increasing Clusters is in line with our hypothesis that greener firms, i.e. belonging to lower Clusters, are less penalized by investors in the happening of the studied floods and will have, as a result, higher CAR_s.

Moreover, the coefficients linked to Polluter6 and to Polluter19 clusters are significant for a 10% significance level, which determines that, for the mentioned significance level, companies from Polluter6 have 0.037 higher CAR_s while browner firms from Polluter19 have 0.033 higher CAR_s, on average, both of them compared to firms in the Polluter20 Cluster.

Table 2 – Regression Analysis with Cluster Dummies

A multiple linear regression was conducted so as to analyze the impact of a natural disaster event on each of the 123 analyzed companies stock returns. All used variables were defined in previous sections. Each of the cluster dummies coefficients are presented in the table below and in parenthesis the standard deviations. The statistical significance of each achieved coefficient is marked with *, ** or *** to express 10%, 5% and 1% significance levels, respectively.

Variables	10 Cluster Strategy	20 Cluster Strategy
Polluter1	0,0068	0,0243
	(0,0108)	(0,0193)
Polluter2	0,0211*	0,0173
	(0,0113)	(0,0193)
Polluter3	0,0088	0,0412**
	(0,0122)	(0,0187)
Polluter4	0,0223*	0,0259
	(0,0122)	(0,0187)
Polluter5	0,0043	0,0269
	(0,0122)	(0,0193)
Polluter6	0,0181	0,0371*
	(0,0122)	(0,0193)
Polluter7	0,0179	0,0293
	(0,0122)	(0,0193)
Polluter8	0,0128	0,0194
	(0,0122)	(0,0187)
Polluter9	-0,0073	0,0296
	(0,0119)	(0,0187)
Polluter10	-	0,0233
		(0,0193)
Polluter11	-	0,0295
		(0,0193)
Polluter12	-	0,0384**
		(0,0193)
Polluter13	-	0,0231
		(0,0193)
Polluter14	-	0,0170
		(0,0193)
Polluter15	-	0,0379**
		(0,0193)
Polluter16	-	0,0234
		(0,0193)
Polluter17	-	0,0249
		(0,0193)
Polluter18	-	-0,0189
		(0,0193)
Polluter19	-	0,0330*
		(0,0193)
OBSERVATIONS	123	123
R-SQUARED	0,0901	0,1689

IV.II – Cluster and Industry Dummies

On a second step to this research, the conducted regressions included industry dummies in order to control for possible industry-linked effects on the cumulative abnormal returns. The main motivation to include this distinct set of dummies relies on the fact that previous research studies, from earlier to most recent ones, achieved significant results on natural disasters' repercussion in financial markets particularly for specific industries (Lamb, 1995; Wang and Kutan, 2013).

Contrary to the motivation findings, incorporating industry dummies in our analysis decreased the results' confidence and only one industry dummy coefficient was significant for the 10 Clusters method. In this case, the dummy representing the Transportation industry was significant at a 10% significance level, suggesting that enterprises which concern the Transportation industry end up having cumulative abnormal returns on average 0.035 higher, when compared to Aerospace firms. Concerning the Polluter dummies, no achieved coefficients were significant.

In line with these results, also the addition of industry dummies to the 20 Cluster ER approach diminishes the significance of the obtained results, having achieved only 2 significant industry coefficients at a 10% significance level and no significant coefficients concerning the Cluster dummies. Taking this into account, the gathered results suggest that corporations in the Electrical and in the Machinery & Equipment industries have, respectively, 0.040 and 0.046 higher CAR_s after the shock of a natural disaster event, also when compared to the Aerospace industry, for a 10% significance level.

The lack of significance from the inclusion of the industry control dummy variables implies that each of the contemplated companies' returns, subsequently to the disclosure of the European floods, are not affected in line with the respective company's industry, indicating that the supplement of the core regressions with industry dummies developed into noise for the model.

Table 3– Regression Analysis with Cluster and Industry Dummies

A multiple linear regression was conducted so as to analyze the impact of a natural disaster event on each of the 123 analyzed companies stock returns. All used variables were defined in previous sections. Each of the cluster dummies coefficients are presented in the table below and in parenthesis the standard deviations. The statistical significance of each achieved coefficient is marked with *, ** or *** to express 10%, 5% and 1% significance levels, respectively.

Variables	10 Cluster Strategy	20 Cluster Strategy
Polluter1	0,0006	0,0132
	(0,0170)	(0,0257)
Polluter2	0,0082	0,0063
	(0,0132)	(0,0257)
Polluter3	-0,0144	0,0281
	(0,0148)	(0,0237)
Polluter4	0,0021	0,0059
	(0,0144)	(0,0221)
Polluter5	-0,0070	-0,0142
	(0,0133)	(0,0237)
Polluter6	-0,0008	0,0237
	(0,0155)	(0,0216)
Polluter7	-0,0177	-0,0140
	(0,0154)	(0,0227)
Polluter8	-0,0174	0,0107
	(0,0149)	(0,0200)
Polluter9	-0,0126	-0,0028
	(0,0126)	(0,0223)
Polluter10	-	0,0028
		(0,0210)
Polluter11	-	0,0039
		(0,0217)
Polluter12	-	-0,0025
		(0,0221)
Polluter13	-	-0,0219
		(0,0223)
Polluter14	-	-0,0246
		(0,0229)
Polluter15	-	-0,0012
		(0,0237)
Polluter16	-	0,0072
		(0,0203)
Polluter17	-	0,0022
		(0,0213)
Polluter18	-	-0,0180
		(0,0203)
Polluter19	-	0,0185
		(0,0195)
OBSERVATIONS	123	123
R-SQUARED	0,044	0,052

IV.III – Cluster and Country Dummies

Lastly, this analysis aimed to ultimately analyze whether there could be a geographical effect affecting CAR_s besides the company's sustainability profile represented by the cluster dummies.

Along with the motivation inherent to the previous section, the addition of country dummies intent was to follow previous studies which had concluded that the effect on stock returns provoked by the ocurrence of an extreme weather event was particular to companies located in the affected areas (Kong et al, 2021; Seetharam, 2017; Bourdeau-Brien and Kryzanowski, 2017).

With reference to the base 10 Cluster regression, the addition of the 2 country dummies did not add significance to the referred model. The significant results are restricted to Polluter4 and Polluter7 dummies' coefficients. In one hand, Polluter4 coefficient entails that the constituent companies' abnormal returns are 0.022 higher when comparing with Polluter10, on average, for a 10% significance level. On the other hand, and for the same significance level, the results suggest that CAR_s for companies which are a part of Polluter7 group turned out to be 0.02 higher in relation to the companies inserted in the most polluting Cluster. This outcome reiterates the tendency of the significant results being in line with the ground hypothesis of this study: higher numbered Clusters will be related to lower CAR_s when a climate associated calamity takes place.

Last but not least, when assessing the aftermath of enclosing location control dummy variables into the 20 Cluster approach, several significant coefficients were found. At a 5% significance level, dummies illustrating Polluter3, Polluter12 and Polluter15 were significant. When examining these Clusters in contrast with the least sustainable one, Polluter3 has 0.04 larger CAR_s, Polluter12 has 0.042 larger CAR_s and Polluter15 has about 0.039 higher CAR_s. On top of that, 3 other Cluster presented significant coefficient results, this time for a 10% significance level. Polluter6, Polluter11 and Polluter19 had, in each turn, 0.036, 0.032 and 0.033 higher CAR_s, as to Polluter20. Contrary to the early 10 Cluster methodology, the findings in this turn were not aligned with our hypothesis, being that more polluting companies ended up having higher coefficients than more environmental-friendly ones.

In spite of the incorporation of country dummy variables in this last model testing stage, the variables' coefficients were not significant in any of the two models, stating that, contradictory to some published literature, following this research's model, one company's location does not further affect its stock price reaction to the unfold of a climate disaster.

IV.III – Overall Results

When gathering all results inferred from the 6 performed regressions, this study's findings are inconclusive. The significant results are not coherent between the two adopted Cluster arrangements, although it can be established that the supplementary Cluster division resulted in a higher number of significant coefficients for the model. In spite of this, and although proved in some of the created models, the hypothesis of higher coefficients for lower Clusters was not persistently significant throughout the analysis.

Complementing that, both groups of control variables included were not significant, in either of the Cluster segmentation processes so the literature review based conjecture of geographical and/or industrial impact on CAR_s was discarded.

The results achieved may imply numerous conclusions, in which we can highlight that the used method may have its limitations in assessing the effect of the event on the stock returns of greener and browner Clusters as well as the fact that this type of weather-related events may not have the previous expected impact on the returns development. The last could be due to the shorter event window, which may not be sufficient to capture the shift on investors' elections in conjunction with the analysis of a single event, for which the switch on investors behavior may not have yet taken place.

Table 4– Regression Analysis with Cluster and Country Dummies

A multiple linear regression was conducted so as to analyze the impact of a natural disaster event on each of the 123 analyzed companies stock returns. All used variables were defined in previous sections. Each of the cluster dummies coefficients are presented in the table below and in parenthesis the standard deviations. The statistical significance of each achieved coefficient is marked with *, ** or *** to express 10%, 5% and 1% significance levels, respectively.

Variables	10 Cluster Strategy	20 Cluster Strategy
Polluter1	0,0074	0,0257
	(0,0106)	(0,0194)
Polluter2	0,0173	0,0210
	(0,0112)	(0,0194)
Polluter3	0,0078	0,0403**
	(0,0120)	(0,0187)
Polluter4	0,0221*	0,0257
	(0,0119)	(0,0185)
Polluter5	0,0029	0,0284
	(0,0120)	(0,0194)
Polluter6	0,0170	0,0364*
	(0,0120)	(0,0195)
Polluter7	0,0206*	0,0294
	(0,0120)	(0,0192)
Polluter8	0,0147	0,0223
	(0,0120)	(0,0186)
Polluter9	-0,0081	0,0287
	(0,0117)	(0,0187)
Polluter10	-	0,0234
		(0,0192)
Polluter11	-	0,0318*
		(0,0192)
Polluter12	-	0,0416**
		(0,0192)
Polluter13	-	0,0254
		(0,0192)
Polluter14	-	0,0202
		(0,0192)
Polluter15	-	0,0388**
		(0,0191)
Polluter16	-	0,0257
		(0,0192)
Polluter17	-	0,0243
		(0,0195)
Polluter18	-	(0,0143)
		(0,0193)
Polluter19	-	0,0331*
		(0,0192)
OBSERVATIONS	123	123
R-SQUARED	0,018	0,025

V – Conclusion

V.I – Concluding Remarks

Sustainability investing has become one of the most attractive investment strategies, mostly as a result of the increasingly frequent occurrence of natural disasters. Climate change is now a global reality and the consequent extreme weather events drive people to become more environmental conscious, and investors are not an exception.

In light of this progressively relevant field, several studies have been conducted not only focused on sustainable investment strategy and its benefits but also on the impact of natural disaster on firms' stock returns. Despite this, there has not been substantial research that connects the referred impact with corporations' sustainability profiles and whether that also influences the stock prices behavior. To incorporate the latter into my analysis, a "green/brown" measure was created – the Emissions Ratio – so as to divide the group of studied companies into more/less sustainable Clusters.

A total of 123 companies were examined for the period of the European floods in an event study structure. Both an estimation and an event window were selected comprehending time samples between 2015 and 2016 and six regressions were conducted in order to measure the repercussion of the considered natural disaster on the companies' cumulative abnormal stock returns performance, and if that same performance was related to the company's sustainability profile.

The findings of this research were, as in some of the existing literature, not conclusive. Although some of the Cluster coefficients were significant, this was proved not be persistent among the executed regressions, when including industrial or geographical control dummy variables. Aligned with these results, there was also not a verified significant tendency in the obtained coefficients and, as a consequence, it was not possible to significantly demonstrate that higher Clusters would have lower coefficients, and vice-versa.

The absence of significant findings contributes to an unexpected finding that the happening of a natural disaster does not influence investors preferences into less environmental harming choices. Regardless of the growing relevance of sustainable investment approaches, the handled study does not find a significant relation between a climate change provoked event and a shift on investors' money allocation, which may imply that investors do not react promptly to the shock of a natural catastrophe or that these events do not have an impact on companies' stock returns based on the fact that they are more or less environmentally conscious, contrary to what was expected.

In conclusion, and in spite of the scarcity of significant results, I must perceive that the present research contributes to the previous existing studies by adding a new approach of study in this field of aiming to understand whether greener companies are favored in disadvantage of browner ones, and if this is enhanced by the occurrence of a natural disaster. Further studies can then ensure if this is in reality a significant effect, which can consequently lead to the development new investment strategies, or, on the other hand, if there is no connection between the two factors, suggesting natural disasters do not generate a heavier environmental awareness into the average investor.

V.II – Limitations and Recommendation for Future Research

Ultimately, these findings, although not significant, pave the way for future studies on the natural disasters and stock returns relation studies.

Several limitations can be applicable to this now concluded research, the most relevant one being the singular event used in the event study, for which a more complete analysis should encompass diverse events. Also, varying estimation and event windows could be used in order to better capture not only the sustainability effect but also the natural catastrophes unroll and its development consequences on investors' market behavior. Other "green/brown" measures could as well be chosen so as to avoid any possible missing effects not taken into account in the scope 1 emissions variable but that affect each company's sustainability profile, such as the shift rate towards more environmental concerned corporate policies, for example.

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VII – Appendix

VII.I – Appendix A – Descriptive Statistics by Industry

Aerospace	
Mean	-2,65%
Standard Error	1,24%
Median	-3,30%
Range	5,30%
Minimum	-4,65%
Maximum	0,65%
Sum	-10,61%
Count	4

Apparel	
Mean	-2,24%
Standard Error	3,88%
Median	-2,24%
Range	7,76%
Minimum	-6,12%
Maximum	1,64%
Sum	-4,48%
Count	2

Automotive	
Mean	-3,15%
Standard Error	0,65%
Median	-2,57%
Range	2,03%
Minimum	-4,46%
Maximum	-2,42%
Sum	-9,45%
Count	3

Beverages	
Mean	-0,82%
Standard Error	0,00%
Median	-0,82%
Range	0,00%
Minimum	-0,82%
Maximum	-0,82%
Sum	-0,82%
Count	1

Chemicals	
Mean	-1,15%
Standard Error	0,55%
Median	-1,04%
Range	4,04%
Minimum	-3,46%
Maximum	0,58%
Sum	-8,05%
Count	7

Construction	
Mean	-4,13%
Standard Error	1,24%
Median	-2,98%
Range	6,88%
Minimum	-8,53%
Maximum	-1,65%
Sum	-20,65%
Count	5

Diversified	
Mean	-0,98%
Standard Error	0,52%
Median	-1,49%
Range	1,57%
Minimum	-1,50%
Maximum	0,06%
Sum	-2,93%
Count	3

Drugs, Cosmetics & Health	
Mean	0,77%
Standard Error	0,47%
Median	1,13%
Range	3,48%
Minimum	-1,07%
Maximum	2,41%
Sum	6,17%
Count	8

Electrical	
Mean	1,07%
Standard Error	2,76%
Median	1,07%
Range	5,52%
Minimum	-1,69%
Maximum	3,83%
Sum	2,14%
Count	2

Electronics	
Mean	-0,81%
Standard Error	1,06%
Median	-0,90%
Range	9,70%
Minimum	-7,08%
Maximum	2,62%
Sum	-6,51%
Count	8

Financial	
Mean	-1,76%
Standard Error	0,48%
Median	-2,18%
Range	8,15%
Minimum	-6,39%
Maximum	1,76%
Sum	-38,75%
Count	22

Food	
Mean	0,39%
Standard Error	0,67%
Median	0,51%
Range	2,33%
Minimum	-0,83%
Maximum	1,50%
Sum	1,18%
Count	3

Machinery & Equipment	
Mean	-1,89%
Standard Error	1,36%
Median	-1,89%
Range	2,72%
Minimum	-3,25%
Maximum	-0,52%
Sum	-3,77%
Count	2

Metal Producers	
Mean	-5,87%
Standard Error	2,92%
Median	-7,96%
Range	22,63%
Minimum	-16,56%
Maximum	6,07%
Sum	-41,06%
Count	7

Miscellaneous	
Mean	-1,28%
Standard Error	0,87%
Median	-1,10%
Range	11,87%
Minimum	-9,05%
Maximum	2,83%
Sum	-15,40%
Count	12

Oil, Gas & Related Services	
Mean	-7,35%
Standard Error	2,89%
Median	-4,63%
Range	8,85%
Minimum	-13,13%
Maximum	-4,28%
Sum	-22,04%
Count	3

Paper	
Mean	-1,38%
Standard Error	1,08%
Median	-1,07%
Range	3,69%
Minimum	-3,38%
Maximum	0,31%
Sum	-4,15%
Count	3

Recreatiom	
Mean	-2,28%
Standard Error	0,92%
Median	-2,28%
Range	1,83%
Minimum	-3,20%
Maximum	-1,37%
Sum	-4,57%
Count	2

Retailers	
Mean	0,03%
Standard Error	0,73%
Median	-0,17%
Range	5,61%
Minimum	-2,53%
Maximum	3,08%
Sum	0,27%
Count	8

Tobacco	
Mean	-0,13%
Standard Error	0,73%
Median	-0,13%
Range	1,45%
Minimum	-0,85%
Maximum	0,60%
Sum	-0,25%
Count	2

Transportation	
Mean	-1,39%
Standard Error	0,14%
Median	-1,39%
Range	0,28%
Minimum	-1,53%
Maximum	-1,25%
Sum	-2,78%
Count	2

Utilities	
Mean	-2,02%
Standard Error	0,49%
Median	-1,41%
Range	5,80%
Minimum	-5,27%
Maximum	0,53%
Sum	-22,21%
Count	11

VII.II – Appendix B – Descriptive Statistics by Country

France	
Mean	-0,58%
Standard Error	0,46%
Median	-1,02%
Range	10,97%
Minimum	-4,90%
Maximum	6,07%
Sum	-17,85%
Count	31

Germany	
Mean	-1,44%
Standard Error	0,49%
Median	-1,40%
Range	7,04%
Minimum	-5,27%
Maximum	1,76%
Sum	-28,84%
Count	20

England	
Mean	-2,29%
Standard Error	0,43%
Median	-1,33%
Range	19,64%
Minimum	-16,56%
Maximum	3,08%
Sum	-162,74%
Count	71

VII.III – Appendix C – Industry Dummies

Variables	10 Cluster Strategy	20 Cluster Strategy
Education & Mass Media	0,022	0,035
	(0,025)	(0,027)
Paper	0,005	0,012
	(0,026)	(0,028)
Metal Product Manufacturers	0,028	0,042
	(0,035)	(0,039)
Recreatiom	0,003	0,009
	(0,028)	(0,030)
Tobacco	0,026	0,019
	(0,027)	(0,029)
Oil, Gas & Related Services	(0,047)	-0,036
	(0,025)	(0,028)
Beverages	0,015	-0,002
	(0,025)	(0,027)
Diversified	-0,036	-0,033
	(0,020)	(0,023)
Metal Producers	0,011	0,007
	(0,019)	(0,021)
Miscellaneous	0,002	-0,001
	(0,019)	(0,021)
Utilities	0,012	0,019
	(0,027)	(0,029)
Transportation	0,035*	0,033
	(0,020)	(0,021)
Retailers	0,004	0,007
	(0,026)	(0,028)
Machinery & Equipment	0,040	0,046*
	(0,026)	(0,026)
Food	-0,0002	-0,005
	(0,022)	(0,024)
Financial	0,019	0,022
	(0,019)	(0,020)
Electronics	0,027	0,032
	(0,029)	(0,030)
Electrical	0,031	0,040*
	(0,019)	(0,021)
Drugs, Cosmetics & Healthcare	-0,017	-0,025
	(0,021)	(0,025)
Construction	0,022	0,026
	(0,020)	(0,022)
Chemichals	-0,012	-0,007
	(0,025)	(0,025)
Automotive	0,002	-0,014
	(0,028)	(0,030)
OBSERVATIONS	123	123
R-SQUARED	0,044	0,052

VII.IV – Appendix D – Country Dummies

Variables	10 Cluster Strategy	20 Cluster Strategy
France	0,013	0,005
	(0,009)	(0,010)
England	-0,005	-0,008
	(0,008)	(0,008)
OBSERVATIONS	123	123
R-SQUARED	0,018	0,025

VII.V – Appendix E – Companies' Estimated Parameters

	β	α
AIRBUS (FRA)	1,2113	0,0021
ALLIANZ	0,8862	-0,0004
BASF	0,8680	-0,0009
BAYER	0,9753	-0,0011
BEIERSDORF	0,7173	-0,0012
CONTINENTAL	0,8966	-0,0005
DEUTSCHE BANK	1,5121	-0,0003
DEUTSCHE POST	0,9569	-0,0005
DEUTSCHE TELEKOM	0,9454	0,0000
E ON N	1,1277	0,0007
HEIDELBERGCEMENT	1,1411	0,0029
HENKEL PREFERENCE	0,8323	-0,0003
INFINEON TECHNOLOGIES	0,9716	0,0019
MERCEDES-BENZ GROUP N	1,0366	-0,0005
MERCK KGAA	0,9147	-0,0010
MTU AERO ENGINES HLDG.	0,8687	0,0001
MUENCHENER RUCK.	0,7489	-0,0001
PUMA	0,8850	0,0001
RWE	0,9627	0,0002
SAP	0,7532	-0,0003
SYMRISE	0,8466	-0,0001
VOLKSWAGEN PREF.	1,1420	0,0027
AIRBUS	1,1606	0,0020
ALSTOM	0,4564	-0,0046
ARCELORMITTAL	1,8795	0,0078
AXA	1,2154	0,0010
BNP PARIBAS	1,2297	0,0007
BOUYGUES	0,6794	-0,0001
CAPGEMINI	0,9540	0,0003
CARREFOUR	1,0275	-0,0008
CREDIT AGRICOLE	1,3838	0,0023
DANONE	0,6539	-0,0009
DASSAULT SYSTEMES	0,7781	-0,0004
ENGIE	0,9071	-0,0007
ESSILORLUXOTTICA	0,8555	-0,0006
KERING	0,9171	0,0004
L'OREAL	0,8205	-0,0008
LVMH	0,9305	-0,0001
ORANGE	0,9080	0,0006
PERNOD-RICARD	0,8202	-0,0004
PUBLICIS GROUPE	0,7037	0,0001
RENAULT	1,2830	0,0034
SAFRAN	0,9912	-0,0005
SAINT GOBAIN	1,0637	0,0016

SANOFI	0,8624	-0,0019
SCHNEIDER ELECTRIC	1,0531	0,0019
SOCIETE GENERALE	1,5253	0,0022
STELLANTIS	1,6885	0,0024
STMICROELECTRONICS	1,1151	0,0000
TELEPERFORMANCE	0,6157	-0,0002
THALES	0,6397	0,0004
TOTALENERGIES	1,0411	0,0012
UNIBAIL RODAMCO WE STAPLED UNITS	0,7885	-0,0002
VEOLIA ENVIRON	0,6249	-0,0011
VIVENDI	0,7686	-0,0019
ABRDN	0,9240	-0,0009
ADMIRAL GROUP	0,5334	0,0004
ANGLO AMERICAN	1,6329	0,0065
ANTOFAGASTA	1,1083	0,0025
ASTRAZENECA	0,6969	-0,0012
AVIVA	1,0752	0,0015
BAE SYSTEMS	0,4509	-0,0002
BARCLAYS	1,1224	-0,0021
BARRATT DEVELOPMENTS	0,6575	-0,0012
BERKELEY GROUP HOLDINGS (THE)	0,5692	-0,0009
BP	0,9589	-0,0001
BRITISH AMERICAN TOBACCO	0,5131	-0,0012
BRITISH LAND	0,7855	-0,0024
BT GROUP	0,7748	-0,0006
BUNZL	0,6291	0,0000
BURBERRY GROUP	0,9915	0,0013
COCA-COLA HBC	0,7376	-0,0009
COMPASS GROUP	0,5402	-0,0002
CRH (LON)	0,9416	0,0018
CRODA INTERNATIONAL	0,5085	-0,0016
DCC	0,4719	-0,0004
DIAGEO	0,5755	-0,0011
EVRAZ	1,1875	0,0030
EXPERIAN	0,8455	0,0012
FERGUSON	0,7997	0,0004
FRESNILLO	0,0357	-0,0005
GLAXOSMITHKLINE	0,5546	-0,0013
GLENCORE	1,8209	0,0106
HALMA	0,7367	0,0016
HARGREAVES LANSDOWN	1,1005	0,0004
HIKMA PHARMACEUTICALS	0,6252	-0,0023
IMPERIAL BRANDS	0,3657	-0,0014
INFORMA	0,5335	0,0007
INTERMEDIATE CAPITAL GP.	0,8511	0,0006
INTL.CONS.AIRL.GP.	0,9079	-0,0002
ITV	0,6261	-0,0014
KINGFISHER	0,5929	-0,0007

LAND SECURITIES GROUP	0,7658	-0,0025
LEGAL & GENERAL	1,0510	0,0003
LLOYDS BANKING GROUP	0,9911	0,0004
LONDON STOCK EXCHANGE GROUP	0,9155	0,0021
MEGGITT	0,6974	0,0014
MELROSE INDUSTRIES	0,4492	0,0013
MONDI	0,9365	-0,0002
NATIONAL GRID	0,3977	-0,0014
NATWEST GROUP	0,9060	-0,0028
NEXT	0,4263	-0,0039
OCADO GROUP	0,9241	-0,0012
PEARSON	0,9957	0,0015
POLYMETAL INTERNATIONAL	0,1671	-0,0013
PRUDENTIAL	1,2417	0,0013
RECKITT BENCKISER GROUP	0,5547	-0,0009
RELX	0,5835	-0,0002
RENTOKIL INITIAL	0,4718	-0,0006
RIGHTMOVE	0,5932	-0,0005
RIO TINTO	1,0787	0,0002
ROLLS-ROYCE HOLDINGS	1,0300	0,0019
ROYAL MAIL	0,6968	0,0000
SAGE GROUP	0,5946	0,0002
SAINSBURY J	0,5771	-0,0005
SCHRODERS	1,0325	0,0003
SEGRO	0,5751	-0,0020
SEVERN TRENT	0,5147	-0,0020
SMITH & NEPHEW	0,7114	-0,0003
SMITH (DS)	0,8246	0,0008
SMURFIT KAPPA GP. (LON)	0,5971	-0,0015
SPIRAX-SARCO ENGR.	0,6691	0,0006
SSE	0,5724	-0,0016
ST.JAMES'S PLACE ORD	1,0974	0,0012
STANDARD CHARTERED	1,4254	-0,0007
TAYLOR WIMPEY	0,7350	-0,0004
TESCO	0,6895	0,0002
UNILEVER (UK)	0,6429	-0,0002
UNITED UTILITIES GROUP	0,4268	-0,0028
VODAFONE GROUP	0,7519	-0,0003
WHITBREAD	0,7559	-0,0029
WPP	0,7757	0,0008

VII.II – Appendix F – Coefficients Graphs