LUND UNIVERSITY
School of Economics and Management

A Sustainable Pioneer in a House on Fire

An event study of the Paris agreement's impact on the Swedish stock market

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Abstract

This paper examines the impact of the Paris agreement on firms on the Swedish stock market. Additionally, the firms were also categorized into sustainable and unsustainable firms by their Environmental Pillar Score (which is part of the ESG score) in order to investigate performance differences between the two groups. On top of that, a comparison between sustainable firms with the market index OMXS30 was performed. For the methodology, an event study over three events was conducted with CAPM as the normal return model. The events chosen were: (1) the signing of the Paris agreement, (2) Trump's withdrawal from the Paris agreement, and (3) the release of the EU climate plan. This paper finds evidence that there exists a significant *difference* between the impact of the Paris agreement on the sustainable firms and on the unsustainable firms. Furthermore, it was found that the sustainable firms performed better than the unsustainable firms overall, however the study could neither prove that the performances were significant nor could evidence be found to support that the Paris agreement-related events had any significant impact on the firms. Although the impact is not statistically significant, it is evident that the events that are advantageous for the Paris agreement's progression, demonstrates a negative impact on both sustainable and unsustainable firms, contrary to the event that is disadvantageous, which presents a positive impact. Moreover, evidence could not be found whether the sustainable firms outperformed the market index after the Paris agreement or not.

Keywords: Climate finance, Climate change, Environmental pillar score, ESG scores, Event study, Paris agreement, Swedish stock market

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1. Introduction

This section presents the background to climate finance, the Paris agreement and climate change risks, which subsequently is followed by problematization and research questions culminating in the purpose of the study.

1.1 Background

There is no time. We must act immediately, but wisely. One of the most famous climate activists to date, once said "I want you to act as you would in a crisis. I want you to act as if our house is on fire. Because it is." (Thunberg, 2019, as cited in The Guardian, 2019), urging leaders to take climate action during the World Economic Forum. Wise climate investments are needed in order to achieve our climate goals, otherwise this will result in climate impacts that will threaten public health, jobs and the overall well-being of humankind (United Nations, n.d.c). The definition of Climate finance is that of local, national or transnational financing with the purpose of mitigating climate change (United Nations Framework Convention on Climate Change (UNFCCC, n.d.). To combat climate change, international large-scale agreements are created in order to implement coordinated solutions, such as the Paris agreement. In consideration of this, it is thus of interest to study the Paris agreement's impact on firms, which will be done in this paper.

The Paris agreement is an international legally binding treaty, which opened for signing and was open for a year starting from April 22nd 2016 (UN, n.d.a.). On this day, 175 parties signed the treaty (UN, n.d.a.). Under the treaty, all parties are to commit to reduce their emissions and cooperate together in order to mitigate climate change and over time, increase their efforts and commitments (UN, n.d.b). The participating countries have agreed upon that the developed country Parties should financially assist the developing country Parties since they are in deeper vulnerability and lack the financial resources and capabilities to help fight climate change and its consequences (UNFCCC, n.d.). The general aim of the Paris agreement is to make consistent financial flows where the financial resources are to be invested for the cause of reducing greenhouse gas emissions and mitigating climate change. Moreover, the agreement also assesses the progress in provision and mobilization of support and additionally focuses on

transparency and predictability in its financial resources (UNFCCC, n.d.). The UNFCCC also states that the Paris agreement is a mobilization considered to be exceptional in terms of progression compared to previous efforts in climate finance.

With climate change comes risks that can affect firms both positively and negatively. A study by the McKinsey Global Institute (2020) found that companies and communities are under-prepared, and thus their pace and scale of adaptation to mitigate climate risk is at insufficient levels (McKinsey Global Institute, 2020). They must therefore increase their efforts in order to handle the escalating physical climate risks. Nevertheless, the adaptation measures most likely will result in rising costs and tough decision making, e.g. choosing between investments in hardening or relocating their human resources and assets, making it essential to make well thought out measures across a firm's several stakeholders and leaders (McKinsey Global Institute, 2020, p. 8). In addition, companies during their decision-making will also need to factor in climate change regarding matters such as; capital allocation, development of products or services and supply chain management (McKinsey Global Institute 2020).

1.2 Purpose and research question

1.2.1 Purpose

As the overall temperature of the Earth is rising at an alarming rate, international treaties have surfaced in order to mitigate global warming, one of which is the Paris agreement. In addition, as mentioned in the background, the current pace and the scale of the firms' and communities' efforts to combat climate change are inadequate. Furthermore, the adaptation measures to mitigate climate change are costly, thus wise and balanced decisions by stakeholders and leaders must be made.

Moreover, the decisions and regulations introduced through the Paris agreement will most likely have some sort of impact on the companies. Therefore, the purpose of this thesis is to contribute to further empirical insights, regarding the impact of the Paris agreement, with a focus on the Swedish stock market. As Sweden is one of the world's most sustainable countries (Swedish Institute, n.d.), it is of interest to analyze the Swedish stock market's reaction to climate measures such as the global Paris agreement. Furthermore, an event study was conducted over three time periods to analyze the impact of the Paris agreement on the market, particularly,

if there is a difference between sustainable and unsustainable firms. The three events chosen for the event study are the following: the signing of the Paris agreement (2016-04-22), Donald Trump's withdrawal from the Paris agreement (2017-06-01), and when the EU released their climate plan (2021-07-14), as seen in table 4, subsection 3.3.2.

Previous research in this field has dominantly touched this subject with a global, European and/or American perspective. However, the results of previous research are ambiguous. Some of them found a positive impact on the different sectors from green policy-related or Paris agreement-related announcements, meanwhile others found a negative impact.

In consideration of previous statements, this paper intends to shed light to the questions displayed in the subsequent subsection below.

1.2.2 Research question

This thesis aims to answer the following questions:

- How does the Paris agreement affect sustainable firms and unsustainable firms, respectively?
- How do sustainable firms do compared to unsustainable firms, after the Paris agreement-related events?
- How do Swedish sustainable firms compare to the market index, after the Paris agreement-related events?

1.3 Findings

The first finding, with regard to our research questions, is that none of the events related to the Paris agreement showed significant impact on either the sustainable or unsustainable firms. Although the impact is not significant, it is found that the events that are beneficial to the Paris agreement have a negative impact on both sustainable and unsustainable firms, meanwhile the event that is disadvantageous has a positive impact.

The second finding is that there exists a significant difference between the performance of the sustainable firms and the performance of the unsustainable firms, after the Paris

agreement-related events. Also, the sustainable firms mainly display a positive correlation with the unsustainable firms, and the first mentioned performed better than the latter.

The third finding is that the sustainable firms cannot be proven to outperform the market index with respect to the events connected to the Paris agreement.

1.4 Disposition

The disposition of this paper is the following: Section 2 provides the theoretical framework of the theory, previous research, as well as the hypotheses. Section 3 presents the methodology and data. Section 4 gives the results, analysis and discussion. Section 5 concludes the paper and suggests further research.

2. Theoretical framework

This section covers the theoretical structure, the previous research and the formulation of hypotheses.

2.1 Theory

2.1.1 ESG: Environmental, Social and Governance Scores

In order to differentiate between sustainable and unsustainable companies in our study, we use ESG scores. This is an objective measurement of a given firm with respect to Environmental, Social and Governance topics (Miller, 2022). These scores are determined by rating platforms by calculating a weighting for each measurement criterion (Miller, 2022). Thereafter, an assessment of a firm's performance against each criterion will be made. Lastly, a firm's final ESG score is often a sum-product of the criteria ratings and the belonging criteria weightings, (Miller, 2022).

In addition, more and more management teams at public companies are being required (by parties such as government bodies and stock markets) to bring forth ESG disclosure along with their quarterly and annual reporting, Miller asserts. The ESG scores will subsequently be reviewed by stakeholders and rating agencies in order to produce ESG scores (Miller, 2022). These ESG scores and ESG rating agencies help bridge the gap between a company's disclosures and the general public, (Miller, 2022).

2.1.2 EMH: The Efficient Market Hypothesis

In our event study we make the assumption of market rationality, which entails that the impact of an event will be instantaneously incorporated in prices, according to MacKinlay (1997). This is in accordance with the Efficient Market Hypothesis (EMH), where market efficiency refers to how well available information is incorporated into prices (Downey, 2022).

EMH argues that markets are efficient, meaning that excess profits cannot be made due to all prices already being accurately priced, Downey continues. This concludes that strategies such as expert stock selection or market timing, with the intention of outperforming the overall

market, is unachievable with the EMH, other than putting more money into higher-risk investments (Downey, 2022).

Additionally, the EMH can be categorized by level of market efficiency in the following ways: strong efficiency (all public and private information in a market is reflected in a stock's price.), semi-strong efficiency (only all public information is reflected in a stock's price.), weak efficiency (all the past prices of a stock are accounted for in the current stock price.), and inefficient markets (where the prices of an asset does not reflect its true value), according to Downey. Our study assumes semi-strong efficiency.

2.2 Previous research

In the paper “Stock Price Reactions to the Paris Climate Agreement”, Chen, Huang, and Sirianni (2021) study the short-run as well as the long-run reaction of the American stock market to the Paris agreement by examining, through an event study around the signation period of the agreement, the connection between a firm’s ESG and their returns. They find that firms with a high ESG score had a lower or negative and significant cumulative abnormal return in their event window of five days, but a year later these firms experienced on the contrary positive and significant cumulative abnormal returns.

In another study, conducted by Diaz-Rainey, Gehricke, Roberts, and Zhang (2021), they examine how the oil and gas industry in the U.S. is affected by climate risk by analyzing the impact of following events on the stock market and option implied volatility: the Paris agreement, the election of Donald Trump, and U.S.’ withdrawal of the Paris agreement. Diaz-Rainey et al. (2021) find that the signing of the Paris agreement led to statistically significant negative abnormal returns for the oil and gas sector, and a rise in the implied volatility, i.e. this event had a negative impact on the oil and gas industry. They also claim that generally the impact was even larger on firms that had its focus in the United States. When it comes to the other events, the authors did not expect, but found that the events had a negative impact on the sector as well, which they suggest is due to the fact that Trump supports domestic production, and that different actors in the U.S. were still making efforts for the climate. On the other side, these two events decreased the expected volatility of the oil and gas industry from the

options markets. Lastly, the authors conclude that policies related to climate risk are being priced by the investors.

A study made by Pham, Nguyen, Ramiah, Saleem & Moosa (2019) analyzed the effects of the Paris agreement on the German stock market. They found that the policy is reaching its goals in the short run as they found evidence that the announcements associated with the Paris agreement, had a negative impact on polluting industries (basic resources, chemicals and industrial) as these industries encountered negative abnormal returns. Additionally, they found signs of market anticipation and delayed reactions within a five-day window in their event study.

A study by Borghesi, Castellini, Comincioli, Donadelli, Gufler and Vergalli (2022) on the impact of green policy-related announcements (GPAs) on green and brown (less sustainable) portfolios, showed positive cumulative abnormal returns (CARs) in both the green and brown sectors, where the green sector experienced a stronger effect. However, Borghesi et al. (2022) labels the effect on the brown portfolios "a positive short-run spillover effect".The GPAs' effect on both sector and country level was also studied. At sector level their findings consisted of positive and significant CARs in the following sectors; energy, financial aid and industrial sectors. Whereas at the country level it was found that Switzerland, Spain, UK, Ireland and Italy were the European countries where GPAs had significant positive sentiment effects. Their analysis at sector and country level confirms that sustainable portfolios especially benefit from the GPAs.

A study made by Monasterolo and de Angelis (2020) empirically analyzed low-carbon and carbon-intensive indices in the stock markets of EU, US and global markets with respect to before and after the Paris agreement. Their purpose was to find out the impact of climate announcements on low-carbon and carbon-intensive assets. Their main findings was that the performance of the low-carbon indices had increased after the Paris agreement as they observed a reduction in the indices' risk level. Moreover, they found a decrease to almost zero in the correlation between low-carbon and carbon-intensive indices after the Paris agreement, and that there was a consistent decrease of the systematic risk of the low-carbon indices, whereas the carbon-intensive indices had a rather mild stock market reaction. They also found that optimal portfolios that included low-carbon indices tend to increase in weight after the Paris agreement's entry. From this, they concluded that low-carbon assets have become less risky and thus more

attractive to investors after the Paris agreement, however carbon-intensive assets have yet to become penalized.

In summary, some of the previous research shows somewhat contradictory results. Some of the studies demonstrated negative CARs for both sustainable and unsustainable firms or industries, in contrast to other research which showed the opposite; positive CARs after the Paris agreement or other green policy-related announcements. The reason for this contradiction might be due to the fact that the previous research which demonstrated positive CARs studied the effects of green-policy-related announcements (broader), whereas some of the ones who portrayed negative CARs mainly focused on the signing of the Paris agreement (narrower).

This thesis differs from and contributes to previous research with the aspect of a detailed focus on the Swedish stock market. Besides our study in the difference between the impact of the Paris agreement on sustainable firms against the unsustainable firms, another perspective of investigating performance differences between sustainable firms and a market index was added. Furthermore, the events chosen were Global, American and European, which examined how a stock market from a smaller economy such as Sweden, would react to happenings from different geographical regions.

2.2.1 Table of key findings of previous research for overview

Table 1 is a summary of the previous research.

Table 1: Overview of previous research

Authors	Geographical area	Findings	Explanation
1. Stock price reactions Chen, Huang, and Sirianni (2021)	U.S.	Sustainable firms: lower or negative significant CAR during the event window for the signing of PA, but positive significant CAR after a year	Investors might believe that these sustainable firms will invest even more resources after the agreement, which yields higher costs. Although in the long run, these sustainable firms have better conditions to adapt to the new environmental regulations.
2. Trump vs Paris Diaz-Rainey, Gehricke, Roberts, and Zhang (2021)	U.S.	Signing of PA led to significant negative AR for the oil and gas sector. Bigger impact on firms with focus in the US. Trump's withdrawal from PA showed a negative impact on the sector as well. Policies related to climate risk are being priced by the investors.	For the lax events, the negative impact on the unsustainable (oil/gas) sector could be explained by the fact that they were still making efforts for the climate.
3. Effects on the German stock market Pham, Nguyen, Ramiah, Saleem & Moosa (2019)	Germany	Announcements associated with PA resulted in negative AR for polluting industries.	-
4. Green policy announcements Borghesi, Castellini, Comincioli, Donadelli, Gufler & Vergalli (2022)	Global	Green policy-related announcements resulted in positive CARs for both the green and brown sectors.	The positive impact on the brown portfolios was explained by "a positive short-run spillover effect".
5. Carbon indices Monasterolo & de Angelis (2020)	EU, US and global	After PA, the performance of the low-carbon indices had increased, the systematic risk of it had decreased, and portfolio weight of it also increased. Carbon-intensive indices had a mild stock market reaction.	-

2.3 Formulation of Hypotheses

2.3.1 Hypothesis 1

The first hypothesis is that the Paris agreement (PA) does have a statistically significant impact on firms that are in the top, respectively bottom, regarding the environmental aspect, when observing the measure of abnormal returns. For the top firms, we expect a positive return for events that are beneficiary for PA, in contrast to the bottom firms where a negative return is expected, and vice versa for events that are lax in relation to PA.

Hypothesis 1 is formulated due to the fact that the findings in previous studies showed that the Paris agreement actually had a significant impact on the green (sustainable) sectors as well as the brown (unsustainable) sectors. Most of the studies also had a result of the brown sectors getting negatively affected by the Paris agreement. Furthermore, the Paris agreement regulates the environmental aspect in a stricter manner; which would, in a logical sense, affect the unsustainable firms in a negative way.

2.3.2 Hypothesis 2

The second hypothesis is that there is a significant *difference* between the impact of the Paris agreement on the top 50 sustainable firms and the bottom 50 unsustainable firms.

For hypothesis 2, it falls natural that the impact of the Paris agreement on sustainable and unsustainable firms are different; since the treaty encourages sustainable behaviors and inhibits unsustainable practices.

2.3.3 Hypothesis 3

The third hypothesis is that the sustainable firms outperforms the market index, with respect to our selected events after the signing of the Paris agreement, when observing the measure of average returns.

EMH tells us that no investor should be able to beat the market, however contradictory evidence exists, as there are many instances where investors have consistently beaten the market in practice (Dhir, 2022). Furthermore, since the market index is broad, there exists diversification gains. Consequently, this also indicates that the market index then must include both green and

brown stocks. Subsequently, if hypothesis 1 holds, the sustainable firms will yield a positive abnormal return after the events related to the Paris agreement, in contrast to the unsustainable firms that will have a negative abnormal return. This in turn implies a probability of sustainable firms performing better than the market, in accordance with our third hypothesis.

Table 2: Table of hypotheses in terms of null hypothesis and alternative hypothesis.

	Hypothesis 1	**Hypothesis 2**	**Hypothesis 3**
Null hypothesis	H_0: $\mu_{top} = 0$ H_0: $\mu_{bottom} = 0$	H_0: $\mu_{top} = \mu_{bottom}$	H_0: $\mu_{top} = \mu_{market}$
Alternative hypothesis	H_A: $\mu_{top} \neq 0$ H_A: $\mu_{bottom} \neq 0$	H_A: $\mu_{top} \neq \mu_{bottom}$	H_A: $\mu_{top} > \mu_{market}$

3. Methodology and Data

This section presents the research method, the collection and selection of data, and the event study methodology.

3.1 Research method

This thesis builds upon previous research regarding the Paris agreement, however with an unique aspect focusing on the geographical region Sweden, rather than globally or the entirety of Europe. An event study was conducted to make a comparison between sustainable and non-sustainable companies and its reactions to the Paris agreement. Additionally, with respect to the Paris agreement, a comparison of Swedish sustainable firms to a benchmark (OMXS30) is conducted.

3.2 Data collection and selection

3.2.1 ESG: Environmental, Social and Governance Scores from Refinitiv

In our event study the Refinitiv ESG scores of Swedish companies are used to differentiate sustainable from non-sustainable companies. ESG is short for Environmental, Social and Governance and the Refinitiv ESG scores measure a company's relative ESG performance, commitment and effectiveness across 10 categories (emissions, environmental production innovation, human rights, shareholders, etc.) based on publicly verifiable reported information (Refinitiv, 2022). These 10 main themes thus form the three pillar scores - environmental, social and corporate governance, in which the final ESG score is created from (Refinitiv, 2022). For our event study we are interested in the environmental pillar (including the themes: resource use, emissions and innovation), thus we excluded the social pillar and the governance pillar and only included the environmental pillar. Figure 1 shows the three pillars and its underlying 10 main themes.

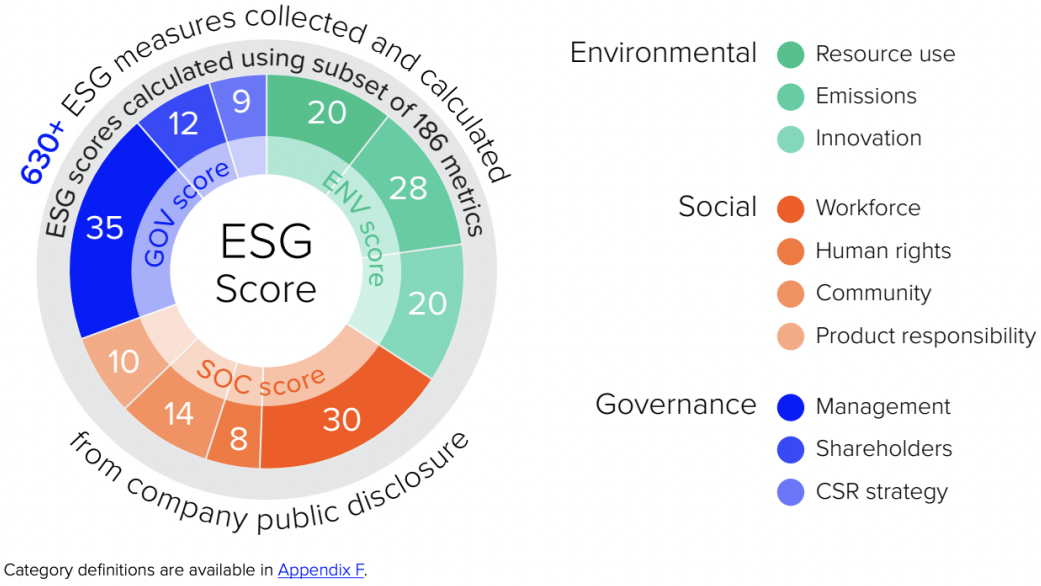


Figure 1: The ESG score divided into 10 categories of the three pillar scores (Refinitiv, 2022).

Moreover, each company is given an ESG score ranging from 1 to 100. A high ESG score indicates excellent relative ESG performance and a high degree of transparency in publicly reporting ESG data, whilst a low ESG score in contrast shows poor relative ESG performance and an insufficient degree of transparency in ESG reporting (Refinitiv, 2022). Table 3 shows Refinitiv's ESG score range.

Table 3: The Refinitiv ESG score range (Refinitiv, n.d.).

Score range	Description	
0 to 25	First Quartile	Scores within this range indicates poor relative ESG performance and insufficient degree of transparency in reporting material ESG data publicly.
> 25 to 50	Second Quartile	Scores within this range indicates satisfactory relative ESG performance and moderate degree of transparency in reporting material ESG data publicly.
> 50 to 75	Third Quartile	Scores within this range indicates good relative ESG performance and above average degree of transparency in reporting material ESG data publicly.
> 75 to 100	Fourth Quartile	Score within this range indicates excellent relative ESG performance and high degree of transparency in reporting material ESG data publicly.

The scores calculation methodology of Refinitiv can be described according to three steps: (1) ESG category scores, (2) Materiality matrix and (3) Overall ESG score calculation and pillar score (Refinitiv, 2022).

The first step involves the treatment of underlying data points and Refinitiv divides them into boolean and numeric data. For the boolean data, if the answer to a question is “Yes” it is equal to 1 and for “No” the system assigns the value of 0. Likewise, when there is no relevant data to be found in the public disclosure of companies, the answer is “Null” and a value of 0 is also assigned. Furthermore, each measure has a polarity (a higher value could be “better” or “worse”); which Refinitiv gives as an example where on one hand, the possession of an emissions reduction policy is positive, whilst on the other hand, being involved in environmental controversies is negative. Considering the polarity of the data point, the boolean data points are converted to numeric values. Regarding the numeric data, Refinitiv states that a relative percentile ranking is only applied, if a numeric data point is reported by a firm, while all the companies in the same industry group also report that respective data point.

For the 10 category scores calculation methodology a percentile rank scoring methodology is used and it is based on three factors: (1) the amount of companies that are worse than the current one, (2) the amount of companies that have the same value and (3) the amount of

companies that even have a value at all. Since the percentile rank score is based on rank, hence the score is less sensitive to outliers. Equation 1 is used for calculation of the percentile rank score (Refinitiv, 2022):

$$score = \frac{no.\ of\ companies\ with\ a\ worse\ value + \frac{no.\ of\ companies\ with\ the\ same\ value\ included\ in\ the\ current\ one}{2}}{no.\ of\ companies\ with\ a\ value} \quad (1)$$

The second step includes Refinitiv's model, the Materiality matrix, applied at category level. The magnitude values of their magnitude matrix are automatically and dynamically adjusted to keep up to date as ESG corporate disclosures change, Refinitiv highlights. The category weights are calculated in order to determine the relative importance of each of the themes for each industry group (Refinitiv, 2022). Thereafter, taking into account the themes in each category, the data points with sufficient disclosure are used. Additionally, Refinitiv uses the relationship of one data point per theme. For some of the themes, however, there are no data points that can be used as meaningful proxies and thus are excluded in the scoring methodology in order to create the materiality matrix, Refinitiv states.

Refinitiv highlights in their category weight calculation that the weights are normalized to percentages ranging between 0 and 100. For the categories that consist of more than one theme and respective data point, Refinitiv takes the average of each data point per industry group in order to calculate the weight at category level.

Refinitiv uses two methods for the calculation of the magnitude matrix, one for numeric data points, which is called "Industry Median", and one for boolean data points, called "Transparency Weights". The methods are used as a proxy of magnitude regarding the environmental and social pillars.

The Industry Median method, uses numeric data points with environmental and social impact, where the materiality weighting is based on the relative proportion of contribution a certain sector imposes, Refinitiv points out. The materiality weight i.e. the relative weight is determined by the relative median value for a company in the industry group in question. The relative median values in each industry group for that specific data point are then compared and ranks are assigned. The ranking determines the relative weight assigned to that data point in determining the industry weight from 1 to 10.

The second method, the Transparency Weights, is primarily used for boolean data points, i.e. measures with values such as "Yes" or "No". These magnitude weights base their value on a company's level of disclosure of each data point in a given industry group, i.e. the relative weight is based on disclosure of relative level in that specific industry group. Afterwards, the disclosure percentage of each industry group for each data point is calculated in order to assign a ranking. A decile rank (1 to 10) is also used in this method and determines the relative weight for that data point in order to determine the industry weight.

Now that the magnitude matrix is calculated, the category weight can thus be calculated (Refinitiv, 2022). Firstly, we take the sum of the magnitude weights of the 10 categories for each respective industry group. After that, to derive the category weight, every one of each category's magnitude weight is then divided by the sum of the magnitude weights of the respective industry, in accordance with equation 2 (Refinitiv, 2022):

$$Category\ weight\ of\ an\ industry\ group = \frac{Magnitude\ weight\ of\ a\ category}{Sum\ of\ magnitudes\ of\ all\ categories} \qquad (2)$$

In summary, the steps in the calculation of category weights for the environmental and social pillars are data points that act as a good proxy for assessing industry impact across environmental and social subjects and are used for calculating the magnitude matrix. Additionally, Industry medians per data point, per industry group, are then calculated and a relative median is derived. The relative median is equal to the median value of an industry group, divided by the sum of the medians of all industry groups for the respective data point, as seen in equation 3 (Refinitiv, 2022):

$$relative\ median = \frac{Median\ value\ of\ an\ industry\ group}{Sum\ of\ medians\ of\ all\ industry\ groups} \qquad (3)$$

Finally, the third step is about the overall ESG score calculation and pillar score. Refinitiv calculated the overall pillar and ESG score by applying the category weights per industry using a data-driven and objective logic (Refinitiv, 2022). More exactly, the ESG scores are aggregated based on the 10 category weights that have been calculated with the help of the Refinitiv magnitude matrix. For a more in-depth calculation, kindly refer to Refinitiv's website. As for the

calculation of the ESG pillar scores, the method is to take the relative sum of the category weights, according to Refinitiv.

3.2.2 Selection of top 50 and bottom 50 of Swedish companies ranked by their Environmental pillar score

The analysis was based on companies on the Swedish stock market where the 50 top-performing companies in terms of their level of sustainability were selected, as well as the bottom 50. Furthermore, the ranking of the companies were obtained from Refinitiv Eikons database, filtered by country and ranked by the firms' environmental pillar score (E-score), where a high E-score indicated a firm to be more sustainable and vice versa for a low E-score.

Furthermore, during the selection of the companies for our analysis, we also filtered the firms based on three aspects in order to get more meaningful findings. One of which was to check whether these companies had existing stock prices available for all the event windows and estimation periods. Another aspect that was taken into consideration was whether these companies had any emerging firm-specific events or price-sensitive information that would affect their stock prices during the periods of the event windows. A third aspect was whether the companies even existed during any of the periods of event windows and estimation windows (due to e.g. being a newly introduced firm or a firm which has undergone bankruptcy), were also removed from the selection. Consequently, this led to the removal of several companies, which in turn resulted in a final company selection, where the firm with the lowest ESG score amongst the top 50 firms and the firm with highest ESG score amongst the bottom 50 firms, almost coincided, which will be discussed later on in section 4. Kindly refer to Appendix, table 8 and table 9, for the lists of firms in our event study.

Another caveat is that of Refinitiv's rating, since firms such as SAS, Saab and Volvo have relatively high E-scores. This could be problematic as they are not really considered to be very environmentally friendly in consideration to their sector being in the car and flight industry, which is very carbon-emission-heavy. By including such firms in our selection of sustainable firms, the results might become warped.

3.2.3 Market index OMXS30

As for the comparative benchmark selected was the stock market index OMX Stockholm 30 (OMXS30), which is a market-value-weighted index of the 30 most traded stocks on the Nasdaq Stockholm stock exchange (Nasdaq, 2022). This was selected as we are analyzing the Swedish stock market as our geographical region.

3.3 Event study

3.3.1 Event study methodology

An event study was conducted in order to measure the impact on a firm's value of a particular event due to the fact that, with assumed market rationality, the effects of an event will be instantly incorporated in the prices, according to MacKinlay (1997). Consequently, this is in line with this thesis of looking at the effect of the Paris agreement on the Swedish stock market.

MacKinlay (1997) describes that an event study can be conducted by firstly defining the event and the proprietary event window. The event window contains the period of the event, but can be extended to a longer period if it is of interest to capture those effects, according to MacKinlay (1997). For instance, if looking at specific announcements as the event, as this thesis is, then the event window holds the announcement day, and it could also expand to the day after if the announcement was made after the stock market closed. In addition, even the period prior to the announcement could be included considering the possibility of the market obtaining information before the actual announcement (MacKinlay, 1997).

Moreover, MacKinlay (1997) emphasizes that the measure of the abnormal return is needed to evaluate the impact of an event. The abnormal return is defined as the difference between the security's actual ex post return and the normal return, both over the event window. The formula is:

$$AR_{i\tau} = R_{i\tau} - E(R_{i\tau} | X_{\tau}) \qquad (4)$$

τ = time period

$AR_{i\tau}$ = abnormal return

$R_{i\tau}$ = actual return

$E(R_{i\tau}|X_{\tau})$ = normal return

X_{τ} = the conditioning information

The normal return is in turn the expected return without the condition of the event occurring, and there are several models to calculate this. The one that will be used in this thesis is CAPM, which is an equilibrium theory to get the expected return of an asset by proceeding from the risk-free rate and the covariance between the market portfolio and the asset (Bodie, Kane, & Marcus, 2021). The formula is:

$$E(r_i) = r_f + \beta_i[E(r_M) - r_f] \qquad (5)$$

where $\beta_i = \frac{\sigma_{iM}}{\sigma_M^2}$ and $\sigma_{iM} = \frac{1}{n-1}\sum_t (r_{it} - \bar{r}_i)(r_{Mt} - \bar{r}_M)$

According to Bodie et. al. (2021), the risk-free rate is the rate earned in risk-free assets. The interest rates of the Swedish 10-year treasury bonds are used to calculate the risk-free rate, since they are considered closest to being risk-free and this paper is analyzing the Swedish stock market. These interest rates are collected from the website of the Swedish Central Bank, and in the form of yearly rates for each day. In order to calculate the risk-free rate, to be used in the calculation for normal return, the rates were divided by 365 to get it on a daily basis, and thereafter the proprietary 120 rates for the period were summarized.

Next, is defining the estimation window after choosing the normal performance model, says MacKinlay (1997). Usually, the period prior to the event window (i.e. the event period itself is excluded) is used if it is practicable (MacKinlay, 1997).

Furthermore, MacKinlay (1997) claims that the testing framework for the abnormal returns needs to be constructed; which contains the null hypothesis and how to aggregate the individual abnormal returns. Normally, the null hypothesis is that the (cumulative) abnormal returns are equal to zero, which implies that the event has no impact on the returns, i.e. what will be tested is whether the abnormal return is significantly different from zero. If the (cumulative) abnormal return is statistically significant, i.e. large, the null hypothesis will be rejected. Note that whether it is or not, also depends on the level of significance, which is the probability of rejecting a true null hypothesis. The power of the test should be considered as well, which is the

probability that a false null hypothesis actually gets rejected. It is essential to have a large sample size when the abnormal return is small in order to attain high power (MacKinlay, 1997).

3.3.2 Event and event windows

There are three events chosen for the event study, which are the following: the signing of the Paris agreement (2016-04-22), Donald Trump's withdrawal from the Paris agreement (2017-06-01), and when the EU released their climate plan (2021-07-14), as seen in table 4. Furthermore, the event window consists of five days, which includes the event date, the two days prior to the event, and also the two days after the event. This is motivated by the assumption that there will be an expectation from the market for these events, and also in order to pick up underreactions since the market can be slow to incorporate news into the prices.

Table 4: The events and its belonging event dates and event window, portrayed in table format.

Event	**Event Date**	**Event Window**
Event 1: Signing of the Paris agreement	April 22nd 2016	20/4-26/4
Event 2: Trump withdraws from Paris agreement	June 1st 2017	30/5-5/6
Event 3: EU climate plan	July 14th 2021	12/7-16/7

The events chosen associated with the Paris agreement, vary in tighter or more lax connection to the treaty. The first event is the signing of the Paris agreement on April 22nd 2016 and is considered to have a tight relation to the treaty. Moreover, a record number of 155 countries had declared their intention of signing the Paris agreement on 22 April at the United Nations headquarters, on Mother Earth Day, according to UNFCCC (2016). This special day is said to be a landmark in international law, due to the fact that the number of signatories of the Paris agreement would surpass the former record (the Law of the Sea in Montego Bay 1982) of 119 signatures for an opening day of an international treaty (UNFCCC, 2016). Furthermore, semi-strong efficiency is assumed, which implies that all public information is reflected in a stock's price. When it comes to this event, it can be argued that the event is unanticipated by the market, because it is untold who will follow through with their words and sign the treaty as

intended, since the Paris agreement was open to sign from 22nd of April 2016 and onwards for a year.

The second event is Donald Trump's withdrawal from the Paris agreement on June 1st 2017, which is considered to have a more lax association to the treaty. On this day, the U.S. President Donald Trump officially announced to the public that the United States would withdraw from the Paris agreement (Shear, 2017), with the reasoning that the Paris agreement would pose a threat to the American economy and sovereignty. The U.S. withdrawal is a major blow to the parties of the treaty as the U.S is the second-largest polluter of the Earth (Shear, 2017). Also, the U.S played a huge role in forming the Paris agreement and leading the climate work (Honkatukia, 2021, as cited by Dönsberg (2021)). Regarding our assumption of semi-strong efficiency, our second event is unanticipated, because it is not officially known to the public before his announcement, as this came suddenly and shockingly. This is because the U.S. has played a major role in the advancement of the Paris agreement's existence and where a record-holding number of participating countries of 194 parties have signed. The U.S.' withdrawal from such a global sustainability treaty would likely cause tension and rupture between countries, or lead to other parties losing hope to achieve the climate goals. Some parties might start to believe it to be unfair and boycott the treaty.

The third event is the release of EU's climate plan on July 14th 2021, and is considered to have a tighter connection to the treaty. This plan was the EU's most ambitious plan unveiled yet, to combat climate change where the abstract green goals were transformed into a concrete action plan (Abnett, 2021). Their plan "Fit for 55" aims to achieve a 55% decrease in net greenhouse gas emission by 2030, measuring from year 1990 levels, which is part of their goal of "net zero" emissions by 2050 (Abnett, 2021). Although the EU only produces 8% of global emissions, the EU hopes to set an example to inspire other big economies of the world (Abnett, 2021). Some of the measures in the climate plan were raising the cost of carbon emissions exhausted for heating, transport and manufacturing (Abnett, 2021). Another measure was taxation of high-carbon aviation fuel and shipping fuel that have not been imposed by a tax previously (Abnett, 2021). Additionally, one measure is to have importers at the border to pay a fee for their carbon emissions during production abroad of products e.g. cement, steel and aluminum (Abnett, 2021). In regard to the assumption of semi-strong efficiency, our third event is unanticipated because the regulations were unknown before the release date, which is our chosen event date.

3.3.3 Estimation windows

The estimation window that is chosen for the calculation of the normal return is 120 days, since according to MacKinlay (1997) the interval should be large enough to show the normal return and simultaneously be relevant. Also, a period of 120 days was used as an example by him. Furthermore, MacKinlay (1997) says that the estimation window and the event window should not overlap, because the normal return should not get affected by the event. Therefore, when choosing the 120 days, a few days of margin was also taken into consideration. In this study, the margin is determined to be five trading days, which means the estimation window starts 125 trading days prior to the event window and ends five days before.

3.3.4 Computation of Abnormal Return (AR) and Average Abnormal Return (AAR)

The average abnormal return is calculated by adding the abnormal returns of each event and then dividing it by the amount of events, according to formula 6 (MacKinlay, 1997).

$$\overline{AR}_{\tau} = \frac{1}{N}\sum_{i=1}^{N} AR_{i\tau} \qquad (6)$$

3.3.5 Computation of Cumulative Abnormal Return (CAR) and Cumulative Average Abnormal Return (CAAR)

The cumulative abnormal return is the sum of an event's abnormal returns, according to formula 7 (MacKinlay, 1997).

$$CAR_i(\tau_1, \tau_2) = \sum_{\tau=\tau_1}^{\tau_2} AR_{i\tau} \qquad (7)$$

The average cumulative abnormal return is calculated by aggregating the CAR over the different securities and then dividing by the amount (N) of securities, according to formula 8 (MacKinlay, 1997).

$$\overline{CAR}(\tau_1, \tau_2) = \frac{1}{N}\sum_{i=1}^{N} CAR_i(\tau_1, \tau_2) \qquad (8)$$

3.3.6 Computation of residual variance and variance

The residual variance is calculated by first squaring the difference between the return of each day in the estimation window and normal return (i.e. the abnormal return), then adding each day's squared abnormal return and finally dividing by the length of the estimation window minus two (MacKinlay, 1997). The formula is:

$$\widehat{\sigma}^2_{\varepsilon_i} = \frac{1}{L_1 - 2}\sum_{\tau=T_0+1}^{T_1} (R_{i\tau} - \ r_f \ - \widehat{\beta}_i[E(r_{M\tau}) - r_f])^2 \qquad (9)$$

The variance of the average abnormal return is the sum of the three events' residual variances, divided by the square of the amount of events, according to formula 10 (MacKinlay, 1997).

$$var(\overline{AR}_\tau) = \frac{1}{N^2}\sum_{i=1}^{N} \sigma^2_{\varepsilon_i} \qquad (10)$$

The variance of the average cumulative abnormal return is the sum of the variance of average abnormal return across the firms, according to formula 11 (MacKinlay, 1997).

$$var(\overline{CAR}(\tau_1, \tau_2)) = \sum_{\tau=\tau_1}^{\tau_2} var(\overline{AR}_\tau) \qquad (11)$$

3.3.7 Computation of significance

The null hypothesis can be tested by getting a statistic by dividing the average cumulative abnormal return with the standard deviation of the average cumulative abnormal return, according to formula 12 (MacKinlay, 1997).

$$\theta_1 = \frac{\overline{CAR}(\tau_1,\tau_2)}{var(\overline{CAR}(\tau_1,\tau_2))^{1/2}} \qquad (12)$$

3.3.8 Two sample t-test

Also, a two-sample T-test was conducted to compare the abnormal returns of the firms with top E-score and the abnormal returns of the firms with low E-score, according to formula 13 (Thakur, n.d.). More specifically, if there is a significant difference between them.

$$t = \frac{\overline{CAR}_{Top\ E-score} - \overline{CAR}_{Bottom\ E-score}}{\sqrt{\frac{var(\overline{CAR})_{Top\ E-score}}{N_{Top\ E-score}} + \frac{var(\overline{CAR})_{Bottom\ E-score}}{N_{Bottom\ E-score}}}} \qquad (13)$$

4. Results, analysis & discussion

This section provides the tables of results from the event study, followed by the results of the tests. Thereafter, an analysis and discussion of these results is presented.

4.1 Hypothesis 1

As mentioned previously in section 2.3 our first hypothesis is that the Paris agreement does have a statistically significant impact on firms that are in the top, respectively bottom, in regards to the environmental aspect.

However, from our event study we found that the cumulative average abnormal returns for each of the events for both the top 50 firms and bottom 50 firms are not significantly different from zero when testing with a significance level of 5%, which implies that the impact of the Paris agreement is not significant.

Table 5 below shows the empirical results of the event study, where the Cumulative Average Abnormal Return (CAAR) was calculated for the selected firms, categorized by sustainable and unsustainable firms.

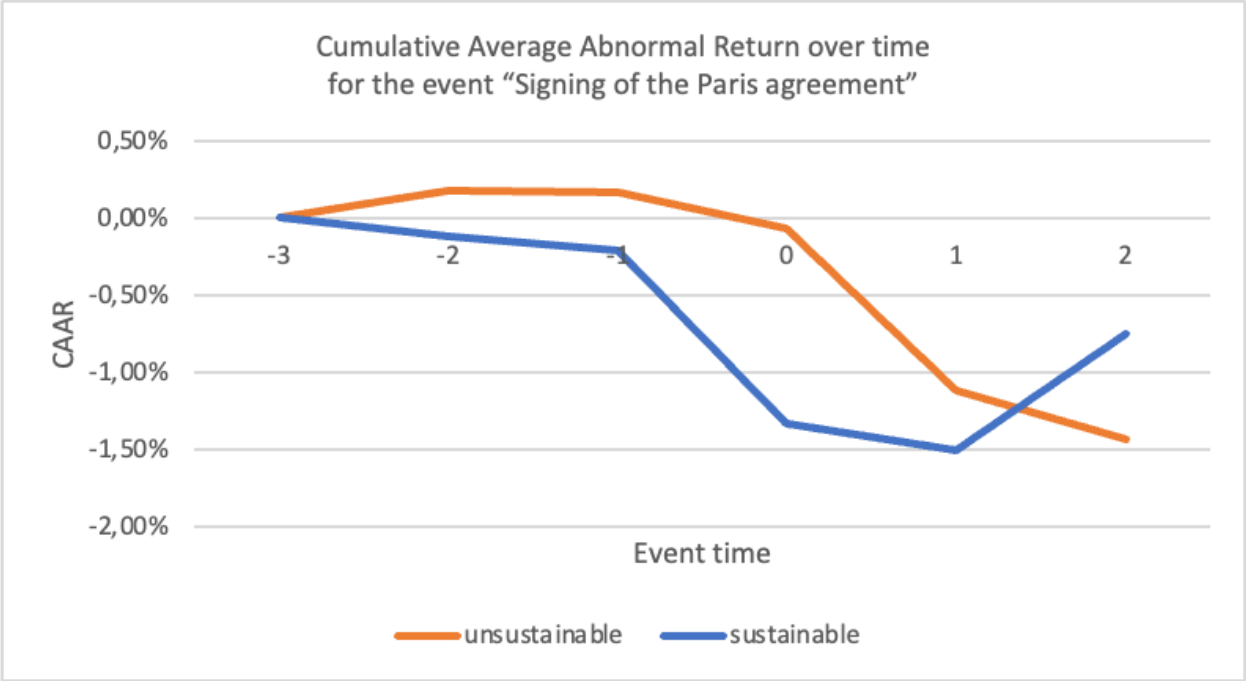
Table 5: Table of results for hypothesis 1. This table presents the CAR and t-statistics for the different events, grouped by sustainable and unsustainable firms. The t-test is used to test whether the events have a significant impact on each category of firms (sustainable and unsustainable). Statistical significance at the 5% level is indicated by *. The event time consists of [t], which is the event date, and [t-2] to [t+2] comprises the event window. All of the values are rounded to four decimal figures.

Hypothesis 1		
Top 50 sustainable firms	**CAAR over the securities**	**t-statistic**
Event 1: Signing of PA (tight)	-0.0076	-1.1613
Event 2: Trump's withdrawal (lax)	0.0056	1.2126
Event 3: EU climate plan (tight)	0.0091	1.5823
Bottom 50 unsustainable firms	**CAAR over the securities**	**t-statistic**
Event 1: Signing of PA (tight)	-0.0146	-1.1765
Event 2: Trump's withdrawal (lax)	0.0106	0.9389
Event 3: EU climate plan (tight)	-0.0038	-0.1389

For event 1, we found that the signing of the Paris agreement gave insignificant negative CAAR for both categories, where the CAAR of the unsustainable firms were more negative than the sustainable ones. The finding of negative CAAR regardless of the firms' level of sustainability is in line with some of the previous research in section 2.2 (see table 1, row 1, 2, 3, in section 2.2.1). However, the negative CAAR that was found is insignificant, which means that our result cannot prove whether the signing of the Paris agreement had a negative impact or any impact at all on the firms. Nevertheless, there are some contradictions in the previous research (see table 1, row 4, in section 2.2.1), where they found that green policy-related announcements resulted in positive CAARs for both sustainable and unsustainable sectors. Due to the contradicting result of previous research, our result is not surprising.

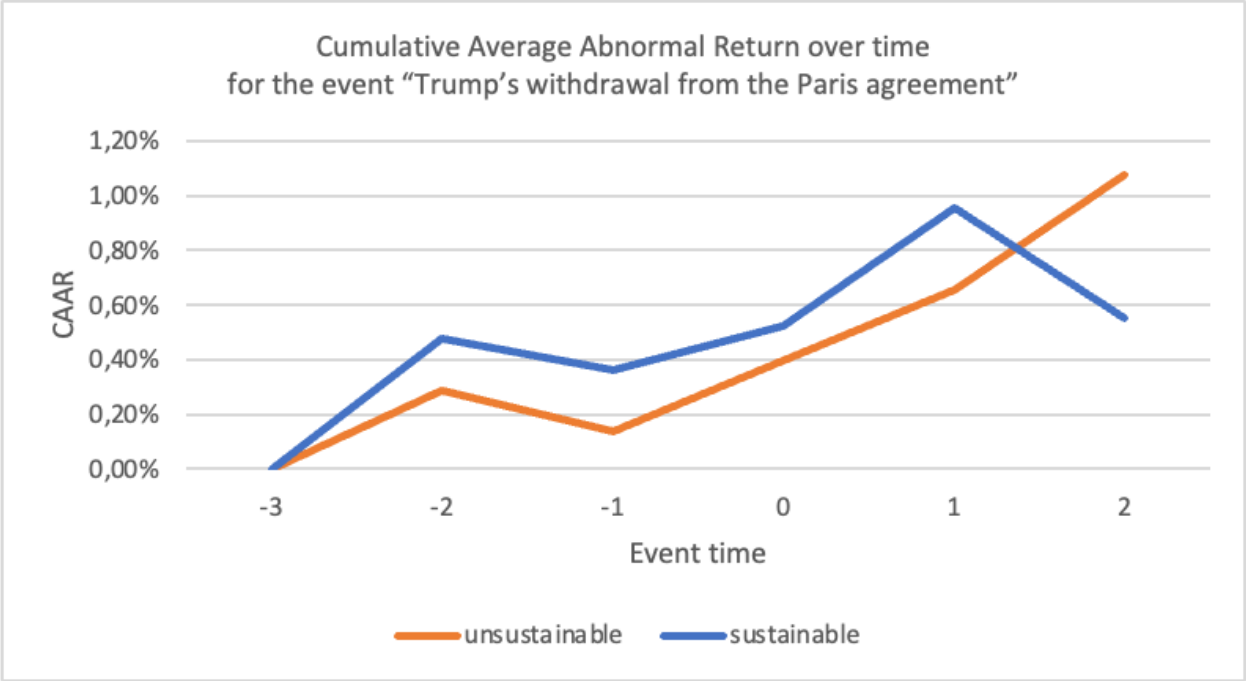
For event 2, Trump's withdrawal of the Paris agreement does neither have a significant impact on the firms, which could be due to the fact that this event is an American announcement and might not affect the Swedish stock market to a significant extent. Nonetheless, we expected a significant impact since the U.S. is such a big economy which Sweden has many tradings with, and because the U.S. played a major role in forming the Paris agreement and leading the climate work. Although the CAARs are not significant, it is interesting to see that for both categories, the CAARs are positive, unlike event 1. It is also of interest to note that the CAARs of the unsustainable firms were more positive than that of the sustainable ones for this event. Considering event 1 having characteristics of tightening the environmental regulations, meanwhile event 2 having the opposite characteristics of loosening the regulations, their respective CAARs are acting accordingly. However, since the results are not significant, this is just a reflective analysis.

For event 3, the impact of the treaty is not significant on either the sustainable or unsustainable firms, but the sustainable firms received a positive CAAR and the unsustainable firms had a negative CAAR. This event has, as event 1, the characteristics of tightening the environmental regulation, but unlike event 1, the respective CAARs for each category of firms are in opposite directions. The positive CAARs of the sustainable firms is contradictory to the previous research in the first row in table 1 where negative CAARs were found, but in line with the previous research in row 5, which also found positive CAARs. For the negative CAARs of the unsustainable firms, it is in agreement with the previous research in row 2 and 3 in table 1.



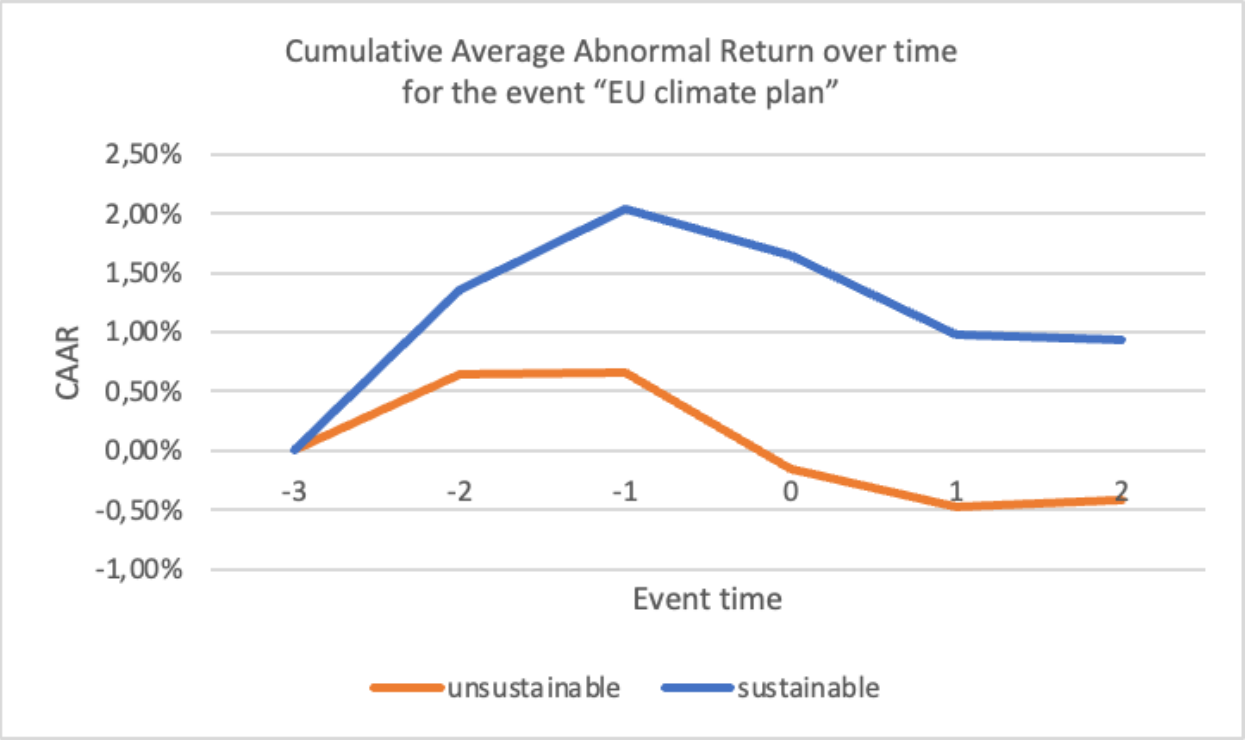
Graph 2: Cumulative Average Abnormal Return over time for the event "Signing of the Paris agreement".

By observation of graph 2, it is seen that the signing of the Paris agreement does have a negative impact on both sustainable and unsustainable firms. For the sustainable firms, the CAAR is already negative and decreasing in the pre-trend, and on the event day (day zero) and the day after, the CAAR becomes even more negative. However, two days after the event, the CAAR is still negative but has increased with an upwards trend. The downward trend has turned, but it could be due to some externalities than the Paris agreement, since the other days that are closer to the event have been showing a negative trend. Furthermore, when it comes to the unsustainable firms, the CAAR is positive before the event has occurred. It is from day -1 that the unsustainable firms start to react negatively with a downward trend and the CAAR continues to become more and more negative for each day.



Graph 3: Cumulative Average Abnormal Return over time for the event "Trump's withdrawal from the Paris agreement".

By studying graph 3 and specifically between day -1 and day 1, it is observed that this laxed event has a positive impact on both sustainable and unsustainable firms, since they have positive CAARs and an upward-going trend. Overall, looking at the entire event window, the firms reacted negatively between day -2 and day -1, and the sustainable firms also reacted negatively after day 1. Although there are a few downward trends, the CAAR still remains positive and the firms reacted positively on the days closest to the event day.



Graph 4: Cumulative Average Abnormal Return over time for the event "EU climate plan".

Observing graph 4 above, we see that both the sustainable and unsustainable firms reacted negatively from day -1 of the event "EU climate plan". This negative reaction might be due to the strict measures suggested in the climate plan of heavy taxes and fees to be imposed in order to tackle climate change. Some of the measures were raising the cost of carbon emissions exhausted for heating, transport and manufacturing, taxation of high-carbon aviation fuel and shipping fuel and imposing a fee for importers at the border for their carbon emissions during production abroad of certain products (Abnett, 2021). However, there is a positive or neutral pre-trend before day -1 for the sustainable and unsustainable firms respectively, which could simply be due to the fact that the CAAR of these days prior to the event, was not affected by the event.

4.2 Hypothesis 2

The second hypothesis is that there exists a significant difference between the impact of the Paris agreement on the top 50 sustainable firms and the bottom 50 unsustainable firms.

This is in accordance with our findings in our event study since the t-test between the cumulative average abnormal return for the top 50 firms and the cumulative average abnormal return for the bottom 50 firms showed that each categories' cumulative average abnormal return is statistically different from each other.

Table 6 below shows the empirical results of the event study, where a comparison between the top and bottom sustainable (or unsustainable) firms for each event separately is conducted to test whether there exists a significant difference between them after the Paris agreement-related events.

Table 6: Table of results for hypothesis 2. This table presents the t-statistics and correlation (calculated by the CORR-function in Excel) for the separate events for both the sustainable and unsustainable firms. The t-test is used to test the differences of the variables between the two categories (sustainable and unsustainable). Statistical significance at the 5% level is indicated by *. The event time consists of [t], which is the event date, and [t-2] to [t+2] comprises the event window. All of the values are rounded to four decimal figures.

Hypothesis 2		
Top 50 sustainable firms & Bottom 50 unsustainable firms **t-test:**	**t-statistic**	
Event 1: Signing of PA (tight)	3.5221*	
Event 2: Trump's withdrawal (lax)	-2.8985*	
Event 3: EU climate plan (tight)	3.2669*	
Correlation:	**Part of event period**	**Event period**
Event 1: Signing of PA (tight)	Day -3 to 1: 0.7515	0.5667
Event 2: Trump's withdrawal (lax)	Day -3 to 1: 0.9749	0.6594
Event 3: EU climate plan (tight)	Day -1 to 2: 0.9230	0.4580

Furthermore, the graphs that can be viewed in section 4.1 can also be used to draw conclusions for the case of hypothesis 2. Observation of graph 2 shows that from the start of the event window to day 1, there is a positive correlation of 0.7515 between the sustainable firms and unsustainable firms as the CAAR is decreasing for both. However, from day 1, the CAARs of the firms in both categories have almost perfect negative correlation, since the CAAR is increasing for the sustainable firms, while it is decreasing for the unsustainable firms. Over the entire event window, the correlation between the CAAR of the sustainable and unsustainable firms is 0.5667. Additionally, it can be observed that on the event day (day zero), there is a difference of more than 1 percentage point in CAAR between sustainable and unsustainable firms.

From graph 3, we can see that there is a positive correlation of 0.9749 between the sustainable and unsustainable firms at the beginning of the event window to day 1, and after that day, there exists a negative correlation of -1 between the two groups. The positive correlation is portrayed by both of the categories of firms reacting positively to Trump's withdrawal from the Paris agreement, meanwhile the negative correlation is shown by the unsustainable firms continuing the positive reaction to the event, in contrast to the sustainable firms starting to react negatively. Furthermore, from day -3 to day 1, the positive CAARs of the sustainable firms are larger than the unsustainable firms'.

From graph 4, we observe that besides day -2 to day -1, there is a positive correlation between the sustainable and unsustainable firms. The correlation from day -1 to day 2 is calculated to 0.9230, which indicates that both categories of firms are highly positively correlated. Also, it is seen that the positive CAARs of the sustainable firms prior to the event day are increasingly larger than that of the unsustainable firms', and that from the event day, the CAARs of the unsustainable firms even turn to negative meanwhile the CAARs of the sustainable firms stay positive.

All in all, a conclusion from the graphs can be drawn that there is mainly a positive correlation between the sustainable and unsustainable firms, and also that there exists a difference in impact of the Paris agreement between the sustainable and unsustainable firms. The result differs from our expectations since we anticipated (see 2.3.1 Hypothesis 1) that the sustainable and unsustainable firms would experience a negative correlation. One potential reason for the differing result could be due to our removal of firms in excess, since several firms

were removed due to firm-specific events that would affect its stock prices. This in turn led to the sustainable firms being closer to the unsustainable firms in terms of E-score, thus making the resulting positive correlation reasonable.

4.3 Hypothesis 3

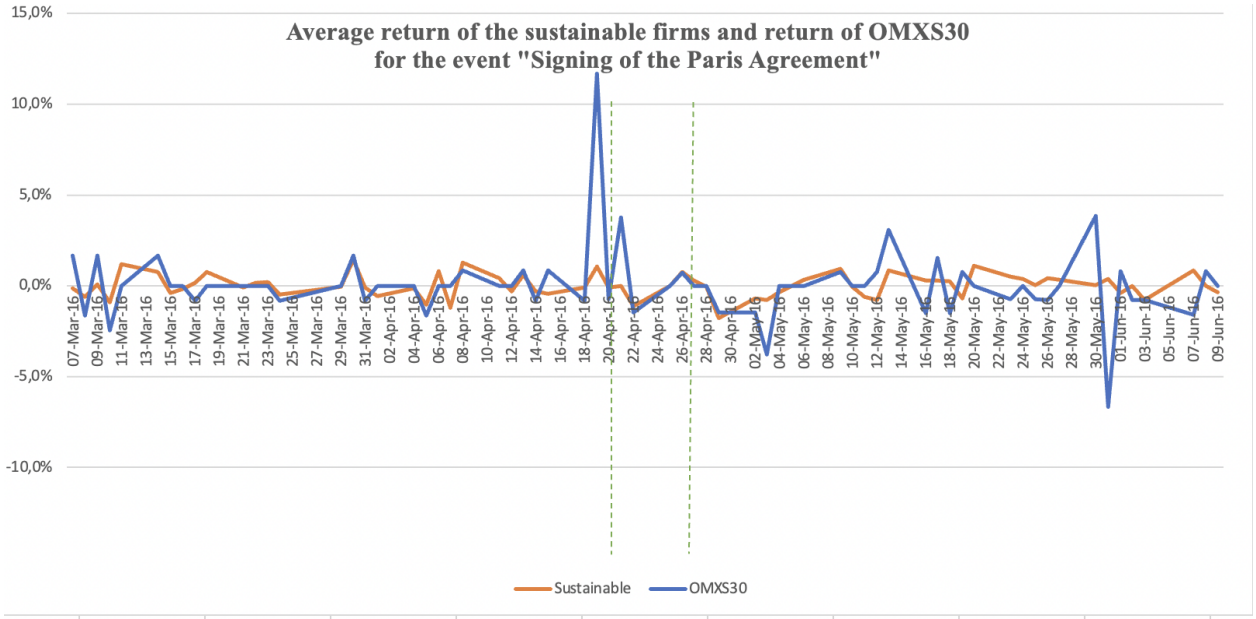
The third hypothesis is that the sustainable firms outperforms the market index after the Paris agreement. However, from our study our results showed that the hypothesis does not hold, since the t-test between the return of the sustainable firms and the return of the market index OMXS30 showed that they are not significantly different from each other. This infers that the sustainable firms do not outperform the market index.

Table 7 below shows the empirical results of the event study, where a comparison between the returns of the sustainable firms and the return of the market index for each event separately, is conducted, to test whether there exists a difference between them after the Paris agreement-related events.

Table 7: Table of results for hypothesis 3. This table presents the t-statistics for the separate events in the case of the comparison between sustainable firms and the market index OMXS30. The t-test is used to test the differences of the variables between the two categories (sustainable firms and OMXS30). Statistical significance at the 5% level is indicated by *. The event time consists of [t], which is the event date, and [t-2] to [t+2] comprises the event window. All of the values are rounded to four decimal figures.

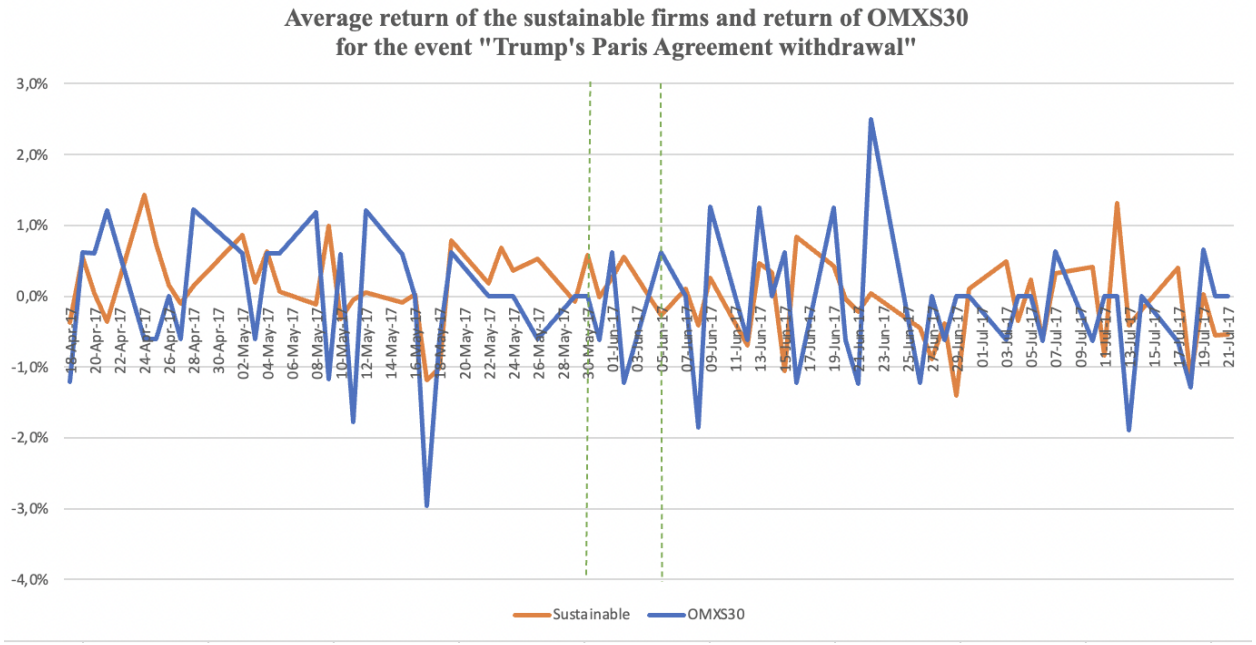
Hypothesis 3	
Sustainable firms and market index	**t-statistic**
Event 1: Signing of PA (tight)	0,5021
Event 2: Trump's withdrawal (lax)	-0,0464
Event 3: EU climate plan (tight)	0,3127

Furthermore, one potential reason that the hypothesis could not be proven, could be due to the fact that it is difficult to beat the market according to the Efficient Market Hypothesis mentioned in section 2.1.2. Another reason could be due to our data selection. During the selection, the removal of several companies, unfortunately resulted in some of our top 50 sustainable firms at the end, to have a lower environmental pillar score than anticipated, which is questionable and will be further discussed in section 4.5.



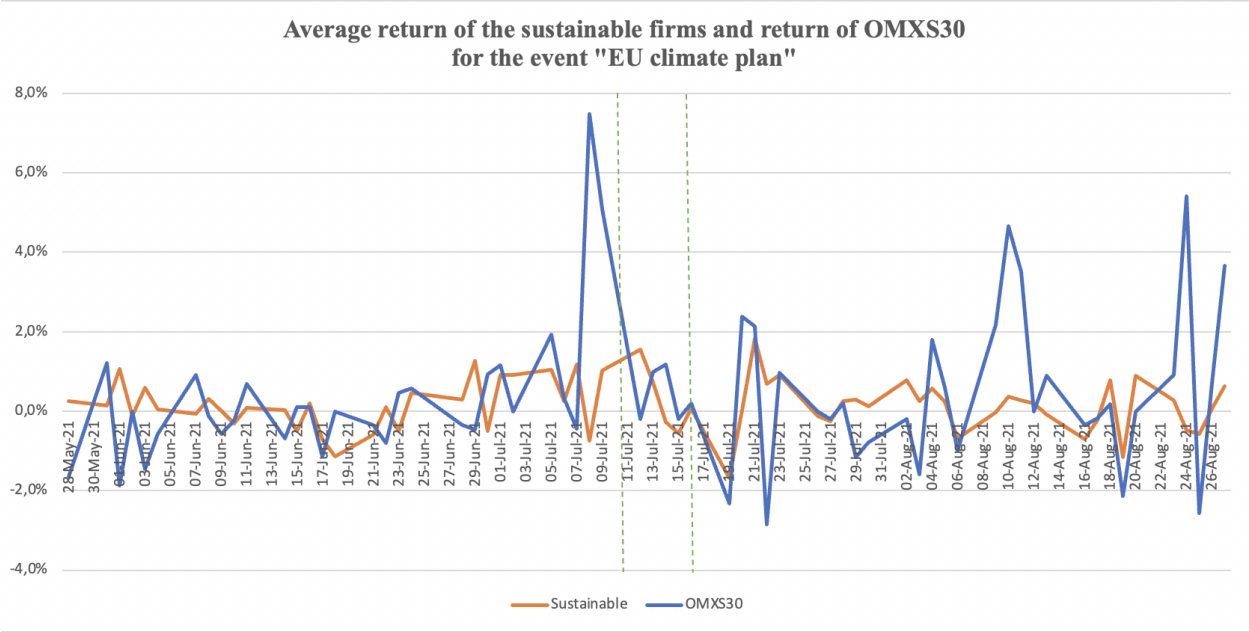
Graph 6: Average return of the sustainable firms and return of OMXS30 for the event "Signing of the Paris agreement", and the event window marked by two vertical lines.

It is shown in graph 6 that the average return for the sustainable firms during the event window is mainly negative. It is only from April 25th 2016 that the return becomes positive after the Paris agreement. However, even though the return of the sustainable firms is negative, the return is increasing after the event date, April 22nd 2016. In addition, it is also observed that OMXS30 yielded a considerably higher return than that of the sustainable firms before the event date. Moreover, the return of the market index has a high positive correlation with the average return of the sustainable firms after the Paris agreement. Taking the whole event window into account, it is clearly seen that the sustainable firms do not perform better than the market after the Paris agreement.



Graph 7: Average return of the sustainable firms and return of OMXS30 for the event "Trump's Paris agreement withdrawal", and the event window marked by two vertical lines.

From graph 7 it is seen that the pre-trend before the event date of 1 June 2017 has a positive correlation. This turns to a negative correlation after the event date. The sustainable firms reacted positively and OMXS30 reacted negatively, only to perform the opposite a day later for both categories, since the sustainable firms showed a negative trend contrary to OMXS30 which demonstrated a positive trend. Nevertheless, the sustainable firms maintain a positive average return from the start of the event window of May 30th 2017 to June 4th 2017, meanwhile OMXS30 has a negative return that increases to positive but right after the event falls and become even more negative, implying that the sustainable firms do better than the market right after the event. However, this turns to the opposite from June 4th 2017 to the end of the event window, which makes it infeasible to conclude whether the sustainable firms outperform the market index or not.



Graph 8: Average return of the sustainable firms and return of OMXS30 for the event "EU climate plan", and the event window marked by two vertical lines.

Looking at graph 8, the sustainable firms were doing better than the market two days prior to the event on July 14th 2021. However, right after the event date, the average return of the sustainable firms is lower than the return of OMXS30 and even becomes negative, indicating the opposite of our third hypothesis of the sustainable firms outperforming the market index.

4.4 Discussion

Regarding the methodology of this study and its credibility, there are two criterias that can be measured from, which are validity and reliability. Validity looks at the degree of the study measuring what it is supposed to measure (Price, Jhangiani, & Chiang, 2015). Reliability refers to the consistency of the study and to what degree the study can be reproduced given the same conditions (Price, Jhangiani, & Chiang, 2015).

When it comes to the reliability of our study, it is consistently conducted since it has been carefully done according to the described steps in the paper of MacKinlay, of how to do an event study. Additionally, anyone can get access to the same data from Refinitiv Eikon or any other relevant databases in order to redo the study. Furthermore, looking at the validity of our study, it is containing relevant events connected to the Paris agreement, and it is measuring the impact of the Paris agreement through abnormal returns. However, there are some aspects that impairs validity.

The first aspect is the location of the events. This thesis is focusing on the Swedish stock market, but event 2 is an American event that turns out not to affect the Swedish stock market to a significant extent according to our results. Moreover, event 3 is on a EU-level, which could be discussed whether it has had a sufficient effect on the Swedish stock market or not. What is implemented on EU-level usually has a somewhat direct impact on the member countries like Sweden, and thus the Swedish stock market reacts to news related to the EU.

The second aspect is the previously mentioned problem about the lower quantile of the top 50 sustainable firms having lower environmental pillar scores than what can be considered sustainable. According to figure 3 from section 3.2.1, the ESG score range can be divided into four quartiles, where the first quartile indicates “poor relative ESG performance” (Refinitiv, 2022) and the fourth quartile indicates “excellent relative ESG performance” (Refinitiv, 2022). In appendix, table 8, shows that only 13 firms are in the fourth quartile, 31 firms are in the third quartile, and 6 firms are in the second quartile. It is thus questionable whether all of the firms selected in the category top 50 sustainable firms are sustainable in actuality (at least for the firms in the second quartile).

Contrarily, almost all the firms in the bottom 50 unsustainable firms are in the first quartile, with only 7 firms in the second quartile. Also, the firm with the lowest E-score in the top 50 sustainable firms has an E-score of 46,61, meanwhile the firm with the highest E-score in

the bottom 50 unsustainable firms has an E-score of 28,34, meaning that there is still a distinction between the two categories *top* and *bottom*. However, having firms in the second quartile that has an indication of "satisfactory relative ESG performance" (Refinitiv, 2022) in the top sustainable firms, questions the term of "sustainable", and could have affected the outcome of the results. It is possible that we might have attained more statistically significant results if more of the selected firms were in the fourth quartile, that marks the most sustainable firms, or if all the firms were at least in the third quartile.

The third aspect is the choice of market index. It was assumed in hypothesis 3 that the market index is broad and diversified, which would give a well distributed proportion of sustainable and unsustainable firms. This is not fully in line with the market index chosen, OMXS30, which consists of the 30 most traded stocks on Nasdaq, and only six of them had an E-score below the third quartile, and can be considered unsustainable. It is clearly seen in appendix, table 10, that most of the underlying stocks in the index have an E-score that is high, and can thus be considered sustainable. The imbalance of proportion between sustainable stocks and unsustainable stocks in the index is a possible explanation for the result of hypothesis 3 and for the fact that the hypothesis could not be proven. However, since this study has its focus on the Swedish stock market, OMXS30 is considered, by us, the most appropriate index already.

There are also other aspects that can be discussed. One aspect is for instance the critique of the Efficient Market Hypothesis. One argument is that investors value stocks differently (e.g. undervalued market opportunities or growth potential of an asset), which leads to different assessments of a stock's true and fair market value, making it infeasible to determine the fair value under an efficient market (Dhir, 2022). A second point of critique is with regards to the EMH claim of that no investor can attain a greater profit than another with the same amount of invested funds, which is not in line with reality (Dhir, 2022). We made an assumption of semi-strong efficiency of the market in our study, however due to the mentioned arguments of critique, EMH might not hold in practice, which could be one of the causes for the fact that some of our results deviate from our hypotheses.

In addition, another perspective are uncontrollable variables, for instance the size of a firm, where large companies have the advantage of economies of scale and higher financial, human and technical resources, while smaller firms often possess more flexibility and innovation (Dzeraviaha, 2022). One could say that the size of a firm could potentially have an effect on our

results, since our data vary in firm sizes. Furthermore, one could argue for both cases; one take is that large firms probably are more likely to have greater profits (AR) than small firms due to cost-saving economies of scale. Contrastingly, smaller firms are more flexible while large firms are more rigid, making it easier for small firms to introduce adaptation measures in order to adhere to the expectations of the public to care for the environment. However, a large company will have more resources in possession that can be used to incorporate change and adaptation to mitigate climate change, depending on the specific firm. This uncontrollable variable, i.e. variable that has not been considered, can potentially have a negative impact on the relationship between the independent and dependent variables (Kelly, 2018). The consequences of this are for instance incorrect correlations, faulty analysis of results and wrongful rejections of a null hypothesis (Kelly, 2018).

Other aspects that could induce biases are the choice of sample size and uncontrollable variables. It is of importance that the sample size is not too small nor too big in order to get accurate and statistically significant results (Qualtrics, n.d.). If the size of the sample is insufficient, it may incur a disproportionate number of firms and some of which may be outliers or anomalies, which then leads to skewness in the results, as the sample does not correctly represent the population (Qualtrics, n.d.). Contrarily, an excessively large sample size will instead result in the study becoming more complex and time-consuming to run (Qualtrics, n.d.). The size of our sample settled for was 100 firms due to deeming 100 firms to be satisfactory of not being too large or small and due to time constraints. However, it might be befitting to enlarge the sample size for further research purposes. By observation of our graphs, ambiguous results were received, which could be due to an insufficient sample size.

Another point of discussion is regarding the three events chosen for the event study. There are two events that are beneficial to the Paris agreement and one event that is disadvantageous. It would have been better if the study included more events of both types, but simultaneously delimitation was necessary and having more events would also mean that in the data selection process, more firms would have been removed due to them having firm-specific events in the event window, which might result in their removal from the selection. Consequently, this would have contributed to the previously mentioned problem, regarding a too excessive removal of firms, leading to lower E-scores for our firms than preferable, in the category “top 50 sustainable firms”.

4.5 Delimitation

To limit the scope of our study, some boundaries were introduced in our thesis. One boundary is the sample size, where a total of 100 firms were analyzed, with an event study where three events were studied. Another limitation was the geographical location, where Sweden was chosen. Consequently, characteristics and traits of the population are that Swedish companies and consumers are tech-savvy, curious and are also willing to purchase sustainably manufactured products (Business Sweden, n.d.).

5. Conclusion

This section presents the conclusion of the study, followed by suggestions on further research.

To conclude, with regard to our first research question, our results show that the signing of the Paris agreement had an insignificant negative impact on both the sustainable and unsustainable firms. The two other Paris agreement-related events (Trump's withdrawal from the Paris agreement and the release of the EU climate plan) displayed an insignificant impact on the firms as well. However, the insignificant CAARs for the events "Signing of the Paris agreement" and "Trump's withdrawal from the Paris agreement" are acting accordingly, where the first event that is in benefit for the Paris agreement yields negative CAARs and the second event that is disadvantageous to the Paris agreement, demonstrates positive CAARs. This could be due to firms being underprepared for new climate regulations and insufficient adaptation, explaining the negative reactions when the progression of the treaty goes well. Although not significant, it is simultaneously shown by graph 2 and 4 that the events that are beneficial to the Paris agreement have a negative impact on both sustainable and unsustainable firms, meanwhile graph 3 indicates that the unfavorable event in terms of the treaty, has a positive impact.

Furthermore, in regard to the second research question it is established that there indeed exists a significant difference between the performance of the sustainable firms, relative to the performance of the unsustainable firms, after the Paris agreement-related events. Although not statistically significant, overall, the sustainable firms performed better than the unsustainable firms during the two events which were beneficial to the Paris agreement. Additionally, the sustainable firms performed worse than unsustainable ones for the event which is a drawback for the advancement of the Paris agreement. This is expected as it is logical to think that events that are positive for the development of the sustainable treaty, thus must have positive effects on sustainable firms and vice versa. Another aspect that is observed in the graphs is that there mainly exists a positive correlation between the sustainable and unsustainable firms.

Moreover, for the third research question, our results could not demonstrate that the sustainable firms outperforms the market index, after the events connected to the Paris

agreement. In regard to the stated hypothesis, only a one-tailed T-test was performed, and thereby it cannot be said whether the sustainable firms do significantly worse than the market index.

All in all, considering Sweden being one of the world's most sustainable countries, it comes to a surprise that the impact of the Paris agreement on the Swedish stock market was insignificant. This might be due to the fact that Sweden has come so far in sustainability that it is not greatly affected by the Paris agreement. For the future ahead, companies need to adhere to the non-stationary state of the climate and make decisions and investments, while simultaneously taking into account environmental aspects, in addition to the new generation being more environmentally conscious, we hence believe that environmental treaties and policies will have a greater impact on the stock market.

Lastly, for further research we recommend conducting a similar event study, however with events regarding the newly instated Swedish government instead. This is in order to analyze how the new Swedish government affects the Swedish stock market and if there are different impacts between sustainable and unsustainable companies. This would be of interest since two of the four parties that constitute the current Swedish government, have a climate policy that implies an increase of emissions and three of the four parties have an insufficient policy for biodiversity, according to researchers, as stated in Dagens Nyheter (2022). Furthermore, the biggest party that is part of the government does not support the climate goals of Sweden as they do not intend to pursue a policy that will live up to the obligations of the Paris agreement, a professor and researcher in climate policy claims (Dagens Nyheter, 2022). However, this may not be doable as the results might be clouded by other world events due to the current situation of the world, especially considering the conflict between Ukraine and Russia, and the Swedish government being instituted parallel in time.

6. References

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7. Appendix

Table 8: Environmental pillar scores of top 50 Swedish firms from database of Refinitiv. Accessed 2022-11-25.

Security	E-score	Security	E-score
Skandinaviska Enskilda Banken AB	91,68	SAS AB	64,22
Svenska Cellulosa SCA AB	87,47	Nolato AB	64,12
SKF AB	86,3	Swedish Orphan Biovitrum AB (publ)	63,95
Fabege AB	86,05	Lagercrantz Group AB	62,84
JM AB	85,38	Dios Fastigheter AB	62,83
Assa Abloy AB	83,1	Saab AB	62,67
Hufvudstaden AB	81,73	Modern Times Group MTG AB	62,67
Electrolux AB	81,67	Catena AB	61,62
Ncc AB	80,93	Trelleborg AB	60,11
Swedish Match AB	80,34	Holmen AB	59,72
Pandox AB	80,02	Skanska AB	58,82
Getinge AB	79,34	Lindab International AB	58,13
Billerud AB (publ)	76,21	Sdiptech AB (publ)	57,95
Elekta AB (publ)	74,83	Meko AB	57,84
Note AB (publ)	73,62	Wallenstam AB	54,12
Clas Ohlson AB	73,46	SkiStar AB	52,83
Beijer Alma AB	70,74	Nobia AB	51,09
Nilorngruppen AB	70,57	Duni AB	50,68
Midsona AB	69,46	Atrium Ljungberg AB	50,25
Telia Company AB	68,43	Cloetta AB	49,53
Nederman Holding AB	67,17	New Wave Group AB	48,89
Hexagon AB	66,49	Strax AB	48,51
Bjorn Borg AB	66,2	Tobii AB	47,18
Telefonaktiebolaget LM Ericsson	65,65	Heimstaden AB	47,09
Ratos AB	64,53	Rottneros AB	46,61

Table 9: Environmental pillar scores of bottom 50 Swedish firms from database of Refinitiv. Accessed 2022-11-25:

Security	E-score	Security	E-score
Moment Group AB	0	Tethys Oil AB	10,41
G5 Entertainment AB (publ)	0	OrganoClick AB	11,28
Fortnox AB	0	Heliospectra AB (publ)	13,34
Enea AB	0	Railcare Group AB	13,43
Investment Oresund AB	0	DistIT AB	13,99
JLT Mobile Computers AB (publ)	0	Platzer Fastigheter Holding AB (publ)	14,24
Prevas AB	0	OEM International AB	14,65
Crown Energy AB	0	Sectra AB	15,01
Kancera AB	0	L E Lundbergforetagen AB (publ)	15,66
Mendus AB (publ)	0	Troax Group AB (publ)	18,09
Diamyd Medical AB	0	Powercell Sweden AB (publ)	19,38
Irisity AB (publ)	0	Sivers Semiconductors AB	19,65
C Rad AB	0	Industrivarden AB	19,72
Bure Equity AB	0,53	Hoist Finance AB (publ)	20,54
Starbreeze AB	2,24	Addnode Group AB (publ)	20,55
Christian Berner Tech Trade AB	3,14	XANO Industri AB	23,73
Medivir AB	5,45	Catella AB	24,56
Senzime AB (publ)	6,18	ADDvise Group AB (publ)	24,61
RaySearch Laboratories AB (publ)	6,18	Pricer AB	25,15
IAR Systems Group AB	7,72	Orron Energy AB	25,23
CTT Systems AB	7,72	SinterCast AB	25,96
Endomines AB (publ)	9,1	Hanza AB	26,41
Precise Biometrics AB	9,43	Bimobject AB	26,56
Avanza Bank Holding AB	9,53	Loomis AB	28,16
Sensys Gatso Group AB	9,7	Boule Diagnostics AB	28,34

Table 10: Environmental pillar scores of the 30 underlying stocks in OMXS30 from Nasdaq and database of Refinitiv. Accessed: 2022-12-27.

Security	E-score	Security	E-score
Volvo B	94	Getinge B	79,34
Handelsbanken A	93,69	Sandvik	74,93
SEB A	91,68	Tele2 B	70,44
Hennes & Mauritz B	91,2	Telia Company	68,43
SCA B	87,47	Hexagon B	66,49
SKF B	86,3	Ericsson B	65,65
Atlas Copco A	85,55	Essity B	58,29
Atlas Copco B	85,55	Investor B	45,69
Alfa Laval	85,48	Autoliv SDB	32,44
Swedbank A	85,47	Kinnevik B	30,26
Boliden	85,36	Evolution	29,98
ASSA ABLOY B	83,1	Sinch	22,75
Electrolux B	81,67	ABB ltd	-
Swedish Match	80,34	AstraZeneca	-
Samhällsbyggnadsbolaget i Norden B	79,97	Nordea Bank Abp	-