

Environmental Targets and Market Reactions:

A Sector Analysis of EU Companies Committing to the Science-Based Targets Initiative

Sixten Thorgerzon & Vilgot Kledzik

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Abstract

This study investigates the effect on short term valuation when EU listed companies commit to environmental targets through the Science Based Targets initiative (SBTi) and if the effects differ between industries. With increased investor interest and stricter environmental legislation this study contributes to the growing research field of how environmental factors affect stock market performance. 615 EU listed companies were investigated in an event study showing significant positive average abnormal returns two days following announcement of committing to environmental targets. Three portfolios of companies from the manufacturing, utilities and services industries were created to investigate differences across sectors. Positive cumulative average abnormal returns were found for the utilities and service sector but no effects were observed for the manufacturing sector. Overall the observed effects were small and insignificant consistent with previous literature finding small or no effects of positive environmental news on firm valuation. Future research can be conducted with a larger number of companies from selected industries in order to gain deeper insights on industry specific factors affecting firm valuation.

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1 Introduction

1.1 Background

In light of one of the largest challenges humanity has ever faced, the climate crisis, societies are facing one of their largest and fastest transitions in human history, pivoting away from fossil and into green and circular solutions. The changes required reaches everyone. Globally, nations, companies and humans are currently partaking in this green transition. To combat this crisis, world leaders from 195 countries came together in 2015 to form the legally binding international treaty, the Paris Agreement (United Nations, n.d.). Given increasing investor interest, accelerating legislative pressure and strategic value for businesses, research on valuation of ESG companies is ever more valuable.

To achieve the goals of the Paris agreement, society must undergo what has been called *The Green Transition* defined by the OECD (n.d.) as the shift toward an environmentally sustainable economy that minimizes pollution, reduces carbon emissions, preserves biodiversity, and mitigates the impacts of climate change. To facilitate this transition, the legislative landscape for businesses has been updated accordingly. Within the European Union, a leader on environmental legislation, commitments has been made in the European Green Deal for the Union to reach net zero greenhouse gas emissions by 2050 and to lower the net emissions by 55% by 2030 (European Commission, n.d.). These commitments have further been written into law in the *European Climate Law* and entered into force as of 29 of July 2021. A pillar of the European Green Deal is the Renewable Energy Directive which, in its latest form, legally binds the Union to increase the share of renewable energy sources to at least 42.5% by 2030 (European Commission, n.d.).

Specific sectors are also subject to the EU Emissions Trading System (EU ETS) designed to set a price on carbon and make polluters pay for their emissions of greenhouse gases in order to lower them and bring revenue that sponsors the green transition of the continent. The EU ETS covers

around 10 000 businesses within the energy sector, manufacturing industry, aircraft operators and, as of 2024, maritime transportation. Combined these sectors is calculated to stand for around 40% of the Union's emissions (European Commission, n.d.). The price of these EU Carbon Permits have increased with a factor of almost three since 2020 levels (Trading Economics, n.d.). These industry specific laws assigns increased media scrutiny on environmental factors for firms operating in these sectors (Capelle-Blancard and Petit, 2019).

In this changing business landscape, investor interest in companies that could solve or benefit from a green transition has increased. As of 2022, a worldwide total of \$30.3 trillion was invested into sustainable assets during that year, an increase from \$22.8 trillion in 2016 (Global Sustainable Investment Alliance, 2022). In addition, to facilitate the implementation of the European Green Deal, approximately 520 billion Euro in investments yearly is calculated to be needed between 2021 and 2030, and an additional 92 billion Euro yearly between 2023 and 2030, to "boost the EU's capacity to manufacture net-zero technologies" (European Environment Agency, 2023).

The large increase in investments into green assets have given rise to researchers investigating, and finding evidence of, the existence of a green premium, or "greenium", on green assets. The greenium refers to the price premium of green assets and has been interpreted as a sign that investors are willing to accept a lower return for owning green assets. One explanation for the phenomenon is given by Alessi et al. (2021) who argue that investors recognizing the risk of the climate crisis as significant and want to hedge against it, as well as an increase in demand for these types of assets. On the other hand, contradicting research has been made finding no evidence of this green premium in the US bond market (Larcker et al., 2020).

The demand for information about corporate social responsibility (CSR) and firms' environmental, social, and governance (ESG) activities and policies has steadily risen argue Cohen et al. (2015). In order for firms to signal their adherence to the green transition and their commitment to mitigat-

ing the effects of the climate change, multiple reporting standards and certifications have emerged. Examples of standards include the Carbon Disclosure Project (CDP), which since 2000 has helped companies set reporting standards for carbon reporting (CDP, n.d) and the International Organization for Standardization that issues certifications for specific procedures such as waste water management (ISO, n.d). However one problem highlighted by Berg et al. (2022) is the low informational value for the certifications as the different standards lead to the same company scoring different depending of choice of certification. A current example is the new EU Corporate Sustainability Reporting Directive (CSRD), taken into effect in 2024 with the aim of increasing and standardizing sustainability reporting within the EU, forcing the CDP and companies using CDP to pivot their standards to the new one (European Commission, n.d.). Cho et al. (2015) theorize that the multitude of standards together with conflicting pressure from society to prioritize sustainability and institutional pressure to maximize profit forces firms to create façades that devalues voluntary sustainability reporting. Creating a problem of green washing, as investors have difficulties in distinguishing the informational quality of companies long term sustainability strategy.

In 2015 a third party certification for climate targets, the Science Based Target initiative (SBTi), was founded as a partnership between CDP, the United Nations Global Compact, World Resources Institute (WRI) and the World Wide Fund for Nature (WWF), with the goal of creating a broad standard, increasing transparency and accountability of companies' reported climate targets. This is achieved by the SBTi having both targets and yearly reporting standardized and evaluated by independent climate scientists. Today the SBTi is one of the largest organisations promoting, and certifying, firms' and organisations' climate targets globally. Through SBTi, over 7600 companies have committed or had their targets certified (Science Based Targets, 2024). In 2022 these companies together represent over one third of the the global economy's market capitalization, thus increasing standardization and comparability between companies' goals and performance on ESG topics (Science Based Targets, 2023).

The strict and transparent certification process Science Based Target initiative mitigate the issue of greenwashing in companies' sustainability targets reporting. By setting targets in line with the Paris agreement and monitoring the firms' progress, SBTi decreases the discrepancy between company sustainability talk and actual practice. Alessi, et al (2021) further argues that a firm's quality of environmental disclosure matters to investors when pricing green assets, which stresses the importance of a standardized, rigorous environmental reporting method such as the SBTi provides. Commitment to the SBTi represents a change in the firm's long-term strategy in relation to their environmental operations and emissions and would therefore, according to the Efficient Market Hypothesis, be priced in immediately on announcement. Previous research investigating climate related events have focused more on short-term, firm specific, events for example receiving a critical report of their disposal of toxic waste or an oil spill (Krüger, 2015), events that have little or no effect on the firm's long term-operations. This paper specifically will look at the effects such a commitment has on valuation for companies within the European Union, and whether there are differences between industries. The study concerns the short-term abnormal returns surrounding the day of announcing the commitment and looks at the Average Abnormal Returns and the Cumulative Average Abnormal Returns 10 days prior and 10 days after the commitment.

1.2 Research Questions and Motivation

With the aforementioned investor interest in, and importance of, environmental asset valuation in combination with SBTi enabling the study of equal environmental commitment events two research questions are formed:

"Does firms climate commitments to the SBTi give short-term abnormal stock returns for EU listed companies?"

"Are there differences in abnormal returns based on industry?"

The questions will be researched through an event study of the stock returns for public companies around the date of their targets being published to the SBTi between 2/13/19 and 2/8/24. With a market model methodology based on theory published by MacKinlay (1997). The comparison index will be the largest European index STOXX 600 comprising the 600 largest companies in Europe.

As will be seen in the following literature review, there are conflicting evidence on what effect a firm's environmental commitment and performance have in the financial markets which is why there is a need for further research in the topic. In addition, there are limited studies in general on the topic of voluntary commitment to environmental targets, and thereby also what effect it has on firm valuation, which is a gap this paper aim to fill. Lastly, most previous studies mainly focus on the U.S market which makes a study on companies of the European Union interesting. The before mentioned increasing and stricter environmental legislation in Europe contribute to make a study on the continent's firms relevant. Much of the new EU legislation also distinguishes between different sectors which motivates the question of whether the effects of the commitments differ between industries.

While there exist previous research on the effect of ESG news items on businesses' short term valuation, historical event studies have looked at a broad range of climate related news that differ in both size and relevance for the companies studied. In contrast, commitment to the SBTi is a standardized event and news article. This allows for an event study of equal ESG news events between securities, much like financial reporting or similar standardized news publication, of which little research has been done.

1.3 Preliminary Results

This study found positive abnormal returns two days after the event day for the full sample of European companies and positive cumulative abnormal returns for the portfolio of firms from the

utilities and service sector. The observed effects of firm commitment to environmental targets on stock market valuation were for the whole dataset small and insignificant, in line with previous research findings of weaker effects of positive news and investor uncertainty in which environmental news to react to. The observed effects in the portfolio of companies in the utilities sector can be explained by the strict environmental legislation imposed on the sector which makes news of commitment to environmental targets a relevant item for investors to react to. For the service industry it is possible that other events were captured in the study given the valuation effect being captured first on day 7. However, the small sample size of firms in this industry renders some uncertainty in regards to whether the results are transferable to the sector as a whole and further research is necessary in order to draw definite conclusions.

1.4 Disposition

The structure of this thesis is outlined as follows: Section 2 provides a comprehensive review of the existing literature on Environmental, Social, and Governance (ESG) reporting in finance. Section 3 details the data collection processes, describes the final sample, and outlines the methodology employed in this study. Section 4 presents the empirical findings which are discussed in Section 5. The thesis concludes in Section 6, where we summarize the key conclusions, acknowledge the limitations of our study, and propose topics for future research.

2 Literature Review

The importance of ESG-factors on investors decisions, especially environmental factors, have gained an increased interest among researchers in recent years. Hartzmark & Sussman (2019) conducted a study on the US fund market that showed that since the introduction of Morningstar's Sustainability Rating in March 2016, investors value sustainability when they have access to reliable sustainability ratings. The study showed that funds being categorized as "low sustainability" experienced a net outflow of between 12 to 15 billion dollars in the succeeding 11-months after

publication of the sustainability ratings and "high sustainability" funds received a net inflow of 24 to 32 billion dollars in the same time period. The authors further argue that sustainability is considered a positive attribute in financial markets and that investors believe that a better sustainability rating predicts positive future financial returns. However, the belief of positive future returns is not the only requirement for the increased interest among investors. Instead, according to Friedman et al. (2016), investors are willing to give up financial benefits to invest in environmentally friendly assets. This is further backed by a survey of pension fund members where over two thirds of 4000 respondents said they were willing to vote for increased focus on investments based on Sustainable Development Goals (SDGs) strategies even if the engagement is expected to hurt financial performance (Bauer et al., 2021). Consistently, papers such as Fama and French (2007) have expanded the broader asset pricing literature from only financial returns to account for investors' tastes for assets with particular characteristics and their effect on asset prices .

Considering the Efficient Market Hypothesis that states that the price of an asset reflects all available information, it is therefore impossible outperform the market over time as the prices constantly adjust to all relevant information. According to Fama (1970) there are three forms of market efficiency: weak, semi-strong and strong. In the weak form the stock price reflect the historical return and price of the share, in the semi-strong form the price reflects all publicly available information and in the strong form the price reflects both public and private information. New information, if relevant, would thus alter the price of the asset immediately.

Building on classical finance theory where valuations are explained by discounting future cash flows, Grewal et al. (2021) argue that Corporate Social Responsibility (CSR) - reporting, a predecessor to ESG frameworks, can be useful to investors in estimating both future cash flows and assessing firms' risk as the topics normally are closely related to firms' normal business activities. Risk associated with carbon intensive assets due to exposure to future costly legislation is underpriced in the market according to a survey published by Stroebel et al. (2021). In their survey of

861 finance academics, professionals, public sector regulators and policy economists, they identify regulatory risk as the top climate risk to businesses and investors in the upcoming 5 years. The results align with those of Azimli and Cek (2023) whose study of 591 financial firms, between 2005 and 2021, indicates that sustainability reporting offsets the negative effects of economic policy uncertainty on valuation. Another study on carbon risk investigated consumer preference and showed that CSR policies, as a product differentiation strategy, decrease systematic risk, decrease cost of capital and increase firm valuations, with a stronger correlation in firms with high product differentiation (Albuquerque et al., 2019). The positive effect on valuation was shown by Kahn et al. (2024) who investigated 895 European firms and suggested that improvement in a firm's ESG profile and ESG performance increases the firm's market value in relation to its true value. Further, the study shows that already overvalued firms become even more overvalued and undervalued firms return closer to their true value when ESG performance is improved. Disclosure of CSR investments indicating greater stakeholder engagement and transparency may also increase the access to capital for firms, particularly in times when capital may be limited or in crisis periods when social capital and trust is more important (Cheng et al., 2014). This does not solely apply to equity but also to debt. Amiraslani et al. (2023) showed an association between CSR and loan spreads, with a more pronounced effect in periods of low trust and crisis, such as during the 2008-2009 financial crisis. At those times, companies with higher social capital could raise more debt, with longer duration and lower spreads, than firms with low social capital. This relationship increased with the risk of default of the firm.

Despite the evidence of investors valuing sustainability, there is still a debate among researchers on how a company's ESG performance affect their performance in financial markets. Bauer et al. (2022) show that green stocks, stocks from more climate-friendly companies, from the G7 countries, have outperformed brown stocks, stocks from less climate-friendly companies in the previous decade, meaning that green stocks yielded higher returns in that period. A supporting paper by Bendig et al. (2023) compared companies' carbon emission performance to corporate financial

performance, measured through the reporting to SBTi, and found a positive correlation. These findings are supported by Pástor et al. (2022) who found that green stocks in the US gave higher realized returns than brown stocks despite green stocks having lower expected returns. An explanation is provided by Pástor et al. (2021) who show that green stocks with lower expected returns can outperform brown stocks in a period of time when ESG concerns increase unexpectedly. This hypothesis aligns with that of Huynh et al. (2021) who examined correlations between climate change news and corporate bond prices, finding that bonds with a higher climate change news beta earn lower future returns, arguing that it is an implication of demand for bonds with high potential to hedge climate risk; when investors are concerned about climate risk they are willing to pay higher prices for bonds issued by firms with better ESG performance.

However, contradictory research results published by Larcker et al. (2020) indicates that in real market settings investors appear entirely unwilling to forgo wealth to invest in environmentally sustainable projects in the US. When comparing green and traditional bonds issued on the same day they found no evidence of a premium for green bonds. Bolton and Kacperczyk (2021) provide one explanation for this discrepancy arguing that brown stocks, based on total carbon emissions, between 2005 and 2017, earned higher returns than green stocks. They provide the aforementioned rationale that brown stocks carry a higher environmental risk which in turn leads to investors demanding a higher return to carry this risk. Similar results have been found by Busch et al. (2022) in the time period 2005-2014. Specifically, they observe that firms with higher carbon emissions see greater short-term financial performance, measured by return on assets (ROA). In addition, they also find evidence that higher carbon emissions is associated with a higher Tobin's Q as defined by Hays (2021), indicating better long-term performance as well. Furthermore, Hsu, Li and Tsou (2023) found that a long-short portfolio of companies with high versus low levels of toxic emission intensity relative to their industry counterparts, yielded an average excess return of approximately 4.42% annually. They also saw that firms with higher emissions have a higher current profitability. However, high emission firms experience a lower future profitability when governments impose

new, stricter, environmental legislation.

With some exemptions research agrees that investors do account for ESG and CSR reporting, especially that there exists a long term climate risk that should be priced in, lowering valuation of and increasing short term returns of brown stocks compared to green ones. In later years it has thus been increasingly interesting to research how the market reacts to ESG news. Krüger (2015) studied the short term market reaction related to both positive and negative corporate social responsibility (CSR) news through an event study. His findings were that the market reacts strongly negative to negative CSR news and, surprisingly, negative to positive CSR news as well, however the reaction to positive news were much weaker and less systematic than for the negative news. Capelle-Blancard and Petit (2019) show similar findings based on around 33 000 ESG related news. The study showed that the market reacts to ESG news and especially to negative news. On average, a firm's market value decreases by 0.1% over a three day window subsequent the publication of a negative news item. For positive news the authors found no significant change in market value. Further, the authors conclude that only news from the media has a significant effect on stock prices. News items from NGOs and firm's press releases do not affect the stock price. Taking a wider view, Ardia et al. (2023) show that on days where climate change concerns unexpectedly increase, measured through the extent of climate change-related news, the prices of green firms' stocks increase while the stock prices of brown firms' decrease. Garagvalia et al. (2023) studied how investors react to a company taking on, and later stopping an ESG initiative in relation to a non-ESG initiative. The study showed that while investors react positively to starting an ESG initiative, there is no significant difference in reaction to a general business initiative. However, the authors discuss an "ESG-stopping effect" where investor show a stronger negative reaction to stopping an ESG initiative compared to a non-ESG initiative. They explain this phenomenon by stating that investors feel an ethical responsibility when an ESG initiative is terminated rendering a stronger negative reaction.

One underlying problem in all aforementioned research, both long and short term, is the definition of the terms "green assets", CSR and ESG. As new field it is quickly evolving in regard to methods for measurement, reporting and legislation which means that there is still a variation in usage and definition of the terms. As results indicated by Berg et al. (2022), ESG ratings from six prominent ESG rating agencies diverge substantially in relation to methodology and weighing of factors rendering low correlations between their ESG ratings ranging from 0.38 to 0.71. This strongly indicates the need of increased standardization of reporting and rating standards. Capelle-Blancard and Petit (2019) investigated the weighting of CSR-dimensions when making Corporate Social Performance (CSP) assessments of companies of different industries and found that previous assessments, based on equal weighting between sectors, misrepresents the actual performance. They argue that, for example, the Banking sector is more scrutinized on governmental issues than environmental, and vice versa for the high emitting sector of Oil & Gas for example.

2.1 Hypothesis

The first hypothesis is that announcing a commitment to the SBTi will yield abnormal returns on the event day. This is motivated by multiple well researched factors; as previously mentioned, investor interest in ESG investment is increasing (Hartzmark et al., 2019; Mansouri, et al., 2022) and increasing legislation has been connected to financial risk for high polluters as well as previous event studies on non equal climate effects showing statistically proven abnormal returns (Garavaglia et al., 2022; Krüger, 2015).

The second hypothesis is that a larger effect can be observed in industries with high levels of carbon emission than industries where carbon emissions are close to zero, as clearer and more proactive strategies are required to reach climate targets, see positive investor sentiment and decreased legal risk (Stroebel et al., 2021; Azimli and Cek, 2023) Further, as Capelle-Blancard and Petit (2017) argued, different sectors are assessed by media and NGOs on different factors. For high emitting industries more scrutiny is put on environmental factors which would result in a larger investor

reaction to an environmental announcement, like committing to SBTi.

3 Methodology and Data

This paper implements a market model event study to examine commitment to the Science Based Targets initiative effect on valuation in the European market. The methodology is based on MacKinlay (1997) and aims to examine one event's effect on the valuation on a firm or security. The field of event studies dates back to 1933 and James Dolly's paper on stock splits. Over the following decades the methodology was refined up until studies by Ball and Brown (1968) and Fama et al. (1969) were published. Since then it has remained overall constant according to MacKinlay (1997).

The first step to conducting a event study is defining the event, be it a stock split, change of leadership, or news event. Then an estimation window is set before the event and an evaluation window that includes the event day and following days but could also include dates predating the actual event day. The null hypothesis is most often that the event has no effect at valuation and the task subsequently to measure abnormal returns and if they differ from 0. Abnormal returns are defined as actual returns subtracted the normal return, or the expected return.

There are two ways of defining normal returns, either a constant mean return model (mean return over time) or market model (regression stock against market). With the second method being a potential improvement over the constant mean return model by accounting for correlation with the market's return reducing the variance of the abnormal return. The event study in general has three parts firstly a estimation window followed by an event window and post-event window as specified in figure 1

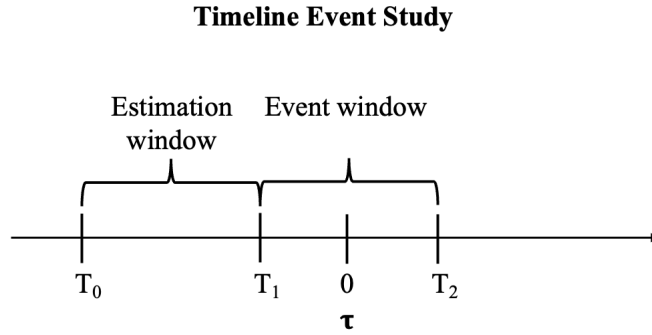


Figure 1: Timeline for an event study

Following is a detailed description of the sample selection.

3.1 Sample Selection

The sample is based on the open database provided by SBTi. The database contains multiple events for each company representing milestones in the application and reporting process. In figure 2 this process is described, in short an organization first commits to SBTi after which they have 2 years to hand in their targets to be approved by SBTi. When handed in, SBTi lets an impartial jury of scientist review the goals and road map, if approved a target is published and annual reporting follows to assure compliance with set targets. This paper will regard "commitments" instead of "targets set" as the event as more than 90% of committed companies are approved and set targets, i.e. the informational value of committing can be assumed equal to that of setting targets and any market reaction should be seen at the commitment according to the efficient market hypothesis (Fama, 1991). Moreover, the number of committed companies is also almost twice as large as the number of companies with targets set (Science Based Targets, 2023) increasing the sample size and generalizability of any results.

Timeline SBTi Application Process

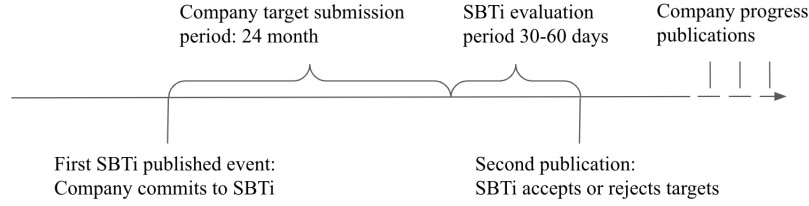


Figure 2: Description of SBTi application process, (Science Based Targets Initiative, 2024)

The original sample of all committed organizations and companies is then screened to match the research topic. This event study looks at listed European companies and for this reason the data is screened on geography, followed by organization type which is set to companies and if the data set contains an ISIN code, required for publicly traded companies and necessary to access market data in Eikon. Lastly the dataset is screened on whether enough market data is available in Eikon, as some companies have not been listed for enough time. The screening process is described in table 1 which also includes number of companies remaining after each screening step.

Description	Criteria	Number of companies
Type of event	Commitment	4508
Region	EU	2397
Type	Company	2226
ISIN	Data available	770
Data	Data available	615

Table 1: Table describing screening funnel and number of data points for each respective step

For the second part of the paper an industry comparison is conducted for a selected number of

industries namely, manufacturing, utilities and professional, scientific and technical services. The screened sample is thus divided into subsets based on industry as summarized in table 2 that also contains the average total CO₂ equivalent emissions to Enterprise Value Including Cash (EVIC) in millions USD, all data is provided by Eikon. The choice of subsets were made based on three factors, amount of data available, opting for industries with most number of companies, additionally at least one low carbon intensive and one high industry as well as prioritizing industries included in the European Union Emission trading system (EU ETS) system.

Sector	Average Total CO₂ Equivalent Emissions To EVIC USD (in million)	Number of companies
Manufacturing	241	276
Professional, Scientific, and Technical Services	8.72	66
Information	9.09	54
Retail Trade	29.8	41
Construction	28.9	36
Utilities	366	24
Transportation and Warehousing	264	21
Wholesale Trade	375	19
Administrative and Support and Waste - Management and Remediation Services	60.8	17
Accommodation and Food Services	55.7	16
Real Estate and Rental and Leasing	9.48	16
Finance and Insurance	0.72	9
Arts, Entertainment, and Recreation	4.71	6
Agriculture, Forestry, Fishing and Hunting	44.9	4
Mining, Quarrying, and Oil and Gas Extraction	147	4
Health Care and Social Assistance	20.8	2
Missing data	-	2
Management of Companies and Enterprises	340	1
Other Services (except Public Administration)	148	1
Grand Total	154	615

Table 2: Summary table of final sample ($N = 615$) separated on sector, describing average total CO₂ equivalent emissions to EVIC USD in millions and number of companies for each sector

3.2 Comparative Index

For the market data the STOXX 600 index was used, the same index is applied for industry comparisons as well. The index is selected as it is the largest index in the EU thus assumed to best reflect the returns of the entire EU stock market (Qontigo, 2023).

3.3 Event Window

The timeline of the event study is described as in figure 1, for each firm the event day is set to be the day the firm committed and announced their climate targets to the SBTi. Three event windows are set according to theory $[\tau_1, \tau_2]$ where $T_1 < \tau_1 \leq \tau_2 \leq T_2$. Namely event windows $[-2 : 2]$, $[-5 : 5]$ and $[-10 : 10]$ are used, capturing short, medium and long term effects on the asset prices. The three event windows constitutes 21 days, 11 days, and 5 days respectively, all centered around the event day. The windows are selected in line with the windows used in Krüger (2015) with the addition of the shorter term $[-2 : 2]$. The inclusion of days before the event is in line with theory and exist to capture any market reactions stemming from information leaking prior to the event day (MacKinlay, 1997).

3.4 Estimation Period

The estimation window is set before the event window seen in figure 1 with an estimation window of length $L_1 = T_1 - T_0$. This paper will use an estimation length of $L_1 = 200$ trading days, starting 250 trading days before the event and ending 50 trading days before the event. This is in line with the recommendation of MacKinlay (1997) that state that the estimation and event windows should not overlap. The length of 200 trading days is somewhat longer than the 120 days used as an example in MacKinlay (1997) and somewhat shorter than that of 250 trading days used in Krüger (2015).

3.5 Market Model

In order to calculate abnormal returns, we first estimate alpha and betas values for each stock, by regressing daily returns against market return during the estimation window according to:

$$R_{i,t} = \alpha_i + \beta_i R_{m,t} + \epsilon_{i,t} \quad (1)$$

$$E(\epsilon_{i,t}) = 0, \quad \text{var}(\epsilon_{i,t}) = \sigma_{\epsilon_i}^2$$

Where $R_{i,t}$ is the realized return of firm i at time t , α_i and β_i are the parameters for firm i , and $R_{m,t}$ is the corresponding market return for the same period. Estimators $\hat{\alpha}_i$ and $\hat{\beta}_i$ are calculated by linear regressing equation 1. The market return is assumed to be the return of the STOXX 600 index. With the alpha and beta values we can calculate abnormal returns for each event window as:

$$\hat{A}R_{i,\tau} = R_{i,\tau} - (\hat{\alpha}_i + \hat{\beta}_i * R_{m,\tau})$$

Thus, the $\hat{A}R_{i,\tau}$ is defined as the difference between the realized return for firm i and the corresponding expected return at time $\tau = \tau_1, \tau_1 + 1, \dots, \tau_2$.

The abnormal return must be aggregated to allow for inferences, aggregation can be done over two dimensions: securities and time. Firstly we aggregate over securities. The results for each security are combined in AAR_t , the Average Abnormal Return:

$$AAR_\tau = \frac{1}{N} \sum_{i=1}^N \hat{A}R_{i,\tau}$$

Secondly we aggregate over the event window. Resulting in Cumulative Average Abnormal Returns ($CAAR$) for the event windows as:

$$CAAR(\tau_1, \tau_2) = \sum_{\tau=\tau_1}^{\tau_2} \left(\frac{1}{N} \sum_{i=1}^N \hat{A}R_{i,\tau} \right)$$

Where τ_1 and τ_2 define the event window with $\tau_1 < \tau_2$.

The mathematical formulation of our hypothesis can now be formulated:

$$H_0 : CAAR = 0$$

With alternative hypothesis:

$$H_1 : CAAR \neq 0$$

Under the null hypothesis the AAR and CAAR values are assumed to be normally distributed with mean zero and variance of $\sigma_{\hat{AAR}_{i,\tau}}^2, \sigma_{\hat{CAAR}_{i,\tau}}^2$. On the estimation data the covariance between securities is assumed for simplicity to be zero in accordance with MacKinlay (1997).

The variance for AAR and CAAR respectively can be developed from the variance of AR. Which, for large estimation windows such as L_1 be estimated as the disturbance variance in equation 1:

$$\sigma_{\hat{AR}_{i,\tau}}^2 = \sigma_{\epsilon_i}^2$$

Where the variance in disturbance defined as:

$$\sigma_{\epsilon_i}^2 = \frac{1}{L_1 - 2} \sum_{t=T_0+1}^{T_1} (R_{i,\tau} - \hat{\alpha}_i - \hat{\beta}_i R_{m,\tau})^2$$

Given our definition of AAR_t the variance $\sigma_{AAR_t}^2$ can be described for large estimation windows:

$$\sigma_{AAR_t}^2 = \frac{1}{N^2} \sum_{i=1}^N \sigma_{\hat{AR}_{i,\tau}}^2 = \frac{1}{N^2} \sum_{i=1}^N \sigma_{\epsilon_i}^2$$

Where N is the number of securities. Lastly, the variance for the cumulative average abnormal returns is calculated as follows assuming that variance is constant over time:

$$\sigma_{CAAR(\tau_1:\tau_2)}^2 = \sum_{\tau=\tau_1}^{\tau_2} (\sigma_{AAR_t}^2)$$

Which can be written as:

$$\sigma_{CAAR(\tau_1:\tau_2)}^2 = \frac{1}{N^2} \sum_{\tau=\tau_1}^{\tau_2} \sum_{i=1}^N \sigma_{\epsilon_i}^2$$

The test-statistics for AAR and CAAR respectively thus become, from which we can sample t-test and two sided p-values:

$$\frac{AAR_t}{\sigma_{AAR_\tau}^2} \sim N(0, 1)$$

$$\frac{CAAR(\tau_1 : \tau_2)}{\sigma_{CAAR(\tau_1:\tau_2)}^2} \sim N(0, 1)$$

4 Results

We will first review the results for the largest event window $[-10 : 10]$, encompassing the other two windows, these results are later compared to the short and medium length event windows. Figure 3 illustrates the results for the $[-10 : 10]$ event window, indicating the existence of a market effect from commitment to the SBTi when viewing the entire sample of 615 firms. The daily AAR returns and significance levels for the same event window are presented in table 3 where a clear effect can be seen on the second day after the event day with a 0.54% increase at a 95% significance level for the entire sample. At the event day there is a slight negative effect on the entire portfolio of -0.14% but it can not be established at any significant level.

The table 3 also contains the results for the selected industry specific sub portfolios of the sample, in total the companies in the sub industries corresponds to 366 or 59% of the entire sample. Of the 366 companies, manufacturing firms amount to 276 companies, services to 66 and utilities to 24. For the industry specific portfolios the AAR results can be differentiated, firstly the significant

data point on day 2 for the entire sample is not significant for the industry subsets. Manufacturing has a significant -0.36% return at 4 days prior to the event and 0.28% return 10 days after the event. Utilities has a -0.76% significant return 6 days prior to the event while services has a 4.8% return 7 days after and -0.70% 10 days after the event.

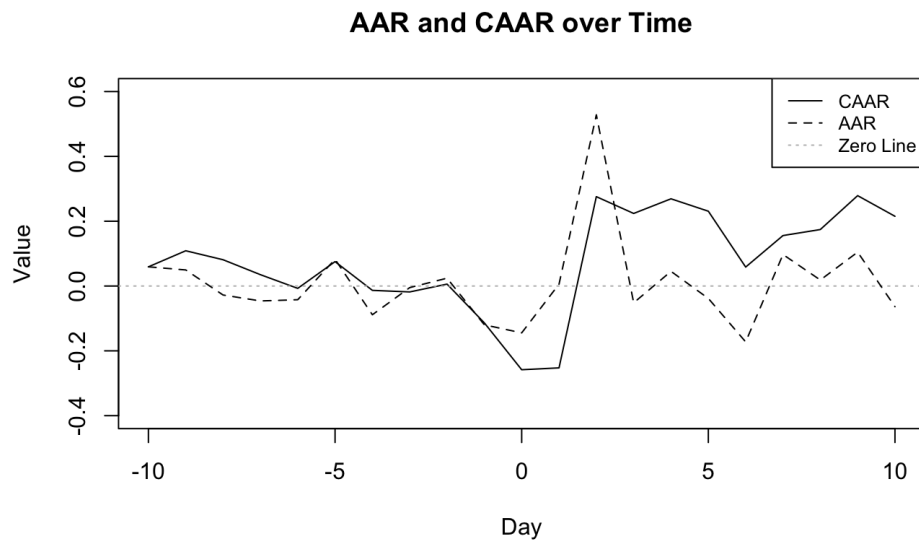


Figure 3: CAAR and AAR for all EU companies over 10 day event window

	All			Manufacturing			Utilities			Services		
Day	AAR	t-stat	p-val	AAR	t-stat	p-val	AAR	t-stat	p-val	AAR	t-stat	p-val
-10	0.06	0.65	0.51	-0.00	-0.02	0.98	-0.05	-0.14	0.89	0.19	0.55	0.58
-9	0.05	0.55	0.58	0.09	0.66	0.51	0.24	0.67	0.51	0.03	0.10	0.92
-8	-0.03	-0.31	0.76	0.01	0.10	0.92	-0.46	-1.25	0.23	0.48	1.42	0.16
-7	-0.05	-0.51	0.61	0.12	0.85	0.40	-0.29	-0.80	0.43	-0.32	-0.95	0.35
-6	-0.04	-0.47	0.64	-0.09	-0.65	0.51	-0.76	-2.08	0.05	-0.05	-0.15	0.88
-5	0.08	0.91	0.36	0.15	1.06	0.29	0.39	1.07	0.30	-0.21	-0.63	0.53
-4	-0.09	-0.98	0.33	-0.36	-2.52	0.01	-0.18	-0.49	0.63	0.17	0.49	0.62
-3	-0.00	-0.05	0.96	0.12	0.84	0.40	0.54	1.49	0.15	-0.41	-1.21	0.23
-2	0.02	0.27	0.79	-0.11	-0.76	0.45	0.31	0.86	0.40	0.05	0.15	0.89
-1	-0.12	-1.32	0.19	-0.16	-1.11	0.27	0.52	1.43	0.17	0.18	0.54	0.59
0	-0.14	-1.60	0.11	0.02	0.11	0.92	0.51	1.39	0.18	-0.41	-1.22	0.23
1	0.01	0.06	0.95	-0.11	-0.77	0.44	0.29	0.78	0.44	-0.20	-0.59	0.56
2	0.53	5.84	0.00	0.14	0.95	0.34	-0.05	-0.13	0.90	0.13	0.38	0.70
3	-0.05	-0.57	0.57	0.13	0.93	0.35	-0.15	-0.42	0.68	0.23	0.68	0.50
4	0.05	0.50	0.62	-0.06	-0.44	0.66	0.29	0.79	0.44	0.01	0.03	0.98
5	-0.04	-0.42	0.67	0.08	0.54	0.59	-0.57	-1.56	0.13	0.49	1.46	0.15
6	-0.17	-1.90	0.06	0.05	0.32	0.75	-0.61	-1.67	0.11	-0.19	-0.57	0.57
7	0.10	1.07	0.28	-0.25	-1.77	0.08	0.17	0.46	0.65	4.80	14.23	0.00
8	0.02	0.21	0.84	-0.10	-0.73	0.46	-0.37	-1.02	0.32	-0.12	-0.35	0.73
9	0.10	1.16	0.25	-0.08	-0.58	0.56	-0.43	-1.17	0.25	0.57	1.69	0.10
10	-0.06	-0.70	0.48	0.28	2.00	0.05	-0.07	-0.18	0.86	-0.70	-2.07	0.04

Table 3: Summary of AAR, t-stat, and p-value by Sector, 21-day event window

The discussed results in table 3 are illustrated in figure 4 highlighting the seemingly stochastic results with few clear patterns or differences between the industry portfolios. In figure 5 the CAAR

values for the same data are illustrated, with similar returns for manufacturing, services and the complete dataset, the outlier is the utilities portfolio with a strong negative CAAR value at day -5 possibly indicating that information has leaked or that the model failed to account for some special effect, the negative effect is then compensated for with the CAAR reaching positive results for the event day and following 5 days for the utilities portfolio.

To understand the significance of the CAAR results presented in 5 a comparison on different event windows and industries is presented in table 4. The utilities and services portfolios have results significant at a 90% level. The utilities portfolio has significant positive returns within the $[-2 : 2]$ and $[-5 : 5]$ windows with a cumulative abnormal average returns of 1.58% and 2.08% respectively. Services on the other hand has significant positive returns within a $[-10 : 10]$ window. The manufacturing portfolio has only negative and non significant returns while the complete sample indicates positive CAAR values for all portfolios, but at non significant levels.

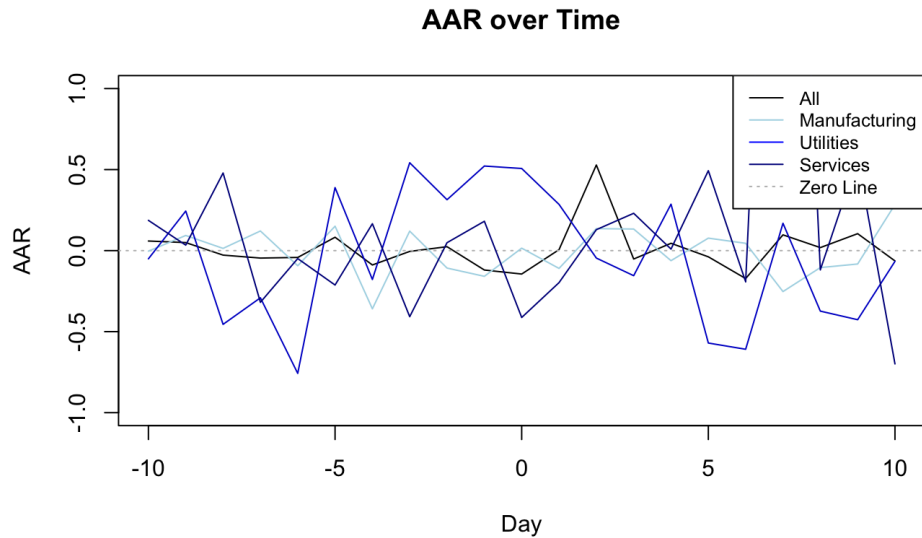


Figure 4: AAR for all companies, Manufacturing, Utilities and Services over 10 day event window

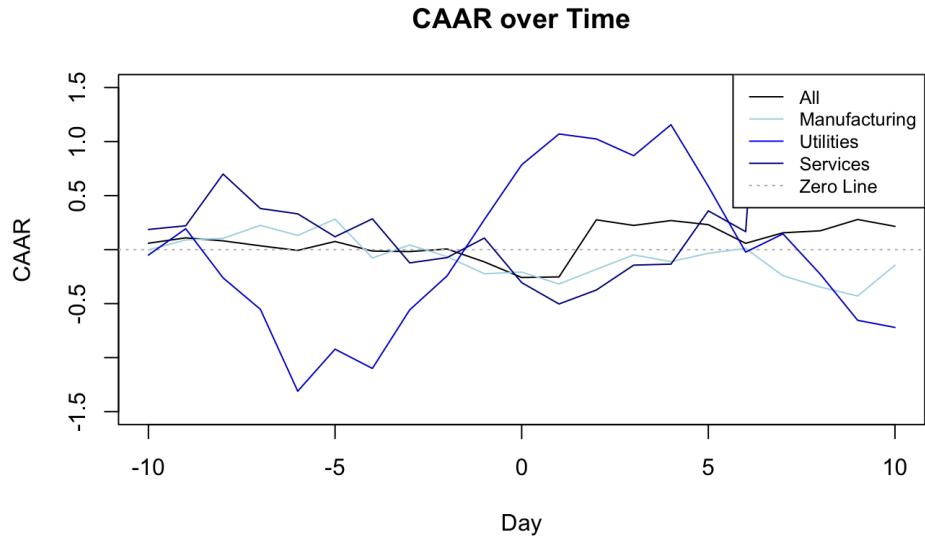


Figure 5: CAAR for all companies, Manufacturing, Utilities and Services over 10 day event window

	CAAR	t-stat	p-val
ALL N = 615			
$[-2 : 2]$	0.29	1.45	0.15
$[-5 : 5]$	0.19	0.71	0.48
$[-10 : 10]$	0.22	0.52	0.60
Manufacturing N=276			
$[-2 : 2]$	-0.23	-0.71	0.48
$[-5 : 5]$	-0.39	-0.92	0.36
$[-10 : 10]$	-0.14	-0.22	0.82
Utilities N=24			
$[-2 : 2]$	1.58	1.94	0.05
$[-5 : 5]$	2.08	1.90	0.06
$[-10 : 10]$	-0.72	-0.43	0.67
Services N=66			
$[-2 : 2]$	-0.25	-0.33	0.74
$[-5 : 5]$	-0.25	-0.25	0.80
$[-10 : 10]$	4.72	3.05	0.02

Table 4: Summary of CAAR, t-stat, and p-value by Sector, 21-day event window

5 Discussion

First the results of the complete sample are discussed and later compared to the industry subsets. The generally low significance levels of average abnormal returns for the entire subset representing an EU market portfolio indicates that either no considerable effect on valuation can be observed by setting SBTi targets or that the models fail to account for some factors, possibly industry. This could be explained by investors not considering commitment to SBTi as a relevant news item to be priced into the asset. Although no sustained nor significant valuation effect is observed when comparing CAAR values, there is an observable and significant peak in AAR on the second day after the event day indicating some reaction to the commitment. There are no significant AARs prior to the event day which indicates that there has been little or no leakage of information that investors react to before the announcement. If we assume SBTi commitment to be considered a positive news item, the findings have support from previous literature. Krüger (2015) found weaker reactions to positive news compared to negative news and Capelle-Blancard and Petit (2019) found no significant effect on valuation from positive news items which could help explain the small effects and low significance levels.

Another explanation is that investors are still unsure about what ESG related factors to act on. As Berg et al. (2022) showed, six prominent ESG ratings still have correlations between them as low as 0.38 meaning that there is an uncertainty in what to incorporate when measuring ESG. If ESG ratings differ that much, investors could have a hard time differentiate between which ESG events that are material and not, thus explaining why few investors react to SBTi commitment. Further, Capell-Blancard and Petit (2019) found that investors do not tend to react to news items coming from NGOs, where SBTi is included. Possibly explaining the low significance measured for both AARs and CAARs values on and around the event day.

When analysing industries however the utilities and services portfolios indicates large positive CAAR values at 90% significance level for two and one period respectively. The positive effect

indicates some effect on valuation. As seen in Table 2, the utilities sector have a high ratio of Total CO₂ emissions to EVIC of 366 compared to other sectors and the complete sample average of 154. It is also governed by the EU Emissions Trading System and would, therefore, be subject to more rigorous scrutiny regarding its environmental efforts (Capell-Blancard and Petit, 2017). Possibly explaining a greater interest from investors and affecting their valuation as a result of SBTi commitment. The firms included in the utilities sector are providers of electricity, natural gas and water and are subject to heavy legislation and a key part of the European Green Deal. In 2019 the European Union adopted new heavier legislation as part of the "Clean energy for all Europeans" package and the share of renewable energy sources are expected to grow from 37% in 2020 to over 60% by 2030 (European Commission, n.d). Considering the extensive legislation and the change in the sector landscape it is feasible that investors care whether the firms of the utilities industry are setting and committing to environmental targets. In addition the sector is subject to a large amount of climate related risks (Gerlak et al., 2018) which would further increase the necessity of having ambitious climate targets.

There is however contradictory information in the results, firstly the utilities have no long term valuation effect as the $[-10 : 10]$ window results indicate negative and non significant returns, possibly indicating that similar to the complete portfolio investors are possibly not pricing in SBTi commitments. Comparing utilities to the similar industry of manufacturing it is surprising that results are different, as both are part of the EU ETS and have a similarly high ratio of Total CO₂ emissions, opening up the discussion of what other, possibly sector specific factors might influence the result. One potential explanation is the relatively smaller sample size of utility companies, with $N = 24$, compared to $N = 276$ for manufacturing. This size discrepancy raises the possibility that the utility sample may not accurately represent the broader market. The same reasoning of low sample size could explain the large effect for the services sector, where significant and high positive abnormal returns were seen within a $[-10 : 10]$ day window, stemming from the significant and extreme positive AAR value at day 7 seen in table 3. The negative and non significant returns on

shorter windows also indicate that the large return could be related to another event rather than the SBTi commitment.

The literature provides arguments for and against low carbon industries having a green premium. Applying the same arguments as for the utilities and manufacturing industries the comparably lower emissions of the service industry, could make commitments to carbon strategies less important for investors compared to the high emitting utilities and manufacturing industries. To be specific, the service industry is currently not included in the EU ETS (Trading Economics, n.d.), meaning that the incentive to decarbonize is lower and the overall lower carbon intensity means that the political risk of becoming included is also small as the financial effect would be smaller than for the high emission sectors. There are however arguments for higher valuations, Bauer et al. (2021) showed that pension owners want to invest in companies serious about SDG strategies even if it hurts financial performance, and Pastor et al. (2022) found evidence that green stocks outperform brown. There are also multiple reports of higher valuations for firms who do ESG reporting (Kahn et al. 2024; Azimli, Cek. 2023)

6 Conclusions

This paper studied the relationship between firms' environmental commitments and their impact on financial markets in an EU context and if there is a difference between industries. An event study methodology was used on 615 EU listed firms with the event day set as the day when the companies announced their commitment to the Science Based Targets initiative and average abnormal returns and cumulative average abnormal returns were calculated. For the full sample the only statistically significant result, at 95% confidence level, was a 0.53% positive AAR two days after the event day. No CAARs were observed for the portfolio of all firms in any of the event windows. Firms from three industries, manufacturing, utilities and services, were selected and investigated separately. Positive and significant CAAR was observed for the utilities portfolio in the

short $[-2 : 2]$ and medium $[-5 : 5]$ windows but not in the long $[-10 : 10]$ window. Manufacturing, also a carbon intensive industry that is included in the EU ETS and subject to carbon tax showed no significant effects on valuation. The service portfolio did measure significant AAR effects on the 7th day, also captured in the $[-10 : 10]$ CAAR event window but showed no effect on valuation on shorter event windows, possibly indicating a separate extreme event not accounted for in the model.

No definite conclusions can be drawn from this paper alone, however the positive AAR on the second day after the event day indicate some investor reaction in relation to committing to the Science Based Targets initiative, although the effect is not persistent over time. Investor uncertainty in regards to what environmental information to act on and prior studies finding small or no reactions to positive environmental news provide explanations to the few statistically significant results on the event day. Different industries are subject to different legislation and scrutiny from the public, and some differences were observed between industries. Most notably manufacturing, however, an expansion of this paper's industry analysis is necessary in order to gain an understanding of how much it differs between industries and why.

6.1 Limitations and Future Research

A limitation of the study is the unequal amount of firms when studying the specific industries. An equal amount of firms would offer greater opportunity for comparison between sectors as well as drawing conclusions from such comparisons. A sufficient amount of firms was used in the analysis of the manufacturing sector (276 firms) and, arguably, for the service sector (66 firms), however only 24 firms was used in the investigation of firms in the utility sector which could be considered a bit scarce. To gain better insights on the conditions of the sector future research would benefit from including more companies in the analysis.

Another improvement of the study could be to control for firm size. It is reasonable to believe that larger companies are subject to more media interest and thus announcing commitment to climate

targets would generate more investor interest and in turn have a larger effect on firm valuation.

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