# THE GREEN TAXONOMY

## AN EVENT STUDY TO EVALUATE THE IMPACT OF EU TAXONOMY ANNOUNCEMENTS ON EUROPEAN SUSTAINABLE COMPANIES

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**Abstract**

This paper examines how sustainable companies based in EU countries react to EU Taxonomy announcements. This is performed using an event study methodology where companies´ share price performances are analysed around three chosen announcement days. The initial assumption was that green firms should generate positive abnormal returns as a result of the announcements. When performing the analysis across the whole EU, results indicate that this holds true for sustainable firms. However, when replicating the analysis for individual EU countries included in the original dataset, the results are less significant with great differences between the countries. In addition, an analysis was conducted with a dataset including only polluting firms. The results indicate that these firms reacted negatively to the taxonomy announcements. The results are consistent with previous event studies analysing regulatory sustainability announcements. To summarize, our results suggest that investors acknowledge the EU Taxonomy despite it being in an early implementation stage, but as significance varies, further analysis is needed to reach a conclusion.

**Keywords**

EU Taxonomy, share price, European stock market, market impact, event study

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# Introduction

In relation to the Paris agreement, the European Union has set a goal of becoming climate-neutral and generating net-zero greenhouse gas emissions by 2050. This target requires all civilians, investors, corporates, and governments to actively pursue activities that are emission neutral or net positive. As a result, corporate sustainability efforts have been an increasingly important factor to consider in valuation processes, and investors interpret superior firm sustainability rankings with lower corporate risk and higher returns (Hartzmark and Sussman, 2019). However, to perform a traditional risk-return analysis, investors need to be able to assess the sustainability commitment of all firms. This includes interpreting CEO sustainability statements, clean versus polluting corporate activities, and thoroughly being able to review sustainability reports. To facilitate this process and enable a successful comparison of companies' sustainability achievements, firms need to report in a comparable format, both in terms of reporting structure and activities' classification. There have been various types of sustainability metric initiatives and reporting standards with the purpose of identifying what is considered green. Several companies have used a mix of these, aggravating the sustainability benchmarking process (Drempetic, Klein, and Zwergel, 2019). The varied reporting formats and lack of a uniform sustainability definition slow down the flow of capital towards green investments, and there is an urgent need for a homogenous sustainability classification of economic activities (European Commission, 2019).

To address this issue, the European Commission has created the first standardized framework for sustainable economic activities, called the EU Taxonomy. By presenting rules and definitions that determine what economic activities are considered sustainable, this tool aims to facilitate the classification of such activities (SP Global, 2022). As a result, the taxonomy helps market participants to identify and compare environmentally sustainable investments (Regeringen, 2022). However, with numerous sustainability reporting frameworks already in place, for example GRI framework and the GHG/Kyoto protocol, the question is how investors will react to the news of yet another reporting standard (Drempetic et al., 2019). This derives the aim of this study.

This study aims to investigate how sustainable companies react to announcements related to the development and implementation of the EU Taxonomy. Specifically, the study aims to answer the following research question:

*Q: Do announcements regarding the EU Taxonomy framework generate abnormal returns for sustainable companies within the European Union?*

This study provides insightful discussions as, on one hand, one can assume that sustainable firms will benefit from green policies and therefore generate positive abnormal returns. On the other hand, the new regulation might cause stress for these firms since the taxonomy requires additional disclosure and intensified corporate sustainability efforts. Despite the firms potentially benefiting from increased transparency, it can be time- and energy consuming to implement the legislative requirements into the business and its reporting. The trade-off between the increased reporting efforts and the potential benefits from being able to transparently reflect firms' superior sustainability performance raises questions. The ambiguity regarding how companies *should* react is also elaborated on in previous research, where the derived results have been mixed. Ramiah, Martin, and Moosa (2013) found results indicating that certain polluting industries reacted positively to news regarding green policies, while a few green industries reacted negatively. Hamilton (1995) on the other hand, showed that news about environmental regulations lead to positive abnormal returns for firms with high environmental standards and negative abnormal returns for other companies. The mixed results suggest that additional analysis is needed to further understand how firms react to sustainability announcements. This study builds on previous analysis, aiming to provide new insights in this field.

The study was conducted through an event study, a methodology widely used in research reports aiming to analyse abnormal returns of financial securities as a result of unexpected events (Armitage, 1995). In detail, this study analysed a selected set of sustainable companies in Europe by examining share price performance surrounding the dates of interest. Three dates were chosen, all of them representing public announcements that convey important information regarding either the development or the implementation of the EU Taxonomy. According to the efficient market hypothesis, developed by Fama in 1970, this new information should be accounted for immediately in the share prices. The market model was used to calculate firms´ expected returns and by subtracting this from the retrieved actual returns, abnormal returns were derived. To test whether abnormal returns occurred during the event window, both parametric and non-parametric significance tests were conducted.

Our findings show that positive abnormal returns exist during the event window analysed for the three dates. This indicates that the green companies reacted positively to the EU Taxonomy announcements. The results show that the date 28 February 2022 had the largest positive impact on market performance, whereas the other two dates exhibited weaker results, including some negative firm reactions. This is consistent with Ramiah et al. (2013), who observed both positive and negative abnormal returns for green industries to green policy announcements. To further deepen the analysis, polluting firms within the oil- and gas industry were examined. The results from this analysis were not significant for the event window chosen in this study. However, when looking at other event windows. one could observe significant negative market reactions to the announcements.

Our findings are important for several reasons. First, this study shows that a governmental regulation still under development can cause significant market reactions. Second, by examining a more recent time horizon than previous studies, this study considers society's current view on regulatory sustainability matters. In addition, as the EU Taxonomy is still under development, this study may facilitate future studies focusing on, for example, taxonomy implementations and reactions to the EU Taxonomy in its entirety.

# The EU Taxonomy

*The aim of this chapter is to provide the reader with sufficient information and background of the EU Taxonomy to be able to follow the logic behind the study's purpose and reasoning throughout the report.*

## Background

In December 2015 at the Paris climate conference, the first-ever legally binding global climate change agreement was adopted, commonly known as the Paris Agreement. The agreement is a global framework that aims to mitigate the increase in global average temperature to below two degrees Celsius. The agreement became one of the driving forces toward the development of other sustainability frameworks and regulations. To reach the targets set up in the Paris Agreement, various objectives concerning emission reduction were decided on. Despite these efforts, global greenhouse emissions have continued to increase (TEG, 2020). This is one of the reasons why the EU Commission deemed it necessary to create a revised and more ambitious strategy to address climate change. This ambition has resulted in what is now commonly known as the EU Taxonomy, a framework with the aim to promote sustainable investments (European Commission, 2022).

## EU Taxonomy in practice

According to the EU Taxonomy, firms are from the year 2022 obliged to disclose their share of taxonomy-aligned activities in a percentage figure. As this is reported in a standardized format, the taxonomy makes it possible to compare companies and investment portfolios with regard to their sustainability achievements. This leads to investors being able to make more informed decisions, which facilitates investments in companies with a large proportion of sustainable activities. As a result, the EU Taxonomy will function like a transparency tool, aiming to reorient capital flows towards a more sustainable economy.

Taxonomy-aligned activities refer to economic activities that have been defined as sustainable according to the Taxonomy Regulation by meeting the following four conditions:

1. Contribute substantially to at least one of six environmental objectives listed in Taxonomy
2. Do no significant harm to any of the other objectives
3. Complying with minimum social and governance safeguards
4. Complying with the technical screening criteria

The technical screening criteria specifies the requirements that need to be fulfilled for an activity to make a *substantial contribution* and do no *significant harm*. Together, these criteria ensure that the objectives in the EU Taxonomy are coherent, and that the progress towards one objective is not made at the expense of another.

The six environmental objectives listed in the Taxonomy are the following:

1. Climate change mitigation
2. Climate change adaptation
3. Sustainable use and protection of water and marine resources
4. Transition to a circular economy
5. Pollution prevention and control, and
6. Protection and restoration of biodiversity and ecosystems

There are three groups that must adopt the taxonomy and these groups are defined as follows:

1. Financial market participants offering financial products in the EU, including occupational pension providers
2. Large companies (over 500 employees) who are already required to provide a non-financial statement under the Non-Financial Reporting Directive (NFRD); and
3. The EU and the Member States, when setting public measures, standards, or labels for green financial products or green (corporate) bonds (TEG, 2020).

In practice, the companies affected by the taxonomy must disclose the share of total turnover and CAPEX (OPEX if relevant), that can be considered sustainable in accordance with the six environmental objectives. The uniform reporting framework structure makes the taxonomy the first-ever common measurement tool. By reporting sustainable activities as a percentage figure of turnover, it provides investors with an understanding of the company's green efforts and its alignment with the taxonomy as of today. CAPEX, on the other hand, shows the direction in which a company is headed, as the investment activities are usually long-term commitments. This allows investors to assess the reliability of the firm's strategy and to determine if the strategy coincides with the one of the investors (TEG, 2020). The disclosure of these proportions of turnover and CAPEX aligned with the Taxonomy should form part of the non-financial statement and may be presented in the annual report or an explicit sustainability report (TEG, 2020).

The first two of the six objectives were mandatory to disclose in January 2022, and the remaining four objectives will become mandatory to disclose in January 2023 (European Commission, 2022).

# Literature Review

*This section describes previous research related to this study, including previous event studies conducted on environmental regulatory announcements. The aim of this section is to motivate what gap our study fills in the existing literature, as well as providing context to our study.*

Previous studies have examined the impact of regulatory sustainability announcements on listed firms, with mixed results.

Klassen and McLaughlin (1996), Hamilton (1995), and White (1995) have all conducted event studies examining environmental regulations. They showed that news about environmental regulations lead to positive abnormal returns for firms with a high environmental standard and negative abnormal returns for companies with a lower environmental standard.

Rogova and Aprelkova (2020), examined the impact of sustainability-related IPCC (Intergovernmental Panel on Climate Change) announcements on U.S. public companies by conducting an event study. Their results indicated that abnormal returns were generated as an effect of the announcements, but that this was valid for both green and polluting industries.

Guo, Kuai, and Liu (2020) performed an event study, over the period 2014-2017, examining how announcements of newly released environmental regulations in China affected the stock performance of the companies affected by the policy. Their result proved that heavily polluting firms´ stock returns were affected negatively by the announcements of new environmental policies. This was confirmed by Ramiah et al. (2013), who utilized an event study methodology to analyse how firms listed on the Australian stock exchange reacted to the announcement of green policies. The study proposed that polluting industries would experience negative abnormal returns and that the opposite would occur for environmentally friendly firms. However, the study found that some polluting industries reacted positively, and some green industries reacted negatively, in other words, the results were mixed and inconsistent with their hypothesis. The study concluded that this could be a result of the environmental regulations being inefficient.

All the studies mentioned above show that there have been previous efforts within the field of regulatory sustainability announcements and market reactions. However, the results have been mixed and consensus has not been reached. Given the theoretical and empirical ambiguity regarding environmental regulations and stock returns, more research is required. This study will contribute to the existing literature by offering some new perspectives on the topic. First, the environmental regulation being examined is an extensive framework as it affects many countries in Europe. This study includes many of these nations. This broadens our scope compared to previous literature, as this is one of the few cross-country analyses conducted in the field, and specifically unique in examining developed EU-member countries. Second, the EU taxonomy is still under development, with the natural follow-effect that research is very scarce regarding the topic. In other words, this study can contribute to starting to fill this gap in the existing literature. As a final note, this study differs from most of the previous studies by looking at a more recent time horizon, 2021-2022. There is a great probability that both attitudes and actions have changed regarding sustainability topics during recent years.

# Theory

*In this section, various theoretical concepts within the fields of finance and economic theory are presented. The aim is that by including these short chapters, the reader will get a basic knowledge of the most important concepts that will be touched upon later in the discussion and analysis.*

## Greenwashing

The increasing focus on sustainability has been followed by the phenomenon of greenwashing, a term coined by Jay Westerveld in 1986. The phenomenon refers to the combination of positive communication concerning environmental performance and poor actual environmental performance (Delmas and Burbano, 2011). Mitigation of greenwashing is one of the aims of the EU Taxonomy since a common reporting standard impedes firms from communicating misleading information regarding their sustainability efforts (European Commission, 2022).

## Sustainability and Firm Performance

According to Hahn and Figge (2011), sustainability is defined as *"meeting our needs today without compromising future generations' ability to meet theirs"*. Corporate sustainability concerns the need for companies to not only focus on short-term financial performance but to also implement a long-term strategy emphasizing future sustainable development. Corporate sustainability has gained a lot of attention in recent years, as market participants have become more aware of the current environmental challenges. Furthermore, markets have become increasingly competitive and, to stay ahead of the competition, sustainability has almost become a must rather than a choice (Alshehhi, Nobanee, and Khare, 2018).

The issue that researchers fail to agree on is how sustainability impacts corporate financial performance. Various researchers have tried to answer this question, and the two most famous competing theories are the value-creation theory and the value-destroying theory. The value-creation theory implies that when a firm integrates sustainable responsibilities, it reduces the firm risk. Evidence exists that markets praise companies who are classified as having superior sustainability performance on the back that green operations are assumed to decrease risk and generate higher returns (see e.g., Statman (2006) or Gallego-Álvarez, Segura and Martínez-Ferrero, (2015)). The value-destroying theory, on the other hand, theorizes that further focus on environmental and social responsibility leads to companies focusing less on profitability. Another theory that supports the value-destroying view is the trade-off theory which suggests that resources allocated towards sustainable activities imply less resources allocated towards profitable activities. This causes a negative relationship between sustainable activities and financial performance (Endrikat, Guenther, and Hoppe, 2014).

Other theories that support the value-creation view are the stakeholder theory and the resource-based view theory. According to the stakeholder theory, meeting stakeholders' demands regarding both environmental and social aspects increases financial performance (Russo and Foutsm, 1997). The resource-based view suggests that by incorporating sustainability, companies may gain competitive advantages that contribute to increased financial performance (Russo and Foutsm, 1997).

Some studies have found a negative relationship between environmentally unfriendly behaviours by companies and market performance (see e.g., Hamilton (1995) or Capelle-Blancard and Laguna (2010)). This is consistent with other studies showing a positive relationship between environmental protection behaviours and market performance (Nehrt, 1996).

## The Impact of Sustainability Regulations on Firm Performance

According to the traditional view which originates from neoclassical economics, governmental regulations have a negative impact on firm performances. Even though the regulations might be beneficial from a societal or environmental perspective, it is argued that they damage businesses from an economic point-of-view (Ramanathan, He, Black, Ghobadian, and Gallear, 2017). More recent research agrees that some regulations may impact firms negatively. However, if the regulations are designed and executed properly, they can have a positive impact on firm performance and enhance competitiveness. By introducing regulations that put pressure on companies, further innovations in the field may be motivated.

Porter and Van der Linde (1995) argue that companies spend too much money fighting new regulations when instead, that money and time could be spent on enhancing the business. More focus on legal disputes than corporate development may decrease competitiveness, especially if other firms accept the regulatory change and focus their efforts on continuing to innovate (Porter and Van der Linde, 1995). Furthermore, the Porter hypothesis, also called the win-win scenario, suggests that efficient environmental regulations can increase social welfare as well as firm performance (Porter, 1991).

## The Efficient Market Hypothesis

According to the efficient market hypothesis (EMH), the price of an asset should reflect all available information. If the financial market is efficient, which the EMH assumes, newly available information will immediately be fully reflected in asset prices. Furthermore, this implies that changes in asset prices will occur randomly. If one cannot foresee *when* new information becomes available, the corresponding changes in asset prices will also be impossible to predict. In other words, the efficient market theory is closely related to the Random Walk Theory which states that future price changes are random and independent of previous prices (Burton, 2003).

There are some studies supporting the EMH. Burton (2005) showed that professional investment managers could not outperform their massive index funds. In other words, the study proved that market prices are rational, unpredictable, and seem to reflect all available information. Another example is the study conducted by Allen, Brealey, and Myers (2011) which showed that today´s stock return will not influence tomorrow´s stock return and therefore confirms return independence which is an underlying assumption of the EMH.

However, there are some researchers that have found instances where the efficient market hypothesis fails to hold. Some studies argue that asset prices tend to overreact to certain events and new information. According to DeBondt and Thaler (1995), all market participants, including investors, experience feelings of optimism and pessimism. As a result, asset prices might deviate from their actual values and the market is not efficient as assumed in the efficient market hypothesis. This overreaction is supported by Eakins and Mishkin (2012) who argue that this overreaction is especially prominent in the announcements of unexpectedly bad news. According to Battalio and Mendenhall (2005), the market also tends to under-react which their study proved by showing how financial announcements often were underestimated by investors. Some criticism of the EMH originates from behavioural finance and regards the irrationality of market participants and the inability to make a correct judgment. One example is Shiller (2000) who observed herd behaviour among market participants. Another example is the study by Battalio and Mendenhall (2005) who argue that due to accumulated loss, investors do not sustain a short position in mispriced assets, causing asset bubbles.

## Behavioural Finance

One of the main underlying assumptions of the efficient market hypothesis, as described above, is that all market participants act rationally. There have been studies both confirming and opposing this assumption, but the issue becomes particularly important to discuss in this study with regard to the recent crisis. The covid-19 pandemic was present during most of the estimation periods used in this study and began to subside only in the beginning of 2022. The last date chosen in this study might not be impacted by the pandemic but instead took place during the first phase of the ongoing war in Ukraine. Hence, it is reasonable to state that the market reactions examined in this study have taken place in times of crisis, which needs to be considered. In times of crisis, the uncertainty is viewed as a risk that the market needs to react to. This uncertainty, combined with scarce information and loss of control, impacts the investment decisions of market participants. The decisions become more short-sighted as urgent psychological needs are being prioritized above long-term needs (Markman, 2020). For example, evidence shows that risk aversion increased during the covid-19 pandemic (Mussio, Andrés, and Kidwai, 2022).

## Event Study Analysis

The event study methodology is an increasingly used concept and is today considered to be the standard approach when evaluating stock price effects across a variety of events (Binder, 1998). Within the field of finance and accounting, the methodology is applied to numerous happenings, such as M&A announcements, stock splits, debt issuance, and earnings announcements. The purpose of the methodology has mainly been twofold. The first purpose has been to test if the market is efficient in its incorporation of information (Fama, 1991). The second purpose, under the assumption that the market is efficient, has been to evaluate the effect on the market capitalization of a firm (Binder, 1998). The abnormal returns are measured over an event window that should stretch over the entire period where one could expect a reaction in stock price for a given event that is previously unknown to the market. This could for example be the release of new information that could be expected to impact a firm in a certain way. One common example is M&A announcements, where unexpected acquisitions most often generate large market reactions (Lamdin, 2001). The event study methodology is recognized as a particularly powerful tool when there is no uncertainty regarding what date the market altered its expectations. In other words, if one can clearly define the date when the news reached the market, this enables a more precise analysis (Campbell, Lo and MacKinlay, 1997).

Event studies do not consider scenarios where information is leaked to the public prior to the event date (McWilliams and Siegel, 1997). However, for regulatory events, the event might already be anticipated by the market to some extent (Kothari and Warner, 2007). For this reason, event studies on regulatory announcements differ from other studies with one well-defined announcement such as stock splits or earnings announcements.
Upcoming regulations have most likely been debated during a longer time horizon prior to their implementation. It is also possible that the implementation process occurs gradually. This is the case for the EU Taxonomy, which in turn would also increase predictability (McWilliams and Siegel, 1997).

Furthermore, the event study methodology disregards the fact that there may be confounding effects taking place during the chosen event window. For example, if an event window stretches over a longer time horizon, there may be clustering effects as more than one event occurs and cause abnormal returns during the examined period (Campbell et al. 1997). There exist further potential issues around the length of the event window. For example, announcements may cause market reactions spread over more than one event day. In other words, there may be ambiguity about whether the market recognizes all the new information during trading hours on the chosen event day or if the reaction spreads over several days. To solve this problem, it may be appropriate to not only examine abnormal returns for the announcement day, but for the following day as well (Campbell et al. 1997).

# Methodology

*This section provides a description of the methodology used in this study. The methodology is inspired by the steps presented by Campbell et al. (1997). Thereafter, the hypotheses are presented as well as a description of the statistical tests used.*

## Event Definition

The first step of the event study is to define the events to be examined. There are various events to consider, as the EU Taxonomy has been successively developed and gradually released. As such, there are numerous dates that are important for the process.

Three different dates were chosen which were all believed to have an impact on the companies examined in this study. These represent dates when new information regarding the EU Taxonomy became public, for example through report releases. The reason why the announcement dates have been chosen rather than the actual implementation dates is because the market is expected to react when new information becomes available, as per the EMH. This is further strengthened by Wang, Delgado, Khanna, and Bogan (2019). They showed that the stock market is more sensitive to announcements conveying information about the planning of an activity rather than the actual implementation of the activity.

*21 April 2021*
The first date chosen is 21 April 2021. This marks the date when the College of Commissioners reached a political agreement on the text of the Delegated Act, which clarifies the economic activities that contribute to meeting the European Union's environmental objectives (European Commission, 2021). Even if the act was formally adopted on 4 June 2021, the announcement that the act had been approved was expected to have a larger impact on share price than the formal adoption.

*9 December 2021*
The second date, 9 December 2021, marks the date when the EU Taxonomy was approved. On this date, the Delegated Act on Climate Mitigation and Climate Adaptation approved the final steps of the regulatory implementation and accepted that the EU Taxonomy would become mandatory as of 1 January 2022. This announcement confirmed to market participants that large corporations (>500 employees) would now have to report their taxonomy alignment in their annual reports for the fiscal year 2021 (European Commission, 2022).

*28 February 2022*
28 February 2022 represents the release date for the social taxonomy report, published by the platform on Sustainable Finance. This report includes objectives such as *decent work, adequate living standards* and *inclusive and sustainable communities* (CSR Europe, 2022). The reason why announcements on the social taxonomy would affect green companies in particular is because the social taxonomy does not only aim to respect human rights and

improve working conditions. Its objective is also to ensure that when companies move towards greener operations, it is not done at the expense of workers and communities. Therefore, the release of this taxonomy is relevant to consider for green firms (Havard-Williams, Barret, Naeem, Bernard, Ballegeer and Winter, 2022).

## Company Selection Criteria

The second step involves deciding the selection criteria for the firms included in the different analyses.

**EU-wide Analysis**

The starting point in the company selection process was the screening tool provided by Capital IQ. Three screening criteria were used: *Company type*, *Geographic location*, and *Industry classification.* Company type was set to only include public firms. The geographic location was set to European Union member countries, since these are the countries affected by the EU Taxonomy. These countries were narrowed down to only include developed countries. The reason for this was to increase comparability of the dataset, as operations of companies within similar industries may vary depending on the company operating in a developed or emerging market. After removing some countries due to insufficient data, we were left with 15 countries (Appendix A1). Norway, despite not being officially affected by the EU Taxonomy, has been included in the dataset. This is because Norway is usually an adopter of EU regulations, and the assumption has been made that this is the case for the EU Taxonomy as well (UK Parliament, 2013). Regarding industry classification, only clearly environmentally friendly sectors were looked at, such as renewable electricity and environmental services. This resulted in a dataset consisting of 88 companies.

**Country-specific Analysis**

Even if all countries analysed in the study above are classified as developed countries, there may still exist great differences between the different countries regarding for example culture and governance. Therefore, a few country-specific analyses will be conducted to investigate these potential differences. The individual countries for these analyses have been screened based on their EPI results for 2020, which provides information regarding the countries´ environmental performances. We started top-down, choosing countries that met the following two requirements: 1) Being part of the EU, and 2) having a sufficient number of companies for the analysis (≥ 10). The countries chosen were Sweden (15 companies), Germany (16 companies), and Spain (10 companies), shown in Appendix A2-A4. The country-specific analysis can be considered as a robustness test for the analysis described above since the same dataset is used, but this time tested in smaller parts. There exist gaps in the countries' EPI score ranking, with Sweden at #8 Germany at #10, and Spain at #14 (Yale, 2020). Therefore, the country-specific analyses will also provide an interesting addition as they test whether national sustainability performance causes differences in firm reactions to the EU Taxonomy.

**Polluting companies**

Lastly, for further insights, an analysis has been conducted on the companies on the other side of the spectrum, the polluting firms. The selection process for these companies was also based on the screening tool in Capital IQ. The criteria company type and geographical location used were the same as for the previous analyses but instead of choosing green industries, industries related to oil and gas were chosen. Just as before, only developed countries in the EU were included and after removing some countries due to insufficient data, 14 countries remained, listed in Appendix A5. The dataset consists of 44 companies.

## Event Window

When deciding on the appropriate event window, there are many things to consider and one technical requirement; the actual abnormal returns should be captured in the chosen event window (Sethi and Krishnakumar, 2010). With that being the only technical requirement, there is no clear consensus on how the event window should be defined, and therefore, event windows often vary in length. Binder (1998) provides examples of studies with event periods covering several months. Campbell et al. (1997), on the other hand, describes that for announcements with daily data, an event window of the event date plus an additional day post the event day is sufficient. Shleifer (2000) argues that changes in stock price can occur before the actual announcements due to market anticipation or information leaks, and therefore argues to include one day prior to the event day in the event window.

There are some potential advantages to having a shorter event window. For example, it reduces the risk of having other events occurring within the event window, also affecting share prices (Konchitchki and O'Leary, 2011). Furthermore, a shorter event window may increase the statistical precision of the calculated abnormal returns (Andrade, Mitchell, and Stafford, 2001). Lastly, a shorter event window can make it easier to identify abnormal returns (Armitage, 1995).

For the purpose of this study, the event window has been defined as three days surrounding the event day. The event window constitutes three days prior to the event ($\tau = -3$), the event day ($\tau = 0$), and three days after the event ($\tau = +3$), yielding a total event window of seven days. The reason why the event window is defined as (-3, +3) is due to the characteristics of the announcement. Upcoming regulatory changes are usually partly known to the public prior to their release date. However, by including too many days, the risk of confounding events increases. Therefore, we have chosen an event window between Binder (1998), Shleifer (2000) and Campbell et al. (1997), corresponding to one week. This allows us to prevent event conflicts while still being able to examine behaviours surrounding the event date (MacKinlay, 1997).

## Market Return

When conducting the EU-wide analysis of green companies and the analysis of polluting companies, the MSCI Europe index has been used as a market benchmark. This index represents large and mid-cap companies across 15 developed countries in Europe (MSCI, 2022).

The country-specific analysis has been conducted using country-specific indices. For the Swedish analysis, the OMX30 index was used. This index comprises the 30 largest Swedish companies, measured by market capitalization (Nasdaq, 2022). For the analysis of German companies, the FTSE Germany index was used. This is also a market capitalization-weighted index, and it comprises all German stocks, including small, medium, and large-cap (FTSE Publications, 2022). Finally, the MSCI Spain index was used to measure market returns for the Spanish market. The index measures mid-and large-cap companies in Spain and covers approximately 85% of the Spanish equity markets (MSCI, 2022).

## Normal and Abnormal Returns

According to Campbell et al. (1997), the abnormal return is defined as the actual return minus the normal return over the event window. The normal return is the return that one would expect during that period in absence of the event in question.
Denoting the event date $\tau$, and each firm i, the following equation can be derived:

$$AR_{i\tau} = R_{i\tau} - \mathrm{E}(R_{i\tau} \mid X_{i\tau}) \qquad \text{(Eq. 1)}$$

where $AR_{it}$ is the abnormal return, $R_{it}$ is the actual return and $\mathrm{E}(R_{i\tau})$ is the normal return for the time period t. $X_{i\tau}$ constitutes the constraints in the model of normal performance. The actual returns can be empirically observed but the normal (expected) return must be estimated. The normal return can be estimated in different ways, with the two most common models being the market model and the constant-mean-return model. The market model posits that the market return and the security return have a steady linear relationship and, in that model, $X_{i\tau}$ is the market return. The constant-mean-return model assumes that a security's mean return remains constant throughout time and therefore, $X_{i\tau}$ is a constant in that model.

In this study, the market model has been applied which builds on the correlation of the firm's return with the return of the market portfolio. By using this model, the firm's individual CAPM risk is considered by multiplying the firm individual $\beta$ factor by the market return. Hence, the following formula is derived:

$$\mathrm{E}(R_{i\tau}) = \alpha_i + \beta_i R_{mt} + \varepsilon_{it} \qquad \text{(Eq. 2)}$$

$$\mathrm{E}(\varepsilon_{it}) = 0 \qquad \text{(Eq. 3)}$$

$$\text{Var}\ (\varepsilon_{it}) = \sigma^2_{\varepsilon i} \qquad \text{(Eq. 4)}$$

Where E($R_{i\tau}$) is the expected return of security i on day t. $R_{mt}$ is the return of the market portfolio on date t which is also the reference market. For the market portfolio, the index used is adapted per market, as described above. $\varepsilon_{it}$ is the zero mean disturbance term and is expected to be zero and with finite variance. The parameters of the market model are $\alpha_i$, $\beta_i$ and $\sigma^2_{\varepsilon i}$. $\beta_i$ is the regression coefficient and measures the sensitivity of $R_{i\tau}$ on the market portfolio.

Below is an extract from using the *rangestat (reg)* function in STATA for the EU-wide dataset. A regression line is assembled using b_cons, b_market_return, and market_return. By using this equation for every data point, expected returns ($E(R_{i\tau})$) can be computed throughout the estimation window.

**Regression extract from Europe-wide analysis**

| company_id | reg_nobs | reg_r2 | reg_adj_r2 | b_market_r~n | b_cons | se_market_~n | se_cons |
|---|---|---|---|---|---|---|---|
| ATSE:TENERGY | 120 | .05146882 | .04343042 | .51170576 | .00029012 | .20222415 | .00214273 |

*Table 1*

By using the market model described above, the formula for the abnormal return can be derived as follows:

$$AR_{i\tau} = R_{i\tau} - E(R_{i\tau}) \qquad \text{(Eq. 5)}$$

## Estimation Period

In order to estimate the expected return E($R_{i\tau}$ ) of the portfolio's stocks, normal returns are registered during a defined estimation period. Campbell et al. (1997) suggest using a period prior to the event. The estimation period is determined to begin approximately one month before the event day, denoted $\tau = -23$, and end at $\tau = -142$, representing an estimation period of 120 trading days (-142, -23). The event window is not included in the estimation period to avoid the event impacting the calculation of normal performance.
The period (-23, -3) has also been excluded from the estimation period, constituting a safety margin to the event window. By including this safety margin, potential information leakages regarding the event are excluded, that could otherwise impact normal returns.

**Timeline for estimation period and event window**

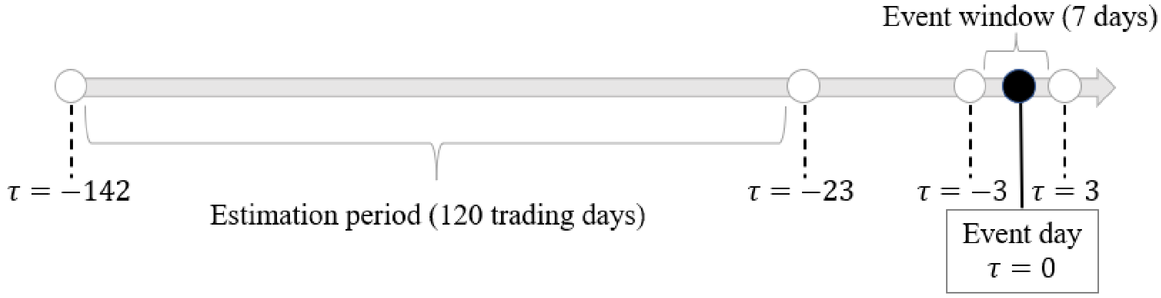


*Figure 1*

# Hypothesis

Based on the previous literature and theories, our assumption is that green companies will react positively to announcements regarding the EU Taxonomy. The positive reaction is measured as the existence of positive abnormal returns. Based on the same reasoning, it is likely to assume that non-green companies will react negatively to these announcements and experience negative abnormal returns. Therefore, the study will examine whether the cumulative average abnormal returns (CAARs) are statistically different from zero. From this, a more qualitative reasoning around a positive or negative mean CAAR is conducted.

The null hypothesis and the alternative hypothesis are described as:

$H_0$: *CAAR = 0*
$H_1$: *CAAR ≠ 0*

# Testing Procedure

In total, five analyses will be conducted, all using the same testing procedure. The dataset for the EU-wide analysis consists of 88 companies and since there are three events being examined, this results in 264 observations (88*3). The Swedish dataset consists of 15 companies and a total of 45 observations (15*3). The German dataset consists of 16 companies and a total of 48 observations (16*3). The Spanish dataset consists of 10 companies and a total of 30 observations (10*3). The dataset for polluting companies consists of 44 companies and a total of 132 observations (44*3).

Using the market model and the software STATA, the abnormal return is calculated for each of the days within the event window for our selected companies and events. The abnormal return over the event window is interpreted as a measure of the impact on the firm's return from the event and is defined previously in the study (Eq.5).

If $AR_{i\tau} > 0$, the event has a positive impact on firms’ share prices on the specific day analyzed
If $AR_{i\tau} = 0$, the event has no impact on firms’ share prices on the specific day analyzed

If $AR_{i\tau} < 0$, the event has a negative impact on firms' share prices on the specific day analysed

First, the average abnormal return (AAR) is calculated, representing the mean of the cross-sectional average abnormal return at the time period $\tau$ (Eq. 6). The AAR conveys information about the impact on all the firms combined at a specific date t. Thereafter, the AAR is tested for significance. An average abnormal return that differs significantly from zero implies that the companies react to the examined events.

$$AAR = \frac{1}{N}\sum_{i=1}^{N} AR_{i,\tau} \qquad \text{(Eq. 6)}$$

According to Mackinley (1997), it is important to aggregate the abnormal returns since tests with single events are less useful when drawing overall inferences. Thus, the individual abnormal returns are summed up, generating cumulative abnormal returns. This measures an event´s total impact over the event window. The equation is as follows:

$$CAR_{(t1,t2)} = \sum_{t=t1}^{t2} AR_{i,\tau} \qquad \text{(Eq. 7)}$$

where $t_1$ and $t_2$ are defined as days within the event window.

The cumulative average abnormal return (CAAR) can be calculated by either deriving the average of the cumulative abnormal returns (Eq. 8) or by summing up average abnormal return (Eq. 9).

$$CAAR = \frac{1}{N}\sum_{i=1}^{N} CAR_i \qquad \text{(Eq. 8)}$$

$$CAAR = \sum_{t=t1}^{t2} AAR_\tau \qquad \text{(Eq. 9)}$$

There are various significance tests being covered in the literature on event-study hypotheses testing. There are two common classifications of these tests, namely parametric and non-parametric tests. The difference between them is that the abnormal returns of the individual firm are assumed to be normally distributed according to parametric tests (Eventstudytools, 2022). According to Corrado (1989) and Corrado and Truong (2008), abnormal returns are likely to show a positive skewness and high kurtosis which contradicts the assumption of them being normally distributed. Because of this, the parametric t-statistics may be biased, which is why in this study a non-parametric rank test will be carried through to complement the parametric t-test. More specifically, the Wilcoxon signed-rank test, developed by Wilcoxon in 1945, will be conducted which considers both the sign and the magnitude of the abnormal returns (Eventstudytools, 2022).

To test if the abnormal returns are statistically significant, a one-sample t-test has been conducted. The t-test assumes independent data points and that the data follows an approximate normal distribution. It is under these assumptions that STATA calculates the t-statistic and its p-value.

According to the decision rule, the null hypothesis $H_0$: CAAR = 0 can be rejected if $|t_{ratio}| > t_{critical}$ or if the p-value < 0.05. Since the test is being conducted at a 5% significance level, $t_{critical}$ equals 1.960. Followingly, $H_0$ is rejected if $|t_{ratio}| > 1.960$. If the null hypothesis cannot be rejected at the 5% level, we examine if it may be rejected at the 10% level. This occurs when the p-value < 0.1, with rejection of the null hypothesis if $|t_{ratio}| > 1.645$.

The $|t_{ratio}|$ is calculated as follows:

$$|t_{ratio}| = \frac{CAR}{SE(CAR)} \tag{Eq. 10}$$

CAAR originates from Eq. 8 or Eq. 9. SE(CAAR) denotes the standard deviation.

# Results

*This section presents the empirical results of the study. First, the EU-wide analysis is presented followed by the country-specific analyses, and lastly, the analysis of the polluting firms is presented. Each analysis is followed by a summary of the most important takeaways.*

## EU-wide Analysis

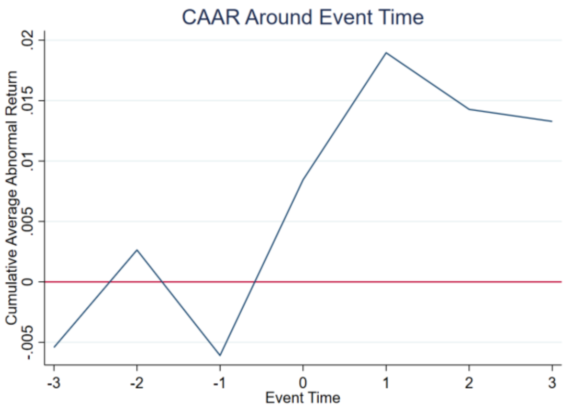


*Figure 2*

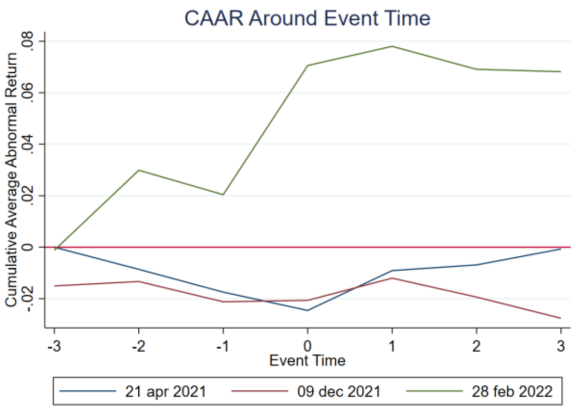


*Figure 3*

Both Figures 2 and 3, plot the CAAR on the Y-axis and the days within the event window on the X-axis (-3,3). The difference between the graphs is that Figure 2 shows the CAAR for all three events aggregated while Figure 3 shows the CAAR for each event separately. As presented in Figure 2, the CAAR becomes positive right before the event day and remains positive throughout the event window. This indicates that the companies had a positive reaction to the announcements related to the EU Taxonomy. Figure 3 shows that the CAAR was positive for the entire event window for the date 28 February 2022. The other two dates show negative abnormal returns for the entire event window.

When conducting a t-test (Table 2), it is shown that the CAAR is separated from zero at a 10% significance level across all three events during the event window since the p-value is 0.064. Therefore, the null hypothesis: $H_0$*: CAAR = 0* can be rejected, but only at a 10% level. Furthermore, as the abnormal returns are above zero, it supports our belief that the sustainable firms were positively impacted by the announcements.

**One-sample t test for Cumulative Average Abnormal Returns**

| | obs | Mean | St Err | t value | p value |
|---|---|---|---|---|---|
| Day -3 to 3 | 264 | 0.013 | 0.007 | 1.859 | 0.064 |

*Table 2*

To deepen the analysis, various event windows have been analysed to see if the CAAR is separated from zero at a higher confidence level for another event window. As shown in Table 3, the event windows (-2,2), (-1,1), (-2,0), and (0,1) all generate a p-value lower than 0.05. This indicates the presence of significant positive abnormal returns during various event windows on a 5% significance level. The longest event window (-5,5) does not illustrate any significant abnormal returns.

**One-sample t test for Cumulative Average Abnormal Returns**

| | obs | Mean | St Err | t value | p value |
|---|---|---|---|---|---|
| Day -2 to 2 | 264 | 0.019 | 0.007 | 3.074 | 0.003 |
| Day -1 to 1 | 264 | 0.017 | 0.005 | 3.123 | 0.002 |
| Day -3 to 3 | 264 | 0.013 | 0.007 | 1.859 | 0.064 |
| Day -5 to 5 | 264 | 0.002 | 0.010 | 0.158 | 0.875 |
| Day -2 to 0 | 264 | 0.014 | 0.007 | 2.171 | 0.031 |
| Day 0 to 1 | 264 | 0.025 | 0.006 | 4.308 | 0.000 |

*Table 3*

The individual days have also been tested for the aggregated events, illustrated in Table 4. For the days, -3, -2, -1, 0 (the event day), and 1, the AAR is separated from zero at a 5% significance level. This indicates that the market had abnormal reactions these days. Specifically, there are negative reactions the day prior to the event date, while positive reactions during the event day and the first post-event day. This strengthens the belief that the dataset with sustainable companies would react positively to EU Taxonomy announcements, despite some fluctuation between positive and negative returns during the event window.

**One-sample t test for Average Abnormal Returns**

| | obs | Mean | St Err | t value | p value |
|---|---|---|---|---|---|
| Day -3 | 264 | -0.005 | 0.002 | -2.611 | 0.009 |
| Day -2 | 264 | 0.008 | 0.004 | 2.323 | 0.021 |
| Day -1 | 264 | -0.009 | 0.003 | -3.139 | 0.002 |
| Day 0 | 264 | 0.015 | 0.005 | 3.119 | 0.002 |
| Day 1 | 264 | 0.011 | 0.005 | 2.397 | 0.017 |
| Day 2 | 264 | -0.005 | 0.003 | -1.851 | 0.066 |
| Day 3 | 264 | -0.001 | 0.002 | -0.453 | 0.651 |

*Table 4*

To examine which event that may have caused the strongest market reactions, t-tests for all three events separately have been conducted, presented below in Tables 6-8.

**CAAR T-tests for 21 April 2021**

| | obs | Mean | St Err | t value | p value |
|---|---|---|---|---|---|
| Day -2 to 2 | 88 | -0.007 | 0.008 | -0.833 | 0.407 |
| Day -1 to 1 | 88 | -0.001 | 0.007 | -0.074 | 0.941 |
| Day -3 to 3 | 88 | -0.001 | 0.011 | -0.067 | 0.947 |
| Day -5 to 5 | 88 | -0.028 | 0.013 | -2.185 | 0.032 |
| Day 0 to 1 | 88 | 0.009 | 0.007 | 1.091 | 0.279 |
| Day -3 to 0 | 88 | -0.025 | 0.009 | -2.545 | 0.013 |

*Table 6*

For 21 April 2021, the CAAR is significantly negative for the event windows (-3,0) and (-5,5) at a 5% significance level with a p-value of 0.013 and 0.032, respectively.

**CAAR T-tests for 9 December 2021**

| | obs | Mean | St Err | t value | p value |
|---|---|---|---|---|---|
| Day -2 to 2 | 88 | -0.005 | 0.007 | -0.601 | 0.55 |
| Day -1 to 1 | 88 | 0.002 | 0.009 | 0.139 | 0.89 |
| Day -3 to 3 | 88 | -0.028 | 0.007 | -3.569 | 0.001 |
| Day -5 to 5 | 88 | -0.05 | 0.011 | -4.362 | 0.000 |
| Day 0 to 1 | 88 | 0.009 | 0.012 | 0.774 | 0.441 |
| Day -3 to 0 | 88 | -0.021 | 0.009 | -2.49 | 0.015 |

*Table 7*

The date 9 December 2021 exhibits significantly negative CAAR for the event windows (-3,3), (-5,5), and (-3,0) at a 5% significance level.

**CAAR T-tests for 28 February 2022**

| | obs | Mean | St Err | t value | p value |
|---|---|---|---|---|---|
| Day -2 to 2 | 88 | 0.071 | 0.015 | 4.867 | 0.000 |
| Day -1 to 1 | 88 | 0.048 | 0.010 | 4.882 | 0.000 |
| Day -3 to 3 | 88 | 0.068 | 0.015 | 4.476 | 0.000 |
| Day -5 to 5 | 88 | 0.082 | 0.024 | 3.51 | 0.001 |
| Day 0 to 1 | 88 | 0.058 | 0.009 | 6.104 | 0.000 |
| Day -3 to 0 | 88 | 0.071 | 0.014 | 5.061 | 0.000 |

*Table 8*

For 28 February 2022, the CAAR is positive and significant for all event windows at a 5% significance level.

To further test the hypothesis, a Wilcoxon signed-rank test has been conducted for the individual days for all three events aggregated (Appendix C1). However, this test did not yield any significant results.

**Summary**
The CAAR for all events aggregated is significant at a 10% significance level for the event window (-3,3) and significant at a 5% significance level for the event windows (-2,2), (-1,1), (-2,0), and (0,1). As the abnormal returns are separated from zero, the null hypothesis can be rejected. Furthermore, as the abnormal returns are above zero, our initial belief of green companies reacting positively to the announcements of the EU Taxonomy is confirmed.

When looking at the events separately, the event on 28 February 2022 exhibits a highly significant CAAR for all event windows examined, indicating that the companies reacted particularly positively to the announcement that day. The event on 21 April 2021 exhibits significantly negative CAAR for two of the event windows at a 5% significance level. The event on 9 December 2021 exhibits significantly negative CAAR for three of the event windows including (-3,3), also at a 5% level. To conclude, the companies have a significantly positive reaction to the announcement on 28 February 2022 and a less significant negative reaction to the announcements on the remaining two dates.

## Analysis of Swedish Companies

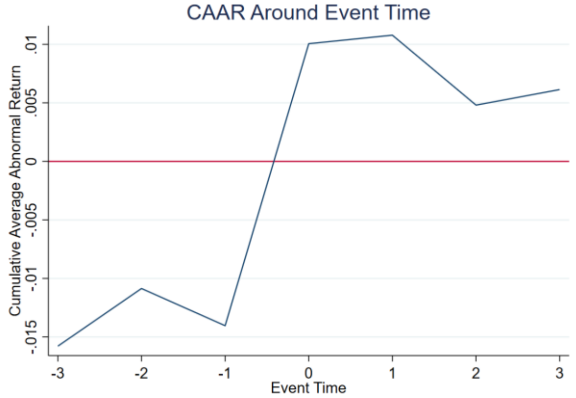


*Figure 4*

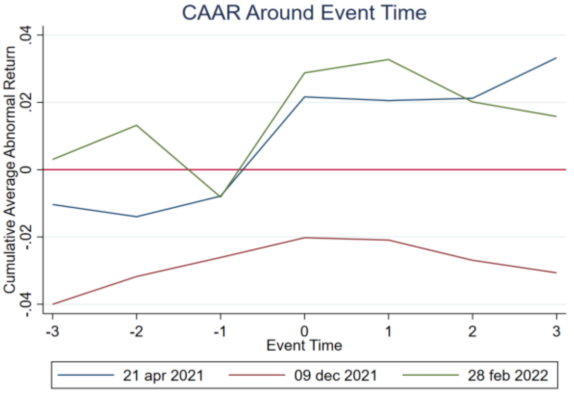


*Figure 5*

As presented in Figure 4, the CAAR becomes positive on the event day (day 0) and remains positive throughout the event window. This indicates that the market had a positive reaction to the announcements related to the EU Taxonomy. Figure 5 shows all three events separately. One can see that the CAAR for 21 April 2021 and 28 February 2022 become positive right before the event day and remain positive throughout the event window. 9 December 2021 exhibits negative CAAR throughout the event window.

When analysing various event windows in Table 9, one can see that no event window generates significant abnormal returns.

**One-sample t test for Cumulative Average Abnormal Returns**

| | obs | Mean | St Err | t value | p value |
|---|---|---|---|---|---|
| Day -2 to 2 | 45 | 0.021 | 0.018 | 1.175 | 0.246 |
| Day -1 to 1 | 45 | 0.022 | 0.017 | 1.312 | 0.197 |
| Day -3 to 3 | 45 | 0.006 | 0.022 | 0.288 | 0.775 |
| Day -5 to 5 | 45 | -0.025 | 0.025 | -1.002 | 0.322 |
| Day -2 to 0 | 45 | 0.026 | 0.018 | 1.465 | 0.15 |
| Day 0 to 1 | 45 | 0.025 | 0.015 | 1.637 | 0.108 |

*Table 9*

Looking at the individual days for the aggregated events, as shown in Table 10, day -3 exhibits negative abnormal returns at a 5% significance level. No other day in the event window is associated with significant abnormal returns.

**One-sample t test for Average Abnormal Returns**

| | obs | Mean | St Err | t value | p value |
|---|---|---|---|---|---|
| Day -3 | 45 | -0.016 | 0.006 | -2.683 | 0.01 |
| Day -2 | 45 | 0.005 | 0.007 | 0.714 | 0.479 |
| Day -1 | 45 | -0.003 | 0.009 | -0.338 | 0.737 |
| Day 0 | 45 | 0.024 | 0.018 | 1.336 | 0.189 |
| Day 1 | 45 | 0.001 | 0.007 | 0.1 | 0.92 |
| Day 2 | 45 | -0.006 | 0.005 | -1.169 | 0.248 |
| Day 3 | 45 | 0.002 | 0.006 | 0.213 | 0.833 |

*Table 10*

The Wilcoxon signed-rank test showed no significant results (Appendix C2).

Similar to the EU-wide analysis, t-tests for each individual event have been performed (Appendix B1). These analyses do not support or contradict the hypothesis as most of the event windows analysed, including (-3,3) do not exhibit significant results.

**Summary**

The analysis of Swedish sustainable companies shows no significant result for any event window examined. Furthermore, given that only one individual day exhibits abnormal returns at a 5% significance level, no conclusions can be drawn.

## Analysis of German Companies

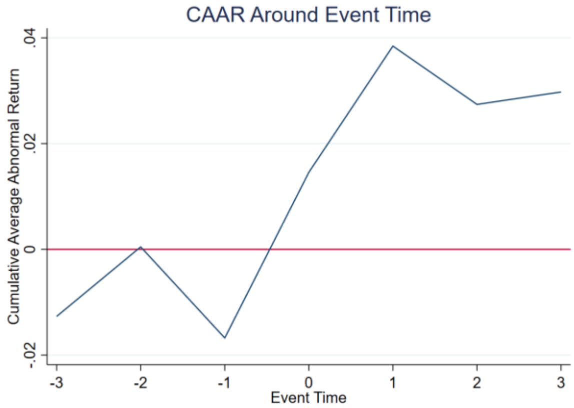

*Figure 6*

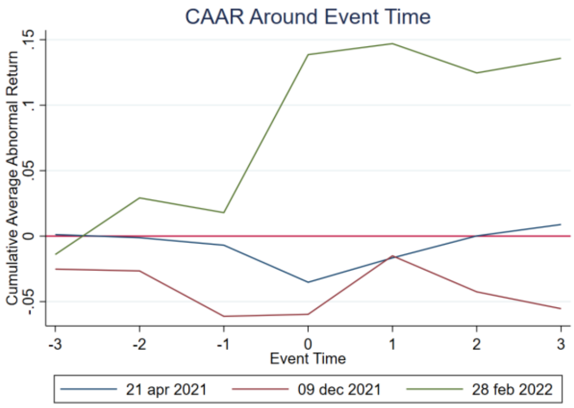

*Figure 7*

As presented in Figure 6, the CAAR becomes positive immediately before the event day and remains positive throughout the event window. This indicates that the market had a positive reaction to the announcements related to the EU Taxonomy. Figure 7 shows all three events separately. One can see that the CAARs for 21 April 2021 and 9 December 2021 are negative but the CAAR for 21 April 2021 becomes positive on day 2. The CAAR for 28 February 2022 is mainly positive throughout the event window.

Looking at various event windows in Table 12, one can see that event windows (-2,2), (-1,1), and (0,1) generate a significant positive abnormal return at a 5% significance level. In other words, there are some indications that the German companies react positively to the EU Taxonomy announcements. However, no conclusions can be drawn for the event window chosen in this study (-3,3).

**One-sample t test for Cumulative Average Abnormal Returns**

| | obs | Mean | St Err | t value | p value |
|---|---|---|---|---|---|
| Day -2 to 2 | 48 | 0.04 | 0.018 | 2.159 | 0.036 |
| Day -1 to 1 | 48 | 0.038 | 0.018 | 2.06 | 0.045 |
| Day -3 to 3 | 48 | 0.03 | 0.021 | 1.429 | 0.16 |
| Day -5 to 5 | 48 | 0.041 | 0.033 | 1.259 | 0.214 |
| Day -2 to 0 | 48 | 0.028 | 0.018 | 1.486 | 0.144 |
| Day 0 to 1 | 48 | 0.055 | 0.025 | 2.261 | 0.029 |

*Table 12*

Table 13 shows the individual days for the three events combined. One can see that the days -1 and 0 exhibit abnormal returns at a 10% and a 5% significance level, respectively, where day -1 is negative and day 0 is positive. However, no conclusion can be drawn regarding days 1-3.

**One-sample t test for Average Abnormal Returns**

| | obs | Mean | St Err | t value | p value |
|---|---|---|---|---|---|
| Day -3 | 48 | -0.013 | 0.008 | -1.589 | 0.119 |
| Day -2 | 48 | 0.013 | 0.009 | 1.5 | 0.141 |
| Day -1 | 48 | -0.017 | 0.009 | -1.917 | 0.061 |
| Day 0 | 48 | 0.032 | 0.015 | 2.069 | 0.044 |
| Day 1 | 48 | 0.024 | 0.021 | 1.151 | 0.256 |
| Day 2 | 48 | -0.011 | 0.010 | -1.086 | 0.284 |
| Day 3 | 48 | 0.003 | 0.005 | 0.416 | 0.679 |

*Table 13*

From the event-specific analyses in Appendix B2, one can observe significantly negative CAAR for the event window (-3,3) on 9 December 2021 and significantly positive CAAR for (-3,3) on 28 February 2022, both on a 5% significance level. On 28 February 2022, all event windows examined exhibit significantly positive abnormal returns at a 5% level.

The non-parametric Wilcoxon signed-rank test (Appendix C3) confirms and strengthens the result of the parametric test, as day -1 is negative and day 0 is positive on a 5% significance level. Similar to the t-test, nothing can be concluded regarding days 1-3.

**Summary**

For the event windows (-2,2), (-1,1) and (0,1), abnormal returns were observed at a 5% significance level. However, as (-3,3) did not show any significant abnormal returns, the null hypothesis is not rejected for Germany. Furthermore, the observed abnormal returns were positive which indicates that the German sustainable companies had a positive reaction to the EU Taxonomy announcements during some event windows.

Looking at individual days, day -1 exhibits negative significant abnormal returns at a 10% level, and event day 0 exhibits positive abnormal returns at a 5% level. This could indicate that the German companies had some positive reactions during the event day. The result is insightful as the event day is the only day in the event window showing significant positive abnormal returns. The most significant result can be observed for 28 February 2022, where all event windows, including (-3,3) exhibited significantly positive CAARs at a 5% level.

## Analysis of Spanish Companies

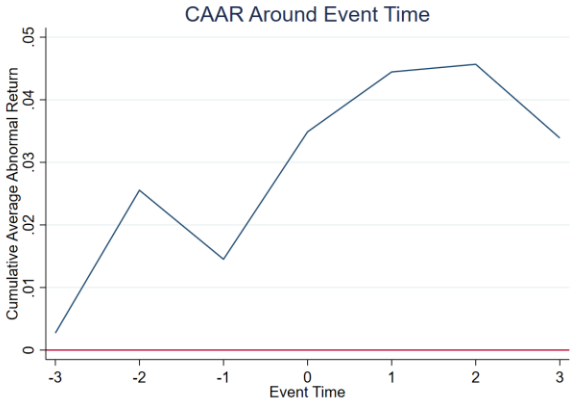


*Figure 8*

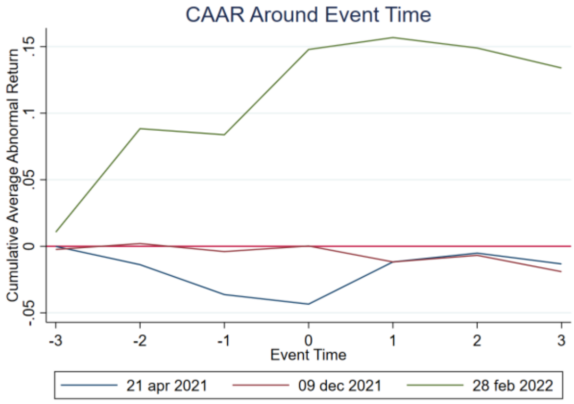


*Figure 9*

As presented in Figure 8, the CAAR is positive throughout the event window, but increased abnormal returns can be identified for the event day and the two following days. This indicates that the Spanish companies had a positive reaction to the EU Taxonomy announcements. Figure 9 shows all three events separately. One can see that the CAAR for 28 February 2022 is positive throughout the event window and becomes increasingly positive during the event day. The CAARs for 9 December 2021 and 21 April 2021 are negative during the event window.

Looking at various event windows in Table 15, event windows (-2,2) and (0,1) illustrate abnormal returns at a 5% significance level. Event windows (-1,1) and (-3,3) exhibit abnormal returns at a 10% significance level. Since the abnormal returns are separated from zero, the null hypothesis can be rejected for our chosen event window (-3,3) at a 10% significance level. In addition, the abnormal returns are positive which aligns with our initial assumption regarding green firms reacting positively to the announcements.

**One-sample t test for Cumulative Average Abnormal Returns**

| | obs | Mean | St Err | t value | p value |
|---|---|---|---|---|---|
| Day -2 to 2 | 30 | 0.043 | 0.017 | 2.527 | 0.017 |
| Day -1 to 1 | 30 | 0.019 | 0.011 | 1.823 | 0.079 |
| Day -3 to 3 | 30 | 0.034 | 0.019 | 1.782 | 0.086 |
| Day -5 to 5 | 30 | 0.037 | 0.028 | 1.358 | 0.185 |
| Day -2 to 0 | 30 | 0.032 | 0.019 | 1.632 | 0.114 |
| Day 0 to 1 | 30 | 0.03 | 0.010 | 3.065 | 0.005 |

*Table 15*

Table 16 shows the individual days for the aggregated events. One can see that the days -2 and 0 show positive abnormal returns at a 5% significance level and days -1 and 3 exhibit negative abnormal returns on the same level. Day 1 shows positive abnormal returns at a 10% significance level.

**One-sample t test for Average Abnormal Returns**

| | obs | Mean | St Err | t value | p value |
|---|---|---|---|---|---|
| Day -3 | 30 | 0.003 | 0.005 | 0.636 | 0.529 |
| Day -2 | 30 | 0.023 | 0.011 | 2.144 | 0.041 |
| Day -1 | 30 | -0.011 | 0.005 | -2.375 | 0.025 |
| Day 0 | 30 | 0.021 | 0.009 | 2.142 | 0.041 |
| Day 1 | 30 | 0.009 | 0.005 | 1.851 | 0.074 |
| Day 2 | 30 | 0.001 | 0.004 | 0.345 | 0.733 |
| Day 3 | 30 | -0.012 | 0.004 | -2.916 | 0.007 |

*Table 16*

The event-specific analyses show no significant results for the chosen event window (-3,3) on 21 April 2021 or 9 December 2021. However, 28 February 2022 exhibits significantly positive abnormal returns for the chosen event window (-3,3) at a 5% level.

The Wilcoxon signed-rank test showed no significant results (Appendix C4).

**Summary**
When conducting the parametric test, most of the event windows examined showed significant abnormal returns. The null hypothesis can be rejected at a 10% significance level, as the p-value for (-3,3) equated 0.086. Additionally, the abnormal returns are positive. When looking at individual days, there are also significant abnormal returns. These are, however, inconsistent in type, with varying positive and negative returns. The event on 28 February 2022 exhibits the strongest and only result with significantly positive abnormal returns for the event window (-3,3) at a 5% level.

## Analysis of Polluting Companies

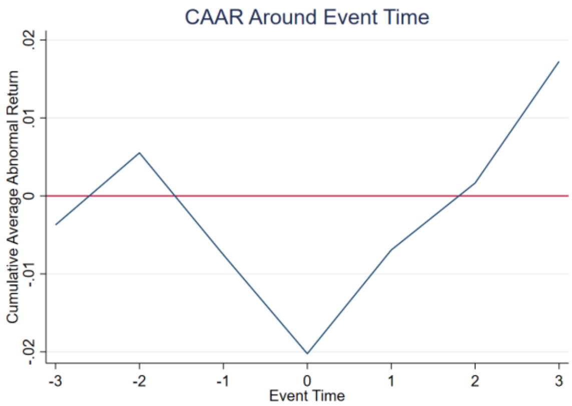


*Figure 10*

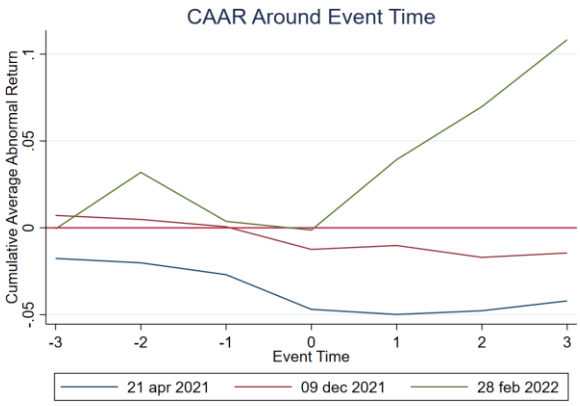


*Figure 11*

As Figure 10 shows, the oil and gas companies display a negative share price reaction to the EU Taxonomy announcements. All three events show a negative trend prior to the event day

(-1,0). However, 28 February 2022 exhibits a strong positive reaction immediately following the event.

As Table 18 shows, the event window (-3,3) does not exhibit significant abnormal returns on neither the 5% nor the 10% level. However, significant negative abnormal returns can be identified for both the event windows (-1,1) and (-2,0) at a 5% level. For the longest event window examined (-5,5), there are instead significant positive abnormal returns.

**One-sample t test for Cumulative Average Abnormal Returns**

| | obs | Mean | St Err | t value | p value |
|---|---|---|---|---|---|
| Day -2 to 2 | 132 | 0.005 | 0.011 | 0.519 | 0.605 |
| Day -1 to 1 | 132 | -0.013 | 0.006 | -2.047 | 0.043 |
| Day -3 to 3 | 132 | 0.017 | 0.015 | 1.179 | 0.24 |
| Day -5 to 5 | 132 | 0.057 | 0.020 | 2.828 | 0.005 |
| Day -2 to 0 | 132 | -0.017 | 0.007 | -2.229 | 0.028 |
| Day 0 to 1 | 132 | 0.001 | 0.005 | 0.111 | 0.912 |

*Table 18*

It can be concluded that there are significant negative abnormal returns for day -1 to day 0 on the 5% level, as shown in Table 19. Day 1 does, however, show signs of a reverse trend, and there are instead positive abnormal returns on the same significance level.

**One-sample t test for Average Abnormal Returns**

| | obs | Mean | St Err | t value | p value |
|---|---|---|---|---|---|
| Day -3 | 132 | -0.004 | 0.007 | -0.503 | 0.616 |
| Day -2 | 132 | 0.009 | 0.004 | 2.248 | 0.026 |
| Day -1 | 132 | -0.013 | 0.004 | -3.591 | 0.001 |
| Day 0 | 132 | -0.013 | 0.004 | -3.227 | 0.002 |
| Day 1 | 132 | 0.013 | 0.004 | 3.646 | 0.001 |
| Day 2 | 132 | 0.009 | 0.005 | 1.892 | 0.06 |
| Day 3 | 132 | 0.015 | 0.007 | 2.322 | 0.022 |

*Table 19*

When observing the event-specific analyses in Appendix B4, one can observe that 21 April 2021 exhibits negative abnormal returns for all the event windows including (-3,3) at a 5% significance level. 9 December 2021 exhibits negative abnormal returns for (-2,2), (-1,1) and (0,1) at a 10% significance level. 28 February 2022 exhibits positive abnormal returns for the majority of the event windows, including (-3,3), at a 5% significance level.

The Wilcoxon signed-rank test (Appendix C5) exhibits significantly negative abnormal returns on the event date (Day 0).

**Summary**
The polluting firms exhibit negative CAAR over event windows (-1,1) and (-2,0) at a 5% significance level. These results are confirmed by the AAR t-test and the Wilcoxon signed-rank test. However, no significant negative abnormal returns were found for the event window (-3,3).

# Discussion and Analysis

*This section elaborates on the results and the implications, focusing on the parts relevant for answering the research question presented in this study. The final part of the analysis develops on the limitations of the study.*

Interpreting the results of the EU-wide analysis, one can conclude two things. First, there are significant CAAR's across most of the event windows, including (-1,1), (-2,0), (-2,2), (0,1) on the 5% level and (-3,3) on the 10% level. This constitutes a strong basis for rejecting the null hypothesis $H_0$*: CAAR = 0*. Furthermore, the abnormal returns are positive, which confirm our belief that EU Taxonomy announcements are beneficial for green firms' market performance.

It is, however, important to elaborate on the inconsistencies in the results. When looking at the individual days, the event date (day 0) displays positive abnormal returns at a 5% level when performing the parametric test, but not when performing the non-parametric test. Furthermore, when examining the parametric test for days -2 and -1, the abnormal returns move from positive to negative. On day 0, the returns are significantly positive again. This reduces the trustworthiness, as it is unclear why the EU Taxonomy announcements would generate this abnormal return fluctuation. The abnormal returns are, however, more significant for the event date (day 0) than day -2. One can also argue for the fact that the positive reactions spill over from the event date to one day post the event, where abnormal returns are also significantly positive. This strengthens our assumption that the firms would react positively.

Further discussions arise as the Wilcoxon test shows significant abnormal returns for both day -1 (negative) and day 1 (positive) on the 5% level, but no significant abnormal returns for day 0. This raises questions about the robustness of our results and is therefore important to consider.

Looking at the country-specific analyses, the common theme was varying levels of consistency and substance, aggravating the rejection of the null hypothesis. This could depend on a variety of factors. One example is the size of the datasets, as the country-specific analyses used significantly smaller datasets than the EU-wide analysis. The expectation was that the country-specific tests would generate similar results as the EU-wide analysis, which was the case for Germany and Spain. Both Germany and Spain showed significant positive CAARs for some analysed event windows, for example (-2,2) and (0,1) at a 5% level.

However, for the chosen event window (-3,3), positive abnormal returns could be observed only for Spain, and only at the 10% significance level. This raises the question of whether the event window chosen was appropriate for a regulatory event like the EU Taxonomy, which will be discussed later in this section. This is also the case for the analysis of the polluting companies where the chosen event window (-3,3) did not exhibit significant abnormal returns, but other event windows did; (-1,1) and (-2,0) showed significant negative abnormal returns and (-5,5) showed significant positive abnormal returns at a 5% level.

Sweden did, surprisingly, lack significant abnormal returns across all event windows, despite being one of the greenest countries with regards to their EPI score. This opens up for an interesting discussion as one could assume that the greenest countries would be home to the most sustainable firms. In turn, these companies would be expected to exhibit the strongest positive reactions to the EU Taxonomy announcements. It could be that the belief is correct in its essence. However, as all companies examined have been chosen based on their green profile, regardless of what country they originate from, it might also be reasonable to assume that the companies would react equally. In other words, the differences between the three countries might not be a result of the countries having different EPI scores. A possible explanation for the difference between Sweden and the rest of the countries could instead be national media attention to the EU Taxonomy announcements. For example, if news reporting frequency varied between countries, so would the awareness and reactions to the EU Taxonomy.

A substantial part of the criticism directed towards the event study methodology regards the main assumptions underlying the methodology.

The first assumption is the efficient market theory which states that share prices incorporate all available information immediately when it is released. This theory in turn assumes rational market participants. One can discuss whether market participants can be considered rational in times of turbulence, which has been the market state during the events examined in this study. The dates 21 April 2021 and 9 December 2021 took place during the covid-19 pandemic and the last date 28 February 2022 took place during the war in Ukraine. In other words, all events examined have occurred in times of crisis. This can lead to market participants not reacting and acting rationally which could explain the inconsistent results, and in some cases, the lack of results.

The second underlying assumption of the event study methodology states that all events are unpredictable and that all market participants, who have no previous information regarding the event, take part of the information at the same time. Since the EU Taxonomy is such an extensive framework that has been developed over a long period of time, there are many articles and announcements related to it. The three dates examined in this study were chosen because they represent important stages of the development of the EU Taxonomy. However, due to the structure of the framework, there is the possibility that investors have already been exposed to several articles about specific events prior to the event date. Therefore, when the final reports are released in full on the event date, all bits and pieces might already have been acknowledged. In other words, the market has already incorporated all available information. This would reduce the share price impact during the actual event date, as this can be classified as information leakage in the context of event studies. However, the opposite might also be true, meaning that the information has not yet been incorporated into share prices because of slow investor reactions. An explanation for this could be the already extensive existence of sustainability reporting frameworks which has made market participants “numb” to releases of additional frameworks. Investors without enough information might only view the EU Taxonomy as another time and resource-consuming sustainability standard to keep track of. Furthermore, as the effectiveness of the EU Taxonomy is yet to be discovered, investors may be hesitant to acknowledge what impact the framework will have. Therefore, they might react slower to the EU Taxonomy announcements, hence the available information is not as swiftly incorporated into share prices.

Since the three event dates regard the same regulatory framework, it is reasonable to assume that the first event should have the greatest impact, the second date should have the second greatest impact, and so on. However, in this case, the results show the opposite as the last event, 28 February 2022, has the greatest impact and exhibits the most significant result. One reason for this could be that 28 February 2022 represents an announcement that has not been as frequently discussed as the two other announcements. This is as it regards an extension to social objectives whereas the previous two dates only concern the environmental objectives. This could also be the reason why the third announcement positively affected the polluting firms, despite our initial belief that this announcement would mainly have a positive impact on green firms. The positive reaction could be due to the social taxonomy not solely involving environmental objectives, thus having equal impact on polluting and green firms.

The third and last underlying assumption of the event study methodology concerns confounding effects. For the event study to generate accurate results, there should only occur one event during the event window, being the event analysed. Although the days surrounding the events have been thoroughly examined, there are extraordinary macro-economic occurrences during all events. For example, as previously mentioned, the covid-19 pandemic extends across all three event dates. Although these effects should be neutralized in the analysis, as the estimation windows stretch over months that are also impacted by the pandemic, there might be unusual market behaviours that impact the result. For example, investors may be more or less risk-averse than prior to the pandemic.

Across all analyses, 28 February 2022 represents the strongest event for generating positive abnormal returns (Appendix B1-B4). However, this date is in the midst of Russia’s invasion of Ukraine which could suggest a confounding event. One can assume that wars are accompanied by recessions. This is, however, not the case in our analysis. The estimation period stretches over days not impacted by the war. The expected returns should therefore be higher than the actual returns during the event date. In other words, a smaller actual return during war less a larger expected return should generate a smaller abnormal return. Despite this, the abnormal returns were significantly positive, which indicates that the market had a positive reaction to the announcements on this day.

To conclude, despite the event study methodology producing interpretable and relevant results, there are areas that can be further developed to better fit our study's purpose. This leads us into a discussion about the selection criteria chosen for this study.

As the nature of the EU Taxonomy events involves continuous disclosures with more blurred announcement dates, the event window can be discussed. In this study, an event window of seven days was chosen (-3,3). When observing the results, however, (-3,3) rarely generated significant abnormal returns. Instead, clearer results were drawn from the shorter event windows. Factors to be taken into consideration can, for example, be the frequency and the magnitude of the announcements as well as the announcement channels. In recent years, the majority of news announcements are made through digital channels, which facilitates swift news spread. Furthermore, the announcements are unlikely to be associated with significant inside information since the potential share-price upside from this information is likely to be small. This reduces the need to include days prior to the event in the event window. Rapid news spread and the lack of inside information both constitute arguments for keeping the event window short.

The dataset chosen for this study can also be further analysed and fine-tuned. This to help understand *how* the firms actually perform sustainability-wise, as well as how transparently they communicate their performance. When investigating the firms, we expected the polluting firms to have a clearly inferior stock performance compared to the green firms during the event windows. This could, however, not be shown with significance across all events (see Appendix B4). This may depend on the two factors discussed above regarding the event- and estimation window, but another explanation could be company disclosure. Investors pick up and analyse the information available to them, which makes it vital for firms to clearly communicate superior sustainability performance. This may also imply that some firms exaggerate their sustainability performance for the purpose of receiving a higher valuation. Some companies might even engage in greenwashing. On the other hand, polluting firms may avoid disclosing excessive sustainability information for the same reason. This aggravates investors to draw accurate conclusions regarding how the EU Taxonomy will impact individual firms and may help explain why the results are not distinct when comparing sustainable and unsustainable firms.

**Limitations**

There are many different factors that impact share prices, including economic factors, industry trends, and company news and performance. Therefore, a limitation of this study regards the difficulty to isolate the share price effects to only be associated with the taxonomy announcements.

Secondly, in today's society, news and information are spread faster and are more accessible than ever. It is not only the official reports regarding the EU Taxonomy that are published on the EU Commission’s website, but also smaller news updates and interim reports. It is difficult to assess how much of this information that investors acknowledge. One can assume that investors only follow the official announcements, but this may not hold true for all cases.

Furthermore, the various platforms and speed of technology makes it hard to assess how fast news spreads after being officially published. This aggravates the process of choosing a specific event date.

All the country-specific indices chosen are a good representation of each market as the largest companies are included. However, the index chosen for the EU-wide analysis includes developed markets in Europe but does not consider whether the countries are members of the EU. This is a limitation to this study as it may cause a misleading representation of the benchmark. However, since the majority of the developed countries in Europe are EU members, this limitation can be considered negligible.

# Conclusion

*This section summarizes the discussion and analysis and highlights the most important take-aways of this study. Lastly, suggestions for future research are presented.*

The release of the EU Taxonomy marks a new era in the landscape of sustainability frameworks. Despite a frequent release of announcements, it is unclear how investors are responding to the new standard. This study aims to investigate how sustainable companies react to the EU Taxonomy announcements, analysing the companies´ share prices during the time surrounding the announcements. The initial assumption was that the market value of sustainable firms would increase following the announcements while polluting firms should experience a decreased market value as a result of the announcements. The specific research question to answer was: *Do announcements regarding the EU Taxonomy framework generate abnormal returns for sustainable companies within the European Union?*

The analysis of sustainable firms across the European Union shows that there are positive significant CAARs during several of the event windows analysed when using a parametric t-test. For the argued event window of (-3,3), the returns were significant but at the lower significance level. These results confirm our belief that sustainable companies have a positive reaction to EU Taxonomy announcements. The results were, however, not uniformly confirmed when conducting the non-parametric Wilcoxon signed-rank test. Neither are the results consistent across all event windows and there are also varying results across the different event dates. The last event had the strongest positive reaction, which is contradictory to the assumption that earlier events should exhibit the most significant results.

As a robustness test, sustainable firms operating in Sweden, Spain, and Germany were tested. The Spanish dataset was the only dataset to generate CAARs for the chosen event window (-3,3). When analysing individual days, the event day exhibited positive abnormal returns for both Germany and Spain at the higher confidence level. This implies that the sustainable companies had positive reactions to the EU Taxonomy announcements. The analysis of Swedish firms provided no significant results, and thus no conclusion can be drawn regarding the Swedish dataset.

The analysis of polluting companies showed significant negative abnormal returns for shorter event windows at the higher confidence level. However, for the chosen event window (-3,3), no significant result could be observed. Analysing individual events, 21 April 2021, provided the most significant negative results, which aligns with the theory that the earliest announcements should have the greatest impact. The results indicate that polluting companies reacted negatively to the EU Taxonomy announcements for some of the event windows.

To conclude by answering our research question, this study shows that the EU Taxonomy kindles market reactions in the form of abnormal returns for sustainable companies within the European Union. The taxonomy can therefore be considered as acknowledged by investors. This study illustrates that in an increasingly environmentally conscious world, even early-stage sustainability frameworks generate market movements.

**Future Research**

As previously mentioned, the EU Taxonomy is still in the early implementation stage, with only two of the six criteria implemented as of May 2022. As a result, the effects of the taxonomy are yet to be discovered. Therefore, we suggest a future replicating study to research the future impact of the taxonomy in its entirety. Furthermore, it would be interesting to analyse a larger dataset, with further distinguishing parameters such as size and revenue. This would enable the researcher to draw further conclusions regarding which companies that exhibit the strongest reactions to the taxonomy announcements. Additionally, for a future study, a suggestion would be to emanate the discussions from a shorter event window than the one included in this study. Lastly, an interesting analysis would be to investigate factors beyond share price and include more qualitative factors, for example how companies' reputations are affected by the increased transparency associated with the EU Taxonomy.

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# Appendix

## Appendix A1: List of companies in the EU-wide analysis

| Company Ticker | Company name | Country |
|---|---|---|
| WBAG:VER | VERBUND AG | Austria |
| ENXTBR:ABO | ABO-Group Environment NV | Belgium |
| ENXTBR:ELI | Elia Group SA/NV | Belgium |
| CPSE:ORSTED | Ørsted A/S | Denmark |
| CPSE:VWS | Vestas Wind Systems A/S | Denmark |
| HLSE:LAT1V | Lassila & Tikanoja Oyj | Finland |
| HLSE:VALOE | Valoe Oyj | Finland |
| ENXTPA:ABIO | Albioma | France |
| ENXTPA:AURE | Aurea SA | France |
| ENXTPA:MLEDR | Compagnie des Eaux de Royan | France |
| ENXTPA:DBG | Derichebourg SA | France |
| ENXTPA:ALESA | Ecoslops S.A. | France |
| ENXTPA:GPE | Groupe Pizzorno Environnement | France |
| ENXTPA:NEOEN | Neoen S.A. | France |
| ENXTPA:SCHP | Séché Environnement SA | France |
| ENXTPA:VLTSA | Voltalia SA | France |
| ENXTPA:ALENE | Enertime SA | France |
| ENXTPA:ALVER | Vergnet SA | France |
| ENXTPA:NAVYA | Navya SA | France |
| ENXTPA:VIE | Veolia Environnement S.A. | France |
| ENXTPA:ALGBE | Global Bioenergies SA | France |
| XTRA:HRPK | 7C Solarparken AG | Germany |
| DB:ABA | ALBA SE | Germany |
| DUSE:ABO | clearvise AG | Germany |

| | | |
|---|---|---|
| XTRA:ECV | Encavis AG | Germany |
| XTRA:PRY | Pacifico Renewables Yield AG | Germany |
| XTRA:2GB | 2G Energy AG | Germany |
| DB:H2O | Enapter AG | Germany |
| XTRA:EKT | Energiekontor AG | Germany |
| HMSE:QCE | Global PVQ SE | Germany |
| XTRA:NDX1 | Nordex SE | Germany |
| XTRA:PNE3 | PNE AG | Germany |
| DB:SFX | Solar-Fabrik Aktiengesellschaft | Germany |
| DB:SWVK | SolarWorld Aktiengesellschaft | Germany |
| XTRA:S92 | SMA Solar Technology AG | Germany |
| XTRA:AB9 | ABO Wind AG | Germany |
| XTRA:ETG | EnviTec Biogas AG | Germany |
| ATSE:TENERGY | Terna Energy Societe Anonyme Commercial Technical Company | Greece |
| OB:ALT | Alternus Energy Group plc | Ireland |
| ISE:GRP | Greencoat Renewables PLC | Ireland |
| OM:KOLL | Kollect on Demand Holding AB (publ) | Ireland |
| BIT:ARN | Alerion Clean Power S.p.A. | Italy |
| BIT:ECK | Ecosuntek S.p.A. | Italy |
| BIT:FKR | Falck Renewables S.p.A. | Italy |
| BIT:FDE | Frendy Energy S.p.A. | Italy |
| BIT:IB | Iniziative Bresciane S.p.A. | Italy |
| BIT:REN | Renergetica S.p.A. | Italy |
| BIT:EVA | Askoll Eva SpA | Italy |
| XTRA:BFSA | Befesa S.A. | Luxembourg |
| NasdaqGS:ARVL | Arrival | Luxembourg |
| ENXTAM:NSE | New Sources Energy N.V. | Netherlands |
| OB:PRYME | Pryme B.V. | Netherlands |
| ENXTAM:ALFEN | Alfen N.V. | Netherlands |
| ENXTAM:FAST | Fastned B.V. | Netherlands |

| | | |
|---|---|---|
| OB:AEGA | Aega ASA | Norway |
| OB:AGLX | Agilyx AS | Norway |
| OB:CLOUD | Cloudberry Clean Energy ASA | Norway |
| OB:EAM | EAM Solar ASA | Norway |
| OB:SCATC | Scatec ASA | Norway |
| OB:NEL | Nel ASA | Norway |
| OB:RECSI | REC Silicon ASA | Norway |
| OB:OTOVO | Otovo AS | Norway |
| ENXTLS:EDP | EDP - Energias de Portugal, S.A. | Portugal |
| BME:ADL | ADL Bionatur Solutions, S.A. | Spain |
| BME:ADX | Audax Renovables, S.A. | Spain |
| ENXTLS:EDPR | EDP Renováveis, S.A. | Spain |
| BME:GRN | Greenalia, S.A. | Spain |
| BME:GRE | Grenergy Renovables, S.A. | Spain |
| BME:SLR | Solaria Energía y Medio Ambiente, S.A. | Spain |
| BME:ANA | Acciona, S.A. | Spain |
| BME:IBE | Iberdrola, S.A. | Spain |
| BME:SGRE | Siemens Gamesa Renewable Energy, S.A. | Spain |
| BME:HLZ | Holaluz-Clidom, S.A. | Spain |
| OM:ARISE | Arise AB (publ) | Sweden |
| OM:ECOWVE | Eco Wave Power Global AB (publ) | Sweden |
| OM:GREEN | Green Landscaping Group AB (publ) | Sweden |
| OM:SES | Scandinavian Enviro Systems AB (publ) | Sweden |
| OM:SLITE | Slitevind AB | Sweden |
| OM:AZELIO | Azelio AB (publ) | Sweden |
| OM:CLIME B | Climeon AB (publ) | Sweden |
| NGM:META | Metacon AB (publ) | Sweden |
| OM:MINEST | Minesto AB (publ) | Sweden |
| OM:STW | SeaTwirl AB (publ) | Sweden |
| OM:STRLNG | Swedish Stirling AB (publ) | Sweden |

| | | |
|---|---|---|
| OM:CISH | Clean Industry Solutions Holding Europe AB | Sweden |
| OM:MIDS | Midsummer AB (publ) | Sweden |
| OM:CLEMO | Clean Motion AB (publ) | Sweden |
| OM:EOLU B | Eolus Vind AB (publ) | Sweden |

## Appendix A2: List of companies in the Sweden analysis

| Company Ticker | Company Name | Country |
|---|---|---|
| OM:ARISE | Arise AB (publ) | Sweden |
| OM:ECOWVE | Eco Wave Power Global AB (publ) | Sweden |
| OM:GREEN | Green Landscaping Group AB (publ) | Sweden |
| OM:SES | Scandinavian Enviro Systems AB (publ) | Sweden |
| OM:SLITE | Slitevind AB | Sweden |
| OM:AZELIO | Azelio AB (publ) | Sweden |
| OM:CLIME B | Climeon AB (publ) | Sweden |
| NGM:META | Metacon AB (publ) | Sweden |
| OM:MINEST | Minesto AB (publ) | Sweden |
| OM:STW | SeaTwirl AB (publ) | Sweden |
| OM:STRLNG | Swedish Stirling AB (publ) | Sweden |
| OM:CISH | Clean Industry Solutions Holding Europe AB | Sweden |
| OM:MIDS | Midsummer AB (publ) | Sweden |
| OM:CLEMO | Clean Motion AB (publ) | Sweden |
| OM:EOLU B | Eolus Vind AB (publ) | Sweden |

## Appendix A3: List of companies in the Germany analysis

| Company Ticker | Company Name | Country |
|---|---|---|
| XTRA:HRPK | 7C Solarparken AG | Germany |
| DB:ABA | ALBA SE | Germany |

| | | |
|---|---|---|
| DUSE:ABO | clearvise AG | Germany |
| XTRA:ECV | Encavis AG | Germany |
| XTRA:PRY | Pacifico Renewables Yield AG | Germany |
| XTRA:2GB | 2G Energy AG | Germany |
| DB:H2O | Enapter AG | Germany |
| XTRA:EKT | Energiekontor AG | Germany |
| HMSE:QCE | Global PVQ SE | Germany |
| XTRA:NDX1 | Nordex SE | Germany |
| XTRA:PNE3 | PNE AG | Germany |
| DB:SFX | Solar-Fabrik Aktiengesellschaft | Germany |
| DB:SWVK | SolarWorld Aktiengesellschaft | Germany |
| XTRA:S92 | SMA Solar Technology AG | Germany |
| XTRA:AB9 | ABO Wind AG | Germany |
| XTRA:ETG | EnviTec Biogas AG | Germany |

# Appendix A4: List of companies in the Spain analysis

| **Company Ticker** | **Company Name** | **Country** |
|---|---|---|
| BME:ADL | ADL Bionatur Solutions, S.A. | Spain |
| BME:ADX | Audax Renovables, S.A. | Spain |
| ENXTLS:EDPR | EDP Renováveis, S.A. | Spain |
| BME:GRN | Greenalia, S.A. | Spain |
| BME:GRE | Grenergy Renovables, S.A. | Spain |
| BME:SLR | Solaria Energía y Medio Ambiente, S.A. | Spain |
| BME:ANA | Acciona, S.A. | Spain |
| BME:IBE | Iberdrola, S.A. | Spain |
| BME:SGRE | Siemens Gamesa Renewable Energy, S.A. | Spain |

| | | |
|---|---|---|
| BME:HLZ | Holaluz-Clidom, S.A. | Spain |

## Appendix A5: List of companies in the polluting companies analysis

| **Company Ticker** | **Company Name** | **Country** |
|---|---|---|
| WBAG:OMV | OMV Aktiengesellschaft | Austria |
| WBAG:SBO | Schoeller-Bleckmann Oilfield Equipment Aktiengesellschaft | Austria |
| OB:ADS | ADS Maritime Holding Plc | Cyprus |
| OB:GEG | SeaBird Exploration Plc | Cyprus |
| CPSE:ATLA DKK | P/F Atlantic Petroleum | Denmark |
| CPSE:DRLCO | The Drilling Company of 1972 A/S | Denmark |
| HLSE:NESTE | Neste Oyj | Finland |
| ENXTPA:CGG | CGG | France |
| ENXTPA:ES | Esso S.A.F. | France |
| ENXTPA:GTT | Gaztransport & Technigaz SA | France |
| ENXTPA:TTE | TotalEnergies SE | France |
| ENXTPA:VK | Vallourec S.A. | France |
| XTRA:CE2 | CropEnergies AG | Germany |
| ATSE:ELPE | Hellenic Petroleum Holdings Societe Anonyme | Greece |
| ATSE:MOH | Motor Oil (Hellas) Corinth Refineries S.A. | Greece |
| NYSE:GLOP | GasLog Partners LP | Greece |
| OB:OET | Okeanis Eco Tankers Corp. | Greece |
| TSXV:FO | Falcon Oil & Gas Ltd. | Ireland |
| BIT:SPM | Saipem SpA | Italy |
| OB:SUBC | Subsea 7 S.A. | Luxembourg |
| ENXTAM:VPK | Koninklijke Vopak N.V. | Netherlands |
| OB:AKRBP | Aker BP ASA | Norway |
| OB:AKSO | Aker Solutions ASA | Norway |

| | | |
|---|---|---|
| OB:AQUA | AqualisBraemar LOC ASA | Norway |
| OB:BWE | BW Energy Limited | Norway |
| OB:DNO | DNO ASA | Norway |
| OB:DOF | DOF ASA | Norway |
| OB:EMGS | Electromagnetic Geoservices ASA | Norway |
| OB:GEOS | Golden Energy Offshore Services AS | Norway |
| OB:MSEIS | Magseis Fairfield ASA | Norway |
| OB:OKEA | OKEA ASA | Norway |
| OB:PEN | Panoro Energy ASA | Norway |
| OB:PNOR | PetroNor E&P ASA | Norway |
| OB:REACH | Reach Subsea ASA | Norway |
| OB:SIOFF | Siem Offshore Inc. | Norway |
| OB:TGS | TGS ASA | Norway |
| ASX:BKY | Berkeley Energia Limited | Spain |
| NGM:ABI | AB Igrene (publ) | Sweden |
| OM:CCOR B | Concordia Maritime AB (publ) | Sweden |
| OM:DOME | Dome Energy AB (publ) | Sweden |
| OM:MAHA A | Maha Energy AB (publ) | Sweden |
| OM:MISE | Misen Energy AB (publ) | Sweden |
| OM:TETY | Tethys Oil AB (publ) | Sweden |
| OM:TRIBO B | Triboron International AB (publ) | Sweden |

## Appendix B1: Event-specific analyses for Sweden

**CAAR T-tests for 21 April 2021**

| | obs | Mean | St Err | t value | p value |
|---|---|---|---|---|---|
| Day -2 to 2 | 15 | 0.032 | 0.035 | 0.914 | 0.376 |
| Day -1 to 1 | 15 | 0.035 | 0.030 | 1.125 | 0.28 |
| Day -3 to 3 | 15 | 0.033 | 0.044 | 0.744 | 0.469 |
| Day -5 to 5 | 15 | 0.018 | 0.040 | 0.454 | 0.657 |
| Day 0 to 1 | 15 | 0.029 | 0.038 | 0.744 | 0.469 |
| Day -3 to 0 | 15 | 0.022 | 0.048 | 0.456 | 0.655 |

**CAAR T-tests for 9 December 2021**

| | obs | Mean | St Err | t value | p value |
|---|---|---|---|---|---|
| Day -2 to 2 | 15 | 0.013 | 0.018 | 0.754 | 0.464 |
| Day -1 to 1 | 15 | 0.011 | 0.021 | 0.53 | 0.604 |
| Day -3 to 3 | 15 | -0.03 | 0.026 | -1.165 | 0.263 |
| Day -5 to 5 | 15 | -0.072 | 0.030 | -2.447 | 0.028 |
| Day 0 to 1 | 15 | 0.005 | 0.016 | 0.328 | 0.748 |
| Day -3 to 0 | 15 | -0.02 | 0.018 | -1.111 | 0.286 |

**CAAR T-tests for 28 February 2022**

| | obs | Mean | St Err | t value | p value |
|---|---|---|---|---|---|
| Day -2 to 2 | 15 | 0.017 | 0.037 | 0.459 | 0.653 |
| Day -1 to 1 | 15 | 0.019 | 0.035 | 0.568 | 0.58 |
| Day -3 to 3 | 15 | 0.016 | 0.038 | 0.417 | 0.683 |
| Day -5 to 5 | 15 | -0.021 | 0.056 | -0.367 | 0.719 |
| Day 0 to 1 | 15 | 0.041 | 0.021 | 2.01 | 0.064 |
| Day -3 to 0 | 15 | 0.029 | 0.033 | 0.879 | 0.395 |

## Appendix B2: Event-specific analyses for Germany

**CAAR T-tests for 21 April 2021**

| | obs | Mean | St Err | t value | p value |
|---|---|---|---|---|---|
| Day -2 to 2 | 16 | -0.001 | 0.017 | -0.061 | 0.952 |
| Day -1 to 1 | 16 | -0.015 | 0.011 | -1.448 | 0.169 |
| Day -3 to 3 | 16 | 0.009 | 0.013 | 0.655 | 0.522 |
| Day -5 to 5 | 16 | -0.052 | 0.025 | -2.066 | 0.057 |
| Day 0 to 1 | 16 | -0.009 | 0.015 | -0.67 | 0.513 |
| Day -3 to 0 | 16 | -0.035 | 0.009 | -3.675 | 0.003 |

**CAAR T-tests for 9 December 2021**

| | obs | Mean | St Err | t value | p value |
|---|---|---|---|---|---|
| Day -2 to 2 | 16 | -0.018 | 0.029 | -0.613 | 0.549 |
| Day -1 to 1 | 16 | 0.011 | 0.043 | 0.269 | 0.792 |
| Day -3 to 3 | 16 | -0.056 | 0.021 | -2.718 | 0.016 |
| Day -5 to 5 | 16 | -0.08 | 0.038 | -2.074 | 0.056 |
| Day 0 to 1 | 16 | 0.046 | 0.060 | 0.776 | 0.45 |
| Day -3 to 0 | 16 | -0.06 | 0.040 | -1.492 | 0.157 |

**CAAR T-tests for 28 February 2022**

| | obs | Mean | St Err | t value | p value |
|---|---|---|---|---|---|
| Day -2 to 2 | 16 | 0.139 | 0.035 | 4.026 | 0.001 |
| Day -1 to 1 | 16 | 0.118 | 0.024 | 4.944 | 0.000 |
| Day -3 to 3 | 16 | 0.136 | 0.047 | 2.887 | 0.011 |
| Day -5 to 5 | 16 | 0.255 | 0.058 | 4.415 | 0.001 |
| Day 0 to 1 | 16 | 0.129 | 0.035 | 3.732 | 0.002 |
| Day -3 to 0 | 16 | 0.139 | 0.026 | 5.399 | 0.000 |

## Appendix B3: Event-specific analyses for Spain

**CAAR T-tests for 21 April 2021**

| | obs | Mean | St Err | t value | p value |
|---|---|---|---|---|---|
| Day -2 to 2 | 10 | -0.005 | 0.011 | -0.433 | 0.675 |
| Day -1 to 1 | 10 | 0.002 | 0.013 | 0.151 | 0.884 |
| Day -3 to 3 | 10 | -0.013 | 0.019 | -0.698 | 0.503 |
| Day -5 to 5 | 10 | -0.036 | 0.022 | -1.672 | 0.129 |
| Day -2 to 0 | 10 | -0.044 | 0.013 | -3.402 | 0.008 |
| Day 0 to 1 | 10 | 0.025 | 0.011 | 2.288 | 0.048 |

**CAAR T-tests for 9 December 2021**

| | obs | Mean | St Err | t value | p value |
|---|---|---|---|---|---|
| Day -2 to 2 | 10 | -0.005 | 0.010 | -0.435 | 0.673 |
| Day -1 to 1 | 10 | -0.014 | 0.005 | -3.003 | 0.015 |
| Day -3 to 3 | 10 | -0.019 | 0.014 | -1.347 | 0.21 |
| Day -5 to 5 | 10 | -0.026 | 0.020 | -1.325 | 0.218 |
| Day -2 to 0 | 10 | 0.003 | 0.013 | 0.209 | 0.839 |
| Day 0 to 1 | 10 | -0.008 | 0.005 | -1.74 | 0.116 |

**CAAR T-tests for 28 February 2022**

| | obs | Mean | St Err | t value | p value |
|---|---|---|---|---|---|
| Day -2 to 2 | 10 | 0.139 | 0.032 | 4.296 | 0.002 |
| Day -1 to 1 | 10 | 0.069 | 0.020 | 3.389 | 0.008 |
| Day -3 to 3 | 10 | 0.134 | 0.036 | 3.764 | 0.005 |
| Day -5 to 5 | 10 | 0.175 | 0.058 | 3.013 | 0.015 |
| Day -2 to 0 | 10 | 0.137 | 0.038 | 3.569 | 0.006 |
| Day 0 to 1 | 10 | 0.073 | 0.021 | 3.565 | 0.006 |

## Appendix B4: Event-specific analyses for Polluting Companies

**CAAR T-tests for 21 April 2021**

| | obs | Mean | St Err | t value | p value |
|---|---|---|---|---|---|
| Day -2 to 2 | 44 | -0.03 | 0.009 | -3.408 | 0.002 |
| Day -1 to 1 | 44 | -0.03 | 0.005 | -6.095 | 0.000 |
| Day -3 to 3 | 44 | -0.042 | 0.011 | -3.753 | 0.001 |
| Day -5 to 5 | 44 | -0.038 | 0.015 | -2.634 | 0.011 |
| Day 0 to 1 | 44 | -0.023 | 0.005 | -5.011 | 0.000 |
| Day -3 to 0 | 44 | -0.047 | 0.007 | -7 | 0.000 |

**CAAR T-tests for 9 December 2021**

| | obs | Mean | St Err | t value | p value |
|---|---|---|---|---|---|
| Day -2 to 2 | 44 | -0.024 | 0.013 | -1.775 | 0.083 |
| Day -1 to 1 | 44 | -0.015 | 0.009 | -1.746 | 0.088 |
| Day -3 to 3 | 44 | -0.015 | 0.018 | -0.827 | 0.413 |
| Day -5 to 5 | 44 | 0.004 | 0.017 | 0.208 | 0.836 |
| Day 0 to 1 | 44 | -0.011 | 0.005 | -1.946 | 0.058 |
| Day -3 to 0 | 44 | -0.013 | 0.012 | -1.024 | 0.311 |

**CAAR T-tests for 28 February 2021**

| | obs | Mean | St Err | t value | p value |
|---|---|---|---|---|---|
| Day -2 to 2 | 44 | 0.071 | 0.024 | 2.942 | 0.005 |
| Day -1 to 1 | 44 | 0.007 | 0.015 | 0.488 | 0.628 |
| Day -3 to 3 | 44 | 0.108 | 0.035 | 3.091 | 0.004 |
| Day -5 to 5 | 44 | 0.207 | 0.050 | 4.154 | 0.000 |
| Day 0 to 1 | 44 | 0.036 | 0.013 | 2.631 | 0.012 |
| Day -3 to 0 | 44 | -0.002 | 0.017 | -0.08 | 0.936 |

## Appendix C1: Wilcoxon Signed-Rank test (EU-wide)

**Wilcoxon Signed-Rank Test (Europe-wide)**

| | obs | Positive | Negative | p value |
|---|---|---|---|---|
| Day -3 | 264 | 113 | 151 | 0.0044 |
| Day -2 | 264 | 128 | 136 | 0.2047 |
| Day -1 | 264 | 101 | 163 | 0.0001 |
| Day 0 | 264 | 137 | 127 | 0.1030 |
| Day 1 | 264 | 142 | 122 | 0.0079 |
| Day 2 | 264 | 119 | 145 | 0.0656 |
| Day 3 | 264 | 113 | 151 | 0.1136 |

## Appendix C2: Wilcoxon Signed-Rank test (Sweden)

**Wilcoxon Signed-Rank Test (Sweden)**

| | obs | Positive | Negative | p value |
|---|---|---|---|---|
| Day -3 | 45 | 14 | 31 | 0.0180 |
| Day -2 | 45 | 25 | 20 | 0.3635 |
| Day -1 | 45 | 27 | 18 | 0.1962 |
| Day 0 | 45 | 23 | 22 | 0.6075 |
| Day 1 | 45 | 21 | 24 | 0.8878 |
| Day 2 | 45 | 19 | 26 | 0.2123 |
| Day 3 | 45 | 20 | 25 | 0.6075 |

## Appendix C3: Wilcoxon Signed-Rank test (Germany)

**Wilcoxon Signed-Rank Test (Germany)**

| | obs | Positive | Negative | p value |
|---|---|---|---|---|
| Day -3 | 48 | 20 | 28 | 0.0777 |
| Day -2 | 48 | 27 | 21 | 0.2034 |
| Day -1 | 48 | 16 | 32 | 0.0034 |
| Day 0 | 48 | 32 | 16 | 0.0120 |
| Day 1 | 48 | 26 | 22 | 0.4540 |
| Day 2 | 48 | 25 | 23 | 0.5657 |
| Day 3 | 48 | 25 | 23 | 0.7505 |

## Appendix C4: Wilcoxon Signed-Rank test (Spain)

**Wilcoxon Signed-Rank Test (Spain)**

| | obs | Positive | Negative | p value |
|---|---|---|---|---|
| Day -3 | 30 | 17 | 13 | 0.5170 |
| Day -2 | 30 | 15 | 15 | 0.1714 |
| Day -1 | 30 | 12 | 18 | 0.0428 |
| Day 0 | 30 | 17 | 13 | 0.1714 |
| Day 1 | 30 | 19 | 11 | 0.1109 |
| Day 2 | 30 | 18 | 12 | 0.3185 |
| Day 3 | 30 | 7 | 23 | 0.0053 |

Appendix C5: Wilcoxon Signed-Rank test (Polluting Companies)

**Wilcoxon Signed-Rank Test (Polluting Companies)**

| | obs | Positive | Negative | p value |
|---|---|---|---|---|
| Day -3 | 132 | 46 | 86 | 0.0001 |
| Day -2 | 132 | 75 | 57 | 0.0094 |
| Day -1 | 132 | 47 | 85 | 0.0001 |
| Day 0 | 132 | 39 | 93 | 0.0000 |
| Day 1 | 132 | 74 | 58 | 0.0094 |
| Day 2 | 132 | 59 | 73 | 0.6173 |
| Day 3 | 132 | 74 | 58 | 0.0795 |