The Impact of Climate Agreements on US Firms: A Comparative Analysis

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Abstract

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This dissertation investigates the differential effects on equity returns between green and brown US firms following the signing of the Paris Agreement in 2015 and the subsequent US withdrawal from the agreement in 2017.

By performing a difference-in-difference analysis with panel data on 106 green firms and 203 brown firms, the dissertation investigates the impact of this type of concerted action on climate policy on US equity markets, in particular on firms' excess returns. Different definitions of green and brown firms are considered. It is found that broader definitions of green firms that consider social and governance aspects of the firms do not seem able to capture the impact of the climate policy events. However, a stricter definition of brown firms, focusing on the oil and gas industry indeed allows to find that these firms are penalized by the signing of the Paris Agreement. Moreover, no significant differential impact is found on the withdrawal nor the election of President Trump, suggesting that a less "environmentally friendly" policy did not benefit "brown" firms' equity valuations as these may still need to adapt to climate change with or without explicit policy decisions. The findings may be attributed to factors such as the broad definition of "greenness" based on Environmental, Social, and Governance (ESG) scores, the anticipation of the withdrawal in advance, and the market's perception of the events.

Keywords: Climate Agreements, Paris Agreement, Difference-in-difference analysis, Equity Valuation.

Sumário

O impacto dos acordos clmáticos nas empresas dos EUA: uma análise comparative

Por Line Sand Tindbæk

Esta dissertação investiga efeitos diferenciados nos rendimentos accionistas entre empresas "verdes" e "castanhas" dos Estados Unidos após a assinatura do Acordo de Paris em 2015 e a posterior retirada dos Estados Unidos do acordo em 2017.

Realizando uma análise de diferenças-em-diferenças com dados em painel de 106 empresas "verdes" e 203 empresas "castanhas" , a dissertação investiga o impacto deste tipo de ação concertada sobre a política climática nos mercados accionistas dos Estados Unidos, em particular nos rendimentos excessivos das empresas. São consideradas diferentes definições de empresas "verdes" e "castanhas". Verifica-se que definições mais amplas de empresas "verdes" que consideram aspectos sociais e de governança das empresas não parecem capazes de capturar o impacto dos eventos da política climática. No entanto, uma definição mais estrita de empresas "castanhas", com foco na indústria de petróleo e gás, permite constatar que estas empresas são penalizadas pela assinatura do Acordo de Paris. Além disso, não foi encontrado nenhum efeito diferencial significativo da retirada nem da eleição do Presidente Trump, sugerindo que uma política "menos amiga do ambiente" não beneficia a valorização accionista das empresas "castanhas", pois estas podem, ainda assim, precisar se adaptar às mudanças climáticas com ou sem decisões políticas explícitas. Os resultados podem ser atribuídos a fatores como a ampla definição de "caráter verde" com base em pontuações ambientais, sociais e de governança (ESG), a antecipação da retirada com antecedência e a percepção do mercado dos eventos.

Palavras-chave: Acordos Climáticos, Acordo de Paris, Análise Diferença-em-diferença, Avaliação patrimonial

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1. Introduction and Motivation

Climate change and sustainability are two of the most pressing global challenges of our time, necessitating collective efforts to mitigate their impacts and transition towards a sustainable future. Consequently, there is a broad agreement that climate challenges and sustainable development should be addressed. The signing of the Paris Agreement in 2015 marked a milestone in global efforts to combat climate change. Consensus on climate change mitigation, compared to pre-industrial levels cannot be achieved without the engagement of the financial sector. The Organization for Economic Co-operations and Development (OECD) estimates that investing $6.9 trillion annually will be necessary to meet the Paris Agreement goals (OECD Publishing, 2017). Hence, governments and investors probably must commit to reallocating their investments to achieve the Paris goal by 2030. However, the withdrawal of the United States from the agreement officially announced in 2017, raised concerns about the potential implications for environmental policies and their impact on financial markets.

The Paris Agreement and the United States' subsequent withdrawal from the agreement have generated considerable interest and debate. The relationship between environmental regulations, corporate sustainability practice, and financial performance has become an area of growing research interest. Understanding the effect of such a global environmental agreement and policy changes on the financial performance of firms is crucial for policymakers, investors, and businesses. The aim of the dissertation is to explore the effects on the financial performance of green and brown firms following the Paris Agreement and the United States' withdrawal from the agreement, the main goal is to answer the question:

> *Is there a differential effect of the Paris Agreement and the US withdrawal from the agreement on the stock returns of green and brown firms?*

One essential aspect of assessing the impact of environmental agreements on firms is examining the financial markets' response. Assessing the impact of, green firms, which have adopted environmentally friendly practices or are related to economic sectors with a low environmental impact, and brown firms, which are associated with less environmentally friendly practices or to economic sectors with a greater environmental impact, provides an interesting direction to the dissertation. By comparing the financial performance of these two groups before and after key events like the signing of the Paris Agreement and the withdrawal,

one can gain insight into the financial markets' reaction and differential effects on these firms. Looking forward, it can provide guidance on which economic sectors may need more adjustment to climate policy and the challenges posed by climate change.

This dissertation examines the effect of the Paris Agreement and the subsequent U.S. withdrawal from the agreement on the excess returns of green versus brown firms. By conducting a comprehensive difference-in-difference analysis, the dissertation evaluates whether the signing of the Paris Agreement resulted in differential excess returns for green firms compared to brown firms. Additionally, the dissertation investigates how the United States' withdrawal from the agreement influenced the excess returns of these firms. Looking forward, it can provide guidance on which economic sectors may need more adjustment to climate policy and the challenges posed by climate change.

Through this dissertation, the aim is to contribute to the growing body of knowledge on the financial implications of climate change policies and foster a deeper understanding of the relationship between sustainability and firm performance. By illuminating the complex dynamics at the intersection of environmental concerns and financial outcomes, the aim is to facilitate the development of more effective strategies for businesses and policymakers to navigate the challenges and opportunities presented by the transition to a low-carbon economy.

Paris Agreement and The Withdrawal

The Paris Agreement and the preceding negotiation were major events with a global scope and significant media coverage. The Agreement is a legally binding international treaty on climate change and stands as a landmark international commitment to combat climate change and limit global warming to well below 2 degrees Celsius above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius. After decades of negotiations, the agreement was adopted by 196 parties at the UN Climate Change Conference (COP21) in Paris, France, on 12. December 2015, and entered into force on 4. November 2016. Each participating country is required to submit its own Nationally Determined Contributions (NDCs), outlining its climate action plans, targets, and strategies to reduce greenhouse gas emissions and adapt to the impacts of climate change. The Agreement establishes a process for regular global assessments of collective progress toward the Agreements goals. Developed countries are encouraged to provide financial resources to assist developing countries in their climate mitigation and adaptation efforts. The Paris Agreement includes a compliance mechanism designed to promote implementation and compliance with its provisions. While the

Agreement does not impose specific penalties for non-compliance, it emphasizes the importance of transparency, reporting, and accountability in tracking countries' progress toward their NDCs. The Agreement represented a commitment by the U.S. government to engage in global climate action, demonstrating leadership on international platform and signaling its dedication to addressing climate change. Further, the Agreement provides a framework for international cooperation and coordination in tackling climate change. By signing and participating, the United States aimed to collaborate with other countries in addressing a global challenge that requires collective efforts. The Agreement recognizes the need for transitioning to a sustainable, low-carbon economy (*The Paris Agreement | UNFCCC*, n.d.).

However, on the 9th of November 2016, Donald Trump was elected as the U.S. President. The election presented a potential threat to the implications of the Paris Agreement, as the new president claimed that global warming is a hoax concocted by China to weaken the competitive industrial power of the United States. On the 1st of June 2017, as earlier publicly promised, U.S. President Donald Trump officially announced that the U.S. would withdraw from the agreement, contending that it would "undermine" the U.S. economy, and put the U.S. at a permanent disadvantage. The Trump administration argued that the Agreement placed an unfair burden on the United States, claiming that it would have adverse economic effects, particularly on industries such as coal and fossil fuels. There were concerns that the Agreements requirements and commitments could hinder economic growth and job creation in certain sectors. However, in the President's speech regarding the withdrawal on 1st of June, the President stated, "We will start to negotiate, and we will see if we can make a deal that's fair" (Pramuk, 2017). Media sources like BBC and CNN have reported on the withdrawal, highlighting that it releases the US from legal obligations, but does not negate the possibility of continued action.

The remainder of this dissertation is structured as follows: Chapter 2 provides a comprehensive review of the literature related to climate change policies, financial performance, and firm valuation. Chapter 3 introduces the hypotheses tested in the dissertation. Chapter 4 describes the data collection, sample selection, and variables. Chapter 5 describes the research methodology and regression tested. Chapter 6 presents the results of the analysis. Finally, chapter 7 will discuss and wrap up the findings and provide recommendations for further studies.

2. Literature Review

The second chapter aims to provide an overview of the field of research and relevant literature. Climate change and sustainability have become some of the most pressing issues throughout the last decade. While the effects of climate changes often are neglected and not observed overnight, investors are increasingly interested in understanding how the shifts to a greener and cleaner economy affects firms (Li et al., 2022). In addition, Bolton & Kacperczyk, (2021) finds evidence that investors increasingly pay attention to climate risk.

Climate risk has arisen as a critical factor influencing investment decisions, motivating broad research on pricing various dimensions of climate risk in equity markets. Climate risk covers both physical risks and transition risks. Physical risks arise from weather and climate-related catastrophes, such as floods, droughts, storms, and sea-level rises (Nordhaus (2019) and Stern (2008)). Transition risk results from the relative uncertainty created by the global shift towards a more sustainable, net-zero economy, this risk arise from adjustments made towards developing a greener economy, such as the Paris Agreement, and depend on the timing and the speed of the process (*Transition Risks*, n.d.). Hong et al., (2019) and Bolton & Kacperczyk (2021) have explored the valuation of firms-based carbon emissions and environmental friendliness. They suggest that firms with higher carbon emissions often are valued at a discount, with one standard deviation increase in emissions associated with a rise in expected returns of approximately 2% per annum. This effect is attributed to exclusionary screening[1] by institutional investors seeking to limit carbon risk in their portfolios (Giglio et al., 2021). Carbon risk refers to the financial risk associated with climate change and the transition to a low-carbon economy.

Moreover, Pástor et al., (2022) explore the influence of climate risk on stock market behavior and finds that green stocks tend to outperform brown stocks[2] when there is bad news about climate change, consistent with green stocks being better hedges against climate risk. The study also provides evidence that green stocks may obtain higher realized returns than brown stocks because of increased concerns about climate change, but similar or even lower expected returns. This is expected as Krueger et al., (2019) find that most institutional investors believe there is climate change, and 91% expect regulatory climate risk to materialize financially

[1] Exclusionary screening (or negative screening) refers to the exclusion from a fund or portfolio of certain sectors, companies, or practices based on specific ESG criteria (Charles et al., n.d.).
[2] Pástor et al. distinguishes between green and brown firms based on their environmental pillars scores and weights obtained from MSCI ESG ratings.

within two to five years, whereas 55% believe it will materialize already today. Furthermore, Antoniuk & Leirvik, (2021) finds that stock market investors are quick to adapt to new information related to climate change.

There have been done several studies that aims to investigate the impact of climate change policy over the past decade, yet the literature is far from being conclusive, and different results are obtained. Alessi et al., (2021) study the evolution of the greenium[3]. The authors find that investors in the European equity market tend to accept lower returns to hold greener and more transparent assets when the economy's shift towards low carbon becomes more credible. They further explore that negative climate news are associated with an increase in the greenium, for instance when the U.S. announced its withdrawal from the Paris Agreement, and opposite, they explore a decrease in the greenium after the Paris Agreement signing.

Kruse et al., (2020) uses an event study approach to examine the daily stock prices of major publicly listed US firms, highlighting that investors do distinguish between green and brown firms[4] and find that the signing of the Paris Agreement did have a positive significant effect on the valuation of green firms. Diaz-Rainey et al., (2021) investigated the short-term effects on the stock market valuation and options market expectation of oil and gas companies when the Paris Agreement was signed, the election of Trump, and when Trump officially withdraw from the Paris Agreement. They found that the signing of the Paris Agreement had a significant negative impact on the oil and gas sector supported by increased implied volatility, which is in line with the findings of Kruse et al., (2020), which observed negative but marginally significant abnormal returns on high carbon intensive firms in the Oil and Gas sector, and furthermore suggest that policy signals on climate change are insufficient to bring rapid shift away from investing in fossil fuels towards low carbon. Antoniuk & Leirvik, (2021) finds that the fossil fuel sector lost returns in connection to the Paris Agreement, however, they found that the fossil fuel sector anticipated negative news due to the Paris meeting long before the agreement took place.

Further, Diaz-Rainey et al., (2021) found that the election of Trump and the withdrawal announcement negatively affected the overall oil and gas sector and that the impact was more substantial on firms that primarily had U.S.-focused operations. Mukanjari & Sterner, (2018)

[3] The greenium is a risk premium linked to the firms´ greenness and environmental transparency based in individual stock returns (Alessi et al. 2021).
[4] Kruse et al. (2020) distinguish green and brown firms using their green revenue share and their carbon intensity respectively.

did not find unique evidence of stock price responses to the announcement of the Paris Agreement nor the Trump election on fossil-based energy companies. Further, Monasterolo & de Angelis, (2020) suggest that stock market investors have started considering low-carbon assets as an appealing investment opportunity after the Paris Agreement signing but have yet to penalize carbon-intensive assets. Kruse et al., (2020) show that the Paris Agreement did have a significant effect on the valuation of green firms. They found evidence that stock markets re-price firms engaged in the commercialization of green goods and services but do not always re-value brown firms. Antoniuk & Leirvik, (2021) applies an event study methodology and finds that the clean energy sector benefited from the Paris Agreement since the event increased climate change awareness and favor toward policies related to reducing the impact of climate change. Lucia et al., (2022) shed light on the role of the financial industry in relation to the policy objectives of achieving sustainability goals and finds evidence that investors have reduced their exposure to carbon-intensive assets in reaction to the Paris Agreement and that the trend reverted after the US withdraw announcement.

However, the literature regarding the performance of firms with higher environmental, social and governance (ESG) scores is still somehow limited.

3. Hypotheses

The previous literature review provides valuable insight into the relationship between climate change policy and stock market behavior. Based on the existing literature, this chapter aims to formulate the dissertations hypotheses, which will be tested to further explore the effects of the signing of the Paris Agreement by the U.S. and the subsequent withdrawal from the agreement on the financial performance of green and brown firms. According to previous research, green stocks tend to outperform brown stocks when there are negative news about climate change. Presumably, green firms will be affected differently than brown firms when huge climate change policy events are announced. Based on the learning outcome so far, one would expect green firms to realize higher returns compared to brown firms during climate policy change events in favor of the climate and in response to policy signals positively related to environmental sustainability, such as the signing of the Paris Agreement. Subsequently, one would expect the opposite when there are negative announcements regarding climate policy change events, such as the withdrawal from the Paris Agreement.

The signing of the Paris Agreement may be associated with a substantial impact on the returns of green firms compared to brown firms. Previous studies by Kruse et al. (2020) and Diaz-Rainey et al. (2021) suggest that the signing of the Paris Agreement positively affected the valuation of green firms[5]. Further, policy measures following the agreement, such as subsidies for green firms and taxes on brown firms, can affect future profitability and competitiveness. These measures incentivize the growth of sustainable industries and penalize carbon-intensive practices, making green firms more attractive to investors and potentially reducing the profitability of brown firms. Therefore, it is hypothesized that green firms will experience a higher increase in excess returns compared to brown firms after the signing of the Paris Agreement. The following hypotheses around the signing of the agreement are formulated:

> ***H0:*** *There is no significant difference in the excess return between US green and brown firms on the signing of the Paris Agreement.*
> ***HA:*** *US green firms have a higher excess return compared to US brown firms on the signing of the Paris Agreement.*

[5] Diaz-Rainey et al. (2021) perform their studies on oil and gas companies. Kruse et al. (2020) use high carbon-intensive firms in the Oil and Gas Sector.

The withdrawal from the Paris Agreement by U.S. President Donald Trump may be allied with impacting the returns of green and brown firms. The studies by Diaz-Rainey et al. (2021) and Munkanjari & Sterner (2018) provide mixed findings regarding the effect of the withdrawal announcement on stock market behavior. The withdrawal from the Paris Agreement, in contrast to its signing, is expected to have a negative impact on the returns of green firms relative to brown firms. The withdrawal signifies a potential shift in policy priorities away from supporting green initiatives and may remove regulatory incentives and subsidies for sustainable industries. This could disadvantage green firms and potentially reduce their profitability compared to brown firms. The withdrawal may also signal a lack of commitment to global climate goals, potentially affecting investor sentiment and leading to a decrease in the perceived value of green firms in relation to their brown counterparts. It is hypothesized that the withdrawal from the Paris Agreement will have a negative impact on the excess returns for both green and brown firms. Still, the effect will be more substantial for green firms due to their stronger association with climate change policies, if the withdrawal is considered as negative news towards the environment. Resulting in the following hypotheses:

> ***H0:*** *There is no significant difference in the excess return between US green and brown firms when Donald Trump officially announced the withdrawal from the Paris Agreement*
>
> ***HA:*** *US Green firms have a lower excess return compared to US brown firms when Donald Trump officially announced the withdrawal from the Paris Agreement*

These hypotheses aim to capture the expected relationship between climate change policy developments, the financial performance of firms, and the differential treatment of green and brown firms. By testing these hypotheses, one can gain further insight into the financial implications of climate change policies and the potential advantages or disadvantages faced by firms adopting sustainable practices. However, one potential drawback of the identification strategy used is that these events may not be sudden surprises that have an immediate and significant impact on market pricing. The negotiations leading up to the Agreement and the subsequent withdrawal is a long-term process with extensive media coverage, allowing investors to anticipate and incorporate the likely outcomes over time. As a result, by the time the Agreement is signed or the withdrawal is announced, the market may have already priced in the expected effects, leading to a potential limitation in capturing a distinct price effect at the moment of these events. The data and methodology chapter provides a detailed explanation

of the data used, the chosen research methodology, and statical techniques employed in order to test the hypotheses.

4. Data

This section describes the data used for the study. The data is collected over a 10-year period between 2013 and 2023 to get larger and more representative sample data. The data is observed daily as daily data can help capture any immediate market reactions and fluctuations surrounding an event. Further, the variables excess return, time and green which are the variables used are presented.

4.1 Data Collection and Variables

The primary data source is financial metrics collected from Refinitive Eikon database —other data, like the risk-free rate is gathered from FRED.

When using panel data, it is desirable to have as complete a dataset as feasible, hence the exclusion of missing data. Consequently, including missing data could lead to skewed estimates, which in turn could lead to low validity in the conclusion (Bartholomew et al., 2008). Table 1 presents the used variables:

TABLE 1
Tested Regression Variables

NATURE OF VARIABLE	VARIABLE
Dependent variable	Excess Return
Independent variables	Green
	Time

Table 1 shows the dependent variables, independent variables, as well as possible control variables.

4.1.1 Excess Return

One of the key measures of a firm's financial performance is the excess return. By applying the excess return, one can capture the performance of a firm's stock relative to the overall market, this helps in isolating the stock-specific factors and assessing the financial performance in a market context (Fama & French, 1988). The excess return is calculated as the difference between the actual return of a firm's stock and the risk-free rate during a specific time period:

$$Excess\ Return_{it} = R_{it} - R_{ft} \quad (1)$$

Where R_{it} denotes the actual return of a specific firm $i\ on\ a\ particular$ point in time t, and R_f denotes the risk-free rate. The actual return is derived from historical stock prices of the firms in the dataset, capturing the change in stock prices, calculated as follows:

$$R_{it} = \frac{Price_{t-1,i} - Price_{t,i}}{Price_{t,i}} \quad (2)$$

The risk-free rate represents the return an investor could earn from a risk-free investment, such as government bonds or treasury bills, which are assumed to have no default risk. By subtracting the risk-free rate from the actual return, the excess return captures the additional returns obtained from investing in the firm's stock above and beyond the risk-free alternative. Hence, it reflects the performance of the firm's stock and provides insight into the profitability and attractiveness of the investment.

The excess returns provide a standardized measure not influenced by macroeconomic factors or market conditions, allowing for a more reliable comparison across different assets and time periods (Campbell & Shiller, 1988).

4.1.2. Other variables

Further, other variables are added to the regression to examine the effect of different factors on the excess returns of firms. These variables aims to capture the greenness of firms, the timing of the events, and the differential effects. By including these variables in the regression analysis, one can investigate the differential impact of the selected policy events on the excess returns of firms.

4.1 Definition of Green Firms

Investments considered environmentally friendly are often referred to as "green", with "brown" denoting the opposite (Pástor et al., 2022). However, nobody truly knows what defines a sustainable operation, and there is currently no standard definition of what constitutes a sustainable activity. Previous literature defines the greenness of firms in various ways. (Alessi et al., 2021) define a firm's greenness based on the companies' greenhouse gas emissions and the quality of their environmental disclosure. Bauer et al., (2023) use CO2 emissions reported by companies to measure their greenness. Pástor et al., (2021) use the environmental ratings from MSCI, which is a leading provider of environmental, social, and governance (ESG) ratings. Following (Pástor et al., 2021), this study will define green firms as the ones included in the MSCI USA ESG select index. The brown sample will represent the firms in the S&P500.

4.2.1. Green sample

The green firms are defined as the constituents included in the MSCI USA ESG select index on the 28th of February, 2023. This index is designed to target companies with favorable ESG factors while exhibiting risk and return characteristics similar to those of the MSCI USA Index, the constituent selection is based on data from MSCI ESG research (*MSCI USA ESG Select*

Index, 2023). The initial sample set retrieved from Refinitive Eikon consists of 173 firms observed, with 455 973 daily observations (see Table 2).

4.2.2. Brown sample

The brown firms are defined as those included in the S&P500 as of 28th of February 2023, excluding those in the green sample. After excluding the green firms, the initial dataset consists of 356 firms with 941 105 observations. Subsequently, excluded for missing values, the final dataset consists of 203 firms with 342 794 observations.

4.3 Descriptive Statistics

The panel data consist of a total of 309 firms observed over 10 years. Table 2 below presents the descriptive statistics of the two samples.

TABLE 2
Descriptive Statistics

Sample Distribution

Sample	No. of obs.	No. of firms	No. of years
Green	195 392	106	10
Brown	342 794	203	10
Total	538 186	309	10

Summary Statistics

Variable	No. of obs.	Mean	Standard Deviation	Minimum	Maximum
GREEN SAMPLE:					
Excess Return (%)	195 392	-2.151	0.668	-4.326	-0.425
Market Value (USD)	195 392	70 583	175 601	1	2 973 018
Total Assets (USD)	195 392	41 344 409	109 266 083	1	2 365 724 446
ROA (%)	195 392	9.873	7.269	-31.920	43.540
Div. per share (USD)	195 392	1.526	1.678	0	10.640
Leverage (E/D) (USD)	195 392	129.494	404.055	-4 505.17	5 001.95
BROWN SAMPLE:					
Excess Return (%)	342 794	-2.165	0.659	-4.286	-0.328
Market Value (USD)	342 794	36 055	58 336	1	911 045
Total Assets (USD)	342 794	31 459 044	47 108 608	1	369 067
ROA (%)	342 794	8.445	6.775	-35.260	70.610
Div. per share (USD)	342 794	1.134	1.472	0	16.400
Leverage (E/D) (USD)	342 794	132.058	705.674	-6 213.18	42 210

Table 2 presents the descriptive statistics of the entire sample with daily observations from 2013 to 2023.

5. Methodology

The methodology chapter describes the chosen methodology and provides a detailed overview of the chosen research methodology and analytical techniques employed in this dissertation. It outlines the quantitative approach used to examine the effect of the Paris Agreement and its subsequent withdrawal on the excess return of green and brown firms. This chapter highlights the use of panel data analysis with fixed effects and difference-in-difference analysis as the primary statistical techniques.

5.1 Choice of Research Methodology

This dissertation uses a quantitative research methodology, considering that quantitative methods provide a broad overview of a large area and its suitability when testing theories. One of the main advantages of conducting quantitative research is the ability to generalize results. Quantitative methods are besides used to draw conclusions about causal relationships by attempting to determine if one or more independent variables affect the output variable.

In order to answer the research question, a difference-in-difference analysis with fixed effects are conducted.

5.1.1 Regression Analysis

This section presents the regression models (and techniques) used to answer the research question. In order to answer the research question, a difference-in-difference analysis for panel data is conducted to get a deeper understanding of the differential effects of green and brown firms, when both positive and negative policy changes about climate change are announced.

5.1.2 Panel Data

The dataset includes both time-series and cross-sectional dimensions, meaning that it is a panel. Panel data have the dimension of both time series and cross-sections and include observations on the same variables from the same cross-sectional sample from two or more different time periods (Studenmund, 2011). By using a panel data, one can address a broader range of issues and tackle more complex problems than would be possible with pure time series or cross-sectional data alone. Another advantage with panel data is that it often is in interest to examine how variables change dynamically over time and can help to mitigate multicollinearity. Further, the impact of certain forms of omitted variable bias in the regression results can be removed using panel data. Panel data refers to N different entities observed at T different time periods (Brooks, 2019):

$$y_{it} = \alpha + \beta x_{it} + u_{it} \tag{3}$$

$$(i = 1, \dots, N) \; and \; (t = 1, \dots, T) \tag{4}$$

Fixed Effects Regression Model

Fixed effects regression is a method that explores the panel data format. Fixed effects regression helps control for omitted variables regression when the omitted variables occur across entities and not time. Fixed effects regression models have $n - 1$ binary variables, and thus make it possible to absorb the influence of all omitted variables that differ across entities but are constant over time (Stock & Watson, 2015). Considering equation 3 above, introducing fixed effects, the distribution term u_{it} is decomposed as followed:

$$u_{it} = \mu_i + v_{it} \tag{5}$$

Where μ_i is an unobserved individual-specific effect encapsulating all the variables that affect the dependent variable y_{it} cross-sectionally, but do not vary over time. v_{it} is the ´remainder distribution´, which captures everything left unexplained in the dependent variable that varies over time and entities about the dependent variable y_{it} (Brooks, 2019). Thus, the fixed effects regression can be denoted in the following way:

$$y_{it} = \alpha + \beta_1 x_{it} + \mu_i + v_{it} \tag{6}$$

In the above model, it is pursued to estimate β, the effect of a unit change in x on y holding μ constant. The fixed effect model can also be estimated using binary variables, termed as the least squared dummy variable (LSDV) approach. However, this model has N + k parameter to estimate, which is a challenging problem when N is large. In order to avoid the necessity to estimate numerous dummy variable parameters, a within transformation can be made. The within transformation involves subtracting the time-mean of each entity away from the values of the variable, defined as the time-mean of the observations for cross-sectional unit i, and similarly calculating the mean of the explanatory variables (Brooks, 2019):

$$\overline{y_i} = \frac{1}{T} \sum_{t=1}^{T} y_{it} \tag{7}$$

Further, one can subtract the time demands from each variable to obtain a regression containing demanded variables only. Such a regression does not require an intercept term since the dependent variable now will have zero mean by construction:

$$y_{it} - \overline{y_i} = \beta(x_{it} - \overline{x_i}) + u_{it} - \overline{u_i} \quad (8)$$

This can be written as $\ddot{y_{it}} = \beta\ddot{x_{it}} + \ddot{u_{it}}$ where the double dots above the variables denote the demanded values. Such a model can be estimated using the Ordinary Least Square (OLS), but it is necessary to make a degree of freedom correction (Brooks, 2019).

Assumptions Behind Fixed Effects Regression

Extending the assumptions behind the OLS estimation, there are four assumptions behind fixed effects regression (Stock & Watson, 2015):

i. u_{it} has conditional mean zero: $E(u_{it}|X_{1,it}, X_{2,it}, \dots, X_{k,it}, \alpha) = 0$
ii. $(X_{1,it}, X_{2,it}, \dots, X_{k,it}, u_{i1}, u_{i2}, \dots, u_{iT}), i = 1, \dots, n$ are identically and independently distributed (i.i.d.) draws from their joint distribution.
iii. Large outliers are unlikely: (X_{it}, u_{it}) have nonzero finite fourth moments.
iv. There is no perfect multicollinearity.

5.2 Choice of Regression

This dissertations dataset contains different time periods and entities (firms); thus, it is a panel data, and it is convenient to use panel data regression models. To examine the causal effect of the Paris Agreement and subsequent withdrawal from the agreement on the excess returns of green and brown firms, a difference-in-difference (DiD) analysis is employed, the DiD is particularly valuable in evaluating the impact of interventions, policies, or events. The purpose of performing this analysis is to compare the effect of some treatment groups against a control group (Abadie, 2005). Thus, it allows for comparing changes in excess returns over time between the green firms (treatment group) and the brown firms (control group). By comparing the differential changes in excess return between the two groups before and after the events, one can isolate the causal impact of the events on the firms' performance, considering the model:

$$y_{it} = \alpha + \gamma_i + \lambda_t + \beta D_{it} + u_{it} \quad (9)$$

Where y_{it} is the dependent variable i, at time t. i and t are dimensions indicating entity and time. γ_i and λ_t are the vertical intercept for i and t. β captures the treatment effect, with D_{it} being the interaction term for the treatment status. u_{it} is the error term. The main coefficient of interest is the coefficient in the interaction term, which captures the differential impact of the policy event on the green firms, and is estimated as:

$$\hat{\beta}_1 = \left(\overline{y_{G,2}} - \overline{y_{G,1}}\right) - \left(\overline{y_{B,2}} - \overline{y_{B,1}}\right) \quad (10)$$

Where, $\overline{y_{G,1}}$ and $\overline{y_{G,2}}$ are the average effect of the green firms before, and after the event and $\overline{y_{B,1}}$ and $\overline{y_{B,2}}$ are the average effect of the brown firms before and after the event. The difference-in-difference analysis provides a powerful approach to assess the causal effects of the specific events by considering the pre-treatment and post-treatment periods for both treatment and control groups.

Assumptions behind the Difference-in-Difference:

All the Ordinary Least Square (OLS) approach assumptions are applied equally for difference-in-difference estimation. Additionally, the difference-in-difference requires an assumption of parallel trend assumption. This assumption implies that $\lambda_2 - \lambda_1$ is equally in both $i = 1$ and $i = 2$. The treatment effect is determined by the difference between the actual values of y and the hypothetical values of y that would have occurred in the absence of treatment with parallel trends. To obtain a precise difference-in-difference estimate, assuming that individuals in the two groups remain unaffected by the other factors over time is necessary.

Further, to account for potential time-invariant unobserved heterogeneity and firm-specific effects, fixed effects regression models will be employed. These models control for unobservable factors that are constant over time but may vary across firms, reducing the potential bias in the estimated effects. By applying the fixed effect regression the following regression is obtained:

$$Excess\ return_{it} = \gamma_i green_i + \lambda_t time_t + \beta_1 green_i * time_t + u_{it} \quad (11)$$

In order to test the hypotheses explained in Chapter 3 regression 11 is runned[6] to capture the effects of the different events. Here the $Excess\ return_{it}$ examining the financial performance serves as the dependent variable. $green_i$ and $time_t$ serve as the independent variables. $green_i$ is a binary variable that takes the value of 1 if firm I belong to the green sample and 0 otherwise. $time_t$ is also a binary variable that takes the value of 1 after the event date and 0 before the event, this variable allows for the examination of how the excess returns of firms change after the events. The coefficient β_1 in the interaction term is the main coefficient of interest to test the hypotheses. Regarding the signing of the Paris Agreement it is hypothesized that green firms will experience a higher excess return compared to brown, the interaction term coefficient β_1 is therefore expected to be positive and statistically significant. Regarding the withdrawal from the agreement, one would expect the coefficient β_1 to be negative and statistically significant indicating that green firms experienced a lower excess return compared to brown firms. The results from the regression analysis are presented in the next chapter.

5.3 Robustness

To ensure the robustness of the results, the dissertation addresses the violation of the independent and identically distributed (i.i.d.) assumption inherent in the dataset. Specifically, as the same firm appears multiple times in the dataset over the observation period, the standard errors may be incorrect due to the presence of heteroskedasticity and autocorrelation. A robust estimation method that corrects these issues is employed to account for this. The standard errors were computed using the vcovHC() function, allowing heteroskedasticity and autocorrelation-consistent estimation. By utilizing this method, standard errors robust to the violation of the i.i.d. assumption are obtained, providing more reliable and accurate inferences to the difference-in-difference analysis.

[6] The statical software R is utilized to conduct the regression analysis and obtain the estimated coefficients, standard errors, and p-values presented in chapter 6.

6. Results

This chapter presents the results of the regression models tested around the signing of the Paris Agreement and the subsequent withdrawal from the agreement. The analysis is done using two different event windows; 1 quarter before and after the event and 1 month before and after the event (see appendix A3). Further, the analysis is performed using both daily frequency data and monthly frequency data. Additionally, alternative treatment and control groups are tested. Finally, additional tests are presented around the election of U.S. President Donald Trump.

6.1 Results from the Paris Agreement Signing

The results of the difference-in-difference analysis regarding the signing of the Paris Agreement are presented in Table 3, with an event window of one quarter before and after the event day, with daily frequency observed data.

TABLE 3: Signing of the Paris Agreement, Quarterly event window

	Within (1)	Within.corr (2)
Time	0.175*** (0.002)	0.175*** (0.003)
Green:time	-0.009** (0.004)	-0.009** (0.004)
Observations	28 169	
R^2	0.226	
Adjusted R^2	0.219	

Panel regression with firm fixed effects, *** Represents a significance level of 1%, ** represents a significance level of 5%, *represents a significance level at 10%. Robust standard errors are reported in the column within.corr (2).

These results suggest that the signing of the Paris Agreement had an overall impact on the excess returns of both green and brown firms, as the "time" coefficient, estimated at 0.175, is positive and significant at a 1% level. However, the coefficient "green:time" is estimated at -0.009 and are significant at a 5% level, implying a differential treatment effect on green firms after the signing of the agreement, however the negative coefficient indicates that green firms experienced a decrease in excess returns compared to brown firms in the post-Paris Agreement period.

Table 4 presents the results of the signing of the Paris Agreement, considering an alternative event window of 1 month before and after the event.

TABLE 4: Signing of the Paris Agreement, Monthly event window

	Within (1)	Within.corr (2)
Time	0.014***	0.014***
	(0.002)	(0.001)
Green:time	-0.002	-0.002*
	(0.003)	(0.001)
Observations	9 404	
R^2	0.014	
Adjusted R^2	-0.012	

Panel regression with firm fixed effects, *** Represents a significance level of 1%, ** represents a significance level of 5%, *represents a significance level at 10%. Robust standard errors are reported in the column within.corr (2).

These results with a shorter event window show similar trends that the ones obtained with a longer event window, although the magnitude of the effect is smaller compared to the results with a longer event window. By applying a shorter event window one may capture more immediate market reactions to the signing of the agreement, resulting in different effects on the excess returns. Furthermore, the smaller magnitude of the coefficients observed in the alternative event window of 1 month may indicate that the initial market responses to the signing of the agreement take longer to incorporate.

Further, table 5 presents the results obtained for the signing of the agreement, considering monthly frequency data, with quarterly event windows.

TABLE 5: Signing of the Paris Agreement, Monthly frequency

	Within (1)	Within.corr (2)
Time	0.174***	0.174***
	(0.009)	(0.002)
Green:time	-0.010	-0.010**
	(0.015)	(0.005)
Observations	1 842	
R^2	0.269	
Adjusted R^2	0.156	

Panel regression with firm fixed effects, *** Represents a significance level of 1%, ** represents a significance level of 5%, *represents a significance level at 10%. Robust standard errors are reported in the column within.corr (2).

Again, these results suggest a positive overall impact of the signing of the agreement on the excess returns of both green and brown firms. However, it still suggests a negative differential treatment effect on green firms compared to brown firms. By applying monthly frequency data compared to daily frequency data one can smooth out the short-term fluctuations and noise present in the daily data. Consequently, the monthly frequency analysis may capture more generalized patterns and trends in excess returns, potentially leading to differences in the estimated coefficients compared to the daily frequency analysis. However, only small differences are obtained by applying monthly frequency data.

6.1.1 Different Treatment and Control Groups

To achieve a deeper understanding of the results obtained, different treatment and control groups are applied. Here the treatment group will serve as all industries in the sample (see appendix 2) excluding the oil and gas industry, and the control group will serve as the oil and gas industry. Table 6 presents the results from the analysis regarding the signing of the agreement:

TABLE 6: Signing of Paris Agreement; Other Industries vs. Oil and Gas

	Within (1)	Within.corr (2)
Time	0.150***	0.150***
	(0.016)	(0.017)
Green:time	0.035**	0.035**
	(0.016)	(0.017)
Observations	28 169	
R^2	0.226	
Adjusted R^2	0.219	

Panel regression with firm fixed effects, *** Represents a significance level of 1%, ** represents a significance level of 5%, *represents a significance level at 10%. Robust standard errors are reported in the column within.corr (2).

These results suggest that the signing of the agreement again had a positive impact on the financial performance of firms across all industries. Here the interaction term, estimated at 0.035 is positive and significant indicating that firms not included in the oil and gas industry achieved a higher excess return than the firms in the oil and gas industry following the signing of the Pars Agreement.

These results are consistent with the findings of Kruse et al. (2021) and Diaz-Rainey et al. (2021) which highlighted the potential for differential effects across industries. The findings

suggest that the signing of the Paris Agreement positively influenced the financial performance of firms, particularly those outside of the oil and gas industry. This implies that the agreement had a significant impact on shaping market dynamics and investor perceptions regarding climate change and sustainability.

Overall, these results further support the idea that the signing of the Paris Agreement had a positive effect on the financial performance of firms, with non-oil and gas industries experiencing a more pronounced impact. This information can be valuable for policymakers, investors, and researchers seeking to understand the implications of climate change policies on different sectors of the economy.

Overall, the results regarding the signing of the agreement, is somehow in line with the previous literature. It is important to note that the literature is not conclusive, and different studies have obtained varying results depending on how the green and brown firms are defined. Kruse et al. (2021) and Diaz-Rainey et al. (2021) found that the signing of the Paris Agreement had a significant positive effect on the valuation of green firms and increased climate change awareness. However, these studies define the greenness of the firms based on their carbon-intensity and based on the oil and gas sector respectively, hence it is in line with this dissertations findings regarding the oil and gas industry. Further, Antoniuk & Leirvik, (2021) have highlighted that the market may already priced in the expected effects of the agreement, potentially limiting the observed impact on excess returns. Overall, these findings suggest that while the signing of the Paris Agreement had a positive overall impact on the excess returns of firms, there may be variations in the treatment of green firms depending on have they are defined. The findings indicate the complexity of incorporating climate change policies into investment decisions.

6.2 Results from the Paris Agreement Withdrawal

This section presents the results of the subsequent withdrawal from the Paris Agreement. Table 7 presents the results from the withdrawal, applying a quarterly event window with daily observed data.

TABLE 7: Withdrawal from the Paris Agreement, Quarterly event window

	Within (1)	Within.corr (2)
Time	0.129***	0.129***
	(0.001)	(0.0004)
Green:time	0.001	0.001
	(0.002)	(0.001)
Observations	27 948	
R^2	0.323	
Adjusted R^2	0.317	

Panel regression with firm fixed effects, *** Represents a significance level of 1%, ** represents a significance level of 5%, *represents a significance level at 10%. Robust standard errors are reported in the column within.corr (2).

The significant coefficient for time, estimated at 0.129, suggests an overall impact on the withdrawal from the agreement on the excess returns of both green and brown firms. The positive coefficient suggests an increase in excess returns for both firms after the withdrawal announcement. However, the insignificant interaction term, estimated at 0.001, implies that there were no differential treatment effects on green firms compared to brown firms following the withdrawal from the agreement.

Further, the results of the withdrawal from the agreement, considering an alternative event window of 1 month before and after the event, with daily frequency observed data are presented in Table 8.

TABLE 8: Withdrawal from the Paris Agreement, Monthly event window

	Within (1)	Within.corr (2)
Time	0.052**	0.052***
	(0.002)	(0.0002)
Green:time	0.001	0.001
	(0.003)	(0.001)
Observations	13 859	
R^2	0.100	
Adjusted R^2	0.085	

Panel regression with firm fixed effects, *** Represents a significance level of 1%, ** represents a significance level of 5%, *represents a significance level at 10%. Robust standard errors are reported in the column within.corr (2).

Appling a shorter event window, the same trends as the ones observed regarding the signing of the Agreement are explored. The same applies when utilizing monthly frequentcy data, presented in table 9 below.

TABLE 9: Withdrawal from the Paris Agreement, Monthly frequency

	Within (1)	Within.corr (2)
Time	0.122***	0.122***
	(0.006)	(0.0004)
Green:time	0.001	0.001
	(0.009)	(0.001)
Observations	1 306	
R^2	0.409	
Adjusted R^2	0.286	

Panel regression with firm fixed effects, *** Represents a significance level of 1%, ** represents a significance level of 5%, *represents a significance level at 10%. Robust standard errors are reported in the column within.corr (2).

6.2.1 Different treatment and control groups

Also for the withdrawal different treatment and control groups are applied to achieve a deeper understanding of the results obtained. Here again the treatment group serves as all industries in the sample (see appendix A2) excluding the oil and gas industry. The control group serves as the oil and gas industry. Table 10 presents the results with the alternative groups, regarding the withdrawal from the agreement:

TABLE 10: Withdrawal; Oil and gas vs. other industries

	Within (1)	Within.corr (2)
Time	0.128***	0.128***
	(0.009)	(0.008)
Green:time	0.002	0.002
	(0.016)	(0.017)
Observations	27 948	
R^2	0.326	
Adjusted R^2	0.326	

Panel regression with firm fixed effects, *** Represents a significance level of 1%, ** represents a significance level of 5%, *represents a significance level at 10%. Robust standard errors are reported in the column within.corr (2).

These results examine the same effect as the ones observed with the primary treatment and control groups, e.g., no differential effects.

Considering the findings regarding the US withdrawal from the agreement suggesting no differential effects between green and brown firms independent of the definition of the treatment and control group may indicate the effect of the withdrawal where already incorporated at the time of the election of President Donald Trump. Hence, it would be relevant to investigate the impact of the Trump election on the excess returns of green and brown firms. The Trump administration's stance of climate change and its decision to withdraw from the Paris Agreement might have introduced factors that could influence the market dynamics for green and brown firms. By analyzing the market reactions surrounding the Trump election, one can gain insight into whether there were significant divergences in the performance of green and brown firms during that period.

6.2.2 Results from Trump Election

In order to get a better understanding of the results already presented. Additional analysis regarding the election of Donald Trump as the new U.S. president is performed to explore the impact the election may have on firms' excess returns. The rationale behind this analysis is to

investigate whether the market may already priced in the potential withdrawal from the Paris Agreement already at the time of his election. Table 11 presents the difference-in-difference results from the analysis following the election of President Trump.

TABLE 11: The Election of Donald Trump as President

	Within (1)	Within.corr (2)
Time	-0.744*** (0.002)	-0.744*** (0.001)
Green:time	-0.0003 (0.003)	-0.0003 (0.001)
Observations	27 500	
R^2	0.922	
Adjusted R^2	0.922	

Panel regression with firm fixed effects, *** Represents a significance level of 1%, ** represents a significance level of 5%, *represents a significance level at 10%. Robust standard errors are reported in the column within.corr (2).

The negative and statically significant "time" variable indicates that there was an overall decline in the excess returns following the election of President Trump. However, the interaction term is insignificant, suggesting that being classified as a green firm does not have a significant differential effect on excess returns following the election. These findings are somehow in line with the study of Munkanjari & Sterner (2018) which did not find unique evidence of stock price responses to the Trump election on fossil-based energy companies. However, these results provide no strong evidence to the argument that the withdrawal was priced already at the time of the election of Donald Trump. On the other hand, these results may suggest that investors believe that firms will need to comply with climate objectives, despite the government withdrawing from the agreement, resulting in the observation of a non-differential effect regarding the withdrawal.

7. Discussion

This chapter will discuss the findings from Chapter 6 and the limitations of the results.

7.1 Comments on Results

The results from the difference-in-difference analysis provide no support to the hypothesis that green firms performed better following the signing of the Paris Agreement nor that the subsequent withdrawal from the agreement generated higher returns on brown firms compared to green firms, however, they provide support considering the oil and gas industry as brown firms. There could be several reasons for this which will be discussed in detail.

Firstly, considering the negative results regarding the signing of the Paris Agreement which were hypothesized by previous literature to be positive. The compared groups in this dissertation are defined by their ESG performance, this performance does not only consider the environmental performance but also the social and governance performance which may blur the results, as the Paris Agreement mostly are targeted towards the environmental part. Pastor et al. (2022) defines the greenness of the tested firms considering only their e-score neglecting the social and governance aspect and find evidence that the greener firms performed better than the brown firms following the signing. While ESG scores provide a broad assessment of a company's environmental, social, and governance practices, they may not comprehensively encompass the specific climate-related risks and opportunities associated with each firm. This limitation in measuring the environmental impact could have contributed to the unexpected findings. Further, it could indicate that investors may not consider the social and governance aspects. One possible explanation is that investors may believe companies with high ESG scores at the time of the signing of the agreement may allocate more resources, thereby incurring higher costs, to fulfill the goals outlined in the agreement. Moreover, it is believable that such companies have already made significant developments in environmentally conscious activities, exhausting easily attainable opportunities. If they are confronted with additional regulations, their less environmentally friendly counterparts may be able to meet new environmental mandates at a relatively lower cost. Further, Diaz-Rainey et al. (2021) find that the oil and gas industry experienced a negative impact following the signing of the agreement, these findings are in line with the results obtained from the additional analysis presented in section 6.1.1, where a differential impact on the oil and gas industry compared to the other industries are explored. This builds upon the previous argument. Further research would be needed to investigate the long-term impact of the signing on ESG performance, if this appears to be positive, the findings from this dissertation may suggest that investors failed to consider

the long-term benefit of greener companies, not only considering the “extreme sectors”, as the signing occurred.

Secondly, considering the withdrawal from the agreement, the unexpected results, indicating no differential effects between green and brown firms following the withdrawal, can be attributed to several factors. Firstly, it is possible that market participants had already priced the potential withdrawal from the agreement well in advance before Trump's official announcement, considering Donald Trump's stance on climate change. If investors and analysts anticipated these events, they might have adjusted their expectations and investment strategies, accordingly, resulting in no discernible differential effect on the financial performance of green and brown firms. Additionally, as also discussed regarding the signing of the agreement, the definition of “greenness” used in the dissertation, based on ESG scores, may not fully capture the nuanced and complex environmental impacts on the firms being studied. Lastly, it is possible that the market did not perceive the withdrawal from the Paris Agreement as a significant factor affecting the financial performance of green firms. The perception of the events' impact may vary among investors, and some might have considered other factors as more influential in the short term. This does also strengthen the argument that the withdrawal only releases the United States from legal obligations but does not negate the possibility of continued climate action, state and local governments, businesses, and civil society can continue to take action to address climate change, independent of federal policies. This may further suggest that the withdrawal was priced already at Donald Trumps' election, however, the results explore no differential effect between firms regarding the election, which indeed strengthens the argument that investors may not consider the social and governance aspect when pricing the considered events. Financial markets can be complex and influenced by multiple factors, and the direct impact of specific events may not always align with expectations.

In conclusion, the findings of this dissertation reveal unexpected results regarding the differential effects of the signing of the Paris Agreement and subsequent withdrawal from the agreement on the financial performance of green and brown firms. The definition of “greenness” based on ESG scores which incorporate social and governance aspects alongside environmental performance, may have contributed to the negative effects following the signing, and the lack of discernible effects following the withdrawal. Previous literature that focused mostly on environmental performance found evidence of better performance for greener firms. This suggests that investors may prioritize environmental considerations over

social and governance aspects when evaluating the impact of climate change policies. These findings emphasize the complexity of financial markets and the need for more comprehensive understanding of the long-term impact of climate change policies on the financial performance of firms. Further, it is important to note that the literature is not conclusive, and further research is needed to fully understand the relationship between climate change policies and firm performance.

7.2 Limitations and suggestions for further studies

The dissertation has varied sample size in the two groups, which could influence the results. Also, as the groups of firms only consist of the constitutes being in the indices in Feburary 2023, one could believe that there is a survivorship bias[7], which may skew the average results. Further, more macro-economic specific variables like the Purchasing Managers Index (PMI) score and oil prices could be added to the regression to isolate the effect of the events further.

For further studies it would be interesting to explore the longer-term impact on the different events to get a further understanding of why the presented results are obtained

[7] Survivorship bias refers to when only the winners are considered while the losers who have vanished are not Chen, 2021).

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Appendix

A1. Timeline considering the different events:

- ⇒ 11. December 2015: The Paris Agreement was scheduled to be signed.
- ⇒ 12. December 2015: The signing of the Paris Agreement took place.
- ⇒ 14. December 2015: The first trading day after the signing of the Agreement, representing the event day around the signing.
- ⇒ 9. November 2016: Donald Trump was elected as the new president of the United State.
- ⇒ 1. June 2017: Donald Trump officially announced the U.S. withdrawal from the Paris Agreement

A2. Frequency by Industry

Appendix 2

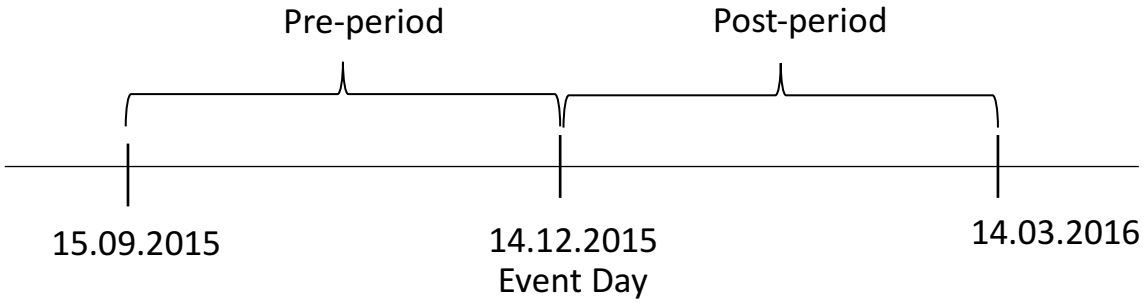
Frequency by Industry

INDUSTRY	# of Firms
Construction & Transportation	17
Diversified	8
Drugs, Cosmetics & Healtcare	29
Electronics & Electrical	62
Financial	4
Food & Beverages	17
Manufacturing	31
Metal Producers	4
Miscellaneous	60
Oil & Gas	14
Paper	4
Recreation	14
Retailers	16
Utilities	29
Total	309

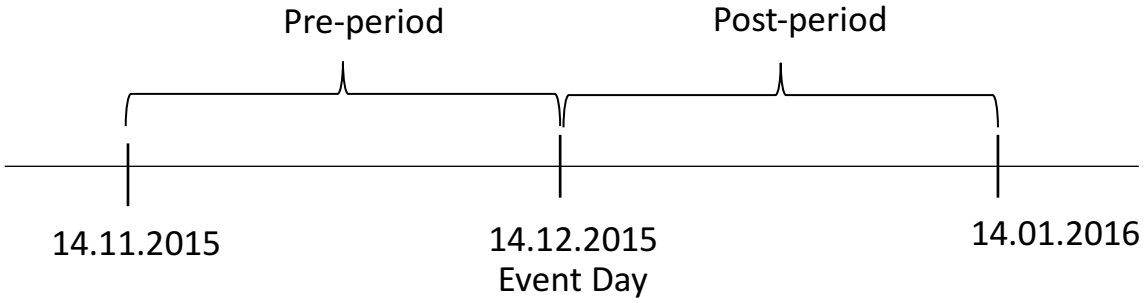
Appendix two gives an overview of the frequency of firms by industry.

A3. Event Windows

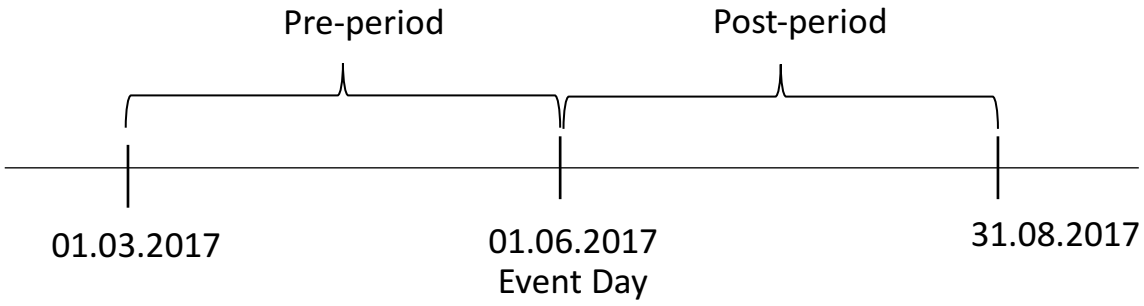
A3.1 Quarterly Event window regarding the signing of the Paris Agreement



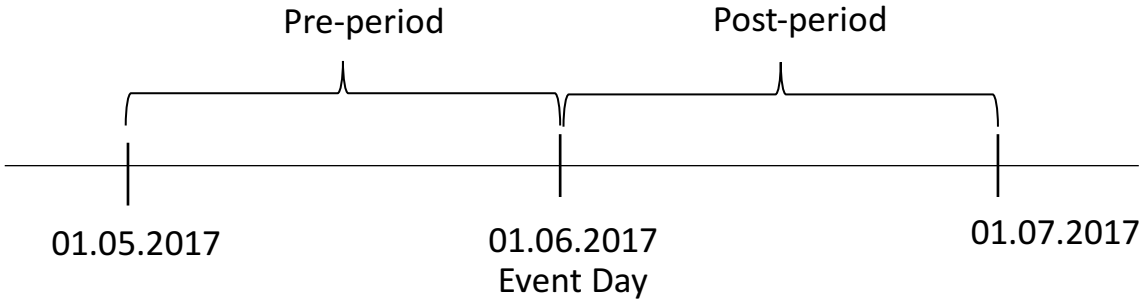
A3.2 Monthly Event Window regarding the signing of the Paris Agreement



A3.3 Quarterly Event Window regarding the Withdrawal from the Paris Agreement



A3.4 Monthly Event Window regarding the Withdrawal from the Paris Agreement



A3.5 Election of President Donald Trump