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Neumann János Egyetem



Csak beszéd vagy cselekvés?

A klímakonferenciák hatása a környezetszennyező és zöld befektetésekre

Talk or action?

The impact of climate conferences on Polluting and Green investments

Készítette: Timár Barnabás

Konzulens: Dr. Neszveda Gábor

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Abstract

Given the serious, complex, and rather concerning effects of climate change, many countries and global organizations have begun working together to prevent or mitigate the potential damages in the form of conferences. In my study I investigate the impact of these conferences through their effect on polluting and green investment. As a proxy I use three ETFs for each sector. I use the event study methodology for testing the effect of the events. I also classify the events based on their sentiment and previous expectations to create the possibility of a more detailed research. My hypotheses are the followings: In case of a positive sentiment event, we can see a significant negative abnormal return in the polluting sector, while a significant positive abnormal return in the green investments. Also, in case of a negative sentiment event, we can see a significant positive abnormal return in the polluting sector, while a significant negative abnormal return in the green investments. This would mean that the conferences have real impact, and they are not just talks with empty promises (greenwashing). However, my results indicate that the conferences have no significant effect neither on the polluting nor on the green investments. Therefore, I reject all my hypotheses. These results are robust for different tests and time periods as well. Overall, my study supports the greenwashing critics of the climate conferences for their lack of real impact.

1. Introduction

In my study I investigate the impact of climate conferences through their effect on polluting and green investment, testing whether the conferences have real impact or are they just greenwashing events. I also take into account the sentiments of the conferences when considering their possible impact. I use the event study methodology on ETF data to evaluate the effects of climate conferences. The study is structured as follows, first an introduction to the topic, then a detailed description of the conferences and the used methodology. After that I examine the results and close with the conclusions.

1.1 Climate change

1.1.1 The causes of climate change

For now, climate change has become a well-know and well-studied phenomenon. Although, the public opinion might still be somewhat divided (Shwom et al., 2015; Hamilton et al., 2019), several studies have shown the causes and effects of climate change. A report made by Houghton et al. (1992) covers a wide range of topics related to climate change, including observations of past and current climate, the science of greenhouse gases and their effects, and projections of future climate change. It also includes discussions of the potential impacts of climate change on natural and human systems, as well as strategies for mitigating and adapting to these impacts. The report concludes that human activities, particularly the burning of fossil fuels, are the primary cause of climate change, and that urgent action is needed to reduce greenhouse gas emissions and limit the severity of future climate change. The Intergovernmental Panel on Climate Change (IPCC, 2007) also assessed the state of scientific knowledge regarding climate change. This provides a comprehensive and authoritative overview of the physical science basis of climate change and serves as a key resource for policymakers, researchers, and the general public. This report arrives to a similar conclusion to the previous, confirming that human activities, such as the burning of fossil fuels, are the primary cause of climate change, and that prompt and urgent action is required to reduce greenhouse gas emissions and limit the extent of future climate change. Hegerl at al. (2019) review the scientific evidence of past climate variability and examine the impact of natural and human-induced factors on the climate. They identify natural factors such as volcanic eruptions, solar activity, and internal climate variability as significant contributors to climate change, but they also recognize the substantial role played by human activities such as the burning of fossil fuels, deforestation, and land use changes. The authors highlight the importance of

understanding the different causes of climate change to develop effective strategies to mitigate its impact and promote sustainable development. Mikhaylov et al. (2020) also discuss the issue of global climate change and the greenhouse effect. They explain how the Earth's atmosphere works to regulate the temperature of the planet, and how human activities are altering this balance by emitting greenhouse gases such as carbon dioxide, methane, and nitrous oxide into the atmosphere. The authors emphasize the importance of taking action to mitigate these emissions and reduce the impact of climate change, such as through the use of renewable energy sources, improved energy efficiency, and changes in land use practices. They also discuss the potential consequences of unchecked climate change, including rising sea levels, more frequent extreme weather events, and disruptions to ecosystems and food production. From the mentioned literature we can see that the main cause of climate change is greenhouse gases generated by human activity. This is also supported and further explained by Wuebbles and Jain (2001), they discuss the link between fossil fuel use and climate change. They explain how the burning of fossil fuels, such as coal, oil, and natural gas, releases large amounts of greenhouse gases into the atmosphere, which contributes to global warming and climate change. The authors highlight the urgent need to transition away from fossil fuel use and towards cleaner and more sustainable energy sources, such as wind, solar, and hydropower.

1.1.2 The effects of climate change

Climate change can have several devastating effects, such as the melting of ice caps. Xu et al. (2009) highlight how rising temperatures are causing the melting of glaciers and snowpack, which are the primary sources of water for the region. This, in turn, affects the availability and quality of water for irrigation, hydropower generation, and domestic use, as well as for the millions of people who depend on the region's rivers for their livelihoods. The authors also discuss the impact of climate change on biodiversity, including the loss of habitats for many plant and animal species, and the potential for increased disease outbreaks. Changes in precipitation patterns, temperature, and land use are affecting the availability and quality of groundwater around the world, which is a critical resource for human and ecosystem survival, providing drinking water and supporting agricultural and industrial activities (Taylor et al., 2013). According to Hallegatte et al. (2013) another effect can be sea level rise and potential future flood losses in major coastal cities. They explain how the increasing frequency and intensity of extreme weather events, such as storm surges and heavy rainfall, can result in significant economic and social losses, particularly in densely populated coastal areas. Rising temperatures, changes in precipitation patterns, and extreme weather events can disrupt

ecosystems and alter the distribution and abundance of species (Cahill et al., 2013). These changes can affect the availability of food and water, disrupt breeding patterns, and increase the risk of disease and predation. Which in the end can lead to mass extinction. According to Connolly-Boutin and Smit (2016) climate change can also impact crop yields, food availability, and income for smallholder farmers, causing food shortages. This to be felt most strongly by vulnerable populations, such as smallholder farmers, low-income communities and countries, creating further inequalities in the world (Gregory et al., 2005). Furthermore, the lack of water supply and food security can lead to migration from the poor regions generating further social, economic, and political stresses (Meze-Hausken, 2000). Urry (2015) argues that climate change is not just an environmental issue, but also a social and political issue that requires systemic change at multiple levels. The author discusses how modern societies are heavily dependent on fossil fuels, which contribute to greenhouse gas emissions and climate change. The latest research by Clayton (2020) shows that climate change can create a range of emotional and psychological responses as well, including fear, anxiety, guilt, and helplessness.

1.1.3 Climate agreements and targets

Given these serious, complex, and rather concerning effects of climate change, many countries and global organizations have begun working together to prevent or mitigate the potential damages. The awareness around climate change started in 1987 after the discovery of the ozone hole and the publication of the Brundtland Commission report (Brundtland, 1987). The United Nations (UN) became a leader on the matter by the United Nations Conference on Environment and Development (UNCED), held in Rio de Janeiro in 1992. The conference aimed to promote international cooperation to address climate change and to establish a framework for reducing greenhouse gas emissions. Which led to the creation of the United Nations Framework Convention on Climate Change (UNFCCC) as a response to the growing concern among scientists and policymakers about the potential impacts of human-induced climate change on the global environment and economy (Bodansky, 2001). In 1995, the first Conference of the Parties (COP) was held in Berlin. It was to kickstart negotiations to strengthen the global response to climate change and to start negotiation for an agreement (Skidmore and Farrell, 2021). Since then, COP conferences are of high importance and many crucial agreements were negotiated during them. The first international legal treaty, the Kyoto Protocol was signed in 1997 with the goal of reducing greenhouse gas emissions in order to mitigate the impacts of human-induced climate change. The Protocol required industrialized countries to reduce their emissions of six greenhouse gases by an average of 5.2% below 1990 levels by the end of 2012

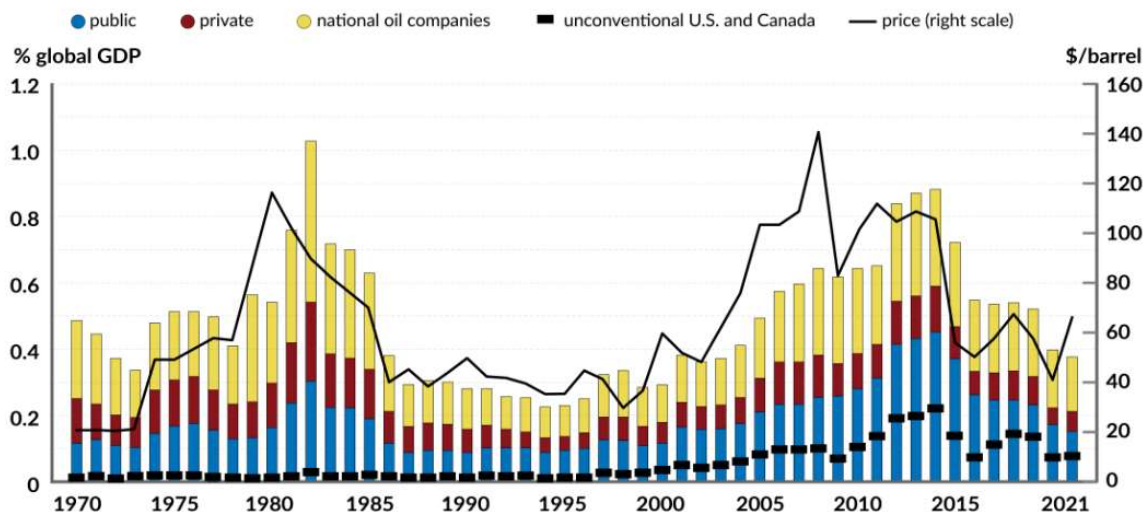
(UN, 1998). The Protocol established three mechanisms to help countries meet their emissions reduction targets: emissions trading, joint implementation, and the clean development mechanism. The Kyoto Protocol entered into force in 2005 and was initially signed by 192 countries. After that there were many conferences with smaller successes, but the next landmark was reached by the adoption of the Paris agreement only in 2015 (Skidmore and Farrell, 2021). The goal of the Paris Agreement is to limit global warming to well below 2 degrees Celsius above pre-industrial levels, with an aspirational target of limiting warming to 1.5 degrees Celsius. It establishes a transparency framework to measure, report, and verify emissions reductions, and creates a financial mechanism to support developing countries in their efforts to address climate change (UN, 2015). However, it can be criticized for prioritizes economic growth and market-based solutions over meaningful emissions reductions by the voluntary nature of emissions reduction targets combined with the lack of enforcement mechanisms (Spash, 2016; Wewerinke-Singh and Doebbler, 2016). There is also the Emissions Trading System (ETS) in the EU. ETS is a cap-and-trade system, which sets a cap on the total amount of greenhouse gas emissions that can be produced by covered industries, such as power plants and heavy industry (Teixidó et al., 2019). Furthermore, there are some EU and US specific targets as well. The EU targets 55% greenhouse gas emissions reduction by 2030 and the U.S. Mid Century Strategy (MCS) sat a goal of reducing total emissions 80% by 2050 relative to 2005 levels (Langevin et al., 2019). Net Zero became a slogan as countries and companies are pledging to deliver net zero emission (Rogelj et al., 2021). So, we can see that there are many talks, targets, and agreements but how effective are they? Are they just empty words, or they can have impact as well?

1.2 Investments and climate change

To answer these questions, we must evaluate the impacts and implications of these agreements and targets. Trivial measures are the achieved emission reduction, and whether the targets were delivered or not. However, these can only be measured retrospectively, so if we want to decide if an event had an impact shortly after it happened, we cannot use these measures. In this case an alternative can be to look at the economic side of the effects, which can be seen in the short term too. Through investments and stock markets we can get an instantaneous picture of the effect of an event (Carls et al., 2006). This approach can easily be used in this case as well, since we have seen the main causes of climate change are the fossil fuel, oil, gas and energy industry. Which is still also one of the biggest industrial sectors for investments today, so all new information should be reflected in the prices and returns. The oil and gas industry is a major

sector of the global economy that involves the exploration, extraction, refining, and distribution of hydrocarbon products such as crude oil, natural gas, and petroleum products. This industry plays a significant role in providing energy for transportation, heating, and electricity generation. As we can see from the 1. Figure, more than 0.5% of the global GDP is invested in oil and gas companies. Although there has been a decrease in the last decade, the demand is still very for oil and gas investments.

1. Figure, Oil and gas investment as a share of global GDP

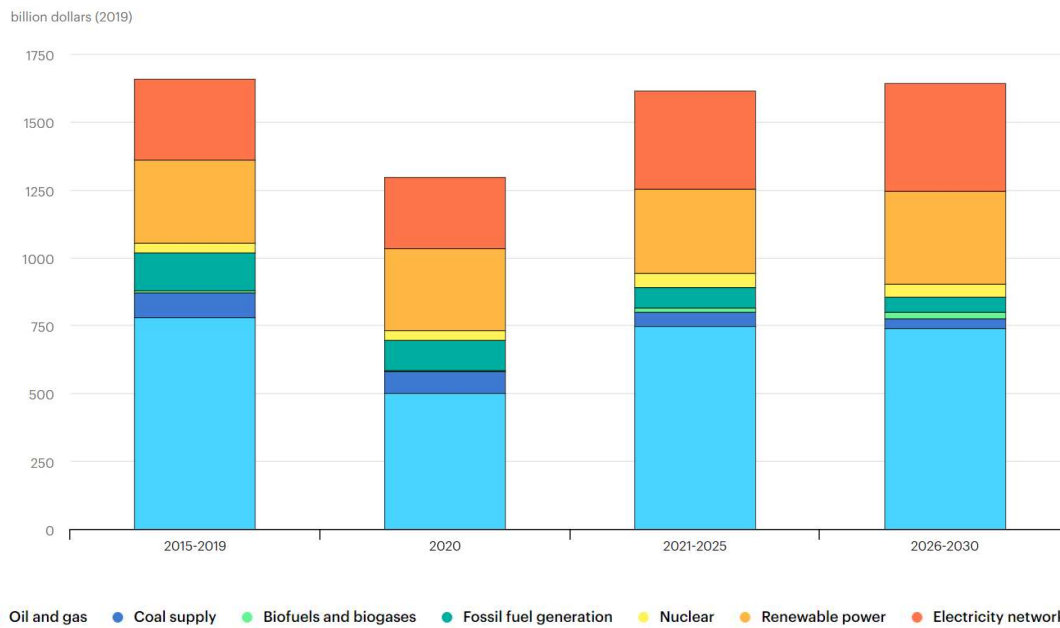


Source: Oil and gas: The investment gap dilemma, <https://www.gisreportsonline.com/r/oil-gas-investment/>

Many forecasts for the future, like the one seen in the 2. Figure, also show that investment into oil and gas will be still high in the medium-term.

Previously we have established that one of the main causes of climate change is the oil and gas (energy) industry (See chapter 1.1.1). Now we have also seen that there are notable investments in this industry. Because of these I make the assumption that a real climate action would have a negative effect on the oil and gas industry, and this can be measured through the investments and investment expectations of the industry. Intuitively this would mean for example that because of the reach of a new agreement about reducing emissions there would be a decrease in the share prices of oil and gas companies. Which could be explained by worse investor expectations about the future.

2. Figure, Average annual energy supply investment in the Delayed Recovery Scenario

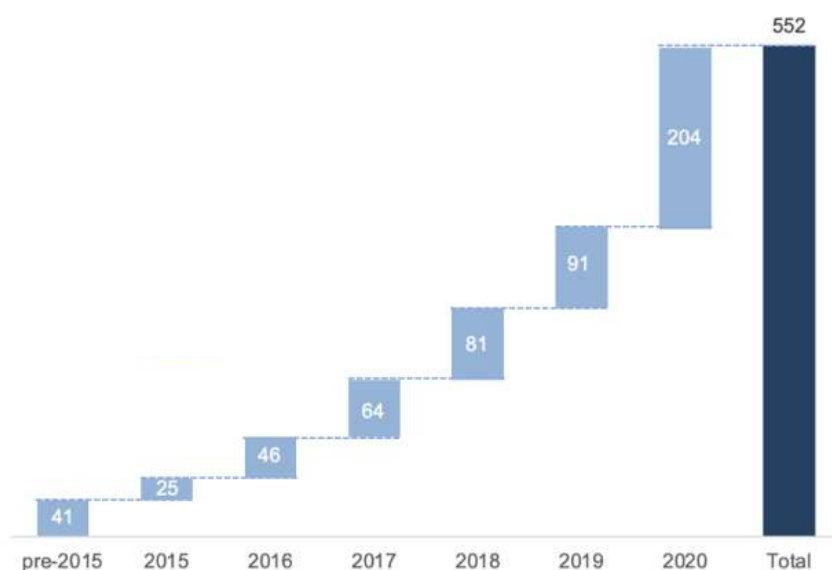


Source: IEA, *Average annual energy supply investment by sector in the Delayed Recovery Scenario, 2015-2030*, IEA, Paris <https://www.iea.org/data-and-statistics/charts/average-annual-energy-supply-investment-by-sector-in-the-delayed-recovery-scenario-2015-2030>

There is also the “good” side of investments in connection with climate change, which are green and sustainability focused investments. The most popular is ESG (Environmental, Social, and Governance) investing. Which refers to investment strategies that focus on companies or assets with strong environmental, social, and governance practices. This means that companies that are committed to sustainability, clean energy, ethical business practices, and social responsibility are more likely to be included in green and ESG investment portfolios. These investments aim to generate positive social and environmental impact, while also providing financial returns. Giese et al. (2019) conclude that ESG investing is an essential part of modern investment analysis, as it provides investors with a more complete understanding of the risks and opportunities associated with an investment. They argue that ESG factors can have a significant impact on a company's valuation and financial performance, and that investors who incorporate ESG analysis into their investment process can potentially achieve better long-term investment outcomes. In the past decade ESG investments have gained significant popularity as more investors prioritize sustainability and responsible investing. A lot of money is flowing in this direction worldwide, with Bloomberg (2021) estimating that ESG assets could reach \$53 trillion by 2025. Also, the number of ESG ETFs have grown exponentially (see 3. Figure). There are many other research focusing on the relationship between ESG and returns with different results (Auer and Schuhmacher, Khan, 2019; 2016; Timár, 2021). Which also shows the

growing interest in this field. We can argue that climate action incentives further investments and generates higher returns by providing subsidies. Therefore, similarly to the previous assumption, in this case I assume that a real climate action would have a positive effect on the green and ESG investments. So, for example the reach of a new agreement about reducing emissions there would be increase in the prices of green and ESG investments. Which could be explained by better investor expectations about the future.

3. Figure, The number of ESG ETFs between 2015 and 2020



Source: ESG ETFs 2021, <https://files.trackinsight.com/ESG-ETF-Report.pdf>

So, the question is, did these climate conferences and agreements have an effect on polluting (energy) and green (ESG) investments and by this, justifying they are not just greenwashing events, but true actions against climate change? To investigate this, I use the event study methodology by MacKinlay (1997). As a proxy for the energy and ESG investments I use the biggest three ETFs by sector, while for events I use the major conferences and agreements from the last 14 years. The details of the data and methodology are described in the next chapter. To have clearer results, I divide the conferences into positive and negative sentiment events based on their mood and achieved results. My hypotheses are the following: In case of a positive sentiment event, we can see a significant negative abnormal return in the polluting (energy) sector, while a significant positive abnormal return in the green (ESG) investments. Also, in case of a negative sentiment event, we can see a significant positive abnormal return in the polluting sector, while a significant negative abnormal return in the green investments. This would mean that the conferences have real impact and they are not just talks with empty promises.

1.3 Literature review

According to the theory of efficient market hypothesis (Fama, 1970), the market price of a share reflects all available information and only new information can cause a price change. Therefore, studying the effect of different events on the stock market has a wide literature. Such an event can be, for example, the announcement of financial results (Bernard, 1992), a management change (Bonnier and Bruner, 1989), a stock split (Fama et al., 1969), an acquisition, a merger (Rosen, 2006) or any news affecting the firm (Chan, 2003; Fernández, Callén and Gadea, 2011). In some cases, new information is not immediately incorporated according to theory, but anomalies are observed. This may be the case of over- or under-reaction. This was documented by De Bondt and Thaler (1987) and Daniel, Hirshleifer and Subrahmanyam (1997). In the case of an overreaction, there is a greater change than the justified effect of the new information, while in the case of an underreaction, on the contrary, there is a smaller effect on the stock price than justified. This part of the literature summary was created partially based on my previous work (Timár, 2022)

There are also some studies specifically examining the effect of climate actions on different measures. Genovese (2021) examines the impact of international climate agreements and Europe's carbon trading system on market responses with event study methodology. The author argues that these global governance mechanisms have the potential to influence market responses and promote more sustainable practices. The results show that these mechanisms have had a positive impact on market responses, particularly in promoting the adoption of sustainable practices. Kumar and Firoz (2019) examine the impact of Certified Emission Reductions (CERs) announcements on the Indian capital market. The authors use an event study methodology to analyze the stock price performance of Indian companies that have announced CERs. They find that the announcement of CERs has a positive and statistically significant impact on the stock prices of Indian companies. Suggesting that this reflects the increasing importance of environmental performance in investment decisions. Jiang and Luo (2018) investigate Chinese market reaction to environmental-policy-related announcements from the Chinese government in response to the Copenhagen Climate Summit from 2009 to 2011. They also use the event study methodology, finding that in some cases announcement of environmental policies has a negative impact on the stock prices of Chinese companies. They also find that the market response is more negative for companies that are more polluting and for companies that are more dependent on natural resources. Birindelli and Chiappini (2021) investigate whether the European Union policies to tackle climate change create or destroy

value for shareholders over the years 2013–2018. Using the event study the authors get mixed results, some announcement of climate change policies has a negative impact on the stock prices of EU firms. The effect is a bit stronger for firms in high-emission sectors. However, they also find positive and not significant effects.

Some articles focus on solely one event. For example, Pham et al. (2019) researched the effects of the 2016 Paris Climate Agreement on the German stock market by considering the impact of 20 announcements pertaining to the Agreement on 17 industries. The event study methodology is used for this purpose, focusing on changes in the systemic risk of the industry. The authors find that the announcement of the Paris climate agreement had an impact on the systemic risk levels. Monasterolo and De Angelis (2020) test if financial markets are pricing the Paris Agreement by decreasing (increasing) the systematic risk and increasing (decreasing) the portfolio weights of low-carbon (carbon-intensive) indices afterwards. They find that after the Paris Agreement the correlation among low-carbon and carbon-intensive indices drops. The overall systematic risk for the low-carbon indices decreases consistently, while stock markets' reaction is not significant for most carbon-intensive indices. Dahlström and Winstedt (2017) uses event study methodology to analyze the effect of COP15. Portfolios of companies in the coal and solar industries, listed in the United States of America and China, are used in the test. The results show that the conference did not have any discernible effect on the coal and solar industries in either of the analyzed markets.

There are also similar studies investigating the effect of more climate events, although not so many. Caporale et al. (2023) examines connectedness with Diebold and Yilmaz methodology between fossil and renewable energy stock indices. The results suggest that renewable energy stock indices play a significant role in terms of connectedness. Two detected breaks indicate that both the unsuccessful COP17 and the anticipation of decisive action at the COP26 in Glasgow affected the connectedness. But only in case of these two conferences can we see an effect. Antoniuk and Leirvik (2021) find that some events related to climate change policy have significantly impacted returns. The clean energy sector benefitted from the Paris Agreement for example. Rogova and Aprelkova (2020) uses 10 industry indexes from the S&P 500 Index over the period 1990–2014, with an event study approach and they analyze the connection between IPCC assessment report announcements and firms' returns. They found that some sectors, regardless of their carbon profiles, react abnormally to IPCC report announcements without remarkable long-run cumulative effects. Ramiah et al. (2013) investigate the impact of 19 announcements of environmental regulation on the equities listed on the Australian Stock

Exchange over the period 2005–2011. Using the most common event study methodology. They find only a few events with significant effect. Schütze et al. (2018) compare the stock price effects on the largest „green“ companies with the largest „brown“ companies globally using event study methodology. They find that international climate negotiations have a signaling effect on global financial markets. Before 2013, climate negotiations mainly had effects on „green“ companies. But the results are not entirely robust. Only starting in 2015 (Paris Agreement), can they find negative effects on „brown“ companies. This indicates that the focus has shifted to the risks for brown companies.

Based on the current literature we can see that the event study methodology is by far the most commonly used. The results are a bit mixed, however we can see some promising events with significant effect. There is also some evidence for the different effect in the energy or polluting industry and for the green or ESG investments. Overall, the literature supports the previously stated hypotheses that: In case of a positive sentiment event, we can see a significant negative abnormal return in the polluting sector, while a significant positive abnormal return in the green investments. Also, in case of a negative sentiment event, we can see a significant positive abnormal return in the polluting sector, while a significant negative abnormal return in the green investments. However, the results are not robust enough, we can mostly see a few significant events and not overall consistent effects. Also, the literature is lacking complex studies examining a number of similar conferences. So, the contribution of my study is to support the robustness of results across many different conferences. While also accounting for the impact on different sectors (polluting and green) and for the expectations or sentiments of the conferences.

2. Data and Methodology

In this chapter the details of the data and methodology used in the study are described. For the study I used 32 climate conferences as the key events, and the effects of these are tested on general energy (polluting sector) and on ESG (green) investments. 3 polluting and 3 green ETFs are used as a proxy for the whole sector. I used the most common approach in the literature, the event study methodology (MacKinlay, 1997) to study the effect of the conferences.

2.1 Climate Conferences

There are many climate conferences but to have clear result I focused on the major ones of UN and UNFCCC. A comprehensive list of past conferences is available on the website of the UNFCCC (UNFCCC, 2022). The time period under study was narrowed down to after 2009.

This was due to the fact that before the Kyoto Protocol entered into force in 2005, there were no major global climate agreement with the aim of emission reduction. After that an additional 3-year period was cut because of the recession of 2007-2009 (Stock and Watson, 2012), to avoid the possible confounding effect of the general economic conditions (Anagnostidis et al., 2016). Therefore, I included conferences after the end of the recession (2009 June). Some further filters were used: The conferences must have been at least one weeklong with more than 175 countries' delegation present and they must focus on new impactful agreements. Smaller conferences were excluded accordingly. This is necessary to only account for the effects of meaningful and sizable events. Because smaller conferences, focusing only on the finalization of previous deals' details, do not have the potential for creating major agreements or binding legislation, therefore their impact is limited. Based on these, a total of 32 conferences were selected. I classified the selected conferences based on their overall sentiment. In this classification a conference received a positive sentiment if there were sizable step or agreement in the negotiation and expectations about them were also taken into account. Otherwise, they received negative sentiment. The sentiment of the conference is explained in the descriptions and is indicated in parentheses after the name of the conference. In total there were 14 conferences with positive, and 18 conferences with negative sentiment. The event dates, seen in parentheses after the conference name were selected based on analysis of Google trends data. I selected the day from the period of the conference where Google trends show the most activity. The Google trends data was for the phrase "climate change", set with the following parameters: worldwide search, on daily data in the given month and focusing on financial industry. Based on previous studies this is a good indicator of the time of the most meaningful full day of the conference (Nghiem et al, 2016, Timár, 2021).

The following description of the conferences was made using the information in UNFCCC (2022), IISD (2023), Skidmore and Farrell (2021). The event dates are also indicated in parentheses, which were selected using google trends data. The details are described later, in the methodology subchapter. The selected events used in the study are the following:

- Bangkok Climate Change Conference - 2009 (Positive, 9 October 2009)

The conference was a United Nations Framework Convention on Climate Change (UNFCCC) meeting that took place from 28 September to 9 October 2009 in Bangkok, Thailand. The purpose of the conference was to prepare for the upcoming UNFCCC's Conference of the Parties (COP) 15 meeting in Copenhagen, where a new global climate change agreement was set to be negotiated. The Bangkok conference focused on discussing issues related to mitigation,

adaptation, finance, technology transfer, and capacity-building, with the aim of facilitating negotiations for an agreement in Copenhagen. Overall, the conference can be seen as a mixed success in terms of climate action (IISD, 2023). While the conference did not result in any major breakthroughs or agreements on its own, it was seen as an important step in building momentum towards COP15 and growing awareness of the need for global action. On 9 October, Yvo de Boer spoke of a constructive two weeks of talks, and said that all the ingredients for a successful outcome in Copenhagen are on the table. So, considering altogether it reserves a positive sentiment for some successful preparatory negotiations.

- Barcelona Climate Change Conference – 2009 (Negative, 4 November 2009)

The next UNFCCC conference aimed to advance the negotiations towards the international climate agreement that was set to be adopted at the United Nations Climate Change Conference in Copenhagen (COP15) the following month. The conference featured a series of plenary sessions, informal consultations, and side events that provided opportunities for negotiations. Despite some progress in the negotiations, the conference ended without significant breakthroughs, and many issues remained unresolved (UNFCCC, 2022). So, it receives a negative sentiment.

- Copenhagen Climate Change Conference – 2009 (Negative, 18 December 2009)

This was the anticipated COP15, it was attended by delegates from more than 190 countries from December 7 to December 18, 2009. Its goal was to negotiate a new global climate agreement to replace the expiring Kyoto Protocol. The conference was highly anticipated and there was widespread hope that a comprehensive agreement would be reached. However, the negotiations were highly contentious and ultimately did not result in a binding agreement to reduce greenhouse gas (IISD, 2023). Only a non-binding political declaration called the Copenhagen Accord was made. It was widely seen as a disappointment, as it fell short of expectations and did not result in the legally binding agreement that many had hoped for (Skidmore and Farrell (2021)). This had an obvious negative sentiment.

- Bonn Climate Change Conference – 2010 (Positive, 8 June 2010)

After the failed COP15, this was the first major conference and it successfully demonstrated the willingness of countries to work together towards a common goal. Yvo de Boer said that progress made during the two weeks opens the way for Cancún to deliver the full package of operational measures that will allow developing countries to take faster, stronger action across all areas of climate change (IISD, 2023). Therefore, it had an overall positive sentiment.

- Tianjin Climate Change Conference – 2010 (Positive, 6 October 2010)

This conference focused on developing a shared understanding among countries about the key issues and challenges related to climate change, and identifying areas where progress could be made towards a global agreement. Some of the key topics discussed at the conference included the establishment of a Green Climate Fund to help developing countries mitigate and adapt to the impacts of climate change, as well as the need for more ambitious emissions reduction targets from developed countries (IISD, 2023). Parties focused on narrowing down the options and finding areas of convergence on issues. Outputs comprise draft texts and notes for the upcoming COP 16. Even though no official deal was made, progress was made, so the conference receives a positive sentiment.

- Cancún Climate Change Conference – 2010 (Negative, 9 December 2010)

COP16 was held in Cancún from 29 November to 10 December. One of the key outcomes of the conference was the adoption of the Cancun Agreements, which laid the groundwork for a comprehensive and balanced international climate change framework (Skidmore and Farrell (2021). It demonstrated that some progress could be made even in the face of significant challenges, but it could only set a path for further negotiations (IISD, 2023). It was enough to save the UN process itself, however it was not a real breakthrough anticipated from the COP16. Therefore, its sentiment is more of a negative.

- Bonn Climate Change Conference – 2011 (Positive, 17 June 2011)

It was following the not so successful COP16 held the previous year. Negotiations continued according to plan with smaller agreements. There was progress towards establishing a new climate fund to help developing countries reduce their greenhouse gas emissions. The facilitator Ould-Dada on the closing plenary announced that the parties had reached an agreement about the impacts of climate change on water resources and integrated water resources management (UNFCCC, 2022). The expectations were not too high, and nothing disappointing happened, so the conference receives a positive sentiment overall.

- Panama Climate Change Conference – 2011 (Negative, 5 October 2011)

“Panama connects all the cardinal directions, north and south by virtue of its location, and east and west by virtue of the legendary Panama Canal”. UNFCCC Executive Secretary Christiana Figueres made this symbolic statement during the opening of the final round of talks in Panama. Progress was made on some issues, however the meeting also exacerbated chasms and

highlighted the wide gulf that still exists on vital issues such as the long-term global goal, finance, and overall expectations. Many felt the outcomes were relatively modest and a lot of work remains to be done in Durban (IISD, 2023), therefore it had a negative sentiment.

- Durban Climate Change Conference – 2011 (Positive, 7 December 2011)

For COP17 the parties convened in Durban with significant outstanding issues to work through, primarily the urgent need for a binding agreement for emission reduction post the Kyoto Protocol's first commitment period ending in 2012. Negotiators at the Durban Climate Change Conference turned a corner and not only resuscitated the Kyoto Protocol but, in doing so, adopted a decision that will lead to negotiations on a more inclusive 21st century climate regime (IISD, 2023). Many welcomed the adopted decisions including on the Green Climate Fund, and the Durban Platform, which established a process to develop a new, comprehensive, and legally binding climate agreement by 2015 (Skidmore and Farrell (2021). Because of the general successes the conference receives a positive sentiment.

- Bonn Climate Change Conference – 2012 (Negative, 22 May 2012)

Again in Bonn, delegates had a daunting agenda ahead of them, as they needed to put into practice the institutions and mechanisms established during the previous conferences in Cancun and Durban. Additionally, they needed to clarify the agreements made during the final hours of the hectic COP17. However, negotiations had a discouraging beginning and were marked by the lack of trust (IISD, 2023). Therefore, for the lack of progress the conference had a negative sentiment.

- Doha Climate Change Conference – 2012 (Negative, 3 December 2012)

COP18 took place in Doha, which was a bit controversial, given Qatar was at the time the nation with the highest per capita emissions. The aim was to secure a second commitment period under Kyoto and eventually negotiate a new legally binding treaty. Many observers predicted that the conference would be a transitional one of limited ambition, which turned out to be true. Also, many activist groups were protesting during the Conference (Skidmore and Farrell (2021). So, the overall sentiment was more negative.

- Bonn Climate Change Conference – 2013 (Negative, 10 June 2013)

Delegates assembled for the annual two-week climate change conference in Bonn in preparation for the next COP. There was a dispute about the decision-making process of the UN and no real progress was made despite a new report stating: carbon dioxide concentrations had surpassed

the critical 400 ppm threshold (IEA, 2013). Overall, a negative sentiment characterized this conference.

- Warsaw Climate Change Conference – 2013 (Negative, 18 November 2013)

COP19 was held in Warsaw. It was marked by some controversy and disagreement, around the issue of climate finance and the role of developed countries in supporting developing countries. Negotiations focused on reducing emissions from deforestation and forest degradation (UNFCCC, 2022). The German Green Party reported the Conference was “the COP with the lowest expectations ever and lived up to that in every respect” (Fuhr et al., 2013). For the lack of progress, the sentiment was quite negative.

- Bonn Climate Change Conference – 2014 (Positive, 5 June 2014)

The Bonn Climate Change Conference was the first time in UNFCCC history that high-level ministerial events were held outside COP. Ministerial convened during the first two days of the session, including the High-Level Ministerial Roundtable which aimed to assess implementation of the Kyoto Protocol (IISD, 2023). Although there were some concerns about the slow pace of negotiations, the sentiment of the conference was more positive because of the high-level participants.

- Lima Climate Change Conference – 2014 (Positive, 12 December 2014)

COP20 was hosted by the Government of Peru, its environment minister, Mr Pulgar-Vidal, was keen to ramp up the pace of progress. He said ““If what we want by Paris 2015 is a new binding global climactic agreement, then what we need to produce in Lima is a solid working draft”. Accordingly, the COP20 adopted the “Lima Call for Climate Action,” which furthered progress on the negotiations toward a necessary global agreement (Skidmore and Farrell (2021). It elaborated the elements of a draft negotiating text and the process for submitting and synthesizing intended nationally determined contributions while also addressing pre-2020 ambition (IISD, 2023). Overall, the conference was seen as a success in that it helped to set the stage. Therefore, it is given a positive sentiment.

- Geneva Climate Change Conference – 2015 (Negative, 13 February 2015)

The Geneva conference was the first of several meetings in preparation for the Paris Climate Change Conference (COP20) that will be held in France in December 2015. The UNFCCC requested to intensify its work to present another legal instrument’s text for a protocol. They

developed a basis for further negotiations but because of the slow pace and lack of time (UNFCCC, 2022), the overall sentiment was a bit negative.

- Bonn Climate Change Conference – 2015 (Positive, 11 June 2015)

At the now annual meeting in Bonn, the primary goal was to continue the negotiations towards a global agreement. Overall, the negotiations were complex and challenging due to the diversity of perspectives and interests represented by the participating countries and stakeholders. However, the conferences helped to build momentum towards the adoption of an agreement in Paris, so it receives a positive sentiment.

- Paris Climate Change Conference – 2015 (Positive, 10 December 2015)

Momentous in the history of multilateral action on climate change, expectations were high going into the much anticipated and long prepared for climate summit, the COP21. Back then Prince of Wales, Prince Charles, opened the Conference, telling Parties they must act now: “On an increasingly crowded planet, humanity faces many threats, but none is greater than climate change. Your deliberations over the next two weeks will decide the fate not only of those alive today but also of generations as yet unborn”. After though negotiations finally on the last day, a compromise was achieved, greater transparency and reporting on climate finance, and the agreement to establish a new goal for climate finance. 196 countries signed the Paris Agreement on 12 December 2015, the first legally binding international treaty on climate change since 1997 (Skidmore and Farrell (2021)). The agreement set out to limit global warming to “well below” 2C with countries committing to exert effort to limit to 1.5C. Another ambitious goal set was to achieve “a climate neutral world by mid-century”. The deal was not perfect, but it was a new landmark agreement for sure, so COP21 receives quite a positive sentiment.

- Bonn Climate Change Conference – 2016 (Negative, 23 May 2016)

Taking place after the historic COP21, the usual Bonn gathering was a lower profile meeting with an agenda aimed at rapidly taking up the technical work needed to operationalize the Paris Agreement. Some operational topics were negotiated including the establishment of a technical expert group on adaptation, the creation of a platform for indigenous peoples, and the development of guidelines for reporting on climate finance (IISD, 2023). However, many important issues remained unresolved, and no big development happened specially after the COP21, this was more of a negative sentiment.

- Marrakech Climate Change Conference – 2016 (Positive, 17 November 2016)

COP22 was the first COP since the Paris Agreement. Negotiations in Marrakech focused on matters relating to the entry into force and the implementation of the Paris Agreement. A joint high-level segment was introduced, bringing together over 70 heads of state and government to generate political will as well. The High-Level Segment was seen as a positive step towards advancing global efforts to address climate change. Many countries announced new initiatives and commitments to reduce greenhouse gas emissions and increase the use of renewable energy (Skidmore and Farrell (2021)). So COP22 was able to keep up the attention and positive sentiment from last year.

- Bonn Climate Change Conference –2017 (Negative, 16 May 2017)

This conference was still about the technicalities of the Paris Agreement implementation. One of the biggest issues was how to ensure adequate financing for climate action in developing countries. Another big question was whether the US will continue the participation in the Paris Agreement. A withdrawal would have been a major setback, so only the possibility had an effect on the mood of the conference (IISD, 2023). Therefore, the sentiment of the conference was clearly negative. Soon after, in June 2017, the Trump administration announced its intention to withdraw the United States from the Paris Agreement, citing concerns.

- UN Climate Change Conference – 2017 (Negative, 14 November 2017)

COP23 was supposed to be held in Fiji, however it was hit by Cyclone Winston. So, instead it was moved to Bonn, Germany. The parties were united in addressing increasing climate threats and establishing the success of the Paris Agreement despite Trump's announcement of US withdrawal earlier. The outcomes from COP23 were rather muted, in part thanks to the technical nature of the summit but also because of the slow pace of negotiations on the Paris rulebook (Skidmore and Farrell (2021)). The whole COP process received criticism for the gap between action and the recommendations of scientists.

- Bangkok Climate Change Conference – 2018 (Positive, 7 September 2018)

This year negotiations continued in Bonn, however they were moving very slowly so the parties had to agree to an additional meeting in Bangkok (IISD, 2023). Which had more important outcomes. With COP 24 drawing near, many viewed substantial progress in Bangkok as necessary for a successful outcome in Katowice. This conference also included a high-level segment, and negotiations included issues like mitigation, adaptation, finance, transparency and

many other. “Bangkok outcome” captures progress made across these issues in a 307-page compilation and mandates the Presiding Officers to undertake intersessional work to help advance parties (UNFCCC, 2022). Because of the progress made the conference receives a positive sentiment.

- Katowice Climate Change Conference – 2018 (Negative, 14 December 2018)

COP24 was held in Katowice, Poland and was tasked to finalize the Paris rulebook. Greta Thunberg, the recently famous 15-year-old climate activist also spoke at the conference: “Our biosphere is being sacrificed so that rich people in countries like mine can live in luxury you say you love your children above all else and yet you are stealing their future in front of their very eyes”. The summit was criticized for being sponsored by a Polish coal company, especially in light of Poland’s President telling the conferences that “efficient” coal use was not contradictory with ambitious climate action (Skidmore and Farrell (2021). Although most of the production of the Paris rulebook in the form of the Katowice climate package was finished, the conference was still characterized by low-ambition, talk and lack of action. So receives negative sentiment.

- Bonn Climate Change Conference – 2019 (Negative, 25 June 2019)

Delegates made progress on some issues, including Paris Agreement Article 6 (market and non-market cooperative approaches), the only outstanding issue from the Katowice Climate Package, the rulebook of the Paris Agreement. But the parties were unable to advance several areas, including the issue of the Adaptation Fund’s Board, with parties diverging on the need to reform the Board, while transitioning from the Kyoto Protocol to the Paris Agreement (IISD, 2023). Many delegates and civil society repeated the motto “Science is not negotiable” to express their frustration with the Intergovernmental Panel on Climate Change Special Report (IPCC, 2018) on Global Warming and the 1.5° threshold. So overall this conference had a negative sentiment.

- UN Climate Change Conference – 2019 (Negative, 13 December 2019)

COP25 turned out to be quite chaotic. Brazil was supposed to host the event but after Bolsonaro’s election it was lost as a proactive and helpful party at climate negotiations. Costa Rica then was thinking about hosting COP25, but they lacked sufficient funding and infrastructure. Chile was the next on the list, however there happened to be a political crisis, which saw rioting in the capital. Finally, Parties convened in Madrid, Spain. COP25 came after the UK’s Energy Minister, Chris Skidmore, enshrined net zero emissions by 2050 into law – the UK as the first major economy to do so (Gov.uk, 2019). There was a demand to match targets

with the science for keeping 1.5C in reach, the success of settling technical issues was key. Negotiations made little success, it was reported that Brazil, India, and China were the key parties blocking an agreement (UNFCCC, 2022). It was the longest climate negotiations in the history of COPs, but it turned out to be a big failure. Alden Meyer, director of strategy and policy for the Union of Concerned Scientists: “This is the biggest disconnect between this process and what is going on in the real world that I have seen”. There were also big protests during the event. So COP25 clearly had a negative sentiment.

- June Momentum for Climate Change – 2020 (Positive, 8 June 2020)

Due to COVID-19, the UNFCCC secretariat was not convening any physical meetings. But the work in 2020 remains critical for making progress on climate change, arrangements for continuing work through virtual meetings have been put in place. One of the key outcomes of the conference was the launch of the "Race to Zero" campaign, which called on governments, businesses, and other stakeholders to commit to achieving net-zero emissions by 2050 (IISD, 2023). Overall, the conference was seen as an important opportunity to maintain momentum on climate action during a challenging time. So, it receives a positive sentiment.

- UN Climate Change Dialogues – 2020 (Positive, 1 December 2020)

Due to the health and safety measures put in place worldwide in response to the COVID-19 pandemic, COP26 and subsidiary body sessions had been postponed to 2021. Instead, another series of virtual events were launched, called the UN Climate Change Dialogues. The impact of COVID on sustainability was also among the topics. The dialogues highlighted the urgent need for countries to increase their efforts to reduce greenhouse gas emissions and enhance their resilience to the impacts of climate change (IISD, 2023). Several non-broadcasted party-only events took place on outstanding negotiation, which made progress towards an agreement at COP26. It was also important to keep the negotiation and dialog going despite the pandemic. Therefore, the conference had more of a positive sentiment.

- Virtual Climate Change Conference – 2021 (Negative, 16 Jun 2021)

More than one year into the pandemic, parties acknowledged that they had little choice but to convene, in a virtual format, to advance work and minimize further delays. So, participants could follow and take part in meetings via a new virtual conference platform. Convening the sessions of the subsidiary bodies virtually is new to the process as previous online sessions were not for the highest-level negotiations. For this reason, the secretariat, with guidance from the Bureau, made every effort to ensure a meaningful participation by all Parties. One of outcomes

of the conference was some progress made towards the preparation of the COP26 climate conference, which was rescheduled to take place in November 2021 (UNFCCC, 2022). The conference saw the launch of the "Race to Zero Breakthroughs" initiative, which aims to accelerate the transition to a net-zero carbon economy. But only informal notes were issued on all items. Elements outlined in the informal notes are not exhaustive and have no formal status, only are meant to inform further discussions. Considerable work remained to reach agreement on the key issues. Therefore, the conference gets a negative sentiment.

- Glasgow Climate Change Conference –2021 (Positive, 12 November 2021)

Delayed a year by the COVID-19 pandemic but back in person, COP26 was most likely the most anticipated Conference with the greatest media coverage. It was characterized by the ambitious UK presidency, by unprecedented civil society and private sector engagement, and ultimately breakthrough deals, crucially on coal and finance. Joe Biden announced that the US had joined a quickly growing list of more than 100 countries to commit to reducing methane emissions by 30% by 2030 (IISD, 2023). One of the surprising moments were when a few days before the end of the summit, US and China announced a bilateral agreement to work together on addressing the gap between both countries' actions and the steps necessary to limit warming to 1.5-2C (Skidmore and Farrell (2021). Also, for the first time, coal was discussed. Parties adopted the Glasgow Climate Pact including: the finalization of the Paris rulebook and a reaffirmed commitment to \$100bn a year with an action plan to achieve this by 2023. After the summit Alok Sharma (President of COP26) said: "We can now say with credibility that we have kept 1.5 degrees alive. But its pulse is weak, and it will only survive if we keep our promises and translate commitments into rapid action." (UNEP/DTU, 2021). Overall, the conference was successful and had a positive sentiment.

- Bonn Climate Change Conference – 2022 (Negative, 9 June 2022)

When delegates returned to Bonn after three years, the venue was the same, but so much else had changed: two parties (Russia and Ukraine) are at war, greenhouse gas emissions are higher than ever, and climate impacts are increasing in severity. One of the main themes of the conference was loss and damage. Which aims to address the needs of vulnerable, developing countries and communities that are disproportionately affected by the impacts of climate change caused mostly by the developed world. However, it was clear that developing countries demand more than just dialogues (IISD, 2023). Only limited progress had happened, so the sentiment was negative.

- Sharm El Sheikh Climate Change Conference – 2022 (Negative, 15 November 2022)

The latest conference at the time of my research was COP27 in Egypt. It was held while there were multiple crises going on: energy, cost of living, nature loss, and geopolitical tensions among major powers. Also, for now people around the world are experiencing the effects of climate change, from heatwaves and droughts to floods and superstorms. For the first time, countries agreed to recognize the need for finance to respond to loss and damage but the details to be worked out over the coming year. They adapted many divisions but most of them were about dialogs and talks, nothing tangible (Skidmore and Farrell (2021). For the lack of action, COP27 receives a negative sentiment.

2.2 Energy and ESG ETFs

Because different sectors have different associations with climate change, therefore we expect different impacts as well. So, we need to differentiate between polluting sectors, where climate agreements have a possible negative effect and green investment where a positive effect is expected. Also, for negative sentiment events I have the opposite hypothesis. This sector specific impact is also supported by some previous studies Antoniuk and Leirvik (2021) Schütze et al. (2018). As a proxy for these investments, I use ETFs, because they can model the behavior of the affiliated industry well (Madura and Ngo, 2008; Luft and Plamondon, 2017). I use 3 polluting and 3 green ETFs to not only rely on one source and to get further perspective on the details of the effect. The biggest emission is created by the energy industry and the second biggest emitter sector is the oil and gas (Lamb et al., 2021). Therefore, I chose ETFs covering these industries. For the green investments, I chose ETFs using ESG, green or sustainable investing strategies. I used Bloomberg to download the data. I filtered for the above-mentioned sectors and another criteria was the starting date of the ETFs, which had to be before 2009. Then according to these criteria, I selected the biggest 3 ETFs in each category based on net asset. The descriptions (based on Bloomberg) of the selected ETFs are the following:

- Energy Select Sector SPDR Fund (Polluting):

This ETF aims to track the performance of companies in the energy sector of the S&P 500 Index. The fund holds a diversified portfolio of stocks in the oil, gas, and energy equipment and services industries. The fund is rebalanced quarterly to ensure that it continues to track the performance of the energy sector.

- Vanguard Energy (Polluting):

Vanguard's Energy ETF aims to track the performance of the MSCI US Investable Market Energy Index. The fund provides exposure to U.S. companies in the energy sector, including oil and gas exploration, production, and distribution, as well as equipment and services providers.

- SPDR S&P Oil & Gas Exploration & Production (Polluting):

The fund seeks to track the performance of the oil and gas exploration and production segment of the S&P Total Market Index. The ETF provides investors with exposure to companies engaged in the exploration, production, and marketing of oil and gas. The fund's portfolio is focused on small- and mid-cap companies, with the aim of capturing the growth potential of these companies. The portfolio is weighted by market capitalization and rebalanced quarterly.

- iShares Global Clean Energy (Green):

The iShares Global Clean Energy ETF is a diversified portfolio of global companies that operate in the clean energy industry. The fund invests in companies that are engaged in activities related to renewable energy sources such as wind, solar, hydro, and geothermal power.

- iShares MSCI USA ESG Select (Green):

The iShares MSCI USA ESG Select ETF is a diversified portfolio of companies that have demonstrated a commitment to ESG principles. The fund seeks to track the performance of the MSCI USA Extended ESG Focus Index. It invests in large and mid-cap U.S. companies that have been screened for environmental, social, and governance (ESG) criteria.

- Invesco MSCI Sustainable Future (Green):

This ETF aims to track the performance of the MSCI ACWI Sustainable Future Index. The fund invests in companies that are focused on sustainable business practices, including companies involved in renewable energy, green technologies, and sustainable agriculture. The portfolio is weighted by market capitalization and rebalanced periodically to ensure that it continues to track the performance of the sustainable future sector.

The summary of the ETFs can be seen in the 1. Table. The selected energy ETFs on average are bigger than the green ones. One reason for this is that there are only a few green ETFs dating back to 2009. But these are still sizable enough for the purpose of the study. As the ETFs focus on the US market, the data of the S&P500 index was downloaded as a proxy for the whole market. The average returns shown are log returns for the whole period of the study. The data was downloaded on 24.02.2023.

1. Table, Characteristics of the chosen ETFs

ETF Name	Ticker	Investment Profile	Category	Net Assets (Billion \$)	Average Return	Standard deviation	Inception Date
Energy Select Sector SPDR Fund	XLE	General Energy	Polluting	39.27	0.03%	1.79%	16-Dec-1998
Vanguard Energy	VDE	General Energy	Polluting	10.13	0.03%	1.81%	23-Sep-2004
SPDR S&P Oil & Gas Exploration & Production	XOP	Oil and Gas	Polluting	3.66	0.01%	2.55%	19-Jun-2006
iShares Global Clean Energy	ICLN	Clean Energy	Green	4.78	0.01%	1.76%	24-Jun-2008
iShares MSCI USA ESG Select	SUSA	ESG	Green	3.21	0.05%	1.11%	24-Jan-2005
Invesco MSCI Sustainable Future	ERTH	Sustainability	Green	0.31	0.03%	1.43%	24-Oct-2006
SPDR S&P 500 ETF Trust	SPY	Market	-	-	0.05%	1.11%	22-Jan-1993

Source: own edit.

2.3 Event study methodology

I use the event study methodology (MacKinlay, 1997), which is the standard approach in the international literature as we have seen earlier. The methodology is presented in detail by Binder (1998). The essence of the methodology is the examination of significance of the difference between the actual and the estimated return, which is called abnormal return (AR). During the calculations, I worked everywhere with log returns, which is more favorable both from a methodological and computational point of view (Platen and Rendek, 2008).

The theory of efficient market hypothesis (Fama, 1970; Malkiel, 1989) suggests that capital markets reflect all available information in the stock price of the given firm. Given this premise, we can study how a particular event changes a firm's prospects by quantifying the impact of the event on the stock price. This can be applicable also for bonds, indexes, ETFs and most of the stock market instruments. In the first step, we need a model to estimate the expected return. For this purpose, in the study I use a regression model, which estimates the expected return of an ETF based on the market return (S&P500) before the given event. Written with an equation:

$$E(r_{i,t}) = \alpha_i + \beta_i r_{m,t} \quad (1.)$$

Where $E(r_{i,t})$ is the expected log return of asset i at time t and $r_{m,t}$ is the market log return at time t , β_i is the coefficient for the market log return, while α_i is the constant for asset i from the regression model. In the regression model the observation period is the last 250 trading days,

which is approximately one calendar year ($n = 250$), similar to Schütze et al., 2018. With this estimate from the regression model, I calculate the abnormal return ($AR_{i,t}$) as the following:

$$AR_{i,t} = r_{i,t} - E(r_{i,t}) \quad (2.)$$

Where $r_{i,t}$ is the actual log return of asset i at time t . With this regression model I basically estimate the difference from the general market movement. Different length of event windows can be used, the most commonly used are three (-1 to 1) or five days (-1 to 3) event windows (Dahlström and Winstedt, 2017; Schütze et al., 2018; Antoniuk and Leirvik, 2021). In this study I used the five days event window from day -1 to day 3, where the event is at day 0 to cover more days with a possible effect. The event window starts one trading day before the event (day -1), to include possible reactions to early announcements and ends three trading days after the event (day 3), to include possible lagged responses as well (Krivin, 2003; Schütze et al., 2018). For this five days event window the cumulative abnormal return ($CAR_{i,-1, 3}$) is calculated as follows:

$$CAR_{i,-1, 3} = \sum_{n=-1}^3 AR_{i,t} \quad (3.)$$

After this a t-statistic can be calculated for the given cumulative abnormal return (Student, 1908; Gravetter and Wallnau, 2014) to test whether the abnormal returns are significantly different from zero. The t-statistic is calculated following Kolar and Pynnonen (2011):

$$t = \frac{CAR_i}{\sqrt{L} \sigma_{AR_i}} \quad (4.)$$

Where L is the length of the event window (in this case $L = 5$) and σ_{AR_i} is the standard deviation of the abnormal return in the observation period. During all the statistical tests, I consider the 5% significance level to be relevant. If the abnormal return is significant, it indicates that the event had an effect on the return of the asset. We can also study the average effect of an event on the polluting on green investments by calculating the cumulative average abnormal returns ($CAAR_i$) the following way:

$$CAAR_i = \frac{1}{n} \sum_{e=1}^n CAR_{i,-1, 3} \quad (5.)$$

Where n is the number of ETFs in one category, three in both cases ($n = 3$). The corresponding t-statistic is calculated similarly to the previous case:

$$t = \frac{CAAR_i}{\sqrt{L} \sigma_{CAAR_i}} \quad (6.)$$

Where AAR_i is simple the average of the abnormal returns ($AR_{i,t}$) of the individual ETFs. To study the effect of a group of events together (positive or negative sentiment group) on average we need to calculate the total cumulative average return:

$$TCAR_i = \frac{1}{k} \sum_{j=1}^k CAR_{i,-1, 3} \quad (7.)$$

Where k is the number of events. Very similar to the $CAAR$ calculation, just instead of cross-sectional averaging, we calculate the average through time for different sentiment groups. The corresponding t-statistic is calculated the same way as for $CAAR$. As a robustness test, we can also calculate the total average of $CAARs$ for different events as:

$$TCAAR_i = \frac{1}{n} \sum_{e=1}^n CAAR_{i,-1, 3} \quad (8.)$$

The corresponding t-statistic is also calculated similarly:

$$t = \frac{TCAR_i}{\sqrt{L} \sigma_{TCAR_i}} \quad (9.)$$

With this we can test the significance of the average effect of several events (positive or negative sentiment group) on one type of investment together (polluting or green). Another possible test for robustness is to create a portfolio where we long the green ETFs and short the polluting ones with equal weights. With this we can also test the hypothesis that the conferences have different effects on polluting and green ETFs. I also calculate the t-statistic (similarly to the previously described methods) for the return of this portfolio, to test whether it is significantly different from zero or not. I expect it to be significantly positive for the positive sentiment events and significantly negative for the negative sentiment events. This approach is the most sensitive for finding the difference between the effect on sectors, because it can be significant even if the effects are not significant separately for the polluting and green sectors. The portfolio return is tested for individual conferences and for groups as well. The methodology description was created partially based on my previous work (Timár, 2022).

3. Results

In this section I present the result of the study. First the results of the positive sentiment group are presented in the 2. Table. Then in the 3. Table we can see the decomposition of the effect of the positive sentiment group into individual events. Similarly, 4. Table and 5. Table show the result for the negative sentiment conferences. In chapter 3.2 I investigate whether the effects are stable through different time periods by dividing the conferences into Pre- and Post-Paris

Agreement periods. Here I expect that the effects will be stronger in the second period because of the rising attention to climate change and sustainable green investment.

3.1 Combined and Individual effects of the conferences

In the tables we can see the cumulative abnormal returns for the individual ETFs. The first three columns are the polluting sector ETFs, Energy Select Sector SPDR Fund (XLE), Vanguard Energy (VDE) and SPDR S&P Oil & Gas Exploration & Production (XOP). The next three columns are the green ETFs, iShares Global Clean Energy (ICLN), iShares MSCI USA ESG Select (SUSA) and Invesco MSCI Sustainable Future (ERTH). After that under CAAR, we can see the cumulative abnormal returns for the sector (the average for the three ETFs) and the portfolio return (where the green sector is bought, and the polluting sector is sold) as well. Under the values of the abnormal returns are the corresponding t-statistics in parenthesis.

Studying the total average effect of all positive sentiment conferences as a group in the 2. Table, we see no significant effect at all. The cumulative abnormal returns are close to zero with no significance for both the polluting and the green ETFs, as well as for their cumulative average abnormal returns.

2. Table, The total average effect of positive sentiment conferences.

	CAR						CAAR		
	XLE	VDE	XOP	ICLN	SUSA	ERTH	Polluting	Green	Portfolio difference
Positive Sentiment Events Together:	0.21%	0.15%	0.16%	-0.31%	-0.16%	-0.52%	0.17%	-0.33%	-0.50%
	(0.05)	(0.04)	(0.03)	-(0.08)	-(0.06)	-(0.16)	(0.04)	-(0.10)	-(0.15)

The columns show the Cumulative abnormal returns (CAR) for the ETFs starting with the polluting sector and the Cumulative average abnormal returns. The corresponding t-statistics are shown in parentheses.

Source: own edit.

These results indicate that the positive sentiment conferences do not have a significant effect on average. To get a better understanding of the drivers behind, in the 3. Table we can see the effect of individual positive sentiment conferences. Although we see much higher abnormal returns for individual events, they are still not significant. Interestingly none of the cumulative abnormal returns are significant on a 5% level from the positive sentiment events. The same is true for the cumulative average abnormal returns both for the polluting sector and the green sector. Even in cases like the Paris Climate Change Conference, June Momentum for Climate Change or Glasgow Climate Change Conference, where we can see relatively high abnormal returns, they are not significant. Also, the direction of the abnormal returns is not pointing into one direction as expected. We can see for both the polluting and the green type of ETFs more

positive and negative abnormal returns. So, the sentiment does not predict well the direction of the effect. Even the portfolio approach does not show any significant result, which clearly indicates that there is no significantly different effect in the polluting and in the green sector for any positive sentiment conference.

3. Table, The individual effect of positive sentiment conferences.

Positive Sentiment Events:	CAR						CAAR		
	XLE	VDE	XOP	ICLN	SUSA	ERTH	Polluting	Green	Portfolio difference
Bangkok Climate Change Conference - 2009	1.86% (0.98)	1.48% (0.78)	1.67% (0.59)	-2.47% (-0.67)	-0.21% (-0.18)	-0.81% (-0.40)	1.67% (0.79)	-1.16% (-0.68)	-2.83% (-1.45)
Bonn Climate Change Conference - 2010	1.34% (0.85)	1.19% (0.74)	0.73% (0.30)	4.01% (1.33)	-0.03% (-0.04)	2.70% (1.69)	1.08% (0.60)	2.23% (1.55)	1.15% (0.61)
Tianjin Climate Change Conference - 2010	0.89% (0.65)	1.03% (0.76)	1.06% (0.49)	0.71% (0.27)	0.40% (0.83)	-0.35% (-0.25)	0.99% (0.64)	0.25% (0.20)	-0.74% (-0.43)
Bonn Climate Change Conference - 2011	-1.12% (-0.71)	-0.99% (-0.64)	0.21% (0.09)	-0.42% (-0.16)	-0.06% (-0.09)	0.43% (0.36)	-0.63% (-0.37)	-0.02% (-0.01)	0.62% (0.32)
Durban Climate Change Conference - 2011	-1.66% (-0.96)	-1.53% (-0.88)	-5.08% (-1.73)	-0.68% (-0.24)	-0.90% (-0.90)	-0.97% (-0.67)	-2.76% (-1.35)	-0.85% (-0.64)	1.90% (0.86)
Bonn Climate Change Conference - 2014	0.88% (0.84)	0.96% (0.92)	1.17% (0.58)	0.86% (0.40)	0.04% (0.08)	0.35% (0.31)	1.01% (0.79)	0.42% (0.45)	-0.59% (-0.38)
Lima Climate Change Conference - 2014	3.25% (1.79)	1.48% (0.79)	6.45% (1.72)	-1.82% (-0.91)	0.04% (0.11)	-0.25% (-0.25)	3.73% (1.55)	-0.68% (-0.76)	-4.40% (-1.82)
Bonn Climate Change Conference - 2015	-0.41% (-0.18)	-0.35% (-0.15)	-0.91% (-0.19)	-0.20% (-0.09)	0.18% (0.39)	-0.61% (-0.52)	-0.56% (-0.18)	-0.21% (-0.21)	0.35% (0.12)
Paris Climate Change Conference - 2015	-1.95% (-0.80)	-1.32% (-0.52)	-7.22% (-1.50)	4.33% (1.72)	-0.28% (-0.55)	-0.20% (-0.14)	-3.49% (-1.10)	1.28% (1.12)	4.78% (1.56)
Marrakech Climate Change Conference - 2016	0.72% (0.29)	1.01% (0.37)	3.00% (0.62)	0.35% (0.15)	-0.80% (-1.73)	-0.43% (-0.26)	1.58% (0.48)	-0.29% (-0.25)	-1.87% (-0.58)
Bangkok Climate Change Conference - 2018	0.61% (0.32)	0.77% (0.38)	0.62% (0.19)	-0.94% (-0.56)	0.02% (0.05)	-0.70% (-0.51)	0.67% (0.29)	-0.54% (-0.61)	-1.20% (-0.50)
June Momentum for Climate Change - 2020	-4.29% (-0.98)	-4.15% (-0.95)	-0.45% (-0.05)	0.79% (0.28)	0.07% (0.13)	-2.28% (-1.13)	-2.96% (-0.54)	-0.47% (-0.33)	2.49% (0.48)
UN Climate Change Dialogues - 2020	6.13% (1.12)	6.18% (1.13)	6.93% (0.75)	-4.99% (-1.47)	-0.45% (-0.74)	-1.50% (-0.65)	6.41% (1.00)	-2.31% (-1.31)	-8.73% (-1.40)
Glasgow Climate Change Conference – 2021	-3.34% (-0.82)	-3.68% (-0.88)	-6.02% (-1.04)	-3.92% (-0.94)	-0.21% (-0.68)	-2.61% (-1.08)	-4.34% (-0.94)	-2.25% (-1.05)	2.10% (0.41)

The columns show the Cumulative abnormal returns (CAR) for the ETFs starting with the polluting sector and the Cumulative average abnormal returns. The corresponding t-statistics are shown in parentheses.

Source: own edit.

The 4. Table shows the total average effect of all negative sentiment conferences as a group. Similarly to the positive sentiment group, there is no significant abnormal return for any ETF, and not even for the portfolio approach.

4. Table, The total average effect of negative sentiment conferences.

Negative Sentiment Events Together:	CAR						CAAR		
	XLE	VDE	XOP	ICLN	SUSA	ERTH	Polluting	Green	Portfolio difference
	-1.16%	-1.17%	-0.80%	-0.20%	0.03%	0.46%	-1.04%	0.10%	1.14%
	-(0.29)	-(0.29)	-(0.14)	-(0.05)	(0.01)	(0.14)	-(0.23)	(0.03)	(0.34)

The columns show the Cumulative abnormal returns (CAR) for the ETFs starting with the polluting sector and the Cumulative average abnormal returns. The corresponding t-statistics are shown in parentheses.

Source: own edit.

In the next table we can see the effect of individual negative sentiment conferences (5. Table). Again, there are relatively high abnormal returns but not really significant. Surprisingly in many cases we see a negative abnormal return for the polluting ETFs. But there is only one event with a significant effect, which is the Katowice Climate Change Conference. However, even this is against the hypothesis because we see a significant negative abnormal return for the SPDR S&P Oil & Gas Exploration & Production (XOP) ETF, for the average of the polluting ETFs and for the portfolio approach as well. Even though because of the negative sentiment, the expectation was positive for the polluting ETFs and negative for the portfolio. This is still only one conference from the eighteen negative sentiment group. So, there is no significant pattern for this negative sentiment group either. One somewhat visible pattern for both sentiment conferences is that in the later years we see higher abnormal returns, indicating a bigger effect. So, the result may vary for different time periods. This can also be supported by intuition, because of the growing climate awareness (Calculli et al., 2021) these conferences receive more attention, therefore they have a bigger effect. So, I propose the hypothesis that, if I only focus on later events, I will see significant results similar to the original hypotheses. This also serves as a robustness test of the results.

5. Table, The individual effect of negative sentiment conferences.

Negative Sentiment Events:	CAR						CAAR		
	XLE	VDE	XOP	ICLN	SUSA	ERTH	Polluting	Green	Portfolio difference
Barcelona Climate Change Conference - 2009	-2.17% -(1.24)	-2.38% -(1.32)	-4.20% -(1.58)	-1.08% -(0.32)	0.41% (0.61)	-0.67% -(0.37)	-2.92% -(1.46)	-0.44% -(0.28)	2.47% (1.28)
Copenhagen Climate Change Conference - 2009	0.78% (0.44)	0.28% (0.16)	1.80% (0.66)	-0.34% -(0.10)	0.20% (0.20)	0.30% (0.16)	0.95% (0.56)	0.05% (0.04)	-0.90% -(0.48)
Cancún Climate Change Conference - 2010	-0.39% -(0.30)	-0.59% -(0.46)	-0.99% -(0.49)	0.65% (0.26)	-0.09% -(0.18)	-0.01% -(0.01)	-0.66% -(0.45)	0.18% (0.15)	0.84% (0.50)
Panama Climate Change Conference - 2011	0.86% (0.51)	0.64% (0.38)	1.65% (0.59)	-2.37% -(0.88)	0.03% (0.04)	0.22% (0.16)	1.05% (0.53)	-0.70% -(0.54)	-1.76% -(0.83)
Bonn Climate Change Conference - 2012	-0.12% -(0.08)	-0.37% -(0.26)	-0.45% -(0.16)	0.34% (0.13)	-0.40% -(0.40)	-0.57% -(0.37)	-0.31% -(0.17)	-0.21% -(0.16)	0.10% (0.05)
Doha Climate Change Conference - 2012	0.80% (0.61)	1.17% (0.90)	2.74% (1.11)	3.94% (1.60)	0.22% (0.31)	1.04% (0.78)	1.57% (0.97)	1.73% (1.50)	0.17% (0.09)
Bonn Climate Change Conference - 2013	-0.42% -(0.35)	-0.35% -(0.30)	-0.91% -(0.41)	0.42% (0.15)	0.26% (0.42)	0.18% (0.15)	-0.56% -(0.38)	0.29% (0.25)	0.85% (0.47)
Warsaw Climate Change Conference - 2013	0.33% (0.31)	0.08% (0.07)	-0.35% -(0.17)	-3.28% -(1.26)	-0.29% -(0.52)	-0.46% -(0.40)	0.02% (0.01)	-1.34% -(1.23)	-1.36% -(0.81)
Geneva Climate Change Conference - 2015	-0.64% -(0.30)	-0.84% -(0.38)	-0.14% -(0.03)	-1.23% -(0.60)	-0.09% -(0.20)	1.74% (1.47)	-0.54% -(0.19)	0.14% (0.15)	0.68% (0.24)
Bonn Climate Change Conference - 2016	-1.22% -(0.46)	-1.10% -(0.38)	-0.72% -(0.14)	-0.79% -(0.32)	0.10% (0.22)	1.80% (1.07)	-1.01% -(0.29)	0.37% (0.31)	1.38% (0.41)
Bonn Climate Change Conference - 2017	0.22% (0.11)	0.35% (0.17)	0.29% (0.08)	-1.38% -(0.67)	0.20% (0.49)	1.69% (1.32)	0.29% (0.11)	0.17% (0.18)	-0.11% -(0.05)
UN Climate Change Conference - 2017	-2.56% -(1.37)	-2.40% -(1.18)	-3.01% -(0.83)	-1.05% -(0.65)	0.32% (0.89)	0.81% (0.84)	-2.66% -(1.08)	0.03% (0.04)	2.68% (1.06)
Katowice Climate Change Conference – 2018	-3.77% -(1.79)	-3.95% -(1.79)	-6.93% -(2.11)	0.36% (0.22)	-0.43% -(0.77)	-0.08% -(0.05)	-4.88% -(1.99)	-0.05% -(0.05)	4.83% (1.96)
Bonn Climate Change Conference - 2019	1.00% (0.50)	1.32% (0.64)	3.37% (1.00)	0.24% (0.15)	0.20% (0.42)	1.52% (1.05)	1.90% (0.79)	0.65% (0.74)	-1.24% -(0.53)
UN Climate Change Conference - 2019	0.14% (0.07)	0.62% (0.29)	4.55% (1.10)	1.76% (1.06)	-0.02% -(0.06)	0.18% (0.16)	1.77% (0.66)	0.64% (0.81)	-1.13% -(0.42)
Virtual Climate Change Conference – 2021	-2.19% -(0.46)	-2.21% -(0.46)	-1.96% -(0.32)	1.07% (0.25)	-0.14% -(0.36)	0.64% (0.29)	-2.12% -(0.41)	0.52% (0.24)	2.64% (0.47)
Bonn Climate Change Conference - 2022	-7.35% -(1.86)	-7.05% -(1.76)	-4.41% -(0.86)	-1.31% -(0.36)	0.21% (0.55)	1.61% (0.61)	-6.27% -(1.47)	0.17% (0.09)	6.44% (1.39)
Sharm El Climate Change Conference - 2022	-4.13% -(0.91)	-4.26% -(0.93)	-4.82% -(0.86)	0.52% (0.13)	-0.21% -(0.51)	-1.64% -(0.60)	-4.40% -(0.91)	-0.44% -(0.21)	3.96% (0.76)

The columns show the Cumulative abnormal returns (CAR) for the ETFs starting with the polluting sector and the Cumulative average abnormal returns. The corresponding t-statistics are shown in parentheses.

Source: own edit.

3.2 The difference between time periods

To test the effects of events for different time periods, I divided the conferences into two time periods. The goal was to have enough events in both period and also to differentiate between these periods. One outstanding event which highly raise climate awareness was the Paris Agreement, where parties committed to action (Ourbak and Magnan, 2018). Other studies also indicate that it was a turning point (Monasterolo and De Angelis, 2020; Fahmy, 2022). Choosing the Paris Agreement also leaves enough conferences in both periods. So, it is a fitting solution for every criteria, therefore I divided the events into pre- and post-Paris periods and reexamined their effect on average. The result for the positive sentiment group is shown in the 6. Table. We can see no meaningful difference between the time periods and also compare to the previously studied whole period. None of the abnormal returns are significant on a 5% level.

6. Table, The total average effect of positive sentiment conferences in different time periods.

Period	CAR						CAAR		
	XLE	VDE	XOP	ICLN	SUSA	ERTH	Polluting	Green	Portfolio difference
Pre-Paris Together	0.63%	0.41%	0.66%	0.00%	-0.07%	0.06%	0.57%	0.00%	-0.57%
	(0.20)	(0.13)	(0.14)	(0.00)	-(0.03)	(0.02)	(0.15)	(0.00)	-(0.26)
Post-Paris Together	-0.35%	-0.20%	-0.52%	-0.73%	-0.27%	-1.29%	-0.36%	-0.76%	-0.41%
	-(0.08)	-(0.04)	-(0.08)	-(0.18)	-(0.10)	-(0.39)	-(0.07)	-(0.23)	-(0.10)

The columns show the Cumulative abnormal returns (CAR) for the ETFs starting with the polluting sector and the Cumulative average abnormal returns. The corresponding *t*-statistics are shown in parentheses.

Source: own edit.

The results for the negative sentiment group are similar (7. Table), no significant abnormal return for any time period. Therefore, I reject the hypothesis that the effects are more significant in the resent years.

7. Table, The total average effect of negative sentiment conferences in different time periods.

Period	CAR						CAAR		
	XLE	VDE	XOP	ICLN	SUSA	ERTH	Polluting	Green	Portfolio difference
Pre-Paris Together	-0.11%	-0.26%	-0.09%	-0.33%	0.03%	0.20%	-0.15%	-0.03%	0.12%
	-(0.03)	-(0.08)	-(0.02)	-(0.08)	(0.01)	(0.06)	-(0.04)	-(0.01)	(0.05)
Post-Paris Together	-2.21%	-2.07%	-1.51%	-0.06%	0.03%	0.72%	-1.93%	0.23%	2.16%
	-(0.48)	-(0.44)	-(0.23)	-(0.02)	(0.01)	(0.22)	-(0.37)	(0.07)	(0.52)

The columns show the Cumulative abnormal returns (CAR) for the ETFs starting with the polluting sector and the Cumulative average abnormal returns. The corresponding *t*-statistics are shown in parentheses.

Source: own edit.

Based on the results I reject all the given hypotheses. Neither the positive nor the negative sentiment conferences had any significant effect on average. Furthermore, even on an individual level conferences did not have a significant effect, except Katowice. However, also in that case the abnormal returns were in the opposite direction as expected. So, the significance might be due to some confounding or other effect, not because of the actual conference. The results are quite robust because they are similar for both sentiment groups and for the cumulative and also for the cumulative average abnormal returns. Even the portfolio approach, which is the most sensitive for the difference between the sectors, shows no significant result. So, I also reject the hypothesis that there is a different effect for the polluting and for the green sectors. The results are also robust through different time periods. These results can be inserted into the already existing literature with mixed conclusions. Although there are some studies arguing for the significant effects (Pham et al. (2019; Caporale et al 2023), they either focus more on systemic risk or one specific event in detail. Or not on conferences but legal requirement changes (Birindelli and Chiappini, 2021). Some other studies focusing on conferences also show no significant impact (Dahlström and Winstedt (2017; Ramiah et al. (2013). So, my results are generally in line with the existing literature.

Overall, all the results indicate that the conferences have no effect on the given investment at all. Meaning that the conferences do not reach their goal for real action with an impact, and they are just meaningless talks as many critics propose (Banerjee, 2012; Christensen and Wormbs, 2017). For example, Greta Thunberg accused world leaders and business executives of "actively creating loopholes and shaping frameworks to benefit themselves." The entire conference, she added, had turned into a "greenwash festival" for wealthy countries (Waldie, 2021). Croeser (2021) argues that capitalism causing the climate crisis, is unlikely to be capable of solving it effectively. This is despite the establishment of an international treaty and the UNFCCC, designed for this very purpose. Based on these critics it is possible that investors and firms do not pay attention to these conferences because they classify them as just talks. Therefore, these events and their outcomes do not change the expectations on the market. This can be a possible explanation for the non-significant abnormal returns.

One possible critique of the methodology is that this regression model is not a good estimator of the returns. But this is a standard methodology used in the literature (as seen in chapter 1.3). Also, the R^2 -s of the models for different ETF returns for the whole period, are ranging from 0.51 to 0.92, with an average of 0.69. Which can be considered a relatively good fit (Chicco et al., 2021), however there is always room for improvement. In a following study I could consider

adding other independent variables to the regression. Good options would be the energy prices or the Vix index to control for other confounder effects. Or could use a factor model instead of a regression for better predictions. One critique of the used data could be that I only study three plus three ETFs, which might not represent the market well. However, these are the biggest available ETFs which tend to follow the market well (Madura and Ngo, 2008; Luft and Plamondon, 2017). Also, we see similar results for all the ETFs, indicating no individual differences, which supports the robustness of my results. So, this is an unlikely possibility. In summary the used methodology cannot be highly criticized, and the results are robust for different tests, indicating that the climate conferences have no real effect. This supports the greenwashing critics of these events.

4. Conclusion

Given the serious, complex, and rather concerning effects of climate change, many countries and global organizations have begun working together to prevent or mitigate the potential damages in the form of conferences. In my study I investigate the impact of these conferences through their effect on polluting and green investment. To have clear result I focused on the major conferences of UN and UNFCCC As a proxy for investment I use three ETFs for the polluting and three for the green sector. I use the event study methodology in many different ways to test the effect of the events. I also classify the events based on their sentiment and previous expectations to create the possibility of a more detailed research. I study the cumulative average abnormal returns and the total cumulative average abnormal returns for the different sentiment groups and for individual events as well. My hypotheses were the followings: In case of a positive sentiment event, we can see a significant negative abnormal return in the polluting sector, while a significant positive abnormal return in the green investments. Also, in case of a negative sentiment event, we can see a significant positive abnormal return in the polluting sector, while a significant negative abnormal return in the green investments. This would mean that the conferences can have real impact and they are not just talks with empty promises (greenwashing). However, based on the results I reject all the given hypotheses. Neither the positive nor the negative sentiment conferences had any significant effect on average. Furthermore, even on an individual level conferences did not have a significant effect, except Katowice. However, also in that case it is probably due to some confounding effect. The results are quite robust because they are similar for both sentiment groups and for the cumulative and also for the cumulative average abnormal returns. Even the portfolio approach and for different time periods. One possible explanation for this can be that investors and firms

do not pay attention to these conferences because they are not meaningful enough. Therefore, these events and their outcomes do not change the expectations on the market. Overall, my study supports the greenwashing critics of the climate conferences for their lack of real impact.

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