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Code Red For Stock Markets?

An Empirical Analysis of the Norwegian Stock Market Reactions to Reports by the Intergovernmental Panel on Climate Change

Marit Randen and Tonje Jacobsen

Supervisor: Guttorm Schjelderup

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The process of writing the thesis has been both educational and challenging. It has been interesting to get a deeper understanding of the chosen topic and apply the knowledge we have attained through five years of studies. We are convinced that the learning outcome of writing this thesis has enriched our skill set to meet future challenges after our studies at NHH.

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Marit Randen

Tonje Jacobsen

Abstract

To raise awareness of the financial implications of reports published by the Intergovernmental Panel on Climate Change, this thesis examines the Norwegian stock market reactions surrounding these publications. In addition, the thesis examines the market efficiency of Oslo Stock Exchange in relation to climate change research. This thesis contributes to recent academic literature on how stock markets react to publications of climate change reports by studying 20 reports published between 2001 to 2020. The research question is answered through three hypotheses, one for each of these indices: OBX Total Return Index, OBX Energy Index, and OBX Financials Index. We apply the event study methodology explained by MacKinlay (1997) to identify if there are abnormal returns surrounding the events.

We conduct several different analyses for all three hypotheses and the results are ambiguous, which makes it challenging to conclude. In the main event window, we find significant cumulative abnormal returns between -1.50% and -1.97% for the OBX Total Return Index. For the OBX Financials Index we find cumulative abnormal return of -1.25% in the main event window. Many factors in the market can contribute to these abnormal returns. Considering such factors we examine the oil price, the Norwegian policy rate, and the Paris Agreement. Including these variables indicate that an increase in the oil price or the policy rate makes the expected cumulative abnormal return less negative. This implies that there are several factors affecting the estimated cumulative abnormal returns. Surprisingly, no significant results are found in the main event window for the OBX Energy Index, which is dominated by oil and gas companies. These results indicate that there are no effects on the Norwegian energy sector in relation to climate change news.

As our analyses show such varying results there is no clear violation of the efficient market hypothesis. Our findings suggest that investors in the Norwegian market perceive climate change news as relevant for investment decisions. Furthermore, there are still market reactions even though it has been 31 years since the first publication by the climate panel. Thus, climate change research is still relevant in 2021.

Keywords – IPCC, climate change, abnormal returns, efficient market hypothesis, event study, Oslo Stock Exchange

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1. Introduction

1.1 Background and Motivation

The issue of climate change and global warming has been on the United Nations' agenda for decades. In 2015 the renowned Paris Agreement was adopted by 196 parties to reach global peaking of greenhouse gas emissions as soon as possible (United Nations Climate Change, n.d.). The Paris Agreement is closely related to economic and social transformation to reach the goal of limiting global warming, as large-scale investments are required to significantly reduce emissions (United Nations Climate Change, n.d.).

In World Economic Forum's risk report of 2021 climate action failure is identified among the highest likelihood risks of the next ten years, together with extreme weather and human-led environmental damage (World Economic Forum, 2021). The Intergovernmental Panel on Climate Change – in the continuation referred to as the climate panel – has published reports regarding knowledge on climate change, its causes, potential impacts, and response options since 1990. By the time of writing this thesis, the climate panel is in its Sixth Assessment cycle where the goal is to publish a synthesis report in September 2022 (IPCC, 2021a). Multiple reports are published throughout each assessment cycle, including working group reports, special reports, and methodology reports. Ultimately, the main findings in these reports are combined in an overall synthesis report which provides an overview of the state of climate change. The most recent climate panel publication resulted from Working Group I's research which provides the physical understanding of the climate system and climate change. The UN Secretary-General António Guterres stated that this report "is a code red for humanity," which the media quoted him worldwide (United Nations, 2021). The extensive media coverage of the report of Working Group I sparked our curiosity as to how the financial markets would react to the publication and its findings. Guterres emphasized that a solution to the crisis "depends on leaders from government, business, and civil society uniting behind policies, actions, and investment that will limit the temperature rise of our planet" (United Nations, 2021). This goes to show that there is a connection between climate change and the world economy and financial markets, and we wanted to dig deeper into this relation.

The petroleum industry is an essential part of the Norwegian economy. The increased focus on reducing pollution and greenhouse gases got us wondering how the Norwegian financial markets would react to the publications of reports by the climate panel. Our initial research revealed studies on similar topics on multiple markets, but we did not find similar research on the Norwegian market – Oslo Stock Exchange. In addition, we found such a research project extra relevant today as the climate panel is currently in its Sixth Assessment cycle, with multiple publications planned for the upcoming year. Moreover, it is worth mentioning that we will investigate multiple sectors in the Norwegian market. Our research is not limited to sectors associated with large emissions of greenhouse gases – we also include the financial sector and the market as a whole.

1.2 Research Question and Hypotheses

Based on the background and motivation, we want to examine the following research question:

How does the Norwegian stock market react to reports by the Intergovernmental Panel on Climate Change?

To do so, we will study reports published by the climate panel between 2000 and 2021. This includes working group reports, special reports, methodology reports, and synthesis reports. The climate panel has three working groups, where each group provides research and reports within a specific area. Working Group I focuses on the physical science basis of climate change. Working Group II looks at impacts, adaption, and vulnerability, while Working Group III deals with climate change mitigation (IPCC, 2021b). The synthesis reports are a summary of the working group reports. In addition to the working groups, the climate panel has its own task force that conducts methodologies for calculating and reporting national greenhouse gas emissions and removals. The special reports are stand-alone reports that assess specific climate change that are highly relevant (IPCC, 2021b). Some days prior to each publication, the climate panel arranges sessions where all parties of the United Nations are invited to assess the latest work done by the researchers. The sessions usually last for four days, where the reports are reviewed and approved. In general, the reports are published a few days after the session ends.

Our research question is examined through the event study methodology described by MacKinlay (1997). The first day of each working group session where a publication has been approved represents an event day. We analyze whether it is possible to obtain abnormal returns in relation to the climate panel publication. To discuss our results, we will look at the efficient market hypothesis which states that all information and value of a stock should be embedded in the price. According to the efficient market hypothesis, it is impossible to achieve abnormal returns – there are no "free lunches" in an efficient market (Fama, 1970). Investors worldwide challenge this hypothesis by trying to achieve abnormal returns. Hence, we want to test whether it is possible to achieve abnormal returns in the Norwegian market, in conjunction with the climate panel reports. The abnormal return is referred to as the estimated normal return subtracted by the actual observed return. The benchmark for normal performance is the expected return without conditioning on the event occurring (MacKinlay, 1997). We will use the Market Model to estimate normal returns in our study, which will be elaborated in the methodology section. To test if abnormal returns obtained in the days surrounding the working group sessions are significant, we will perform a standardized t-test and ordinary least squares (OLS) regression. In the regression we control for the oil price, the Norwegian policy rate, and the time before and after the Paris Agreement. To ensure robustness, we include several event windows and test some of the OLS assumptions. Further details about the methodology are elaborated in section 4.

Given that the efficient market hypothesis holds, we expect no abnormal returns when the climate panel publishes their reports. This leads us to this study's first hypothesis, which would imply that the market is inefficient if the hypothesis is statistically rejected. The purpose of the first hypothesis is to see if there is any effect of announcements by the climate panel on the largest industries and companies listed on Oslo Stock Exchange without being sector-specific. For this reason, we will test the OBX Total Return Index[1], which consists of the 25 most traded securities on Oslo Stock Exchange based on six months turnover rate (Euronext, 2021). See Table A1 in Appendix for an overview of the companies and subsectors included in the OBX Total Return Index.

Hypothesis 1: The OBX Total Return Index yields no abnormal returns in the event of a publication by the Intergovernmental Panel on Climate Change.

Hypothesis 1 tests the efficiency in the Norwegian market, and we would expect our analysis to find that the market is efficient. Thus, we do not expect to observe any abnormal return. This means we do not expect to see any difference in the actual return versus the estimated normal return when examining a diversified portfolio from Oslo Stock Exchange.

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[1] See Appendix 1, Table A1 for an overview of firms.

A considerable part of the Norwegian economy is the oil and gas industry. For that reason, we would like to examine whether there are effects on the energy sector in the Norwegian market considering announcements by the climate panel. To examine the effect on the energy sector, we will perform analyses on the OBX Energy Index[2], a sector-specific index at Oslo Stock Exchange. The energy sector in Norway is closely linked to climate change and the debate of reducing carbon emissions as it heavily relies on non-renewable natural resources and accounts for a large share of the total national emissions. Thus, we expect this sector to be more negatively affected by the green shift and the outline in the reports than other indices on Oslo Stock Exchange. "The green shift" is referred to as a change in the way society grows and develops such that we can reach the global goals set by the climate panel (Regjeringen, 2020). Therefore, the second hypothesis will test if there are negative abnormal returns for the energy sector concerning a publication by the climate panel.

Hypothesis 2: The OBX Energy Index yields negative abnormal returns following the announcement of reports by the Intergovernmental Panel on Climate Change.

Hypothesis 2 tests the efficiency in the energy sector, and we would expect our analysis to find that the market is inefficient; hence we expect to observe abnormal returns. This means that we expect to see a difference in the actual return versus the estimated normal return when examining a portfolio of energy companies. Although we focus on the non-renewable aspect of the energy sector in this study, it is important to mention that the energy sector and the OBX Energy Index also consist of companies that profit through renewable resources and want to be a part of the green shift. We expect to see the opposite change in share price for these companies, as they should be positively affected by the green shift and warnings about future climate change. However, today there are no established criteria or classification system for grouping the renewable and non-renewable companies in Norway. In addition, some companies that take great advantage of non-renewable sources also use renewable sources in other areas of their business and are working on more sustainable solutions for the future. A possible solution and improvement for similar or further studies would be to separate the renewable companies from the non-renewable in different portfolios. We have chosen not to go forward with this approach in our study because some companies, especially energy companies, have both renewable and non-renewable business operations. This would demand

[2] See Appendix 1, Table A2 for an overview of firms.

a thorough qualitative analysis, separation of profits and a deeper analysis of each firm's financials, increasing the complexity of the dataset. There is still a relatively large portion of oil and gas companies – companies that rely on non-renewable sources and contributes to a high share of greenhouse gas emissions – in the OBX Energy Index. Based on these arguments we choose to examine the OBX Energy Index, although it is essential to consider the limitations described.

For Hypothesis 2 regarding the OBX Energy Index, we want to have a comparison group where we do not expect to see any effect of the publications by the climate panel. For this purpose, we need a sector less exposed to climate change. Hence, we will look at a sector that does not rely on natural resources and does not have large greenhouse gas emissions – compared to the energy sector. We believe the financial sector is a good comparison for the energy sector, where the main business area is to provide financial services to commercial and retail customers. The OBX Financials Index[3] on Oslo Stock Exchange comprises banks, investments companies, and insurance companies. One common feature of all these companies is that they are highly digitalized and demand small use of natural resources – apart from electricity and heat in the offices and the use of airplanes for travel purposes. The latter is such a small contribution to the total national emissions compared to the energy sector that it would justify using it as a comparable portfolio. Thus, the financial sector is somewhat neutral when we think of how it may be affected by research related to climate change risk. Therefore, the third hypothesis of this thesis will test the effect the reports have on the OBX Financials Index.

Hypothesis 3: The OBX Financials Index yields no abnormal return following the announcements of reports by the Intergovernmental Panel on Climate Change.

Hypothesis 3 tests the efficiency in the Norwegian financial sector, where we expect to find the same as Hypothesis 1, that the market is efficient. Thus, we do not expect to observe any abnormal returns in relation to the research published by the climate panel. In other words, it means that we do not expect to see any difference in the actual return versus the estimated normal return for the OBX Financials Index.

[3] See Appendix 1, Table A3 for an overview of firms.

1.3 Structure

This thesis consists of ten sections. In this first section, we have now introduced the topic of climate change, defined the research question and hypotheses, and provided some background information. The second section provides the reader with relevant literature on the topic, exploring previous research, and clarifying our contribution to existing literature. The third section is dedicated to the theoretical framework of our thesis, where we explain two financial theories: the efficient market hypothesis and behavioral finance. In section four, we provide a thorough explanation of the event study methodology and our decisions for the study. The fifth section gives the reader an overview of the data our analysis is based on, how the data is collected, and our thoughts on decisions regarding the sample. The analysis where the research question is examined, the hypotheses are tested, and the results presented are found in section six. Section seven provides a robustness test of the analysis. In section eight, the analysis results are discussed and compared to findings of similar research. Finally, in section nine, we provide a critical assessment of the analysis before the thesis is concluded in section ten.

2. Literature Review

This section presents studies on the connection between climate change and stock markets. Some of the studies presented are similar to our thesis, as they examine the effect of reports by the climate panel on various stock markets (Rogova & Aprelkova, 2020; Chatzivasileiadis et al., 2018; Walsh & O'Riordan, 2020). We will also introduce studies that focus on the stock market effects of announcements of environmental regulations (Pham et al., 2019; Ramiah et al., 2013). It is relevant to examine studies on environmental regulations as the introduction of new regulations – or changes in existing regulations – often are introduced after publications by the climate panel. This literature review provides an overview of research relevant to our hypotheses presented in section 1 regarding market efficiency and abnormal returns following the announcements of reports by the climate panel.

2.1 Studies on Stock Market Reactions to Reports by the Intergovernmental Panel on Climate Change

To our knowledge, there has not been conducted any studies on the Norwegian stock market reactions to reports by the climate panel. However, studies on similar topics have been performed on the US, Australian, and Singapore stock markets. Rogova et al. (2020) and Chatzivasileiadis et al. (2018) have conducted event studies on the US stock market. Both studies identified abnormal returns around the publication date of climate panel reports. However, both studies also emphasize that the stock price effect fades away shortly after the announcements. This implies that the market is not able to price the risk of climate change in the long term. If the market cannot price the effect of climate change in the long term, one might observe abnormal returns for each new report published. Chatzivasileiadis et al. (2020) observed that even though the reports are published regularly the market goes "back to normal" after the initial reaction. This implies that the market is unable to incorporate the climate change risk in the long-term pricing. The same goes for Rogova et al., who found that the US stock market still reacts to new scientific announcements, although it has been more than three decades since the first report was published by the climate panel (Rogova & Aprelkova, 2020, p. 13). This shows that studies on the topic are still relevant and could provide meaningful insight into stock market reactions to upcoming reports.

Walsh et al. (2020) examined the S&P 500 Energy Index, but they chose to limit the number of events to one special report by the climate panel entitled "Global Warming of 1.5°C". The results from the empirical analysis of Walsh et al. showed no statistically significant reaction in the returns for energy companies around the time of publication of the climate panel report (Walsh et al., 2020, p. 209). According to the authors, the short-termism in the market is illustrated by "showing that energy companies do not experience any abnormal returns beyond the market rate when disquieting information … is published" (Walsh et al., 2020, p. 201). Short-termism refers to investors preferring short-term results at the expense of long-term interests (CFA Institute, n.d.). This is connected to efficient markets, as markets where investors have a short-term perspective will not be as efficient and sustainable as markets where long-term focus dominates. From a short-term perspective, investors are more interested in obtaining profits in the short run rather than making sustainable investments that will give returns in the future. The results of Walsh et al. (2020) differ from that of Rogova et al. (2020) and Chatzivasileiadis et al. (2018) – which both identified abnormal returns in the US stock market. However, Walsh et al. (2020) decided to analyze the stock market reaction to one specific publication by the climate panel. Thus, the number of events included in the study is limited, and it might be challenging to assume anything about stock market reactions to the climate panel reports in general, based on a small number of events.

Our hypotheses seek to examine whether the Norwegian stock market is efficient and reflects the information available in the market. Chatzivasileiadis et al. (2018) found that investors closely follow the discussion generated by the climate panel and its working groups. Their study implies that the stock market recognizes the importance of the findings in the reports, as they identify abnormal returns for firms in conjunction with the publications. The abnormal returns identified are positive and negative, depending on industries and which report is examined. For instance, firms categorized as energy firms respond negatively to a publication from Working Group I, but positively by the findings from Working Group III (Chatzivasileiadis, 2018, p. 4). This shows that the direction of the abnormal return observed in the market is connected to the content of the report and in which industry a firm operates.

The objective of Rogova et al. (2020) was to explore the stock market's reaction to announcements by the climate panel and compare them to regulatory announcements of climate and energy policies. Their findings show that markets react more to announcements by the climate panel than to actual regulatory changes in the energy sector. This can be interpreted as the climate panel announcements having a strong market signal and high forward guidance (Rogova et al., 2020, p. 2). In other words, the market tries to interpret what the information from the climate panel reports means for future profits. Stock prices are essentially the net present value of future profits, and researchers observe changes in stock prices in conjunction with publications of reports by the climate panel. This implies that the announcements by the climate panel affect investors' perception of the present value of future profits. These findings by Rogova et al. (2020) are in line with the findings discussed in the previous paragraph, as Chatzivasileiadis et al. (2018) also found that investors follow the discussion generated by the climate panel. In addition, the latter also observed abnormal returns after events, which implies that the announcements affect investors' perception of potential future profits.

Another topic assessed in two of the reports is whether the effect of every successive report leads to lower market reactions than previous reports. Chatzivasileiadis et al. (2018) identify a tendency that the stock market reaction is reduced with every passing climate panel report. The authors provide explanations as to why this might be. Firstly, subsequent reports seem to add less new information, and the content of the reports might not be as surprising as when the first report was published. In addition, they highlight that the general public's concern about climate change in the US is decreasing during the 2000s. The authors argue that as public interest decreases, policymakers are less likely to act on the release of new reports (Chatzivasileiadis et al., 2018, p.7). Rogova et al. (2020) do not find the same in their study. They find that every successive report announcement has led to similar market reactions as the previous ones. Hence, their study shows that the US market still reacts to new scientific announcements. The effect over time is not assessed in the study of Walsh et al. (2020) as they limited the research to one climate panel report.

It is essential to remember that the climate panel does not conduct its own research. Experts volunteer their time to assess thousands of scientific papers published each year to provide a comprehensive summary published in reports by the climate panel (IPCC, 2021b). Therefore, people following the scientific literature on climate change should not be surprised by the content in the climate panel reports (Chatzivasileiadis, 2018, p. 6). Nevertheless, both Chatzivasileiadis et al. (2018) and Rogova et al. (2020) find that the stock market treats the climate panel reports as new and relevant information. This perception might be because the climate panel reports can change public opinion and political trends. The climate panel is the United Nations body for assessing the science related to climate change. Hence the reports could have a substantial impact on global environmental policies.

2.2 Studies on Stock Market Reactions to Announcements of Environmental Regulations

In this section we will present studies that examine the stock market reactions to announcements of environmental regulations. The current literature on the economic and financial effects of environmental regulations on firms provides two differing views. On one side, some studies find that environmental regulations may produce unfavorable outcomes for firms, as complying with environmental regulations is costly and might hurt a firm's bottom line (Cohen et al., 1997). On the other hand, some find that corporations adopting higher environmental standards have higher market values (Dowell et al., 2000). In essence, there is no agreement as to whether environmental regulations create or destroy value for firms. Business performance and reputation are important factors to how the financial markets decide the market value of a company, i.e., the stock price in the market. To adjust to new information about climate change and new regulations implemented, companies will have to invest more in new, cleaner technologies – or be ready to be penalized by states and markets (Rogova & Aprelkova, 2020). Thus, how firms address relevant climate challenges and environmental regulations will likely affect their performance and possibilities in the financial markets.

Some researchers, such as Pham et al. (2019) and Ramiah et al. (2013), have performed similar studies to those presented in section 2.1. However, rather than looking at reports by the climate panel, they have examined the stock market reactions to environmental policies and regulation announcements. In the following we will examine these two studies, which focus on the Singapore stock market and the Australian stock market, respectively. The main finding of Pham et al. (2019) was that the environmental regulations set by the government tend to achieve the desired effects in Singapore. They found that big polluters were negatively affected by the announcements of environmental regulations and carbon tax, as these firms attained negative abnormal returns around the announcement of the carbon tax (Pham et al., 2019, p. 16). In addition, they found that regulations seemed to boost the performance of environmentally friendly sectors, as industries focusing on new renewable energy technologies experienced a positive abnormal return following the announcements of regulations (Pham et al., 2019, p. 17). This finding is closely linked to our two last hypotheses, where we hypothesize that the OBX Energy Index will yield negative abnormal returns in conjunction with announcements of reports by the climate panel. In Hypothesis 3, we hypothesize that the OBX Financials Index does not yield abnormal returns concerning the reports by the climate panel. Ramiah et al. (2013) investigated the impact of 19 announcements of environmental regulation on the Australian stock market. The study shows that such announcements had a major impact on stock returns for about 60% of the Australian stock market, where some sectors yield negative abnormal returns and others yield positive abnormal returns (Ramiah et al., 2013, p. 1750). Whereas Pham et al. (2019) concluded that environmental regulations set by the government in Singapore tend to achieve the desired effects, the results from the Australian stock market are not as clear. Ramiah et al. (2013) identified 14 sectors that did not experience statistically significant abnormal returns after announcements, surprisingly including the electricity industry. As previously stated, environmental policies aim to affect big polluters negatively and boost environmentally friendly sectors. Thus, the electricity industry not reacting to announcements of green policies might imply the failure of the green policies targeting the big polluters. However, Ramiah et al. (2013) argue that this interpretation of the result might be flawed. They state that "what appears to be an ineffective policy may be due to the ability of the industry to pass on the extra cost to consumers" (Ramiah et al., 2013, p. 1752). This shows that environmental policies are not always successful in targeting the big polluters, and it also highlights the division in the literature of stock market reactions to environmental regulations.

2.3 Our Contribution to Existing Literature

Our thesis contributes to the existing literature by looking at the Norwegian stock market, which is something that has not been done before. The Norwegian economy relies heavily on natural resources, such as oil, gas, and hydropower. Therefore, climate change should be of interest and highly relevant in the Norwegian market. Moreover, the state of the climate is constantly evolving, which makes it relevant to perform an updated study that includes the latest reports released. Our data sample consists of recent publications from the climate panel, which is a strength due to the rapid nature of climate change. Due to limited data availability we will not include all reports ever published as events in this study; this is elaborated in section 5. As seen in this section, much research on the topic also includes how changes in regulations affect stock markets. Initially, this was an aspect we wanted to include in our analysis. However, because of the added complexity of data, we focused only on announcements by the climate panel.

3. Theoretical Framework

In this thesis we will perform an event study, see chapter 4 for a thorough review of the methodology applied. The event study methodology is based mainly on assumptions about rationality and efficiency in the marketplace, closely linked to the efficient market hypothesis and behavioral finance (MacKinlay, 1997). This chapter will give a review of these relevant economic theories.

3.1 Efficient Market Hypothesis

The efficient market hypothesis is a theory which states that in an efficient market share prices fully reflect all information, making it impossible to outperform the market through expert stock selection or market timing (Downey, 2021). Fama introduced the efficient market hypothesis in 1970, and even though the assumption that markets are efficient is a cornerstone of modern financial economics, the model has been debated ever since (Downey, 2021). The theory also states that stocks should always trade at their fair market value, implying that it is impossible to consistently obtain abnormal returns. The null hypothesis of the efficient market hypothesis is that all available information is at all times fully reflected in the market price. This is quite an extreme hypothesis, as it might seem impossible that all information, both public and private, is reflected in a stock price. There can certainly be inefficient markets, but Fama also discusses modifications to the strongest form of the efficient market hypothesis. In Fama's original article he presents three forms of market efficiency: weak form, semi-strong form, and strong form (Fama, 1970). Firstly, weak form claims that prices are decided by historical prices of the security. Next, semi-strong form claims that prices are decided by publicly available information, as announcements of annual earnings and stock splits. Lastly, strong form claims that all public and private information is reflected in security prices (Fama, 1970).

Our research will test the semi-strong form of market efficiency related to public information being reflected in security prices. If the market is semi-strong efficient, security prices will fully reflect new information so that investors cannot time their investments to generate abnormal returns. Supposing that our research detects the possibility to generate abnormal returns in connection with publications from the climate panel, this would be inconsistent with the theory of efficient markets.

3.2 Behavioral Finance

The event study methodology and the efficient market hypothesis depend on rational markets, but empirical findings show that rational markets are not always the case. The evolvement of the field of behavioral finance has been fueled by the inability of the traditional economic framework to explain many empirical patterns, such as deep recessions and stock market bubbles (Ritter, 2003). Behavioral finance proposes that psychological factors and human biases affect the behaviors of investors in the financial markets (Hayes, 2021). Behavioral finance can explain different market anomalies, and specifically severe rises or falls in stock prices such as the ones one can observe in a stock market bubble. Psychology literature can document that people make systematic errors in the way they think, for instance being overconfident in their abilities and putting too much weight on recent experience (Ritter, 2003). This makes people act irrationally in the market, as opposed to rational economic behavior based on traditional economic theory. A necessary clarification concerning the efficient market hypothesis is that it does not assume that all investors are rational, but *markets* are rational (Ritter, 2003).

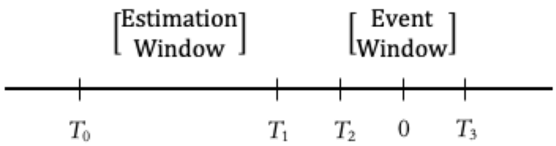
So why do we also mention behavioral finance? Behavioral finance assumes that markets are informationally inefficient in some circumstances, meaning all market participants cannot always retrieve all available and relevant information. We include theory of behavioral finance in this thesis because it is relevant for how investors perceive new information about climate change. How investors perceive information has a large impact on how the Norwegian stock market reacts to the information in the reports by the climate panel. The perception and interpretation of the climate panel reports might not be what economic theory will describe as "rational". Thus, there is a possibility that abnormal reactions and returns will be observed, and this abnormality can even be explained from a behavioral finance point of view.

4. Methodology

4.1 Event Study

In this chapter, we will elaborate on the methodology we use to analyze the effect of the publications by the climate panel on the Norwegian stock market. As we examine the effect of specific events from 2001 to 2021, the event study methodology explained by MacKinlay (1997) is a good fit for our analysis. The event study methodology is widely used in finance and accounting research. Rogova et al. (2020) and Chatzivasileiadis et al. (2018) have both performed studies on stock market reactions to the climate panel reports, and they have also applied an event study approach. For event studies, MacKinlay (1997) assumes that the market is efficient in that prices reflect all publicly available information. This is referred to as a semi-strong efficient market based on the definitions by Fama (1970), as explained in section 3. The figure below is the baseline for the event study methodology, which we will be referring to in the following sections.

Figure 4.1: Illustration of Estimation and Event Window



4.2 Event Window

To measure the impact of an event that takes place at a particular time, we must define an event window reaching from *T_2* to *T_3*. The vital part to have in mind when setting the event window is to make sure we include all relevant information for the specific event while avoiding irrelevant information (MacKinlay, 1997). As mentioned in the introduction, prior to the publications of reports, the climate panel hosts working group sessions that usually last for four days. During these sessions the latest research for the reports is discussed and approved. When the sessions start and the parties begin to discuss the contents of the reports, it is reasonable to say that the information is public as the sessions contribute to more attention on the topic of climate change. However, as the efficient market hypothesis states that all new or anticipated information should be reflected in the stock price, we must consider that the reports' contents are publicly available some days before the sessions start (Fama, 1970). Since the first report was published in 1990, the topics have revolved around many of the same environmental challenges (IPCC, 2021d). Therefore, it is reasonable to assume that investors will expect the outline in the upcoming report when the session is about to start. To deal with these potential issues and ensure that we capture the actual event, we will define an event window larger than the specific session start date, which is customary in event studies (MacKinlay, 1997, p. 14). We will set the beginning of the main event window to four days prior to the session start date in order to capture the effects of investor expectations. It is also reasonable to expand the event window some days after the session starts. The reports are often published at the last day of the sessions or some days later. By expanding the event window some days past the actual event, we will in most cases include the publication of the report in the event window as well. In addition, the opening hours on Oslo Stock Exchange are limited and there might be slight lags in market reactions. To ensure we observe the effect even if the news is not immediately reflected in the stock market, we set the main event window to four days after the sessions start. In this way, we should observe an effect even though the event occurs right before the weekend. To summarize, the main event window counts for a total of nine days spanning from [-4, 4]. An important restriction in the event study methodology is that event windows should not overlap (MacKinlay, 1997). The event dates of our study are presented in section 5, where one can observe that we will not have a problem with overlapping event windows.

In addition to the main event window, we added four more event windows in the analysis. This makes it possible to examine the market reactions for various lengths of event windows. The first one we added was a window spanning from the day before the event to the day after the event, [-1,1]. Hence, we shortened the event window to last for three days. With the shorter window we seek to identify even more specific reactions just around the event day. The second event window we added was a pre-event window, starting three days before the event day and including the event day, [-3,0]. The motivation for adding this window was to see whether there were investor anticipation effects in the market before the working group session started. We included a post-event window as well, spanning from the event day to three days after the event day, [0,3]. In this way, we could examine the effect in the trading days after the event took place. Lastly, we added a very short post-event window that only includes the event day and the following trading day, [0,1]. With this event window we might be able to identify how the market reacts the following trading day after a working group session starts.

4.3 Normal Return

In our analysis we seek to examine abnormal returns in the stock market. Abnormal return is defined as the actual return obtained minus the estimated normal return (MacKinlay, 1997, p. 20). Hence, we must start by estimating the normal return. MacKinlay defines normal return as "the expected return without conditioning on the event taking place" (1997, p. 15). The period we use to estimate the normal return is called the estimation window, which we will define in section 4.3.2. MacKinlay states that there are a lot of different models available to estimate normal returns and splits these models into two categories: statistical and economic models (1997, p. 17). The difference between the two categories is the assumptions made, where the statistical models are only based on statistical assumptions while the economic models also consider investors' behavior and economic restrictions (MacKinlay, 1997). There are arguments that economic models like the Capital Asset Pricing Model and the Arbitrage Pricing Theory could yield some advantages compared to statistical models. However, generally these advantages are very modest for an event study approach (MacKinlay, 1997, p. 18). Since there are limited gains by using an economic model instead of or as a supplement to statistical models, we find it beneficial only to use a statistical model. As for statistical models, MacKinlay (1997) mentions the market model and the constant mean return model. We have chosen to use the market model to estimate normal return, as it reduces the variance of the abnormal return compared to the constant mean return model. This advantage might increase the probability to observe event effects (MacKinlay, 1997).

4.3.1 Market Model

The market model is a single factor model that follows linearity due to the assumption of joint normality of all asset returns (MacKinlay, 1997, p. 18). In our analysis the asset returns are the chosen indices' returns. The model connects the return of a given index to the market portfolio's return. We will use the Oslo Stock Exchange Benchmark Index (OSEBX) as the market portfolio. This choice will be motivated further in section 5. For each index *i* the market model estimates normal performance expressed by equation 4.1.

$$R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it} \tag{4.1}$$

$$E(\varepsilon_{it} = 0) \qquad\qquad Var(\varepsilon_{it}) = \sigma_{\varepsilon}^2$$

Where R_{it} represents the returns on index i in period t, R_{mt} represents the returns on the market portfolio in period t. ε_{it} is the error term for period t with an expected mean value of zero. α_i and β_i are parameters of the market model and estimated by OLS regression.

4.3.2 Estimation Window

The estimation window is a period before the event used to estimate the normal return. It is typical and beneficial if the estimation window and the event window do not overlap (MacKinlay, 1997, p. 20). If they overlap, there is a chance that the estimation window also captures the effect of the event, which makes the estimation of the normal return less accurate. MacKinlay (1997) suggests an estimation window of about 120 days as an appropriate length to estimate the normal return when using the market model. It is also common to take leave some days between the estimation window and the event window to make sure that the effects of the event are kept outside the estimation window and so that the two windows do not capture the same effects. Based on this, we define the estimation window to start 140 days prior to the event day and last for 121 days, [-140, -20]. The estimation window [T_0, T_1] is illustrated in Figure 4.1 along with the event window and the event day.

An issue arises with such a definition of the estimation window regarding the short period between some events in our study. During some years in our study, several reports are published, making an estimation window overlap with the event window of the previous event. In these cases, the estimation of normal return will capture the effects of the previous event and not be representative for normal performance. Hence, we exclude a period of ten days prior and ten days past the overlapping event in the estimation window. This makes the estimation window for some events shorter, but we ensure we do not capture the possible effect of a working group session when we estimate normal performance. It is also possible that other events than the sessions could affect the estimation window. This could be other global or national events that affect the Norwegian market. The most important of such events in the period 2000-2021 are the financial crisis in 2008 and the Covid-19 outbreak in 2020, which we have controlled for in our study. Data from 2008 – when the market was affected by the financial crisis – is not included in our analysis. Data from the extreme decline and subsequent recovery in the Norwegian market around 12th March 2020 is not included either. When we refer to data as not included, it means that the timing of the data is outside any of the event windows and estimation windows.

4.4 Abnormal Return

To examine the effect of the climate panel reports on the Norwegian stock market, we must calculate the abnormal returns. The abnormal return is the actual return obtained minus the estimated normal return (MacKinlay, 1997, p. 20). The normal return is obtained through the market model explained previously. First, we calculate the abnormal return for each day within each event window. In event studies, one usually examines firms rather than indices. Hence, the methodology from MacKinlay must be adapted to fit our data and our analysis. For index *i* the abnormal return at time *t* is given by equation 4.2.

$$AR_{it} = R_{it} - (\alpha_i + \beta_i R_{mt}) \tag{4.2}$$

As stated above, recall that R_{it} represents the returns on index *i* in period *t*, R_{mt} represents the returns on the market portfolio in period *t*. α_i and β_i are parameters of the market model and estimated by OLS regression.

To draw overall inferences for the events of interest, the abnormal return observations must be aggregated for each event (MacKinlay, 1997, p. 21). We will aggregate the abnormal returns across time for index *i* as shown in equation 4.3, to retrieve the cumulative abnormal return for each event. In the following equation, AR_{it} is the abnormal return for index *i* at time *t* in the event window [T_2, T_3].

$$CAR_i(T_2, T_3) = \sum_{t=T_2}^{T_3} AR_{it} \tag{4.3}$$

4.5 Significance Test

The cumulative abnormal return must be tested for significance to estimate the probability that the observed effects did not occur only by chance (Wooldridge, 2020). There are several different tests for this purpose where the literature distinguishes between parametric and non-parametric significance tests. Parametric tests are based on assumptions about the probability distribution of the data, while non-parametric tests do not rely on these assumptions (Wooldridge, 2020). To test the three hypotheses in this study, we will perform a parametric t-test and an OLS regression. In the regression, we will control for other factors that may impact the possible abnormal returns of the chosen indices.

4.5.1 Standardized t-test

The conventional t-test is simple, but one of the most common parametric tests used when testing for nonzero forecast errors in an event period (Collins & Dent, 1984). With the t-test we can test whether the mean of cumulative abnormal returns is significantly different from zero. The statistical formula given by MacKinlay (1997) for this test is shown in the following equation:

$$t = \frac{CAR}{\sqrt{Var(CAR)}} \tag{4.4}$$

This parametric test relies on the assumption that normal returns are normally distributed (Collins & Dent, 1984). Due to the simplicity and assumptions required in the standardized t-test, we will increase the study's validity by performing a regression analysis in addition to the t-test.

4.5.2 Regression

The OLS regression with robust standard errors is included to ensure the robustness of our study. In the regression, we will control for other variables that potentially affect the cumulative abnormal returns in the Norwegian stock market and especially for the selected sectors. We will run the regression in equation 4.5 based on the theory by Wooldridge (2020).

$$CAR_{ij} = \alpha_i + \beta_i \times Controls_{ij} + \varepsilon_{ij} \tag{4.5}$$

Where CAR_{ij} is the cumulative abnormal return for index i during event j. $Controls_{ij}$ represents the control variables we will use, and ε_{ij} is the error term with an expected value of zero and a variance of $\sigma^2_{\varepsilon_i}$. α_i and β_i are parameters estimated by OLS regression. We will test some of the OLS assumptions and discuss these in section 7, and present and discuss the control variables in section 5.

5. Data

In the following chapter, we present the data and explain the choices of the data collection process. First, we describe the dataset used in the event study including financial data, the event sample, and decisions regarding the sample period. Second, we describe the control variables included in the regression and the motivation for choosing these specific control variables. Lastly, we provide an overview with descriptive statistics to show the construction of our data sample.

5.1 Data Collection

5.1.1 Financial Data

To answer the research question, it is necessary to retrieve a substantial amount of financial data from the Norwegian stock market. There are several databases and providers of financial information. We explored Eikon Datastream, Bloomberg Terminal, and Euronext to see where we could get the most appropriate data for our analysis. We needed data from three indices noted at Oslo Stock Exchange from the year 2000 – 2021. Eikon Datastream and Bloomberg Terminal did not have enough historical data for the indices of interest. The Euronext market, which Oslo Stock Exchange is a part of, had the longest time span of historical data. Hence, we retrieved the data needed directly from this database.

Our hypotheses aim to examine both the Norwegian market as one and specific sectors in the Norwegian market. The energy sector in Norway is closely related to natural resources, thereby also affected by climate change. The oil and gas industry relies on non-renewable natural resources and has high carbon emissions. This was essential reasoning as to why we wanted to examine the energy sector closely. In our research, we also want to include a sector that is minimally affected by the climate change. We therefore included the financial sector in our analysis so we could compare two sectors. The market model used to estimate normal performance, as explained in section 4, requires a market index for prediction. We decided to use the Benchmark Index at Oslo Stock Exchange (OSEBX) for this purpose. The Oslo Stock Exchange Benchmark Index represents all shares listed on Oslo Stock Exchange (Oslo Stock Exchange, 2020). It is a weighted index that is rebalanced semi-annually, and it is commonly used as a proxy for the market portfolio. As our research aims to analyze two specific sectors, we decided to examine sector-specific indices. In this way, it will be easier to draw conclusions for specific sectors, as the companies included in the indices belong in the same sector. We obtained historical adjusted closing prices for the four indices: OBX Total Return Index (OBX), OBX Energy GR (OENG), OBX Financials GR (OFING), and Oslo Stock Exchange Benchmark Index (OSEBX). The adjusted closing price is often used when examining historical returns. It considers any factors that might affect the stock price after the market closes, such as stock splits, dividends, and rights offerings (Ganti, 2020). By using the adjusted closing price, we can obtain an accurate record of the indices' performance. We have chosen the gross return (GR) indices as they had the most extended period of historical data.

5.1.2 Event Data Sample Selection

The events in this study are the working group sessions arranged by the climate panel. For any event study it is crucial to identify the correct timing of events, but this timing might be challenging. MacKinlay stresses that when event announcements appear in academic journals or other papers, one cannot be sure if the market was informed before the close of the marketplace on the prior trading day (MacKinlay, 1997, p. 35). Market participants may also act prematurely to announcements they expect. To deal with these issues, a common solution for event studies is to apply an event window as explained in section 4. Nevertheless, it might still be challenging to decide when the event occurred. Concerning our study, the event dates were difficult to identify as the reports are usually published a few days after working group sessions. Such working group sessions typically last for four days and the findings are often finalized with high media coverage. Based on the arguments by MacKinlay (1997), we decided to use the working group sessions as a starting point to identify the event dates. The specific dates of the working group sessions were also easier to identify than the publication dates of the reports. This approach is supported by Rogova et al. (2020), which performed a similar study. They argue that it is best to use the start of the working group sessions as event dates, as there might be leakages from the working groups and media coverage during the sessions (Rogova et al., 2020, p. 7). We agree with this reasoning, and therefore the event dates used in our analysis are the start date of the working group sessions. The event dates and the related reports are presented in Table 5.1.

Table 5.1: Overview of published reports and related events.

Event number	IPCC Report	Working Group Session Start
	3rd Assessment Cycle	
1	TAR Climate Change 2001: The Scientific Basis	17 January 2001
2	TAR Climate Change 2001: Impacts, Adaption and Vulnerability	13 February 2001
3	TAR Climate Change 2001: Mitigation	28 February 2001
	TAR Climate Change 2001: Synthesis Report	No date identified
	Special Report: Carbon Dioxide Capture and Storage	No date identified
4	*Special Report:* Safeguarding the Ozone Layer and the Global Climate System	6 April 2005
5	*Methodology Report:* 2006 IPCC Guidelines for National Greenhouse Gas Inventories	26 April 2006
	4th Assessment Cycle	
6	AR4 Climate Change 2007: The Physical Science Basis	29 January 2007
7	AR4 Climate Change 2007: Impacts, Adaption and Vulnerability	2 April 2007
8	AR4 Climate Change 2007: Mitigation of Climate Change	30 April 2007
9	AR4 Climate Change 2007: Synthesis Report	12 November 2007
10	*Special Report:* Renewable Energy Sources and Climate Change Mitigation	5 May 2011
11	*Special Report:* Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaption	5 November 2011*
	5th Assessment Cycle	
12	AR5 Climate Change 2013: The Physical Science Basis	23 September 2013
13	AR5 Climate Change 2014: Impacts, Adaption, and Vulnerability	25 March 2014
14	AR5 Climate Change 2014: Mitigation of Climate Change	7 April 2014
15	AR5 Synthesis Report: Climate Change 2014	24 October 2014
16	*Special Report:* Global Warming of 1.5°C	1 October 2018
17	*Methodology Report:* 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories	08 May 2019
18	*Special Report:* Climate Change and Land	02 August 2019
19	*Special Report:* The Ocean and Cryosphere in a Changing Climate	20 September 2019
	6th Assessment Cycle	
20	AR6 Climate Change 2021: The Physical Science Basis	26 July 2021

*Non-trading day. Closest trading day before this date (4th November) is used as event date.

The climate panel was established in 1988, and since then they have completed five assessment cycles and delivered five Assessment Reports. The first assessment report was published in 1990, which goes to show that there is a long history of events we could include in our analysis (IPCC, 2021c). As Table 5.1 shows, our event data sample goes back to January 2001. The main reason for excluding events prior to 2001 is data availability for the indices of interest. As mentioned, Euronext provided the most extended period of historical data, where the earliest date was January 2000. This limitation in the financial data affected our sample of events, as we could not examine the stock market reactions to climate panel announcements without financial data. For two of the climate panel reports we were not able to identify the working group sessionn start dates, which further limited our event sample.

For event studies, some issues may arise with event clustering. In the event study methodology event clustering refers to overlapping event windows of the included securities (MacKinlay, 1997, p. 24). In our analysis we do not examine firm-specific news. Instead, we study global announcements which will be general market news. Thus, all indices will have the same event window for each event, as the news is announced simultaneously for each sector. In his article, MacKinlay (1997) describes two ways to handle clustering where the first approach is the one we apply in our analysis. This approach is described as follows: "The abnormal returns can be aggregated into a portfolio … and the security level analysis of Section 5 can be applied to the portfolio." (MacKinlay, 1997, p. 27). We have divided our analysis into three hypotheses which we will test separately. Each hypothesis tests one index – a portfolio of securities listed on Oslo Stock Exchange. In this way, we have handled the potential issue of event clustering so that we allow for cross correlation of the abnormal returns.

Another element to consider in the event data sample is confounding events. This is a crucial part of the event data selection, as the event study methodology attributes the abnormal return to the event examined. McWilliams and Siegel (1997) stated that if other financially relevant events occur during the event window under consideration, it is challenging to isolate the impact of one specific event. Such confounding effects could be declarations of dividends or announcements of unexpected earnings. In our study, relevant confounding events could be an introduction of new regulations, oil price shock, climate discussions, changes in the Norwegian policy rate, or other news of financial relevance for Norway. These are just some examples of relevant confounding events that could impact the index value during the event window of choice. The process of identifying potential confounding events can be challenging, as one must classify which news is relevant confounding events. We have previously discussed how to decide the length of the event window, which is again relevant in conjunction with confounding events. The longer the event window is, the more difficult it is to control for confounding events (McWilliams & Siegel, 1997, p. 634). The way we treated the issue of confounding events was to keep the event window as short as possible – but long enough to capture any effects of leakages or lags in market reaction. In addition, we ran regressions with control variables of some of the possible confounding effects. The control variables will be elaborated on in the next section. Even though we have attempted to control for confounding events, in such a study one cannot be entirely sure that we have been able to capture all confounding effects in our analysis. Hence, it is crucial to address the issue of confounding events in the discussion of the analysis results.

5.2 Control Variables

There will always be multiple factors affecting the returns in the Norwegian financial market. Such factors are often closely related to the business cycles we observe. In short, business cycles are fluctuations found in the aggregate economic activity of nations, typically measured by gross domestic product (Achuthan, 2020). We will not perform a thorough business cycle analysis in this thesis, but we have included factors that considerably affect the Norwegian economy. In our analysis, we perform regressions with some control variables to test if the chosen variables might explain some of the effects on the cumulative abnormal returns. The variables we decided to include in our analysis are the oil price, the Norwegian policy rate, and the Paris Agreement. This section describes and explains why these specific variables were included as controls and where the data is collected.

According to an article published by Statistics Norway, the Norwegian economy is susceptible to changes in the oil price (Cappelen et al., 2014). This is consistent with the fact that the oil industry is a large part of the Norwegian economy. The activity in the oil industry also contributes to ripple effects in other parts of the Norwegian economy. By this reasoning, we found it relevant to control for the oil price in our regressions as the oil price could potentially be a relevant explanatory factor of abnormal returns. We collected historical data for the Europe Brent Spot Price from the U.S. Energy Information Administration (2021), which provides independent and impartial energy information. In the analysis we use the natural logarithm of the oil price. This is for interpretation purposes, as it is common to refer to oil price changes in percentages.

The second control variable we decided to include was the Norwegian policy rate. The policy rate is the interest rate on banks' overnight deposits in Norges Bank, and it is the main instrument for stabilizing inflation and developments in the Norwegian economy (Norges Bank, n.d.). Without going into detail about all the effects of changes in the policy rate, we will explain why we found it relevant to include the policy rate in this analysis. Interest rate levels influence households and businesses' level of money for consumption and investment. Increased policy rate will lower demand for goods and services, which may lead to lower output and fewer jobs (Norges Bank, n.d.). In short, higher interest rates slows down the economy. An increase in the policy rate is typically observed when the economy is doing well. The policymakers seek to set the policy rate at a level where both the economy and inflation are stable. Simultaneously, the policymakers seek to have the possibility of lowering the policy rate, as this is a measure to stimulate the economy during times of low economic growth, such as the Covid-19 pandemic. As explained, the Norwegian policy rate has tremendous implications for the Norwegian economy – including the stock market – and we therefore wanted to include this factor as a control variable in our analysis. We collected historical data of the interest rate level from the Norwegian central bank's official statistics (Norges Bank, 2021).

The last variable of interest included in the regression is the Paris Agreement. We included a time dummy, which corresponds to 1 if the event occurs 12. December 2015 or later, and 0 otherwise. This is the date of which the Paris Agreement was adopted. The Paris Agreement was the first binding agreement to bring all nations into a common cause to undertake efforts to combat climate change (United Nations Climate Change, n.d.). The adaption of this treaty marks a new international dedication to battle climate changes, which might affect the way financial markets treat climate change news. Therefore, we wanted to examine whether the increased focus on actions towards limiting a further increase in temperature could be part of the abnormal returns.

5.3 Descriptive Statistics

This subsection describes the three indices mentioned. The final dataset applied in our analysis consists of 20 events for three indices on Oslo Stock Exchange, as presented in table 5.1. Table 5.2 describes the financial data obtained from Oslo Stock Exchange. We have collected daily adjusted returns for the period and identified minimum and maximum daily returns. We also computed the mean return and the standard deviation of daily returns.

Table 5.2: Descriptive Statistics of Financial Data, 2000-2021

Index	Min return (%)	Mean return (%)	Max return (%)	SD (ret)
OBX Total Return Index	-10.6	0.047	11.6	0.0147
OBX Energy	-19.4	0.049	12.3	0.0177
OBX Financials	-14.4	0.061	17.1	0.0165

Note: The minimum, mean, and maximum values are of the adjusted daily returns in percent. The standard deviations are provided in decimals.

As the table shows, the mean daily returns are close to zero, and there are also some extreme values for both minimum and maximum daily returns. The content of this table is not surprising, as the economy has been exposed to shocks throughout the last 21 years, such as the financial crisis in 2008 or the outbreak of the Covid-19 pandemic. From the table, the three indices appear to be relatively stable as the mean daily returns are close to zero. At the same time there are examples of more extreme days, for instance where OBX Energy yields a daily return of -19.4%.

We have provided tables of the firms listed in the three indices in Appendix 1. Table 5.1 gives an overview of the 20 events included in our analysis. The third column "Working Group Session Start" lists all the event dates.

6. Empirical Analysis

The aim of the empirical analysis is to answer the following research question: *How does the Norwegian stock market react to announcements by the Intergovernmental Panel on Climate Change?* This section contains the empirical analysis we performed using the event study methodology thoroughly described in previous sections. The empirical analysis is divided into two parts. First, we present the results from the event study for each of the three hypotheses. Second, we provide three regression analyses where we include the control variables described in section 5.

6.1 Event study

In this subsection we present the results from the event study conducted. We provide the results of a two-tailed t-test for each of the chosen indices. In each sub-analysis the following null hypothesis will be tested against the alternative hypothesis:

H_0: The cumulative abnormal return is = 0.

H_A: The cumulative abnormal return is ≠ 0.

In the output tables we present different event windows to examine the longevity of the stock market effects. The event windows are shown in square brackets, where number 0 is the event day. Negative values are the number of days prior to the event date, and positive values are the number of days after the event date.

6.1.1 OBX Total Return Index

We start by presenting the results connected to Hypothesis 1: "The OBX Total Return index yields no abnormal returns in the event of a publication by the Intergovernmental Panel on Climate Change". Table 6.1 shows the mean cumulative abnormal returns (CAR) for five different event windows around the time of the working group sessions.

Table 6.1: OBX Total Return Index, t-test results

Event Window	CAR
[-4,4]	-0.000397 (-0.6851)
[-1,1]	-0.00541 (-1.4586)
[-3,0]	**-0.000803**** (-2.2364)
[0,3]	-0,000386 (-1.0167)
[0,1]	-0.00433 (-1.4429)
Observations	20

T-statistics in parentheses. Degrees of freedom: 19. Significance level: *10%, **5% ***1%.

The results show that for most of the event windows, the events do not have a statistically significant effect on the market valuation of the OBX Total Return Index. In the main event window [-4,4], we find a mean cumulative abnormal return of -0.04%, but this is not statistically significant. The only event window with a statistically significant result is the pre-event window [-3,0], which gives a cumulative abnormal return of -0.08% at a 5% level. This could imply that some investors expect the net present value of future profits in the Norwegian market to be reduced due to the upcoming working group session. However, the significant cumulative abnormal return is close to zero. The main results from this analysis are in line with our hypothesis that the OBX Total Return Index yields no abnormal returns in the event of a publication by the climate panel. Based on the t-test, we cannot reject the null hypothesis, as the cumulative abnormal returns are not statistically significant different from zero.

6.1.2 OBX Energy Index

In the following, we will analyze the sector-specific Hypothesis 2: “The OBX Energy index yields negative abnormal return following the announcement of reports by the Intergovernmental Panel on Climate Change”. This is the hypothesis in our study where we expect to see an effect, because of the index exposure to climate change risks. We expect the cumulative abnormal return to be different from zero; hence, we expect to reject the null hypothesis. Table 6.2 presents the mean cumulative abnormal returns for five different event windows around the time of the working group sessions.

Table 6.2: OBX Energy Index, t-test results

Event Window	CAR
[-4,4]	-0.004493 (-0.7547)
[-1,1]	**-0.004593*** (-2.0662)
[-3,0]	-0.001421 (-0.3747)
[0,3]	-0.003707 (-1.1172)
[0,1]	-0.005307 (-0.8712)
Observations	20

T-statistics in parentheses. Degrees of freedom: 19. Significance level: *10%, **5% ***1%.

From Table 6.2 we find no statistically significant cumulative abnormal return on average for any event windows, except for the event window [-1,1]. The main event window [-4,4] observes a mean cumulative abnormal return of -0.45%, but the result is not significant. The shorter event window [-1,1] shows a significant cumulative abnormal return of -0.46% on average, at a 10% significance level. Finding a significantly negative effect when shortening the event window may be because the effect is strongest closest to the event day (0). We have to remember that there is a higher possibility of capturing irrelevant information with a broader event window. The significant results obtained with the event window [-1,1] may suggest that the main event window of our study is too large. If the main event window is too large, other factors may influence the results. Given that the cumulative abnormal return is significantly different from zero for the event window [-1,1] one could be tempted to reject the null hypothesis. However, as the main event window and the three other representative event windows are not significant, we should be careful to do so. Hence, we cannot say that the OBX Energy Index yields cumulative abnormal returns that are different from zero concerning the climate panel's working group sessions. Given Hypothesis 2, this is not what we expected, as we thought OBX Energy would yield abnormal returns different from zero in a negative direction.

6.1.3 OBX Financials Index

This section will assess the results connected to Hypothesis 3: “The OBX Financials Index yields no abnormal returns in the event of a publication by the Intergovernmental Panel on Climate Change”. The results are provided in Table 6.3 The mean cumulative abnormal returns are shown in the right column, where the statistically significant results are marked in bold.

Table 6.3: OBX Financials Index, t-test results

Event Window	CAR
[-4,4]	**-0.012012*** (-3.2649)**
[-1,1]	-0.003984 (-1.1160)
[-3,0]	-0.001220 (-0.4387)
[0,3]	**-0.010786*** (-2.8872)**
[0,1]	**-0.005307* (-1.8843)**
Observations	20

T-statistics in parentheses. Degrees of freedom: 19. Significance level: *10%, **5% ***1%.

For the OBX Financials Index, the analysis provided statistically significant abnormal returns for three of the event windows; [-4,4], [0,3], [0,1]. For the main event window [-4,4] the mean cumulative abnormal return is -1.20% and significant at a 1% level. The cumulative abnormal return during the post-event window [0,3] of -1.08% on average is also significant at a 1% level. The shorter post-event window [0,1], with a mean cumulative return of -0.01%, is significant only at a 10% level. The fact that none of the pre-event windows are statistically significant may indicate that there is little attention in the market regarding the sessions before they start. To draw a conclusion based on the main event window, we can reject the null hypothesis. Based on this result, it is reasonable to assume that the research done by the climate panel may affect the OBX Financials Index. It is also possible that this effect is somewhat lagged, given significant average cumulative abnormal returns for the post-event windows. As the mean is negative in all the significant event windows, it could be said that the OBX Financials yields a negative abnormal return in relation to the publications by the climate panel. This is not what we expected, as we chose this index because we believed it would be a neutral sector in relation to climate risk.

6.2 Regression Analysis

In this section we will present a total of three regression analyses to add to our empirical analysis. We regress the cumulative abnormal return in the main event window for each of the three indices we examine in our hypotheses. Control variables are included in the regression analysis to see whether they can explain parts of the cumulative abnormal returns. In the regressions we gradually add variables to see how it affects the estimated coefficients and their significance. The results will be statistically interpreted in this section. A thorough explanation of the results will be provided in the discussion, linking the findings to relevant theory.

6.2.1 Regression for OBX Total Return Index

Table 6.4 presents the regressions for the OBX Total Return Index in the main event window when adding the control variables oil price, policy rate, and Paris Agreement to the regression.

Table 6.4: Regression for OBX Total Return Index, Main Event Window

	(1)	(2)	(3)
Event Window	[-4,4]	[-4,4]	[-4,4]
ln_OilPrice	0.002225 (1.6604)	**0.003261**** (2.0940)	**0.004094**** (2.2818)
ln_PolicyRate		0.001082 (1.4036)	**0.002042*** (1.8472)
Paris Agreement			0.001436 (0.8733)
Constant (CAR)	-0.009764 (-1.6939)	**-0.015017**** (-2.1679)	**-0.019675**** (-2.3060)
N	20	20	20
r2	0.1658	0.2143	0.2365
F	2.7569	2.3444	2.0747

Robust standard errors. T-statistics in parentheses. Degrees of freedom: 19. Significance level: *10%, **5% ***1%.

The results from the regression of cumulative abnormal returns in the main event window for the OBX Total Return Index give more significant results than the t-test. Regression (2) and (3) show that the cumulative abnormal returns are statistically significant between -1.50% and -1.97%, respectively. By adding the natural logarithm of both the oil price and the Norwegian policy rate the cumulative abnormal return decreases and becomes significant at a 5% level. When adding the Paris Agreement dummy, indicating 1 for the time after the agreement was adopted, the mean cumulative abnormal return is also significant at a 5% level.

The control variable ln_OilPrice is significant at a 5% level in regression (2) and (3). The interpretation of this is that with a 1% increase in oil price we expect the cumulative abnormal return to increase between 0.33 and 0.41 percentage points. Hence, it seems like the oil price explains some of the variation in cumulative abnormal returns for the OBX Total Return Index.

The variable for the natural logarithm of the Norwegian Policy rate, ln_PolicyRate, is significant in regression (3). This indicates that with a 1% increase in the policy rate we expect to observe a 0.20 percentage points increase in the mean cumulative abnormal return.

6.2.2 Regression for OBX Energy Index

Table 6.5 shows the regressions for the OBX Energy Index in the main event window when adding the control variables gradually. The control variables are added in the same order as for the OBX Total Return Index, oil price, policy rate, and Paris Agreement dummy, respectively.

Table 6.5: Regression for OBX Energy Index, Main Event Window

Event window	(1) [-4,4]	(2) [-4,4]	(3) [-4,4]
ln_OilPrice	0.005697 (0.2777)	0.012578 (0.6301)	0.008964 (0.3689)
ln_PolicyRate		0.007184 (0.7883)	0.003017 (0.1898)
Paris Agreement			-0.006232 (-0.3167)
Constant (CAR)	-0.028481 (-0.3163)	-0.063376 (-0.7154)	-0.043163 (-0.3708)
N	20	20	20
r2	0.0103	0.0305	0.0345
F	0.0771	0.4697	0.3621

Robust standard errors. T-statistics in parentheses. Degrees of freedom: 19. Significance level: *10%, **5% ***1%.

The regressions show no significant effect for the OBX Energy Index. The coefficients on oil price and policy rate are positive, as it was in the regression for the OBX Total Return Index. However, as the coefficients are not significant, we cannot say that these variables affect the cumulative abnormal return for the OBX Energy Index. The Paris Agreement dummy is not significant, meaning there is no observed difference before or after the agreement for the energy sector represented by the OBX Energy Index.

The cumulative abnormal return is negative in all regressions, but no significant results mean we cannot reject the null hypothesis for the energy sector. This is in line with the results from the t-test. The OBX Energy Index does not yield abnormal returns different from zero in relation to the climate panel's working group sessions and publications.

6.2.3 Regression for OBX Financials Index

In Table 6.6 the results from the regressions of the cumulative abnormal return for OBX Financials Index during the main event window are presented. For these regressions we start by adding the control variable for the Norwegian policy rate. The reason for this is that we believe the policy rate affects the finical sector to a greater extent than the other control variables included. In regression (2) we include the oil price and for regression (3) the Paris Agreement dummy is also included.

Table 6.6: Regression for OBX Financials Index, Main Event Window

	(1)	(2)	(3)
Event Window	[-4,4]	[-4,4]	[-4,4]
ln_PolicyRate	0.000566 (0.0944)	0.004055 (0.7315)	0.007984 (0.7031)
ln_OilPrice		0.007846 (0.7341)	0.011254 (0.9082)
Paris Agreement			0.005875 (0.3980)
Constant (CAR)	**-0.012478**** (-2.1868)	-0.048391 (-1.0294)	-0.067447 (-1.0817)
N	20	20	20
r2	0.0006	0.0299	0.0391
F	0.0089	0.3925	0.3547

Robust standard errors. T-statistics in parentheses. Degrees of freedom: 19. Significance level: *10%, **5% ***1%.

The regression of cumulative abnormal return where only the policy rate is included as control shows a constant of -1.25% at a 5% significance level. The coefficient on policy rate indicates an increase of 0.06 percentage points in cumulative abnormal return when the policy rate increases by 1%. However, the coefficient on policy rate is not significant, meaning we cannot say that the policy rate influences the cumulative abnormal return in regression (1).

Cumulative abnormal return decreases on average as we include the other control variables in regression (2) and (3), but the cumulative abnormal return is not significant in these regressions. This may be because the cumulative abnormal return is determined by more than the event and the policy rate. When controlling for several factors that affect the OBX Financials Index return, the cumulative abnormal return cannot be said to differ from zero. This means we cannot reject the null hypothesis for the OBX Financial Index based on the regression results, contrary to the results obtained by the t-test.

7. Robustness Analysis

In the following chapter we will conduct additional analyses to control the results obtained thus far. The purpose is to make our conclusions more robust. First, we will perform an OLS regression of cumulative abnormal returns during the other event windows used earlier in this thesis. We will also test the OLS assumptions to see if some of them are violated in our sample. Further, we will briefly discuss the results from the robustness analysis before we compare the results with the main analysis in section 8.

7.1 Regressions for Remaining Event Windows

To ensure that the main event window does not provide a wrong or random result, we will run a regression on the other four event windows used in the t-test. For the analysis shown in the following tables, all the control variables are included at once. We also ran the regression where we included the control variables gradually for these event windows to see if this gave different results. The results from these regressions are mentioned in the summary of empirical analysis.

7.1.1 Regression of Remaining Event Windows for OBX Index

Table 7.1 presents the results from the regression for the OBX Total Return Index on the pre-, post-, and short event windows.

Table 7.1: Regression for OBX Total Return Index, Multiple Event Windows

Event Window	(1) [-1,1]	(2) [-3,0]	(3) [0,3]	(4) [0,1]
ln_OilPrice	0.000197 (0.22)	0.001388 (1.21)	0.001346 (1.13)	0.000175 (0.19)
ln_PolicyRate	-0.000080 (-0.12)	-0.000152 (-0.18)	0.000201 (0.29)	-0.000272 (-0.38)
Paris Agreement	0.000215 (0.19)	-0.001445 (-1.35)	0.000683 (0.85)	0.000426 (0.46)
Constant (CAR)	-0.001268 (-0.29)	-0.006161 (-1.13)	-0.006389 (-1.18)	-0.001053 (-0.23)
N	20	20	20	20
r2	0.0188	0.3122	0.1294	0.0817
F	0.09	2.20	0.69	0.64

Robust standard errors. T-statistics in parentheses. Degrees of freedom: 19. Significance level: *10%, **5% ***1%.

From the regressions, we find no significant coefficients in any of the controlling event windows. As we found significant results for the cumulative abnormal return and the two controls ln_OilPrice and ln_PolicyRate in the main event window for the OBX Total Return Index this is somewhat surprising. The results show that there might be coincidences related to the findings in the main regression analysis, or that our main event window observes irrelevant information.

7.1.2 Regression of Remaining Event Windows for OBX Energy

The following table shows the regression analysis results for the OBX Energy Index for the remaining event windows.

Table 7.2: Regression for OBX Energy Index, Multiple Event Windows

Event Window	(1) [-1,1]	(2) [-3,0]	(3) [0,3]	(4) [0,1]
ln_OilPrice	0.002645 (0.30)	-0.010374 (-0.65)	**0.020561*** (2.06)	0.001236 (0.17)
ln_PolicyRate	0.000534 (0.08)	-0.005355 (-1.08)	-0.000670 (-0.12)	-0.004206 (-0.67)
Paris Agreement	-0.000919 (-0.11)	-0.011927 (-1.26)	-0.001186 (-0.17)	-0.003682 (-0.49)
Constant (CAR)	-0.015941 (-0.36)	0.049656 (0.69)	**-0.089432*** (-1.92)	-0.002531 (-0.07)
N	20	20	20	20
r2	0.0142	0.0701	0.4564	0.0973
F	0.12	0.59	2.15	0.47

Robust standard errors. T-statistics in parentheses. Degrees of freedom: 19. Significance level: *10%, **5% ***1%.

In the former t-test and regressions we found no significant results for the OBX Energy Index, except from the t-test result in the event window [-1,1]. The regression in Table 7.2 finds significant cumulative abnormal return in the post-event window [0,3] of -8,94% at a 10% significance level. In the same event window, the coefficient on the ln_OilPrice is 0,0206 at a 10% level. This indicates an increase in cumulative abnormal return of 2,06 percentage points if the oil price increases by 1% i.e., for a higher oil price we expect a cumulative abnormal return closer to zero.

7.1.3 Regression of Remaining Event Windows for OBX Financials

The last regression is shown in Table 7.3, which presents the results for OBX Financials Index for all remaining event windows.

Table 7.3: Regression for OBX Financials Index, Multiple Event Windows

Event Window	(1) [-1,1]	(2) [-3,0]	(3) [0,3]	(4) [0,1]
ln_PolicyRate	-0.006711 (-0.43)	0.001671 (0.19)	0.007974 (0.54)	0.003217 (0.31)
ln_Oilprice	-0.000825 (-0.06)	0.014209 (1.37)	-0.001514 (-0.09)	0.003764 (0.30)
Paris Agreement	-0.010155 (-0.55)	-0.004257 (-0.40)	0,012359 (0.78)	0.002852 (0.27)
Constant (CAR)	0.007559 (0.10)	-0.061361 (-1.20)	-0.014075 (-0.17)	-0.024518 (-0.40)
N	20	20	20	20
r2	0.0512	0.2666	0.0965	0.0077
F	0.26	1.62	0.63	0.03

Robust standard errors. T-statistics in parentheses. Degrees of freedom: 19. Significance level: *10%, **5% ***1%.

Table 7.3 shows no significant results for any coefficients in the remaining event windows. The t-test showed significant results in the main event window [-4,4] and in the two post-event windows [0,3] and [0,1]. The regressions in the main event window also found some significant effects. However, the findings in the t-test and the regression were relatively limited with minor effects. The robustness analysis indicates that these small effects may not be valid.

7.2 Testing OLS Assumptions

Ordinary Least Squares (OLS) was used to estimate the unknown parameters in the regressions. This regression method builds on five assumptions to hold. In the following subsection we will test the two assumptions we think might be violated in our thesis: multicollinearity and homoscedasticity.

7.2.1 Multicollinearity

We check for multicollinearity to see whether there is a perfect linear relationship among the explanatory variables. If there is such a relationship, the estimated coefficients of the correlated variables will be biased (UCLA, n.d.). This means that it should not be possible to linearly predict one of the explanatory variables in the model in terms of another. If this OLS assumption is violated the regression model is said to have a problem with multicollinearity.

A common method to test whether the regression has a problem with multicollinearity is by reviewing the Variance Inflation Factors in a VIF-test (Studenmund, 2014). The test examines to what extent a given explanatory variable can be explained by the other explanatory variables in the model. The result from the VIF-test performed is provided in Table 7.4.

Table 7.4: VIF-test results

Variable	VIF	1/VIF
ln_OilPrice	4.74	0.2109
ln_PolicyRate	2.79	0.3586
Paris Agreement	2.73	0.3658

Note: VIF values above 5 or 1/VIF values below 0.2 indicate that there might be a problem with multicollinearity in the regression.

A high value of VIF indicates multicollinearity, but there is no official definition of what a "high" value is. Studenmund (2014) uses a rule of thumb to assess the severity of multicollinearity. If the VIF-value is above 5 this indicates a problem with multicollinearity in the regression. From Table 7.5 one can see that the VIF-values are below 5. The VIF-value for oil price is very close to 5, which indicates that there might be a problem with multicollinearity with this variable. However, the value of 5 is just a rule of thumb, and some researchers also use a threshold of 10. By this reasoning, we will still include the oil price in our analyses. Hence, the test does not indicate large problems arising from multicollinearity in the regression analysis.

7.2.2 Homoscedasticity

Homoscedasticity means that the variance of the error terms should be constant, independent of the explanatory variables (Wooldridge, 2013). If this OLS assumption is violated, the model is said to have a problem with heteroscedasticity. In the case of heteroscedasticity, OLS is no longer efficient, as the standard errors will be wrong. We will test this assumption by running a Breusch-Pagan and a White test for the main event window in Stata. The results are presented in Table 7.5. The Breusch-Pagan and White tests examine the following hypothesis:

$$H_0: \sigma_1^2 = \sigma_2^2 = \cdots = \sigma_k^2$$
$$H_A: \sigma_1^2 \neq \sigma_2^2 \neq \cdots \neq \sigma_k^2$$

The null hypothesis says that the error variances are all equal, which is in line with homoscedasticity. The alternative hypothesis states that the error variances are not equal, meaning we have a problem with heteroscedasticity (Breusch & Pagan, 1979).

Table 7.5: Breusch-Pagan and White test

Regression	Breusch-Pagan	White
OBX Index	0.6298	0.7548
OBX Energy Index	0.5686	0.4632
OBX Financials Index	0.2038	0.8337
Degrees of Freedom	1	8

Event window [-4,4]. p-values presented in table. Significance level: 10% if p<0.10, 5% if p<0.05, 1% if p<0.01.

We performed these tests for the main event window in our analysis. As Table 7.5 shows, all p-values are above the limits for significance levels. Hence, we cannot reject the null hypothesis of constant variance. This implies that our model does not have a problem with heteroscedasticity.

7.3 Summary of Empirical Analysis

The analyses on Hypothesis 1 regarding the OBX Total Return Index show varying results. For the main event window [-4,4] we find some significant results in the regression analysis but no significant results in the t-test. The t-test only shows a significant result for the pre-event window [-3,0]. The overall significant results show that we expect a cumulative abnormal return between -0.08% and -1.97%, all at a 5% level. The regressions indicate that the effect on cumulative abnormal return is positive if the oil price or policy rate increases. We expect that the effect on the cumulative abnormal return is between +0.33 and +0.41 percentage points if the oil price increases by 1%. If the policy rate increases by 1% the effect on cumulative abnormal return is estimated to be +0.20 percentage points. The robustness test indicates no significant cumulative abnormal return concerning the working group sessions. When we performed an extra check by adding the control variables gradually for the remaining event windows, we found significant results for the event window [-3,0]. The regression where only the oil price variable was included showed significant cumulative abnormal return of -0.67% at a 5% level. The estimated coefficient on oil price indicates an effect of +0.14 percentage points on cumulative abnormal return if the oil price increases by 1%. The regression where both the oil price and the policy rate are controlled for estimates cumulative abnormal returns of -1.08% and an expected increase of +0.22 percentage points if the oil price increase by 1%. These estimates are significant at a 5% level. In summary, the results are rather ambiguous.

The energy sector is examined through Hypothesis 2, where we expected to see an effect by the research revealed by the climate panel. However, the results are limited. The t-test provides a significant result only in the short event window [-1,1] with a significance level of 10%. This result is small, with a cumulative abnormal return of -0.45% on average. The most prominent result from the analysis on the OBX Energy Index is derived from the robustness regression where all control variables are included. In this regression, the post-event window [0,3] estimates the cumulative abnormal return to be -8.94% at a 10% significance level. The effect of the oil price is also notable; a 1% increase in oil price indicates a 2.06 percentage points increase in cumulative abnormal return at a 10% significance level. The effect of the oil price is again positive, making the cumulative abnormal return less negative as the oil price increases. The results from these analyses are quite ambiguous as well, so it will be challenging to draw conclusions.

For the OBX Financials Index we find most evidence of abnormal returns in the t-test. In this test the main event window and the two post-event windows show significant results. Event window [-4,4] and [0,3] estimates a cumulative abnormal return between -1.08% and -1.20% at a 1% significance level. The event window [0,1] find a small effect on the cumulative abnormal return of -0.01% at a 10% significance level. The regression for the main event window where only the policy rate is included estimates a significant cumulative abnormal return of -1.25% at a 5% level. The initial regressions performed in the robustness analysis gave no significant results. However, if we run the regressions for all event windows by gradually adding control variables, we find some significant results. In event window [0,3] we see the same as for the main event window, the cumulative abnormal return is significant at a 5% level when only controlling for the policy rate. This regression shows a mean cumulative abnormal return of -1.37%. The regression in event window [-3,0], where oil price and policy rate are included as controls, provides a significant cumulative abnormal return of -7.52%. The same regression indicates an effect of +1.67 percentage points if oil price increases by 1%. Both estimates are at a 5% significance level. As we have summarized our findings, we observe that they vary noticeably – it is not easy to conclude.

8. Discussion

In this section we discuss the findings in the analysis and compare the results to previous research on the topic. First, we examine the results obtained for our three hypotheses. Second, we discuss the overall research question: *How does the Norwegian stock market react to reports by the Intergovernmental Panel on Climate Change?*

8.1 Hypotheses Results

8.1.1 OBX Total Return Index

The results for the OBX Total Return Index may indicate that the Norwegian market reacts negatively to news about the climate panel's research, especially in a period of three days prior to the working group sessions. As Rogova et al. (2020) and Chatzivasileiadis et al. (2018) found for the US stock market, it appears as the stock price effect also fades away in the Norwegian market. The Norwegian market may be unable to incorporate the climate change risk in the long-term perspective, as short-termism seems to exist in relation to the risk outlined in the reports. If the market were able to price the risk in a long-term perspective, we would not expect to see any effect of the reports in the later years, as the outline should be old news. Rogova et al. (2020) studied reports until 2014, and the fact that we found some significant results in the period between 2000 and 2021 supports their conclusion that the reports still have the same effect as the years go by. Regarding the efficient market hypothesis, we would have preferred significant results in all event windows and perhaps more extreme values of abnormal returns before we go as far as saying that the Norwegian market is inefficient. However, as mentioned earlier, markets dominated by investors with a short-term perspective will be less efficient than markets where long-term perspectives dominate (CFA Institute, n.d.).

8.1.2 OBX Energy Index

For the energy sector previous studies have shown varying results. These studies show that the energy sector reacts differently to different reports and reacts differently to reports than to regulations. Rogova et al. (2020) found that the energy sector did not experience large abnormal returns in relation to the publications of the reports, nor did it experience abnormal returns caused by regulations. We did not find substantial effects either, except for the robustness analysis for one event window. The sector-specific results from Rogova et al. (2020) show that sectors categorized as medium polluters are more mispriced than high polluting sectors around the time of a publication by the climate panel. An explanation can be that the market is already aware of the climate risk for high polluting sectors – so this can already be priced in the valuation of a big polluter. For medium polluters, climate risk assessment might be more challenging for investors. Thus, the pricing of the future risk of medium polluters is not as straightforward as opposed to large polluters. This might explain that Rogova et al. (2020) found more mispricing for medium polluters than big polluters. As mentioned, the climate panel has released reports since 1990, and the focus on climate change is ever-increasing. For instance, investors have known for a long time that the oil industry has large emissions of greenhouse gases. Thus, the climate panel publications might not affect the big polluters to a large extent. It is reasonable to believe that the OBX Energy Index will be categorized as a big polluter, as the Norwegian energy sector is large on oil and gas. This might explain why we see limited results for the energy sector. Another explanation for why we do not find significant results for the energy sector may be related to the question of who is paying for the regulatory changes made by the government. To some extent, firms can roll over the cost of environmental regulations to the consumers. If so, the regulations might not have the intended effect of penalizing big polluters and rewarding green companies. We will elaborate on this in section 8.2.

8.1.3 OBX Financials Index

After analysing Hypothesis 3, where we look at the effect on the OBX Financials Index, we find significant results in the main event window and event window [0,3] in both the t-test and in some regressions. All significant results showed negative cumulative abnormal returns, indicating that the financial sector is not as neutral towards climate risk as we first expected.

There are several possible explanations for the results obtained in our analysis. Firstly, the financial sector is complex and it is affected through several different channels, such as monetary policy and the general state of the economy. Such factors are difficult to control for in the analysis. We included the policy rate as a proxy for the monetary policy, but this is a simplified approach that might be imprecise. Secondly, we initially assumed that the financial sector has little connection to climate change. This assumption might be wrong, and our results imply that the effect of climate change news on the financial sector is more extensive than we assumed. Another plausible explanation can be that the financial sector loses business opportunities – such as financing industrial and technological projects – when the issue of climate change is brought to attention. Ultimately, there are several possible explanations for why we see negative cumulative abnormal returns in the financial sector that cannot easily be explained.

8.2 Discussion of Research Question

Firstly, we want to remind the reader of the main research question: *How does the Norwegian stock market react to reports by the Intergovernmental Panel on Climate Change?* As shown in previous sections, our results differ substantially across event windows and regressions with control variables. Our results are ambiguous, which makes it challenging to conclude the research question. There might be several reasons to explain why our results are ambiguous. In the following, we will highlight some of these reasons.

We will start by underlining one of the points made by Chatzivasileiadis et al. (2018). Firms in an industry might react differently to climate panel reports, depending on the content of the reports. For instance, Chatzivasileiadis et al. found that firms categorized as energy firms responded negatively to a publication from Work Group I but positively to the findings from Work Group III (Chatzivasileiadis, 2018, p. 4). This shows that the direction of the abnormal return observed in the market is connected to the content of the report and in which industry a firm operates. In addition, we chose to look at data from indices in our study. This induces the possibility that some firms may react positively while other firms react negatively. If this is the case, the positive and negative abnormal returns could even out the total abnormal return of the index. The fact that we chose to look at indices rather than individual firms might explain that we did not uncover clear results of market reactions.

A topic of discussion that might be even more complicated is the discussion of efficient markets and how efficient markets *should* react to the climate panel announcements. The efficient market hypothesis does not state that markets cannot react to new information – it states the opposite. Efficient markets should reflect all relevant information, meaning the market should adjust to new relevant information. There is a possibility that the information from the climate panel reports is leaked in the market long before the start of the working group sessions. In this case, the market would have had the opportunity to adjust to the information presented. Previous research presents differing views on this topic of market reactions. Walsh et al. (2020) outline reasons why an efficient market should respond to climate change information and why the climate panel reports serve as pertinent information to investors. They argue that climate change is a real threat to economic activity as an increase in extreme weather could destroy many companies' premises and make large portions of land nonarable. The authors emphasize the climate panel's role in synthesizing climate change knowledge. They state that "Despite this, we see no reaction in the returns of energy companies to the report" (Walsh et al., 2020, p. 209). As we have mentioned, the climate panel does not conduct its own research, but synthesizes already available research. Some may argue that this is not new information in the market, as investors who follow climate research continuously should not be surprised by the climate panel publications. By this reasoning, the market should not react to the publications. Rogova et al. (2020) also provide an interpretation of this issue. They argue that the climate panel does not only present the climate knowledge at its face value, but also "produce an interpretation for policymakers, offering predictions and courses of action to maintain the status quo" (Rogova et al., 2020, p. 13). This argument goes in the direction that the climate panel reports introduce relevant new information in the market. The research is already available, but the climate panel helps market participants understand what the research means for the future. We comply with this reasoning, and thus we argue that the climate panel reports should be interpreted as new information in the market.

The next question in line is whether the Norwegian stock market should react to the announcements of the climate panel studied in this thesis. A stock market reaction will typically follow if the information presented implies changes in future operations for businesses. The market valuation of firms is based on investors' view of potential future earnings. In essence, the question of interest is whether the climate panel reports convey pertinent information to investors. Some investors might be skeptical to the research and future scenarios portrayed in the reports. In addition, it is not a given that firms see the need for any changes in the foreseeable future after the publication of reports. It might be that the climate panel reports do not induce enough forward guidance for investors to react particularly to the information conveyed. Rogova et al. provide an interesting reflection on this perspective: "However, over the last 24 years, the climate panel reports may have reiterated the same message: that the world needs to decarbonize and that the so-called tipping point of the new climate environment is ever more imminent" (Rogova et al., 2020, p. 4). According to this statement, the Norwegian market might be saturated with climate change information already, and investors do not see the need to react to yet another climate panel report. Announcements of a more tangible kind that could affect firms' future earnings are environmental regulations induced by governments. The climate panel reports are of informative nature, unlike regulations which are more binding and have a direct impact. Such regulations could for instance be taxes on greenhouse gas emissions. Environmental regulations typically target the biggest polluters, but as we presented in the literature review, environmental policies are not always successful. Industries can often pass on the extra cost of environmental regulations to consumers, leaving the firms' profitability unaffected by the policies (Ramiah et al., 2013, p. 1752). If a firm's profitability is unaffected, the market reactions will not be too noticeable either, as investors' future earnings will be relatively unaffected.

As this discussion around the main research question shows, it is not easy to conclude what is right. Our results are ambiguous, but what does this imply? It is challenging to decide whether this points towards an efficient or an inefficient market. The answer boils down to how the market should interpret the information in the report. Is it new information to investors, or should the information already be priced in the market? To wrap up this discussion, we can say that if we observe abnormal returns around every event, this implies that the market has not been able to price in the climate change risk previously. If abnormal returns are recurring for every climate panel report, investors can time their investments to make abnormal profits around these events. That would imply an inefficient market. We see some results of this in all three indices, but the tendency is surprisingly most remarkable for the OBX Total Return Index and the OBX Financials Index. The most extreme negative abnormal return is found for the OBX Energy Index, but the results from the various analysis are very conflicting for this index. However, our results do not imply that the Norwegian stock market shows such an inefficiency.

9. Critical Assessment

In this section we want to stress that the findings from our analysis should be carefully interpreted based on the limitations of the study. The components of an event study come with a set of assumptions and decisions. Thus, the results obtained can be viewed as an approximation of reality, and one should be aware of the limitations of the analysis to draw reliable conclusions. Firstly, we will evaluate the limitations of our sample. Secondly, we will elaborate on the inherent limitations of the event study methodology applied in our thesis.

9.1 Limitations of the Sample

The first limitation of the sample is the sample size. As mentioned, the first report was published by the climate panel in 1990. Optimally we would prefer to examine all reports available. However, due to the limitations of the historical data on Oslo Stock Exchange we were only able to collect stock market data back to January 2000. This limitation has reduced the possible size of our dataset noticeably. A small sample size will lack a high number of degrees of freedom, which might lead the t-statistic to be invalid. A larger sample could give more reliable results and more significant test statistics. In addition to this, we only studied three indices on Oslo Stock Exchange. This might be too small of a sample to say enough about the Norwegian stock market in general – which is what the research question is concerning.

Another limitation of the data collecting process was that we were unable to find a reasonable way to separate big polluters from small polluters. The result was that we analyzed indices based on assumptions of total emission contribution. We assumed that the OBX Energy Index in total was a big polluter, as opposed to OBX Financials Index as a small polluter. This is not necessarily the case, and the chosen indices might not be the best representatives for "big polluters" and "small polluters". This is an issue we briefly discussed previously in the thesis. To deal with this problem, we could have studied the greenhouse gas emissions of each firm in an index and categorized the firms in portfolios based on the level of greenhouse gas emissions. This might have been a better approach in some ways, but it would also induce problems. Data on the level of greenhouse gas emissions is difficult to obtain back to 2001 for all firms. In addition, it could make human error more prominent as the classification and information collecting process would have to be done manually.

9.2 Inherent Limitations of the Methodology

The event study methodology requires the researcher to make several decisions, such as length of the estimation window, the definition of the event window, choice of normal performance model, and which explanatory variables to include. All these choices are likely to affect the result of the analysis. Hence, it is crucial to address these potential issues when interpreting the results.

In the analysis we examine abnormal returns. To calculate abnormal returns, we first need to estimate normal performance. The calculation of normal performance is based on two main assumptions: dating of estimation window and normal performance model. When we decided the length of the estimation window our decisions were based on the research by MacKinlay (1997). It is crucial that the estimation window observe a period that is as normal as possible without any shocks or crises such as the outbreak of Covid-19. We have done our best to identify the most critical events in the global economy over the estimation windows to make sure the estimation of normal return is representative. In our study, the two most prominent events identified were the financial crisis of 2008 and the strike of the Covid-19 pandemic in 2020. We have ensured that none of these events are included in any estimation window. Although we have omitted these events from the estimation windows, there is a possibility that other critical events could be captured in the estimation windows. In addition, the choice of normal performance model could affect the calculation of normal performance. There are several pricing models in financial theory, which all have their strengths and weaknesses. We chose the market model, which we motivated in section 4. Even though empirical evidence shows little difference between the various models, there is a risk that the market model is not the best for our sample. Here we want to stress that every estimation model is just an approximation of reality, it cannot resemble reality perfectly.

Another essential part of the event study methodology is deciding the event date and the length of the surrounding event window, which was explained in section 4. MacKinlay states that in cases where the event date is difficult to identify, or the market partially anticipates the event date, the event study methodology might be challenging (MacKinlay, 1997, p. 37). In our study, the event dates were quite challenging to assess, even though we based our final decisions on MacKinlay's study (1997) and the study of Rogova and Aprelkova (2020). There is a possibility that our event dates are not correctly defined. To cope with this, we introduced event windows of various lengths, but there is no guarantee that the chosen event windows capture the effect of the events. The event dates are also connected to the issue of confounding events, as mentioned in section 5.1. As confounding events were identified manually there is a risk that there are confounding events we failed to observe. The process of identifying confounding events was challenging in this study, as we had to consider both international events and Norwegian events that could potentially impact the result of our analysis. However, despite the mentioned limitations and weaknesses, the event study is widely accepted and often applied in empirical analysis.

10. Conclusion

In this last section, we will answer our research question by providing a summary of the main results of the analysis in light of the discussion. Finally, we assess topics of interest for further research regarding stock market reactions to climate panel announcements. In this conclusion we will focus on the results from the main event window [-4,4]. The main event window was defined according to MacKinlay's event study methodology. The extra event windows were added to examine different effects and the longevity of events.

10.1 Conclusion of the Research Question

Our thesis examines the impact of climate panel announcements on the Norwegian stock market by answering the following research question: *How does the Norwegian stock market react to reports by the Intergovernmental Panel on Climate Change?* To answer the research question, we performed an event study including 20 events on a sample of three indices listed on Oslo Stock Exchange.

The results from our analyses of the three different hypotheses are ambiguous, which makes it challenging to conclude. The OBX Total Return Index, which we used as a proxy for the Norwegian stock market, showed statistically significant cumulative abnormal returns only in the regression where we included control variables. For the simple t-test, the cumulative abnormal return was approximately equal to zero and statistically insignificant. The results from the regressions implies that the OBX Total Return Index yields negative abnormal returns between -1.50% and -1.97% in the main event window. The effects of the oil price and the policy rate are small, but positive. This finding implies that one should control for additional variables when analyzing the cumulative abnormal returns, as oil price and policy rate can explain some of the cumulative abnormal returns.

The analyses of the OBX Energy Index shows a cumulative abnormal return of -0.4% when we do not include any control variables. When adding the control variables, the estimated cumulative abnormal return was -4.3%. However, none of these results were statistically significant. Thus, we cannot state that there is an effect of the events on the OBX Energy Index. The analyses of the OBX Financials Index resulted in a cumulative abnormal return of -1.20% in the t-test. When controlling for the policy rate the regression resulted in a cumulative abnormal return of -1.25%. Both of these results are statistically significant. This implies that the financial sector is affected negatively by the events, but we still have to remember that other factors might affect these cumulative abnormal returns.

To summarize our findings in light of our research question, the Norwegian stock market seems to generate negative abnormal returns in conjunction with the reports by the climate panel. As mentioned, we used the OBX Total Return Index as a proxy for the Norwegian stock market. The cumulative abnormal returns for this index are between -1.50% and -1.97% over the main event window. However, the conclusion should be viewed in the context of our ambiguous results.

10.2 Suggestions for Future Research

A reasonable continuation of our research would be to include other events connected to climate change that might affect the stock market. During the writing of this thesis, the 2021 United Nations climate change conference (COP26) took place in Glasgow. The climate change conference received extensive media coverage in the Norwegian news, which implies that this was an event of great public interest. The climate change conferences can impact international environmental policies and regulations, such as the Paris Agreement, which was agreed upon during the COP21 summit in Paris. It could give meaningful insight to conduct a similar study with the climate conferences as events instead of, or in addition to, the working group sessions.

Another topic of interest would be how the stock market reacts to environmental regulations implemented. In the literature review we presented various articles that have addressed environmental regulations. Rogova and Aprelkova (2020) compared stock market reactions to climate panel publications, to stock market reactions to implementation of new regulations. It could be interesting to look at the taxation of emissions, such as carbon tax or oil tax, and analyze stock market reactions to increased environmental taxes. We briefly mentioned that changes in regulations often follow research by the climate panel. Thus, this is a logical continuation of our research.

The topic of climate change will probably be relevant in many years to come. Even though it is nearly three decades since the first publication by the climate panel, the reports still seem to be of great public interest. This means that further research on the connection between climate change and stock markets will be relevant.

References

Achuthan, L. (2020, October). *Business Cycle*. Retrieved 2021 November, from Investopedia: https://www.investopedia.com/terms/b/businesscycle.asp

Breusch, T., & Pagan, A. (1979, September). A Simple Test for Heteroscedasticity and Random Coefficient Variation. *Econometrica, 47*(5), pp. 1287-1294. Retrieved from https://www.jstor.org/stable/1911963

Cappelen, Å., Eika, T., & Prestmo, J. (2014). Virkninger på norsk økonomi av et kraftig fall i oljeprisen. *Økonomiske analyser*(3), pp. 31-41. Retrieved November 2021, from https://www.ssb.no/nasjonalregnskap-og-konjunkturer/artikler-og-publikasjoner/_attachment/180823?_ts=14662dc53a8

CFA Institute. (n.d.). *Short-Termism*. Retrieved October 2021, from CFA Institute: https://www.cfainstitute.org/en/advocacy/issues/short-termism#sort=%40pubbrowsedate%20descending

Chatzivasileiadis, T., Tol, R. S., Estrada, F., & Hofkes, M. W. (2018). The stock markets' reflection on the IPCC's findings. *University of Sussex Economics*.

Cohen, M., Fenn, S., & Konar, S. (1997, January). *Environmental and Financial Performance: Are They Related?* Retrieved from Research Gate: https://www.researchgate.net/publication/251170815_Environmental_and_Financial_Performance_Are_They_Related

Collins, D. W., & Dent, W. T. (1984). A Comparison of Alternative Testing Methodologies Used in Capital Market Research. *Journal of Accounting Research, 22*(1), 38.

Dowell, G., Hart, S., & Yeung, B. (2000). Do Corporate Global Environmental Standards Create or Destroy Market Value? *Management Science, 46*(8), pp. 1059-1074. Retrieved from doi.org/10.1287/mnsc.46.8.1059.12030

Downey, L. (2021, March). *Efficient Market Hypothesis*. Retrieved October 2021, from Investopedia: https://www.investopedia.com/terms/e/efficientmarkethypothesis.asp

Euronext. (2021). *Welcome to Oslo Børs!* Retrieved October 2021, from Euronext: https://www.euronext.com/en/markets/oslo

Fama, E. F. (1970, May). Efficient Capital Markets: A Review of Theory and Empirical Work. *The Journal of Finance, 25*(2), pp. 383-417.

Ganti, A. (2020, December 28). *Adjusted Closing Price*. Retrieved November 2021, from Investopedia: https://www.investopedia.com/terms/a/adjusted_closing_price.asp

Hayes, A. (2021, May). *What Is Behavioral Finance?* Retrieved October 2021, from Investopedia: https://www.investopedia.com/terms/b/behavioralfinance.asp

IPCC. (2021a). *AR6 Synthesis Report: Climate Change 2022.* Retrieved from IPCC: https://www.ipcc.ch/report/sixth-assessment-report-cycle/

IPCC. (2021b). *About the IPCC*. Retrieved October 2021, from IPCC: https://www.ipcc.ch/about/

IPCC. (2021c). *History of the IPCC*. Retrieved November 2021, from IPCC: https://www.ipcc.ch/about/history/

IPCC. (2021d). *Reports*. Retrieved November 2021, from IPCC: https://www.ipcc.ch/reports/

MacKinlay, A. C. (1997, March). Event Studies in Economics and Finance. *Journal of Economic Literature, 35*(1), pp. 13-39.

McWilliams, A., & Siegel, D. (1997, June). Event Studies in Management Research: Theoretical and Empirical Issues. *The Academy of Management Journal, 40*(3), pp. 626-657. Retrieved from http://www.jstor.org/stable/257056?origin=JSTOR-pdf

Norges Bank. (2021, November). *Interest rates*. Retrieved 2021 November, from Norges Bank: https://www.norges-bank.no/en/topics/Statistics/Interest-rates/

Norges Bank. (2021, November). *Policy rate daily observations*. Retrieved November 2021, from Norges Bank: https://www.norges-bank.no/en/topics/Statistics/Interest-rates/Key-policy-rate-daily/

Norges Bank. (n.d.). *Knowledge Bank*. Retrieved November 2021, from Norges Bank: https://www.norges-bank.no/en/knowledge-bank/the-policy-rate/how-does-the-policy-rate-influence-the-economy-and-inflation/

Norges Bank. (n.d.). *The policy rate*. Retrieved November 2021, from Norges Bank: https://www.norges-bank.no/en/topics/Monetary-policy/Policy-rate/

Okereke, C., Wittneben, B., & Bowen, F. (2012). *Climate Change: Challenging Business, Transforming Politics*. Retrieved 2021 September, from https://doi.org/10.1177/0007650311427659

Oslo Stock Exchange. (2020, January). *Oslo Børs - Equity Indices - Index Methodology.* Retrieved November 2021, from Oslo Stock Exchange: https://www.oslobors.no/content/download/125721/2153467/file/2017-08-01%20Index%20Methodology%20-%20Equities.pdf

Pham, H. (2019, November 24). The Effects of Environmental Regulation on the Singapore Stock Market. *Journal of Risk and Financial Management*(12). Retrieved from https://www.mdpi.com/1911-8074/12/4/175

Ramiah, V., Martin, B., & Moosa, I. (2013, January). How does the stock market react to the announcement of green policies? *Journal of Banking & Finance, 37*(5), pp. 1747-1758. Retrieved from https://doi.org/10.1016/j.jbankfin.2013.01.012

Regjeringen. (2020, November 11). *Det grønne skiftet i Norge*. Retrieved from Regjeringen.no: https://www.regjeringen.no/no/tema/klima-og-miljo/klima/innsiktsartikler-klima/gront-skifte/id2076832/

Ritter, J. R. (2003). Behavioral Finance. *Pacific-Basin Finance Journal, 11*(4), pp. 429-437. Retrieved from https://doi.org/10.1016/S0927-538X(03)00048-9

Rogova, E., & Aprelkova, G. (2020). The Effect of IPCC Reports and Regulatory Announcements on the Stock Market. *Sustainability, 17*, pp. 1-17.

Studenmund, A. (2014). *Using Econometrics: A Practical Guide* (Vol. 6). Pearson Education.

U.S. Energy Information Administration. (2021, November). *Petroleum & Other Liquids*. Retrieved November 2021, from EIA: https://www.eia.gov/dnav/pet/hist/RBRTED.htm

UCLA. (n.d.). *Regression With Stata Chapter 2 - Regression Diagnostics*. Retrieved 2021 November, from UCLA Institute for Digital Research & Education: https://stats.idre.ucla.edu/stata/webbooks/reg/chapter2/stata-webbooksregressionwith-statachapter-2-regression-diagnostics/

United Nations. (2021, August 9). *Meetings Coverage and Press Releases*. Retrieved from United Nations: https://www.un.org/press/en/2021/sgsm20847.doc.htm

United Nations Climate Change. (n.d.). *The Paris Agreement*. Retrieved from United Nations Climate Change: https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement

Walsh, J., & O'Riordan, A. (2020). Financial Markets and Climate News: Evidence of Short-Termism? *Student Economic Review, 34*, pp. 201-213. Retrieved from https://www.tcd.ie/Economics/assets/pdf/SER/2020/15financial_markets_and_climate_news_evidence_of_short_termism.pdf

Wooldrigde, J. M. (2020). *Introductory Econemetrics A Modern Approach* (Vol. 7). Cengage Learning.

World Economic Forum. (2021). *The Global Risks Report 2021, 16th edition.* World Economic Forum. Retrieved from http://www3.weforum.org/docs/WEF_The_Global_Risks_Report_2021.pdf

Appendix

Appendix 1: Companies in the Indices

Table A 1: OBX Total Return Index, Overview of firms – September 2021

Company	ICB Subsector	Weight
Adevinta	Consumer Services	2.94%
Aker	Diversified Financial Services	1.18%
Aker BP	Oil: Crude Producers	2.35%
Bakkafrost	Farming, Fishing, Ranching and Plantations	2.78%
DNB Bank	Banks	14.20%
Equinor	Integrated Oil and Gas	19.39%
Frontline	Marine Transportation	0.52%
Gjensidige Forsikring	Full Line Insurance	2.96%
Golden Ocean Group	Marine Transportation	0.70%
Kahoot!	Education Services	1.37%
MOWI	Farming, Fishing, Ranching and Plantations	7.02%
MPC Containter Ship	Marine Transportation	0.46%
NEL	Renewable Energy Equipment	1.45%
Nordic Semiconductor	Semiconductors	3.48%
Norsk Hydro	Aluminum	6.73%
Orkla	Food Products	4.60%
REC Silicon	Speciality Chemicals	0.28%
Salmar	Farming, Fishing, Ranching and Plantations	2.62%
Scatec	Renewable Energy Equipment	1.48%
Schibsted ser. A	Consumer Digital Services	2.49%
Storebrand	Life Insurance	2.99%
Subsea 7	Oil Equipment and Services	1.31%
Telenor	Telecommunications Services	7.08%
Tomra Systems	Machinery: Industrial	4.14%
Yara International	Fertilizers	5.49%

Table A 2: OBX Energy Index, Overview of firms – November 2021

Company	**ICB Subsector**
Akastor	Oil Equipment and Services
Aker BP	Oil: Crude Producers
Aker Carbon Capture	Oil Equipment and Services
Aker Solutions	Oil Equipment and Services
Archer	Oil Equipment and Services
Awilco Drilling	Offshore Drilling and Other Services
Borr Drilling	Oil Equipment and Services
BW Energy Limited	Oil: Crude Producers
BW Offshore Limited	Oil Equipment and Services
DNO	Oil: Crude Producers
DOF	Oil Equipment and Services
Eidesvik Offshore	Oil Equipment and Services
Electromagnetic Geoservices	Oil Equipment and Services
Equinor	Integrated Oil and Gas
Havila Shipping	Oil Equipment and Services
Interoil Exploration and Production	Oil: Crude Producers
Magnora	Renewable Energy Equipment
Magseis Fairfield	Oil Equipment and Services
NEL	Renewable Energy Equipment
Northern Drilling	Oil Equipment and Services
Northern Ocean LTD	Oil Equipment and Services
Norwegian Energy Company	Oil: Crude Producers
Oceanteam	Oil Equipment and Services
Odfjell Drilling	Oil Equipment and Services
OKEA	Oil: Crude Producers
Panoro Energy	Oil: Crude Producers
Petrolia	Oil Equipment and Services

Company	ICB Subsector
PGS	Oil Equipment and Services
Questerre Energy	Oil: Crude Producers
RAK Petroleum	Oil: Crude Producers
Reach Subsea	Oil Equipment and Services
Scana	Oil Equipment and Services
Scatec ASA	Renewable Energy Equipment
S.D. Standard Drilling	Oil Equipment and Services
Seabird Exploration	Oil Equipment and Services
Seadrill	Oil Equipment and Services
Shelf Drilling	Oil Equipment and Services
Siem Offshore	Oil Equipment and Services
Solstad Offshore	Oil Equipment and Services
Subsea 7	Oil Equipment and Services
TGS ASA	Oil Equipment and Services

Table A 3: OBX Financials Index, Overview of firms - November 2021

Company	**ICB Subsector**
ABG Sundal Collier	Asset Managers and Custodians
Aker	Diversified Financial Services
Arendals Fossekompani	Diversified Financial Services
Axactor	Diversified Financial Services
B2Holding	Consumer Lending
DNB Bank	Banks
Gjensidige Forsikring	Full Line Insurance
INSR Insurance Group	Property and Casualty Insurance
Komplett Bank	Banks
Pareto Bank	Banks
Protector Forsikring	Full Line Insurance
SBanken	Banks
Sparebank 1 SR-BK	Banks
Storebrand	Life Insurance
Treasure	Diversified Financial Services
Voss Veksel- og Landmandsbank	Banks