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# Stock Market Reactions to Firm-Specific ESG News

*An empirical analysis of the effect of positive and negative firm-specific ESG news on stock market returns and trading volume at the Oslo Stock Exchange*

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# Abstract

This empirical analysis investigates the effect of firm-specific ESG news on daily stock returns and trading volume in the period 2010-2020, and seek to examine whether non-financial ESG news is valuable for investors. We use a sample of the 25 companies in the OBX-Index at the Oslo Stock Exchange as of January 2020. The news data is manually collected from Infomedia's monitoring portal and consists of 107 positive and 225 negative ESG news from DN.no and E24.no. The event study methodology is conducted to detect abnormal returns and trading volume in short-term event windows around the news publications.

No significant results are found in the case of positive ESG news, neither on the event day (0) nor the surrounding days. Thus, this study fails to link positive ESG news to stock market returns. However, our findings provide evidence for negative abnormal returns to negative ESG news on the event day (0) at the 1% level, with an average abnormal return of -0.29%. This finding is in line with our hypothesis, stating that negative ESG news has a significant negative effect on abnormal returns. No significant results are found on the day prior to the negative news and in the two following days, which indicates that the market adjusts rapidly to this information. Furthermore, average abnormal trading volume is only found the day after the publication of positive news (+1), at -0.08% and statistical significance at the 5% level. We do not uncover any abnormal trading volume from negative news.

In broader terms, this study investigates investor behavior after the publication of ESG news and finds asymmetric impacts of positive and negative news. Overall, our findings suggests that investors do not reward positive ESG behavior but penalize negative ESG behavior.

***Keywords:*** Corporate social responsibility (CSR), ESG-investing, news, event study, abnormal returns (AR), abnormal volume (AV), the Oslo Stock Exchange (OSE)

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# 1 Introduction

## 1.1 Background and Motivation

In 2015, the UN adopted a number of international sustainability goals as a tool in the work to eradicate poverty, combat inequality and stop climate change by 2030 (FN, 2021). The Paris Agreement was adopted the same year, which is an international treaty with the long-term goal of limiting global warming (United Nations, n.d.). The financial sector plays an important role in order to meet these targets, and in Europe the European Union is a major driver for sustainable finance. While reporting practices on sustainability so far have been voluntary, the EU taxonomy for sustainable finance is planned by the end of 2021. This classification system of sustainable activities will provide investors with information on sustainability, with mandatory reporting requirements for large corporations in the EU. The awareness of these global issues has also increased the focus on incorporating environmental, social and governance (ESG) factors into investment decisions and risk management. This shift is consistent with the 2018 SRI Study, noticing a positive trend in Europe for sustainable investing between 2013 and 2019, among both retail and institutional investors (Eurosif, 2018). However, the lack of mandatory regulations makes it challenging to obtain reliable information on a company's ESG performance, which makes the news media an important source of information. In this thesis, we study whether the increased focus on ESG is reflected in financial markets, by examining stock price and trading volume behavior around the publication of ESG news.

Whereas the importance of ESG news has been studied in foreign markets, the Norwegian stock market has received little attention. According to the European SRI Study (2018), the Norwegian financial industry has historically been considered at the forefront of socially responsible investing, partly due to the ethical investment strategy by the Norwegian Government Pension Fund. This makes the Norwegian stock market interesting to study. To the best of our knowledge, no prior studies have examined the impact of ESG news on the Norwegian stock market, hence this study contributes to uncover the importance of ESG in Norway.

## 1.2 Research Question and Methodology

Based on the background and motivation, this thesis is represented with the following research question:

*How do firm-specific ESG news affect stock market returns and trading volume at the Oslo Stock Exchange?*

The research question is addressed by performing a multiple event study, which aims to measure the impact of events in financial markets by testing for significant abnormal returns and trading volume. In event studies, the efficient market hypothesis (EMH) is an assumption which states that all available information, such as news, is reflected in the stock price of a company. We investigate the effect of firm-specific ESG news with a sample of 25 companies at the Oslo Stock Exchange in the period 2010-2020. We hypothesize that the stock price reactions will be positive after the publication of positive ESG news and negative after negative news. Moreover, we hypothesize that the ESG news leads to abnormal trading volume.

This study contributes to the existing literature on the importance of the ESG factors in the financial markets. In a broader sense, we are hoping to gain a better understanding of whether investors value the information from ESG news. If so, this contradicts the classical view that profit maximization is the only responsibility of firms. As a result, this research may be of interest for companies, investors and other stakeholders. Both institutional and retail investors can have a big impact on corporations' strategies, and if investors favor companies with high ESG performance over companies with poorer performance, this can influence corporations to improve the footprint they leave in the world.

## 1.3 Structure

The thesis is structured in the following way: **Chapter 2 ESG - Environmental, Social and Governance** presents a definition of ESG investing and an overview of the three factors. **Chapter 3 Theoretic Framework and Literature Review** presents relevant economic theory and previous literature that has been conducted on the topic of ESG. **Chapter 4 Methodology** is about the event study methodology in general and the chosen approach in this thesis. **Chapter 5 Data** presents the data collecting and processing for the event study. **Chapter 6 Hypothesis Development** presents the three hypotheses of the analysis. In chapter **7 Empirical**

**Results and Discussion** we provide the results and following discussion in light of previous research and the theoretic framework. Finally, in chapter **8 Concluding Remarks**, we summarize the findings and conclude. The thesis ends with limitations to the study and suggestions for further research on this topic.

# 2 ESG – Environmental, Social and Governance

## 2.1 ESG Investing

Today, many investors are not only interested in the financial performance of their investments, but also focus on the impact the investments can have on global and societal issues. The many terms to describe such investment strategies are used interchangeably, as for instance socially responsible investing (SRI), impact investing and ESG investing. MSCI defines ESG investing as "the consideration of environmental, social and governance factors alongside financial factors in the investment decision-making process" (MSCI, n.d.). There is a variety of approaches to ESG investing, such as ESG integration, positive screening, negative screening and active ownership (MSCI, n.d.). ESG integration is reported as the most popular approach in 2020 (Statista, 2021). This strategy entails systematic inclusion of the ESG risk factors into the investment process, with the intention to enhance long-term risk-adjusted returns (MSCI, n.d.). Thus, incorporating ESG enhances traditional financial analysis by adding the risk and opportunities of the three factors.

Three important drivers to explain the increased interest for ESG investing are global sustainability challenges, change in investor demographics and improvements in data and analytics on ESG (MSCI, n.d.). The investor demographic changes are related to the increasing percentage of millennials and women participating in the stock market, who typically demand more from the companies they invest in. This is consistent with research suggesting that investment behavior and preferences are driven by demographic factors, of which women and younger persons, persons with higher income and persons with higher education see greater benefits of socially responsible investing and are therefore more likely to practice it (Nilsson, 2008; Cheat et al., 2011; Berry & Junkus, 2013).

Amel-Zadeh and Serafeim (2017) investigate the motives behind ESG investing with a survey on why and how investors use ESG information. They find that the most frequent motivation for using ESG data is the expectation of improved investment performance, followed by change and ethical issues. Another survey from Aon (2020) also finds that investors' primary objective of ESG investing is the belief that it will lead to better investments, while the second largest objective is the desire to impact global issues. This belief among investors that ESG will lead to better investment performance have conflicting support in empirical research, as discussed in the literature review in section 3.

## 2.2 The ESG Factors

MSCI has developed a key issue framework, which highlights the most important ESG factors. This is used as a pointer in the selection of firm-specific ESG news. The following table presents the three ESG factors and subcategories.

**Table 1:** The ESG Factors

| ENVIRONMENTAL | SOCIAL | GOVERNANCE |
|---|---|---|
| Climate change | Human capital | Ownership management |
| Natural resources | Product responsibility | Corporate governance |
| Pollution and waste | Stakeholder oppositions | Corporate behavior |
| Environmental possibilities | Social possibilities | |

***Note:*** *The table shows the three ESG factors and subcategories from the framework by MSCI that will be used to find relevant news articles of the selected companies.*

The first pillar, environmental, includes environmental issues such as climate change, natural resources and pollution, as well as environmental opportunities. These factors are centered on negative and positive externalities that occur from company operations. The second pillar, social, involves the social responsibility of companies, for their employees and the local societies in which they operate. The last pillar, governance, involves transparency for stakeholders as well as ethical issues such as corruption. Some investors focus on the financial materiality of the ESG factors, where they for example do not value charitable giving, while other include non-material factors because it is considered "the right thing to do".

Ratings are often used to study the importance of ESG, but there has been a lack of official ESG standards. ESG ratings are now provided by most leading credit analysis agencies such as Standard & Poor's, Moody's and Fitch. However, variations in ratings for the same company between agencies raise concerns about their usefulness. There has also been a lack of available ratings of companies in Norway. Other sources of information on ESG include index inclusions and the news media. Newspapers can report extreme ESG events such as oil spills, accidents and frauds, and also smaller events such as charitable giving by corporations.

## 2.3 Geographical Differences

There are differences across continents and countries in the embracement of ESG and SRI practices. Duuren et al. (2016) reveal that there is a substantial difference between U.S. and European asset managers, where European managers are more optimistic about the benefits of socially responsible investing in terms of financial performance. According to Auer and Schuhmacher (2016), Europe has the highest rated companies on average in terms of environmental and social performance, whereas the United States has the highest rated companies in terms of governance performance. Moreover, they find that value driven investors have to sacrifice financial performance when practicing responsible investing in Europe.

When it comes to the Nordic region, Norway is considered as a pioneer of socially responsible investing. Scholtens and Sievänen (2013) examine the drivers of SRI in the Nordic countries, and reveals that Norway has the largest SRI market both in relative and absolute terms and clearly stands apart from the other Nordic countries. Moreover, they find that SRI in Norway has by far the largest share of norm- and value-based investments. The authors claim that Norwegian SRI is strongly driven by the practices of the Government Pension Fund of Norway, which serves as a role model for responsible investors worldwide. In comparison to the other Nordic nations, institutional investors are the largest in Norway in terms of SRI, partly due to this fund.

# 3 Theoretic Framework and Literature Review

## 3.1 The Efficient Market Hypothesis

The efficient market hypothesis (EMH) is one of several assumptions in event studies. In the event study framework of MacKinlay (1997), he states that "the usefulness of such a study comes from the fact that, given rationality in the marketplace, the effects of an event will be reflected immediately in security prices". EMH states that stock prices fully reflect all available information at any time and distinguishes between three forms of market efficiency: weak, semi-strong and strong form (Fama, 1970). The event study methodology assumes that capital markets are semi-strong efficient, suggesting that all publicly available information is reflected into the price of a security. With the assumption of semi-strong efficiency, and that the news contributes to new information of the securities, there should be immediate stock price reactions if investors value the information.

EMH is linked to the random walk hypothesis, suggesting that all subsequent price changes represent random departures from previous prices (Malkiel, 2003). If news is unpredictable, this implies that the price changes follow a random-walk model, where securities always trade at their fair market value. This means that neither technical nor fundamental analysis can produce risk-adjusted excess returns. Empirical findings of the efficient market hypothesis both confirm and disprove the hypothesis, where especially strong form efficiency is difficult to find in real capital markets, see for instance Rosenberg et al. (1985). Economists and psychologists in the field of behavioral finance emphasize psychological and behavioral elements as important determinators of stock prices and believe that future stock prices are somewhat predictable based on past stock prices, as opposed to the idea of random walk (Malkiel, 2003).

## 3.2 Behavioral Finance

The efficient market hypothesis depends on rationally behaving investors, but empirical findings indicate that this does not always hold in practice. Behavioral finance aims to explain these inconsistencies based on human behavior and helps explain why and how markets might be inefficient (Baker & Nofsinger, 2010). Behavioral biases influence the investment behavior, and consequently affect how investors incorporate information from news. The presence of such biases may lead to irrational decisions. Bordalo et al. (2012) presents salience theory, which suggests that investors tend to seek their attention towards one or a few factors that

appear salient, and hence overweight these factors in a decision process. An investor, given an underlying preference for ESG, will thus tend to overreact to ESG news compared to other company news. Moreover, since bad news often appears more salient than positive news, this bias suggests stronger reactions to negative news than to positive news.

Within behavioral finance is also emotional finance, which explains how emotions impact investment decisions. Bad news is often associated with anxiety and stress, which people seek to avoid, while good news provokes the opposite emotions of excitement or pleasure, which people constantly seek. If markets respond immediately and appropriately only to good news, this behavior can be a possible explanation (Baker & Nofsinger, 2010). Galai and Sade (2006) refer to this behavior as "the ostrich effect", where investors avoid risky financial situations by pretending they do not exist. Karlsson et al. (2009) takes this term slightly further, stating that people not only may pretend that the bad news didn't occur, but also avoid collecting this type of information. Given good news, however, the individuals will seek out the information. In contrast with salience theory, which suggests an overreaction to negative ESG news, the ostrich effect may prevent investors from overreacting since the bad news is deliberately avoided. Moreover, investors are more likely to trade when they are paying attention to the stock market, which indicates a higher trading volume for positive news than for negative news (Baker & Nofsinger, 2010).

## 3.3 Shareholder and Stakeholder Theory

The shareholder theory and the stakeholder theory both discuss the relationship between corporate social responsibility in business and value creation. The shareholder theory (also called the Friedman doctrine) argues that in a free market economy, the social responsibility of business is to increase its profits and that the only responsibility of a company is to its shareholders (Friedman, 1970). Friedman argues that social issues should be solved by individuals, not firms, because firms spending money on social causes would effectively mean spending stakeholder's money. Businesses should still stay away from deception and fraud but use its resources on profit-increasing activities. Stakeholder theory is a genre of theories that are counter-reactions to the shareholder perspective. Stakeholder theory describes the relationship between firms and their stakeholders as well as the performance outcomes of these relationships (Jones et al., 2018). The theory suggests that including the needs and interests of all stakeholders in a strategic management plan can lead to improved financial performance of

the firms (Jones, Harrison, & Felps, 2018). Instead of only maximizing wealth for shareholders, the firm should maximize the wealth of all stakeholders without prioritizing one over another. This theory provides the theoretical link between CSR[1] (closely linked to the ESG term) and competitive advantage for firms. This can explain the incentives for investors to invest in firms that perform according to the ESG factors, because of the belief that this will lead to long-term competitive advantage.

## 3.4 Literature Review

### 3.4.1 ESG and Financial Performance

The relationship between ESG and corporate financial performance (CFP) has been debated among researchers for many years with varying conclusions, and can contribute to explain the financial motives for ESG investing. Previous research has primarily focused on the effects of the individual E, S and G categories, but more recent literature includes the ESG term in its entirety. A meta-analysis conducted by Wang et al. (2015) based on 42 individuals studies provides evidence for a positive and significant relationship between corporate social responsibility (CSR) and corporate financial performance (CFP). They also find a stronger relationship in advanced economies compared to developing countries. A more comprehensive meta-analysis from Friede et al. (2015) investigate 2200 individual studies on the impact of ESG on CFP in the period 1970-2014. They find that the vast majority of the studies concluded with a positive relationship, and less than 10% of the studies find a negative relationship. The authors argue that “the business case for corporate ESG investments is solid”.

When it comes to research on ESG and the market performance of firms, findings are heterogenous. Sahut and Pasquini-Descomps (2015) investigate how ESG scores influence monthly stock market returns from 2007-2011. To explain monthly returns, they use a multifactor linear model with ESG as the fifth factor. The overall results imply that the link between ESG and financial performance is not recognized by the financial markets. A more recent study by La Torre et al. (2020) examines the impact of ESG on stock performance in the period 2010-2018 with companies from the Eurozone. They use a combination of several ESG indicators, including scores, ratings and qualitative opinions, and finds that the linear correlation between ESG and stock returns is very weak and varies across companies. Overall,

[1] CSR encompasses the first two elements of ESG (Gerard, 2018)

literature shows that the relationship between ESG and stock performance is small. Taylor et al. (2018) suggest that investors may perceive the firms' responsible behavior as window dressing or greenwashing, which can explain these findings. Sprinkle and Maines (2010), explain that firms may engage in responsible activities only as window dressing to appease various stakeholder groups and to avoid negative publicity.

There are few studies on the ESG factors in the Norwegian stock market, partly due to the previous lack of ESG ratings. Leirvik et al. (2019) investigate the relationship between ESG ratings and financial performance at the Oslo Stock Exchange by constructing ESG ratings based on the Dow Jones Sustainability Nordic Index. They apply a portfolio strategy, where high-rated ESG portfolios do not show any significant excess market returns compared to low-rated portfolios. Furthermore, with a Fama-MacBeth procedure they find no evidence for the explanatory power and pricing of the ESG factor, which implies no connection between ESG and stock returns in the Norwegian Stock Market. Their results do however show that one does not have to sacrifice returns by investing responsibly, as there is not a negative statistical relationship.

### 3.4.2 News and the Stock Market

Newspapers play an important role in disseminating information to a broad audience, especially to individual investors (Fang & Peress, 2009). The literature is comprehensive in explaining and predicting stock price movements, and multiple researchers provide evidence that news contain information that is related to stock market movements. Examples include Tetlock (2007), Tetlock et al., (2008), Fang & Peress (2009) and Heston & Sinha (2017), in which the authors reveal that news with sentiment have an impact on the stock market to a various extent, where especially the tone and the content of the news is found to play an important role. The literature is limited when it comes to the impact of news in the Norwegian stock market, but a study conducted by Larsen and Thorsrud (2017) for the Norwegian Central Bank addresses this question of interest. The study utilizes newspaper articles from a business newspaper in Norway, *Dagens Næringsliv*. Briefly summarized their findings imply that news has predicting power on daily returns in Norway, where the topic of the news plays a crucial role for the return movements.

### 3.4.3 ESG News and the Stock Market

There are many studies that deal with events related to ESG and the impact of such events in financial markets. To the best of our knowledge, no studies have been conducted that examine events related to ESG events and reactions in the Norwegian stock market. However, there are studies that address this research question for stock markets in other countries, and particularly in the US. Early studies are centered on extreme environmental events, for instance Hamilton (1995), who investigates stock market reactions in the US to pollution news. His findings indicate significant negative abnormal returns for companies reporting TRI[2] pollution figures upon the first release of the information (Hamilton, 1995). Another study conducted by Capelle-Blancard and Laguna (2010) includes publicly listed companies in ten developed countries, including Norway. The authors investigate how the stock market responds to chemical disasters over the period 1990-2005, and finds that petrochemical firms on average experience a drop in the market value of 1.3% in the following two days after a disaster.

More recent studies investigate both positive and negative events. Flammer (2013) provides evidence for positive reactions in the US stock market to announcements of eco-friendly initiatives and negative reactions to announcements of eco-harmful behavior. Over time, she finds that the strength of positive reactions has decreased, while the strength of negative reactions has increased. She explains these findings with an increasing pressure over time for firms to become green. A similar study conducted by Krüger (2015) investigates stock market reactions to positive and negative events related to CSR, and finds strongly negative reactions to negative events and weakly negative reactions to positive events.

Studies that are more comparable to this thesis include both positive and negative news within all three ESG factors. Capelle-Blancard and Petit (2019) examine the reactions to ESG news for listed companies in the US stock market in the period 2002-2010. In the case of negative ESG news, the authors find that the companies' market value on average drops by 0.1%, while in the case of positive ESG news the companies on average gain nothing. Similar findings are provided by Serafeim & Yoon (2021), who further explain reactions to ESG news with ratings. Their findings imply that market reactions to positive news on average are weaker for high ESG-rated firms, because the positive news are already reflected in the stock prices. Another

[2] TRI stands for Toxics Release Inventory, whereas the purpose is to track the management of certain toxic chemicals which potentially pose threats to the environment and human health (United States Environmental Protection Agency, n.d.)

study by Cui and Docherty (2020) examines ESG news over the period 2000-2018 using a long-term event window. They find a significant drop in the stock price following negative ESG news, which recovers within the next 90 days. This implies that investors over-emphasize ESG, which results in market overreactions to ESG controversies.

Most studies that examine the volume effects related to new information are based on financial incidents such as earnings, acquisitions and dividend payments. The existing literature on the impact of ESG events on stock market behavior, as described above, focuses solely on price reactions (i.e. abnormal returns). We only find Cui & Docherty (2020) investigating trading behavior around ESG news publications, suggesting a clear increase in trading volume from negative news and a smaller increase from positive news.

A summary of the literature on the impact of ESG news on the stock market is listed in the following table.

**Table 2:** Research on ESG news and Stock Market Reactions

| Author(s) | Sample market | Time period | Firms (N) | Method [analysis window] | Key findings |
|---|---|---|---|---|---|
| Flammer (2013) | US | 1980-2009 | All publicly listed | Event study [-1,0] [-1,1] [-1,2], [-1,3] | Positive reaction to eco-friendly news and negative reaction to eco-harmful news |
| Capelle-Blancard and Laguna (2010) | Australia, France, Germany, Japan, Netherlands, Norway, Spain, Switzerland, UK, US | 1990-2005 | 38 | Event study [0,120] | Average drop in the MV of 1.3% for petrochemical firms in the following two days after a disaster |
| Capelle-Blancard and Petit (2017) | US | 2002-2010 | 100 | Event study [-1,1], [-5,5] | Significant drop in MV with negative news and no significant effect from positive news |
| Cui and Docherty (2020) | US | 2000-2018 | 1,500 | Event study [-10,90] | Overreaction to negative news compared to positive news. Stock price drop recovers in 90 days.<br><br>Clear increase and small increase in abnormal trading volume for negative and positive ESG news respectively. |
| Hamilton (1995) | US | 1989 | 436 | Event study [-1], [0], [0,5] | Negative, statistically significant abnormal returns for companies reporting TRI pollution upon the first release of the information |
| Krüger (2015) | | 2001-2007 | 745 | Event study [-5,5], [-10,10] | Strongly negative reaction to negative events and a weakly negative reaction to positive events |
| Serafeim and Yoon (2020) | US | 2010-2018 | Not specified | Prediction of news based on ESG ratings | Positive market reaction to positive ESG news and negative reaction to negative ESG news |

***Note:*** *This table presents previous empirical research on ESG news and stock market returns. The left column presents the authors and publication year, followed by the sample market used in the study. The third column is the time period in which news are collected from, followed by the number of firms used in the study. The two last columns present the method with the event window and key findings.*

# 4 Methodology

## 4.1 The Event Study Methodology

With the use of an event study, we assess whether there are significant abnormal returns and trading volume in the days surrounding the publication of ESG news. Event studies have a long history in financial research and were initially designed for the purpose of testing the semi-strong form of the Efficient Market Hypothesis (Salinger, 1992). Today, the event study methodology is a well-known empirical method that aims to measure market responses to specific events. The events are often related to new information introduced to market participants, such as firm-specific or economy-wide events. There are many published empirical event studies, where especially financial events such as mergers, acquisitions and earnings announcements are included. The event study is based on several assumptions, which includes that (1) the market is semi-strong efficient, (2) the event is unanticipated, and (3) there are no confounding effects during the event window (McWilliams & Siegel, 1997). The application of the event study design has been discussed in theoretical literature by several authors. The structure of this event study is based on MacKinlay's (1997) framework for event studies, and can be summarized with the following workflow:

1. Define the event window
2. Estimate normal returns and trading volume
    - Choice of estimation model
    - Define the estimation window
3. Hypothesis testing
4. Presentation of the empirical results
5. Closing comments

## 4.2 Event Window

The event window is the period where the abnormal returns are calculated, which includes the event date and often also a period around the event. According to MacKinlay (1997) it is common to define the event window wider than the event date as this permits examination of periods surrounding the event. To detect whether the potential market response is quick or delayed, the event study is performed with multiple event windows with the time intervals presented in Table 3 below. This study aims to examine short-term effects, hence relatively

short time intervals are chosen in the different event windows. Moreover, short event windows are beneficial considering the decreased risk of confounding events within the event window.

**Table 3***:* Event Windows

| Event window start | Event window end |
|---|---|
| -1 | 2 |
| -1 | 1 |
| 0 | 1 |
| 0 | 2 |
| 0 | 0 |

***Note:*** *0 denotes the event day when ESG news are published, and all other days are relative to the event day.*

## 4.3 Estimation of Normal Return

### 4.3.1 Estimation Model

MacKinlay (1997) lists the market model[3] and the constant mean return model as two common statistical models for estimating normal returns. The constant mean model is based on the assumption that returns stay constant over time, which can be problematic in times where the volatility is high. According to MacKinlay (1997) the market model is considered an improvement of this model, because returns related to the variation in the market are removed. This reduces the variance of the abnormal returns, and thus the ability to detect event effects will increase. The market model is over time the most frequently used model when estimating normal returns, and empirical results indicate that this model generally surpasses the other models. Other frequently used economic models to estimate normal returns include the Capital Asset Pricing Model (CAPM), the Fama-French Factor models and the Arbitrage Pricing Theory (APT) model. Multi-factor models can potentially reduce the variance of the abnormal returns, by explaining more of the variation in the normal returns, which gives a higher $R^2$. According to MacKinlay, the gains from adding additional factors are usually small. Armitage (1995) outlines several empirical results using a variety of estimation models and concludes that the market model is the most reliable in the sense that it is always at least as powerful as the best alternative in each tested circumstance[4].

[3] Also referred to as the single-index model (SIM)

[4] Armitage has explored empirical results where the Market Model has been tested against the following models: Index model, Average-Return model, CAPM, Fama-MacBeth model and Control Portfolio model.

Based on these findings, we will use the market model to estimate normal returns for the sample of stocks. The market model is a one-factor model that links the return on a given asset, in this case stocks, to the return of the market portfolio. For each stock, *i*, the market model estimates that the return is given by:

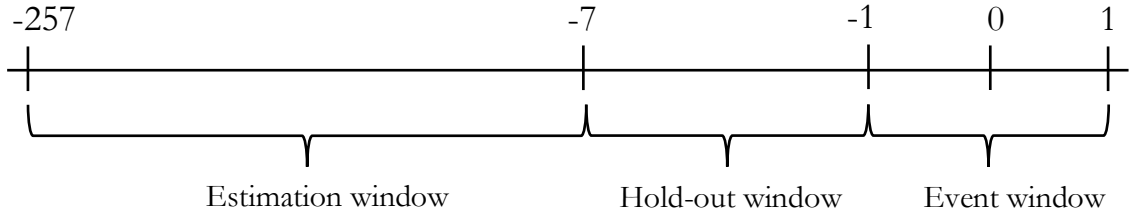
$$R_{i,t} = \alpha_i + \beta_i R_{m,t} + \varepsilon_{i,t}, \quad (1)$$

where $R_{i,t}$ and $R_{m,t}$ are returns in period *t* on stock *i* and the market portfolio *m*, respectively, and $\varepsilon_{i,t}$ is an error term with an expected mean value equal to zero. The market model parameters, $\alpha_i$ and $\beta_i$, are estimated for each stock within the estimation window with an ordinary least squares (OLS) regression. OLS regressions rely on statistical assumptions in order to produce best possible estimates, see Appendix 2 for an assessment of the assumptions.

### 4.3.2 Estimation Window

An important part of the event study is to define an estimation window where the normal returns are estimated. There is no set rule in the literature on how long the estimation window should be, but according to Armitage (1995) a minimum of 100 days is sufficient for the result to no longer be sensitive to varying lengths of the estimation window. MacKinlay (1997) states that the most common choice is to use a period prior to the event window for the estimation window. Furthermore, it is typical that the estimation window does not overlap with the event window in order to ensure that the normal return estimation is unaffected by the event returns. In this study we use an estimation window of 250 days prior to the event window, which approximately equals to one trading year. Between the estimation window and the event window there is a hold-out-window of 6 days. The purpose of this window is to prevent potential information leakage from impacting the estimation window.

**Figure 1:** Estimation and Event Window




***Note:*** *Figure 1 gives an overview of the timeline of the event study, where 0 represents the event day. The estimation window ranges from -257 to -7 prior to the event day and the hold-out window ranges from -7 to -1. We use several different event windows in the study, and the figure illustrates the event window from -1 to 1.*

## 4.4 Abnormal Returns

To detect whether ESG news has an impact on stock market returns, we calculate the abnormal returns[5], in the event window for each security. Continuously compounded logarithmic returns are used instead of simple returns, which according to Strong (1992) are more likely to be normally distributed and consequently meet the requirement of normality in parametric testing. Daily logarithmic returns are calculated with the following formula:

$$R_t = ln\left(\frac{P_t}{P_{t-1}}\right), \tag{2}$$

where $R_t$ is the daily return[6], ln is the natural logarithm, $P_t$ is the closing price on day $t$ and $P_{t-1}$ is the closing price the before day $t$. The abnormal return is the mathematical difference between the actual return and the predicted normal return, expressed in the following formula:

$$AR_{i,t} = R_{i,t} - E\left(R_{i,t}|X_t\right), \tag{3}$$

where $AR_{i,t}$ is the abnormal return, $R_{i,t}$ is the actual return and $\left(R_{i,t}|X_t\right)$ is the expected return for day $t$ with $X_t$ as the conditioning information of the normal performance model. By including the estimated parameters from the market model, the abnormal returns are reformulated to the following formula:

$$AR_{i,t} = R_{i,t} - \hat{\alpha}_i - \hat{\beta}_i R_{m,t}, \tag{4}$$

where $R_{i,t}$ and $R_{m,t}$ is the stock return and the market return in the event window. $\hat{\alpha}_i$ and $\hat{\beta}_i$ are the estimated parameters from the market model, where $\hat{\beta}_i$ represents the systematic risk of security, $i$, by a measure of how the security fluctuates with the market returns and $\hat{\alpha}_i$ is the average return in excess of the benchmark.

### 4.4.1 Aggregating Abnormal Returns

In order to draw overall inferences for the events of interest, the abnormal return observations are aggregated across two dimensions – across securities and across time (MacKinlay, 1997). Aggregation across securities is necessary to avoid noise from one single stock's return data and aggregation across time is to fully capture the effect of the event due to uncertainty of when

[5] Other commonly encountered labels for abnormal returns are prediction errors (PE) and residuals
[6] Nominal returns are used as this is more common with daily data than excess or real returns (MacKinlay, 1997)

the event information enters the market (Strong, 1992). To find the effect for each individual day, we aggregate the abnormal returns for all securities each day in the event window with the following formula. The securities have multiple events, here *i*, which are all equally weighted by:

$$AAR_t = \frac{1}{N}\sum_{i=1}^{N} AR_{i,t}\,, \tag{5}$$

where $AAR_t$ is the average abnormal return for all events on day *t*, and $AR_{i,t}$ are the abnormal returns for event *i* at day *t*.

To measure the effect across time, the abnormal returns are aggregated within the event window, which yields the cumulative abnormal return (CAR) for each event. The CAR for each event is calculated with the following formula:

$$CAR_i(t_1, t_2) = \sum_{t=t_1}^{t_2} AR_{i,t}, \tag{6}$$

Where $CAR_i(t_1, t_2)$ is the cumulative sum of abnormal returns $AR_{i,t}$, within the event window $t_1$ to $t_2$.

Finally, the cumulative abnormal returns are aggregated across all events, which yields the cumulative average abnormal return (CAAR). Aggregating abnormal returns across both time and events allows us to run a test for all events. The CAAR is given with the following formula:

$$CAAR = \frac{1}{N}\sum_{i=1}^{N} CAR(t_1, t_2), \tag{7}$$

where CAAR is the average of all CARs from N events with the event window ranging from time $t_1$ to $t_2$.

### 4.4.2 Significance Testing of Abnormal Returns

Statistical tests of the aggregated returns are performed to determine whether the ESG news have significant impacts in the stock market. We perform a one-sided standard t-test for both AAR and CAAR. The literature on significance testing and the power of tests in event studies

is extensive. According to Brown and Warner (1985) standard parametric tests are well specified when using daily data and the market model. The null hypothesis is therefore tested using the following test-statistic from MacKinlay (1997):

$$t_{CAAR,t} = \frac{CAAR(t_1, t_2)}{\sqrt{var\big(CAAR(t_1, t_2)\big)}} \sim N(0,1), \tag{8}$$

where the denominator is the estimated standard deviation of the CAAR and $t$ is normally distributed. The same formula is used to test AAR by replacing CAAR with AAR in the formula. This parametric test relies on the important assumption that the abnormal returns are normally distributed, see Appendix 3 for the distributions.

The estimated variance is given by the following formula:

$$var(CAAR(t_1, t_2) = \frac{1}{N^2}\sum_{i=1}^{N}(CAR_i(t_1, t_2) - CAAR(t_1, t_2))^2. \tag{9}$$

For the estimator of variance to be consistent, the abnormal returns must be uncorrelated, which is generally the case if there is no event clustering. Event clustering is not an issue if there is no overlapping in the event windows of the securities. This is discussed in greater detail in section 5.

## 4.5 Abnormal Trading Volume

As an additional approach to research market reactions to ESG news, we perform a trading volume-based event study with the use of daily trading volume. Although price-based event studies are most prevalent in the literature, there is a growing body of research examining trading volume behavior to new information. Cready and Hurtt (2002) even argue that volume-based metrics provide more powerful tests of investor reactions to public disclosure than return-based metrics. Yadav (1992) states that price changes in value-based event studies represent consensus in the evaluation of information while volume can be an indication of the lack of consensus in interpreting information. The null hypothesis in volume event studies states that the event day's average abnormal trading volume is zero. In the case of ESG news, findings of abnormal trading volume after a news publication can indicate that there is a reaction among investors to the news, because more investors are interested in buying or selling their stocks.

### 4.5.1 Estimating Abnormal Volume

The trading volume metric can be calculated in several ways. We use the daily log-transformed relative trading volume of the stocks, which is calculated with the following formula from Yadav (1992). By using each stock's relative trading volume, the volume can be compared across securities.

$$V_{it} = ln\left(\frac{n_{i,t}}{S_{i,t}} * 100\right), \tag{10}$$

where $V_{it}$ is the trading volume for security *i* at day *t*, $n_{i,t}$ is the number of shares traded and $S_{i,t}$ is the total number of shares outstanding. Using log-transformed volume data is beneficial as this provide a distribution closer to normal, and is recommended in previous literature on abnormal volume, for instance in Ajinkya and Jain (1989), Cready and Ramanan (1991) and Campbell and Wasley (1993). Some versions of the formula add a constant of 0.000255 in the numerator to avoid issues with log transformations on zero values. However, this is not an issue with the data used in this study because there are no days with zero trading[7].

In contrast to value-event studies, there is no widely accepted consensus on which model yields the most powerful results in volume studies (Yadav, 1992). In this study we estimate the expected trading volume using the mean adjusted trading model. In this model, the expected volume is the mean of the trading volume within the estimation window of 250 days. To find the abnormal volume, the predicted volume is subtracted from the actual volume in the event window, as shown in the following formula:

$$AV_{i,t} = V_{i,t} - mean(V_{i,t}), \tag{11}$$

where $AV_{i,t}$ is the abnormal volume for stock *i* at day *t*. $V_{i,t}$ is the actual trading volume and mean($V_{i,t}$) is the mean trading volume in the estimation window, i.e. the expected volume.

[7] There was some missing volume data from Børsprosjektet's database that incorrectly gave zero trading volume on certain days. We solved this by excluding the missing observations in the calculation of the mean AV in the 250-day estimation window.

### 4.5.2 Aggregating Abnormal Volume

Abnormal volume is aggregated to draw overall inferences and for the purpose of statistical testing. To aggregate across all events, the average abnormal volume (AAV) is calculated for each day in the event window ranging from day -1 to 2. The AAV is calculated with:

$$AAV_t = \frac{1}{N}\sum AV_{i,t}\,, \tag{12}$$

where $AAV_t$ is the average abnormal volume at day *t* which is equally weighted by N number of events and $AV_{i,t}$ is the abnormal volume for event *i* at day *t*.

### 4.5.3 Statistical Testing of Abnormal Volume

To test for significant average abnormal volume for each of the days in the event window, we use a parametric test-statistic as used in Ajinkya and Jain (1989). We use the following two-sided t-test to test if the AAV is statistically different from zero:

$$t_{AV,t} = \frac{AAV_t}{\hat{\sigma}AV}, \tag{13}$$

where

$$\hat{\sigma}AV = \sqrt{\frac{1}{N}\sum_{i=1}^{N}\left(AV_{i,t} - AAV_t\right)^2}\,. \tag{14}$$

In this formula, $AAV_t$ is the equal weighted mean abnormal trading volume for each day in the event window. $\hat{\sigma}AV$ is the estimated standard deviation of the abnormal volume. The methodological issues in volume studies are closely related to the issues of return event studies, such as non-normality of the volume metric. This parametric test requires that the $AV_{i,t}$ values are normally distributed and independent variables to achieve proper specification under the null hypothesis. See Appendix 3 for the abnormal volume distributions.

In addition, autocorrelation in the raw volume metric and in the residuals is a more common issue than in return event studies, which may be due to investors not rebalancing their portfolios within one day after the arrival of information (Ajinkya & Jain, 1989). The computation of the standard deviation is based on the assumption of no residual autocorrelation, which can cause the estimator of variance to be biased downwards. This will cause the test-statistic to be

overstated and the null hypothesis will be rejected more often than it should because of the misspecification. We detected autocorrelation in the volume residuals, see Appendix 7. Ajinkya and Jain (1989) discover that for one-day intervals there is only a small increase in the power of the test when autocorrelation in residuals is taken into account by using a different estimation model (EGLS-model). This suggests that autocorrelation is not necessarily a problem because we use one-day intervals.

# 5 Data

## 5.1 Financial Data

The financial data is retrieved from Børsprosjektet, which is a source of financial market data at the Norwegian School of Economics. Because manually collecting news data proved to be very time consuming, the analysis is limited to a smaller sample of firms from the Oslo Stock Exchange. The sample consists of the 25 most liquid companies on Oslo Stock Exchange as of January 2020, which constitute the tradeable OBX Total Return Index. The index is rebalanced semi-annually and covers a broad range of industries in Norway, including oil and gas, banking, telecommunication, agriculture and insurance. Moreover, the composition of the companies includes both large cap companies as well as growth companies, providing a varied and representative sample of stocks in Norway. For a complete list of companies with sectors, weights in the index and market capitalization see Appendix 4.

The financial variables are log-transformed and consist of daily returns and daily relative trading volume for the 25 firms, as well as the OBX-index which is used as the benchmark in the market model. The daily returns are adjusted for dividend payments, stock mergers and stock splits. The use of adjusted returns removed extreme outlier, see Appendix 1 for outlier detection, and the adjusted data consequently represents the true stock returns. According to Fama (1991), the use of daily observations allows precise measurements of the speed of the stock-price response and can also attenuate or eliminate the joint hypothesis problem[8]. For the purpose of this short-term study, the use of daily data may help isolate the potential price effect from ESG news to a greater extent, compared to using weekly or monthly data.

## 5.2 Sample Period

In order to secure a broad sample of events, a sufficient period of time is required. The analysis is conducted with news over a 10-year period ranging from 2010 to 2020. This time frame is analyzed due to less focus on ESG in the media before this period of time. It is also beneficial considering that some of the companies are not publicly listed until after 2010. Stock prices of firms listed after 2010 are retrieved from their first trading day. Because the estimation window begins 250 days before the event, the financial data ranges from 2009 to 2020[9].

[8] The joint hypothesis problem states that testing for market efficiency difficult or impossible.
[9] December 2020 is not included in the analysis due to lack of available data at NHH's database.

## 5.3 Index Selection

In order to estimate normal returns with the market model, a market index must be selected as a proxy for the market movements, i.e. the systematic risk. In this study, we use the OBX-index as the index in the market model. This index is adjusted for dividends and weighted according to market capitalization (EuroNext, 2021). Strong (1992) states that "the theoretically correct market index is a value-weighted index of the entire universe of capital assets" and "such an index is practically unmeasurable". Thus, selecting an index in practice is often determined by data availability. Brown and Warner (1980) point out that an equally weighted index leads to more powerful tests than a value-weighted index, because the probability of detecting abnormal returns is greater. This suggests that the use of the value-weighted OBX-index may lead to some issues, particularly because some of the high market cap securities are heavily weighted, such as Equinor and Telenor. Alternatives to the OBX-index are for instance the broader OSEBX[10] or the OSEFX-index, where the latter is a capped benchmark index with weight restrictions. A robustness test did however suggest no significant difference in the parameter results with the use of the three different indices. In addition, using the OBX-index in the model provided the highest R-squared, which suggests better explanatory power of the stock movements and a better fitting model. See Appendix 5 for details of the index selection. Considering these arguments, we consider the OBX-index as a suitable benchmark for the securities in the sample.

## 5.4 News data

The news data is retrieved from Infomedia, which is a company in the Nordic region who offers media intelligence and research. Their media monitoring portal gives access to news data from more than 178,000 news media worldwide, including online newspapers, print and social media. The extent of the research question of this study speaks in favor of using news providers within business, economics and society. The news search is therefore limited to online news articles from Dagens Næringsliv (DN) and E24, which constitute the two largest and most read business newspapers in Norway. Small economies like Norway typically have few business newspapers, which makes one newspaper more representative of the mass media compared to newspapers in larger economies, as argued by Larsen and Thorsrud (2017). Hence, we consider DN and E24 as sufficient to provide relevant business news in Norway.

[10] The OSEBX-index includes 69 stocks as of January 2021. It is a value-weighted index of the largest and most traded stocks at the OSE (EuroNext, 2021).

With the use of Infomedia's integrated tools, we created one search profile for each of the 25 companies in the sample. A news search is made within each of these profiles, where we classify all relevant news into either positive or negative sentiments. The selected news is at a company-specific level and must be of sufficient relevance to the individual company. News that only mentions but does not have a direct link to the company is consequently excluded. News categorized as debate posts, journalistic comments etc. is also excluded to avoid articles where the writer's subjective tone is expressed. Furthermore, all publishing from social media is excluded. In cases where the same news is published in both of the two news providers, the first published article will be included. In cases where the news is published outside of the stock market opening hours, the following trading day will apply as the event date.

In order to identify ESG-related news, the search is limited to capture news articles containing at least one of several specified ESG keywords. The identified news with the use of these words is then processed manually, where only a sample of the most relevant news is selected. The keywords are based on the definition of ESG from section 2 as well as a general review of ESG news to detect common words and patterns in such articles. There is, however, a potential concern that the list of ESG words is too narrow, which may omit some relevant articles and consequently affect the power of the results. In other words, the list is not exhaustive, but nonetheless we consider the list comprehensive to detect news of interest related all three factors.

**Table 4:** ESG Words Used in the Search for News

| E | S | G |
|---|---|---|
| Climate | Child labor | Board |
| CO2 | Diversity | Conflict |
| Emission | Equality | Corporate governance |
| Environment | Health | Corruption |
| ESG | HSE | Crime |
| Green | Minimum wage | Lawsuits |
| Natural disaster | Social responsibility | Management |
| Pollution | Underpaid | Money laundering |
| Renewable | Work accident | Trial |
| Sustainability | Working conditions | Økokrim |

***Note**: In the original search for news, we have used Norwegian words, i.e., the words presented in this table are translated into English. The words are truncated using "*" to capture different spellings or inflections of the word.*

In order to isolate the effect of ESG events to a highest possible degree, all ESG news that is clearly of financially material importance to the individual company is excluded. Examples of such news may be that a company receives a fine as a consequence of an oil spill or that a company receives a valuable contract for construction of wind power.

### 5.4.1 News Sentiment Classification

The question of definition that arises in the categorization of ESG news has been carefully considered. The news is classified as either positive or negative, and we do not categorize according to the degree of sentimental strength. This results in a sample that includes both extreme and ordinary events. The classification of positive and negative news is based on our own criteria:

i. The news must be of sufficient sentimental strength in order to be categorized as either positive or negative.
ii. The company featured in the news takes an action or is related to an event causing positive (negative) consequences related to either E, S or G for other parties such as individuals, societies or ecosystems.
iii. News involving leakage of favorable (unfavorable) information related to either E, S or G about the individual companies is to be regarded as positive (negative) news.

### 5.4.2 Confounding Events

An underlying assumption for the event study to provide reliable inferences is that there are no other events within the event window, referred to as confounding events. Confounding events should be reduced for the purpose of isolating the effect of the event. In order to reduce the risk of confounding events in our sample, all ESG news published on the same day as financial announcements for the companies, such as quarterly and annual reports, are excluded. Confounding events can also occur if ESG news about the same company has overlapping event windows. To deal with this problem, we only use the first of the overlapping events in such circumstances. Sorescu et al. (2017) examine the issue of confounding events, and do not find this problematic in short-term event studies, which suggests that eliminating overlapping observations may be unnecessary for our study. To be sure that our final findings are not affected by this issue, we performed our event study both with and without the overlapping events. We found slightly different results between the two tests; hence we use the data without

overlapping events. Evidently, there is still a possibility for unobserved events that we have not been able to capture, which may affect the validity of the results of the study.

### 5.4.3 Event Clustering

Another issue that may cause statistical errors occurs when abnormal returns are aggregated across companies. According to the event study framework of MacKinlay (1997), it is assumed that the events across companies do not occur at the same time. This assumption must hold in order to ensure that the abnormal returns and the cumulative abnormal returns are independent across the companies. The presence of this overlapping is referred to as event clustering, and may cause contemporaneous correlation across companies, and hence reduce the statistical power. Considering the amount of news data in this study, there will be some occurrences of event clustering, but taking this into account would reduce the amount of data considerably and resulted in a limited data sample. See Appendix 6 for a table of clustered event dates, which shows the frequency of event clustering in our data.

### 5.4.4 Final Sample

The final result of the collected news data, which is the fundament for the further analysis, includes only ESG-related news. The data consists of information about the event date, event time, news source, company name and headline as well as the sentiment of the news. An example of the data is presented in Table 5 below.

**Table 5:** Example of News Data

| Event Date (m/d/y) | Company | Source | Positive | Negative | Headline |
|---|---|---|---|---|---|
| 01/23/20 | Equinor | DN.no | x | | Equinor planlegger verdens første forsyningsskip på utslippsfri ammoniakk |
| 09/12/20 | Equinor | E24.no | | x | Equinor med alvorlige brudd på regelverket i sikkerhetsarbeidet |
| 11/03/18 | Norsk Hydro | DN.no | | x | Hydro innrømmer ulovlige utslipp i Brasil |
| 01/06/20 | Norsk Hydro | E24.no | x | | Hydro bygger fabrikk for resirkulering av elbilbatterier i Fredrikstad |
| 29/09/15 | Telenor | E24.no | x | | Telenor-ansatte i hele verden får et halvt års fødselspermisjon |
| 08/12/15 | Telenor | E24.no | | x | Telenor-kvinner ble aldri innkalt til intervju om konsernsjef-jobben |

***Note**: The news in the table represents a small sample of the total news data and is intended as an example for the reader. The original headlines are presented in Norwegian as we have used Norwegian news providers to collect the data.*

## 5.5 Descriptive Statistics

The following two tables provide descriptive statistics of the financial data and the news data for each of the 25 companies.

**Table 6:** Descriptive Statistics of Financial Data (2009-2020)

| Company | Min return (%) | Mean return (%) | Max return (%) | SD (ret) | Min volume (%) | Mean volume (%) | Max volume (%) | SD (vol) |
|---|---|---|---|---|---|---|---|---|
| Aker | -20.67 | 0.07 | 18.6 | 0.022 | 0 | 0.11 | 1.36 | 0.001 |
| Aker BP | -28.27 | 0.12 | 53.62 | 0.032 | 0 | 0.24 | 14.92 | 0.004 |
| Bakkafrost | -13.97 | 0.13 | 24.24 | 0.022 | 0 | 0.21 | 11.84 | 0.003 |
| BW LPG | -14.73 | 0.06 | 13.34 | 0.031 | 0.04 | 0.53 | 9 | 0.004 |
| BW Offshore Ltd | -30.98 | 0.06 | 33.33 | 0.037 | 0 | 0.33 | 10.66 | 0.006 |
| DNB | -18.54 | 0.09 | 15.98 | 0.022 | 0.03 | 0.2 | 2.49 | 0.002 |
| DNO | -45.84 | 0.07 | 36.48 | 0.036 | 0.07 | 0.63 | 14.71 | 0.006 |
| Entra | -11.42 | 0.07 | 19.69 | 0.015 | 0.01 | 0.11 | 3.29 | 0.002 |
| Equinor | -17.72 | 0.02 | 9.88 | 0.018 | 0.04 | 0.22 | 2.45 | 0.001 |
| Frontline | -43.5 | -0.01 | 30.81 | 0.041 | 0.01 | 0.63 | 13.11 | 0.008 |
| Gjensidige Forsikring | -10.31 | 0.06 | 12.28 | 0.014 | 0.02 | 0.1 | 2.76 | 0.001 |
| Lerøy Seafood Group | -14.76 | 0.11 | 13.07 | 0.021 | 0 | 0.11 | 1.32 | 0.001 |
| Mowi | -14.76 | 0.11 | 13.07 | 0.023 | 0.1 | 0.65 | 5.32 | 0.005 |
| NEL | -40.62 | 0.13 | 81.51 | 0.056 | 0 | 0.91 | 17.58 | 0.013 |
| Norsk Hydro | -12.06 | 0.04 | 12.4 | 0.022 | 0.04 | 0.4 | 3.26 | 0.003 |
| Orkla | -11.76 | 0.03 | 10.55 | 0.015 | 0.03 | 0.19 | 1.07 | 0.001 |
| SalMar | -14.19 | 0.14 | 17.39 | 0.025 | 0 | 0.13 | 2.54 | 0.001 |
| Scatec | -12.88 | 0.2 | 18.08 | 0.025 | 0.01 | 0.25 | 5.26 | 0.002 |
| Schibsted ser.A | -13.79 | 0.12 | 33.72 | 0.023 | 0.03 | 0.24 | 5.54 | 0.002 |
| Storebrand | -19.55 | 0.08 | 13.46 | 0.026 | 0.07 | 0.46 | 4.27 | 0.003 |
| Subsea 7 | -21.13 | 0.06 | 18.89 | 0.026 | 0.1 | 0.56 | 9.19 | 0.004 |
| Telenor | -8.34 | 0.05 | 14.57 | 0.016 | 0.03 | 0.17 | 1.45 | 0.001 |
| TGS-Nopec Geophysical Company | -27.12 | 0.08 | 17.19 | 0.027 | 0.07 | 0.53 | 4.2 | 0.004 |
| Tomra Systems | -11.24 | 0.11 | 19.01 | 0.021 | 0 | 0.14 | 2.53 | 0.002 |
| Yara International | -9.3 | 0.05 | 12.73 | 0.02 | 0.05 | 0.45 | 3.8 | 0.004 |
| OBX-Index | -8.95 | 0.05 | 7.19 | 0.014 | - | - | - | - |
| OSEBX-Index | -9.18 | 0.05 | 6.65 | 0.013 | - | - | - | - |
| OSEFX-Index | -9.26 | 0.05 | 6.78 | 0.013 | - | - | - | - |
| All stocks | -45.84 | 0.08 | 81.51 | 0.027 | 0 | 0.35 | 17.58 | 0.005 |

***Note**: The first column shows the company name of the 25 stocks in the sample as well as the three indices. The next columns contain minimum values, mean, maximum and standard deviations (SD) of the adjusted daily returns in percent. The following rows are the minimum. mean, maximum and standard deviations (SD) of the relative trading volume given in percent. The SDs are provided in decimals. The numbers are presented in regular values even though we use log-transformed values in the event study as these values are more intuitive to interpret for the reader.*

**Table 7:** Summary Statistics of News Data (2010-2020)

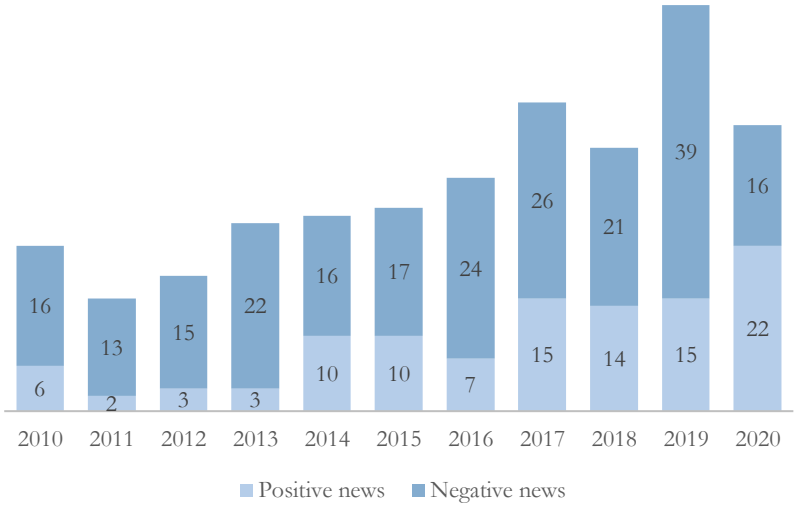
| Company | Positive ESG news | Negative ESG news | Total |
|---|---|---|---|
| Aker | 2 | 2 | 4 |
| Aker BP | 2 | 2 | 4 |
| Bakkafrost | 0 | 6 | 6 |
| BW LPG | 0 | 0 | 0 |
| BW Offshore Ltd | 0 | 1 | 1 |
| DNB | 5 | 25 | 30 |
| DNO | 1 | 2 | 3 |
| Entra | 0 | 0 | 0 |
| Equinor | 44 | 68 | 112 |
| Frontline | 3 | 0 | 3 |
| Gjensidige Forsikring | 0 | 3 | 3 |
| Lerøy Seafood Group | 0 | 8 | 8 |
| Mowi | 5 | 19 | 24 |
| NEL | 5 | 4 | 9 |
| Norsk Hydro | 7 | 14 | 21 |
| Orkla | 2 | 2 | 4 |
| SalMar | 1 | 5 | 6 |
| Scatec | 1 | 0 | 1 |
| Schibsted ser. A | 1 | 2 | 3 |
| Storebrand | 9 | 1 | 10 |
| Subsea 7 | 1 | 1 | 2 |
| Telenor | 5 | 28 | 33 |
| TGS-Nopec Geophysical Company | 0 | 3 | 3 |
| Tomra Systems | 0 | 1 | 1 |
| Yara International | 13 | 28 | 41 |
| **Total** | **107** | **225** | **332** |

***Note:*** *The first column shows the company name of the 25 stocks in the data sample. The next columns contain the amount of positive and negative news for each company. The last column is the amount of news in total for each company.*

### 5.5.1 Dataset Limitations

Of the 25 companies, only 23 are included in the analysis due to a lack of observations for some of the companies. Two of the companies have no observations at all, while other companies have observations for either positive or negative ESG news only. Table 7 reveals that our dataset is unbalanced due to a skewed distribution of observations across the companies as well as an overweight of negative news. Some of the companies represent a very large share of the observations, such as Equinor, Telenor and DNB. Within the period 2010-2020, our sample of news data includes 332 events, of which 107 are positive and 225 are negative.

**Figure 2**: Distribution of ESG News (2010-2020)




***Note:*** *The chart shows the distribution of the collected ESG news for each year from 2010 to 2020. There is an overall increase of news across time and an overweight of negative news.*

The number of observations varies from year to year. This is shown in the figure above which indicates a gradual increase in the number of incidents from the start of the period to the end, with some exceptions. This trend can reflect the increased focus on ESG controverses over the past decade.

# 6 Hypothesis Development

In order to answer the research question, we have constructed several hypotheses based on theory and previous literature. The reference literature used in this study is mainly conducted in the US stock market, but with certain differences between the Norwegian and the US market, it is not obvious whether this study will achieve similar results. First, we test whether the potential effect is positive and negative for positive and negative ESG news respectively. Finally, we examine whether the ESG news has a significant effect on the average trading volume. The potential impact on both returns and trading volume is expected to be short-term, hence our test is solely constructed to capture short-term effects. In line with our research question "*How do firm-specific ESG-news publications affect stock market returns and trading volume at the Oslo Stock Exchange?*" we have constructed three hypotheses. Hypotheses 1 and 2 are both tested by performing a one-sided t-test, which allows us to test whether the potential price effect is positive and negative for positive ESG news and negative ESG news respectively. With the assumption that the news appears as new information to investors, we expect that this information will create an abnormal price reaction to positive and negative ESG news. Hypothesis 3 is developed as an alternative measure of the market activity around ESG news publications, which may provide some additional insight in the analysis.

**Hypothesis 1: Positive ESG news has a significant positive effect on stock returns**

Hypothesis 1 suggests that positive firm-specific ESG news on average has a positive and significant effect on stock returns. The increasing focus over the past decade to achieve goals such as the Paris Agreement and the UN Sustainable Development Goals combined with a growing evidence that good CSR behavior is closely related to the firm performance, leads to this hypothesis. The idea is that investors value this type of information, which consequently leads to a positive stock price reaction.

**Hypothesis 2: Negative ESG news has a significant negative effect on stock returns**

In line with the arguments for hypothesis 1, we hypothesize that negative ESG news is followed by a negative stock price reaction, in the same way that we hypothesize that positive ESG news is followed by a positive stock price reaction. Moreover, we find support for this hypothesis in the US market, see for instance Capelle-Blancard and Petit (2019) and Cui and Docherty (2020). With the high focus on topics related to ESG in Norway and the fact that Norway is

considered as a pioneer in SRI, it is plausible to assume that similar discoveries will be found in the Norwegian stock market.

**Hypothesis 3: ESG news has a significant effect on trading volume**

Hypothesis 3 suggests that positive and negative firm-specific ESG news on average has a significant effect on trading volume. In contrast to the effect of ESG news on stock prices, there is a lack of similar studies investigating the impact on trading volume. It is therefore not obvious how the market activity is reflected in the trading volume; hence we perform a two-sided t-test to investigate whether the mean abnormal volume is statistically different from zero.

# 7 Empirical Findings and Discussion

## 7.1 Return Results

### 7.1.1 Average Abnormal Returns

According to **hypothesis 1 and 2** we expect to find positive abnormal returns from positive ESG news and negative abnormal returns from negative ESG news. This is first tested across all events by performing a one-sided t-test for the average abnormal returns (AAR) each day. The null hypothesis states that there are no significant average abnormal returns, and if the null hypothesis can be rejected, this indicates that ESG news has a significant effect on stock returns. The results for the average abnormal returns are presented in Table 8 below:

**Table 8**: Average Abnormal Returns

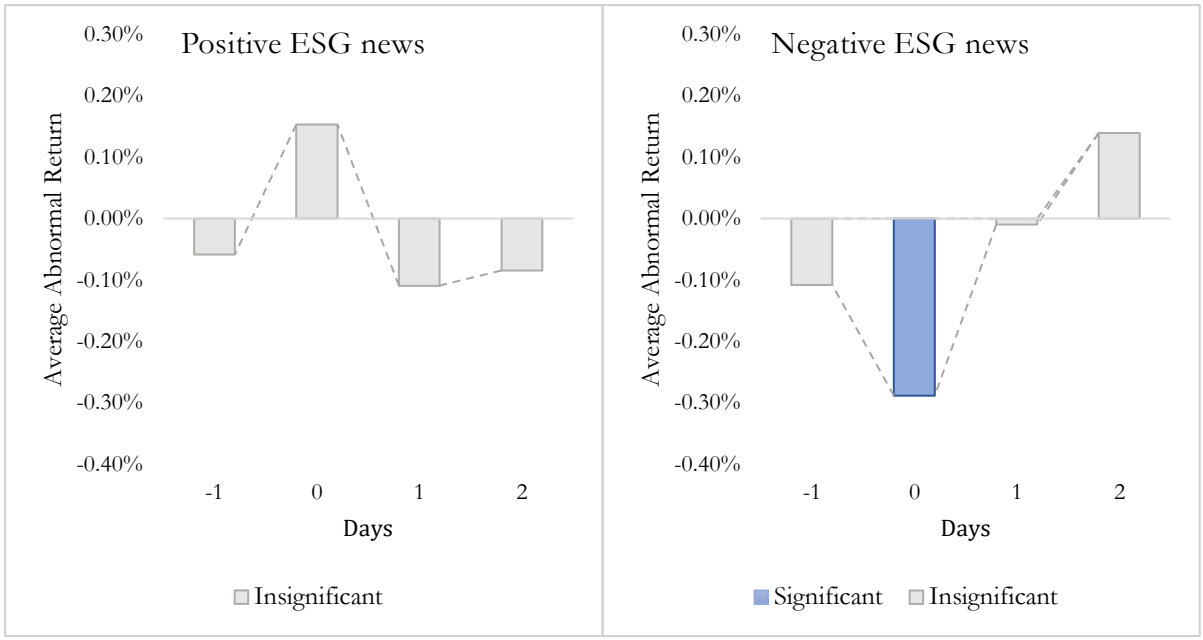
| | **Positive news** N=107 | | **Negative news** N=225 | |
|---|---|---|---|---|
| Days | AAR (%) | t-stat | AAR (%) | t-stat |
| -1 | -0.0583 | -0.4350 | -0.1081 | -0.9752 |
| | (0.0013) | | (0.0011) | |
| 0 | 0.1531 | 1.0635 | -0.2885*** | -2.7350 |
| | (0.0014) | | (0.0011) | |
| 1 | -0.1092 | -0.8960 | -0.010 | -0.0955 |
| | (0.0012) | | (0.00102) | |
| 2 | -0.0843 | -0.6604 | 0.1395 | 1.5833 |
| | (0.0013) | | (0.0009) | |

***Note:*** *This table presents the average abnormal returns for each of the days in the first column (AAR). Heteroscedasticity robust standard errors in parentheses below and the t-values are listed next to the AARs. N is the number of events in each sentiment. ***Denotes the significance of the coefficients at the 1% level, **at the 5% level and *at the 10% level.*

The table presents the average abnormal return for each of the days in the event window, ranging from -1 to 2. On the event date (0), the AAR is positive for positive ESG news and negative for negative news, which corresponds to our expectations. There is an overriding proportion of insignificance among the observations, where no significant AARs can be observed in the days surrounding the event for neither positive nor negative news. However, on the event day of negative news, we find a negative and significant AAR of -0,288% at the 1% level. This implies that negative ESG news, on average, has a significant and negative

impact on the stock prices on the event day. We are unable to provide the same support for positive ESG news, of which none of the days have significant AARs.

**Figure 3:** Average Abnormal Returns (AAR)




***Note:*** *The blue color signals significance, while grey signals insignificance.*

Figure 3 provides a graphic illustration of the average abnormal returns of each day within each sentiment. We observe that the strength in reaction is greatest on the announcement day (0) for both positive and negative news with an average abnormal return of 0,15% and -0,29% respectively, of which the latter is statistically significant. The adjustment process of the prices seems immediate instead of gradual, which suggests efficiency in the incorporation of information in the market. This response is both a confirmation that our event dates are correct and that the market incorporates the information quickly. Moreover, since the AARs are not significantly different from zero on the day prior to the event, this indicates that no information leakage has occurred.

### 7.1.2 Cumulative Average Abnormal Returns

Furthermore, we investigate the results from the significance tests of the cumulative average abnormal returns (CAAR). This metric is useful in addition to the AAR to get a sense of the aggregate effect of the events across time. An overview of the CAARs is presented in the table below.

**Table 9:** Cumulative Average Abnormal Returns

| | **Positive news N=107** | | **Negative news N=225** | |
|---|---|---|---|---|
| Event window [start, end] | CAAR (%) | t-stat | CAAR (%) | t-stat |
| [-1, 1] | -0.0144 | -0.0649 | -0.4064*** | -2.1850 |
| | (0.0022) | | (0.0018) | |
| [0, 1] | 0.0439 | 0.2393 | -0.2982** | -2.0297 |
| | (0.0018) | | (0.0015) | |
| [0, 2] | -0.0404 | -0.1701 | -0.1588 | -0.9161 |
| | (0.0024) | | (0.0017) | |
| [-1, 2] | -0.0987 | -0.3582 | -0.2669* | -1.3019 |
| | (0.0028) | | (0.0021) | |

***Note**: The first column displays the different event windows. The table displays cumulative average abnormal returns (CAAR) for positive and negative news with heteroscedasticity robust standard errors in parentheses and t-statistics in the next columns. N is the number of events. ***Denotes the significance of the coefficients at the 1% level, **at the 5% level and *at the 10% level.*

As can be seen from the table, no significance can be found in any of the event windows for positive news. The CAAR coefficient is negative in all event windows for negative news. In the event window [-1,1] the CAAR is -0.406% and significant at the 1% level, in the event window [0,1] the CAAR is -0.298% and significant at the 5% level and in the event window [-1,2] the CAAR is -0.267% and significant at the 10% level. As can be seen from the results, we find the CAAR to be significant and negative in all event windows except [0,2]. Seeing these findings in context with the average abnormal returns on each day, this indicates that the market reacts rapidly to new information. Furthermore, the fact that CAAR is significant and negative in all event windows which includes the day prior to the event can be an indication of some information leakage. However, as we do not find any evidence for abnormal return on this day, we cannot state that this is true.

### 7.1.3 Discussion

The overall results show that the impact of positive and negative news is asymmetric. From the results of the empirical analysis, we cannot provide any statistical evidence that positive ESG news has an impact on the value of the stocks. Thus, we do not find the expected results of **hypothesis 1**, which hypothesizes that there are stock market reactions to positive news at the Oslo Stock Exchange. On the other hand, we provide evidence for negative stock market reactions to negative ESG news, which supports **hypothesis 2**. These findings are aligned with previous literature, which mainly finds negative reactions to negative ESG news, but weak or

no reactions to positive news (Capelle-Blancard & Petit, 2019; Cui & Docherty, 2020; Serafeim & Yoon, 2021).

One possible explanation to the asymmetric findings is salience theory, which suggests that investors place greater emphasis on negative ESG news as this type of news often seems more salient than positive ESG news. Another explanation to the lack of reactions to positive ESG news is that the information could already be discounted into the stock prices. This is particularly relevant for companies with higher ESG ratings, which according to Serafeim and Yoon (2021) tend to have weaker stock price reactions to positive news. Considering that some of the companies in our sample have business strategies highly related to the ESG factors, for instance within the field of renewable energy, the positive ESG news might already be reflected in the stock prices. Due to an increasing pressure from stakeholders on companies, positive ESG news might be expected and even demanded by investors. Moreover, since Norway is considered at the forefront of socially responsible investing, it is reasonable to assume that investors in the Norwegian market demand more from companies, and hence react less to positive news. This is consistent with Flammer (2013), who argues that the increasing pressure to become green has resulted in decreased reactions to eco-friendly initiatives over time. Another possible explanation could be skepticism among investors on whether the firms' ESG practices are genuine or just to improve their appearance by "window dressing". If investors recognize window dressing, this may also be an explanation for the lack of reaction to positive ESG news.

In the case of negative ESG news, we find a low, but significant drop in the stock price on the event day. Even though the magnitude of the coefficient is low, the significance level supports hypothesis 2, suggesting that negative ESG news has a negative impact on the Norwegian stock market. The readjustment of the price is instant on the day of the event, with no gradual increase or significant recovery the following days. Thus, the findings of reactions to negative ESG news seem to be consistent with the semi-strong market efficiency in the EMH. From figure 3, the stock price movements indicate a slight price recovery on day 2, but this is not found statistically significant. Given the instant reaction, we find no evidence that investors or portfolio managers can benefit from trading strategies by buying stocks after the release of negative ESG news and profiting from a subsequent mean reversion. In addition, the magnitude of the negative return is only -0.3% on the event day, which is not a substantial amount when

transaction costs are taken into account. Consequently, we cannot provide a trading strategy based on the findings of this study.

In one way, these findings challenge the view that profit maximization is the sole interest for shareholders and proposes that there are performance benefits for firms to prioritize more than profit-maximization. The results indicate that investors do value ESG and include more than just financials in their investment strategies. With that being said, we cannot prove whether the market reaction is a consequence of investors having a genuine focus on ESG or whether it is related to expectations of future financial performance and reputational costs. This can be seen in context with the relationship between ESG and corporate financial performance, as discussed in the literature review. There is also a risk of omitted confounding events in the event windows, thus a causal relationship between ESG news and stock price reactions cannot be proved. Moreover, our sample data suffers from event clustering, which may reduce the statistical power of the tests.

## 7.2 Trading Volume Results

As an addition to the study on returns, we investigate the level of trading volume around the publication of ESG news. The purpose of the volume event study is to further examine investor behavior from ESG news, which can provide more insight to the market reactions. The average abnormal volume (AAV) is calculated for each of the days in the event window and tested with a two-sided t-test. The null hypothesis is that the average abnormal volume is zero in the event window. If there is significant AAV, the null hypothesis can be rejected which indicates that there is abnormal trading volume related to the publication of ESG news. The table below presents the results for the volume event study for the 25 stocks in the sample.

**Table 10**: Average Abnormal Volume

| | **Positive news N=107** | | **Negative news N=225** | |
|---|---|---|---|---|
| Day | AAV (%) | t-stat | AAV (%) | t-stat |
| -1 | -0.0373 | -0.9438 | 0.0326 | 1.0915 |
| | (0.3952) | | (0.0299) | |
| 0 | -0.0068 | -0.1620 | 0.0423 | 1.3255 |
| | (0.0419) | | (0.0319) | |
| 1 | -0.0776** | -2.2586 | 0.0160 | 0.5057 |
| | (0.0344) | | (0.0316) | |
| 2 | -0.0561 | -1.2980 | 0.0006 | 0.0205 |
| | (0.0433) | | (0.0309) | |

***Note:*** *The AAVs are the log-transformed and relative trading volume measure, denoted in %. Standard errors are in the parentheses below and t-statistic provided in the next columns. ***Denotes the significance of the coefficients at the 1% level, **at the 5% level and *at the 10% level.*

According to **hypothesis 3** we expect to find abnormal trading volume in the event window of ESG news. An interesting observation is that all coefficients for positive news are negative and all the coefficients for negative news are positive. This indicates that the level of trading is lower than the mean around the publication of positive ESG news, and higher around negative news. Seeing these findings in context with the abnormal returns, it appears that the negative news is more interesting to investors than the positive news. However, as none of the coefficients for negative news are significant, there is no statistical evidence of abnormal trading volume. For positive news, there is significant abnormal trading volume the day after the news (day 1), with a significant AAV at the 5% level, but the magnitude is however very close to zero. As a result, it is difficult to conclude that ESG news has an impact on the trading volume.

As previously explained, abnormal volume indicates a lack of consensus among investors on whether the new information is a good or a bad signal for the value of the stock. This model can thus capture differences in investor's opinions of the interpretation of the news that the return model cannot. The return model can show insignificant aggregate price changes, but the volume model can prove that the news had an effect with changed trading activity. When it comes to research presented in the literature review, the results from Cui and Docherty (2020) showed a clear increase in abnormal trading volume for bad ESG news, as well as a small increase from positive news. They also find that the increase starts before the publications and

continues after the publication. Our findings are inconsistent with this, because we only find a very small change in abnormal trading volume on the day after the publication of positive news.

Statistically, there are methodological issues with the use of trading volume data in this study. See Appendix 7 for the detection of autocorrelation in the residuals, which makes the results questionable. We did not take this into account because previous literature suggested that this is not a problem when using one-day intervals. Taking autocorrelation into consideration or adapting a more advanced model, such as the market model, could possibly improve the ability to detect abnormal trading volume.

# 8 Concluding Remarks

## 8.1 Conclusion

To summarize, this thesis investigates the impact of ESG news on the Norwegian stock market by answering the following research question: "*How do firm-specific ESG- news publications affect stock market returns and trading volume at the Oslo Stock Exchange?"*. To answer the research question, we performed a multiple event study with both stock returns and trading volume, with non-financial ESG news articles as the events. The news data includes a total of 107 positive and 225 negative news from a sample of 25 companies listed at the Oslo Stock Exchange.

As hypothesized, we find that positive (negative) ESG news on average is related to positive (negative) returns on the event day, but only the latter was found statistically significant. The asymmetric stock price reaction between positive and negative ESG news is consistent with previous literature, where mainly negative ESG news has a significant impact on the stock market. As an additional approach to investigate the market behavior from ESG news, we also conducted a volume event study. We did not find any significant abnormal trading volume around negative news. The day after the release of positive ESG news, we found a significant but small reduction in average trading volume, which is inconsistent with previous literature. This result is interpreted as a confirmation that investors do not value positive ESG news.

In broader terms, this study aims to investigate investor behavior after the release of ESG news and whether investors value this type of non-financial information. The thesis contributes to existing research on the importance of ESG, for both businesses and investors. An overall conclusion that can be drawn from the literature review and our findings is that investors on average do not reward positive ESG behavior, but on the other hand they penalize negative ESG behavior. This inference is drawn from the behavior of previous stock prices, which is no guarantee for future price movements. If the market continues to penalize bad ESG-behavior, this forces companies to integrate sustainability which can eventually contribute to set new standards for corporate behavior.

## 8.2 Limitations

The approach of this study does inherit some empirical limitations. When it comes to the sample size, it is evident that a larger sample size could give more reliable results and more significant test statistics. We have not had access to software tools nor the time to collect a substantial amount of data, which limited this study to the 25 companies in the OBX-Index. One may argue that this sample is not random and does not fully represent all stocks listed at the Oslo Stock Exchange. Moreover, the news data suffers from severe skewness, of which Equinor represents a dominant proportion of the entire sample. This issue makes it difficult to interpret our results as representative for the full sample, and even more challenging to draw an overall conclusion for the Norwegian stock market as a whole. There is also an overweight of negative news in our sample, so there may be differences in the validity of the results for positive and negative news respectively. An improvement of the approach could also be to include neutral news as a control group.

Another limitation of the data collecting is that we are unable to completely separate financial ESG news from non-financial ESG news. We tried to the best of our knowledge to include strictly non-financial news to isolate the effect of ESG, but there is no absolute line between financial and non-financial news. Furthermore, we cannot completely rule out that the results are driven by investors' genuine focus of the ESG concerns. Considering that previous literature find evidence of a positive relationship between good ESG behavior and corporate financial performance, there may be a possibility that the non-financial ESG news only affects expectations of future financial performance.

As this study utilizes daily returns, we overlook intraday fluctuations and are consequently unable to capture the most immediate price reactions. Moreover, there can be omitted explanations and confounding events that our model does not capture, as we only study the effect that the news media has on stock prices. There could be additional explanatory factors, such as ESG ratings, which we do not take into account. In conclusion, we cannot completely prove a causal relationship between ESG, stock market returns and volume, but the results seem overall reliable.

## 8.3 Suggestions for Further Research

A natural next step for this study would be to take the mentioned limitations into account for a

more precise analysis. To take this study even further, it could be interesting to separate the three ESG factors to detect whether investors place different emphasis on the different areas. Furthermore, an interesting approach could also be to investigate differences across sectors. This could reveal whether ESG concerns are more prominent in certain industries. Finally, one could also investigate if there are geographical differences in the impact of ESG news to detect variations between countries in the importance of ESG.

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# Appendix

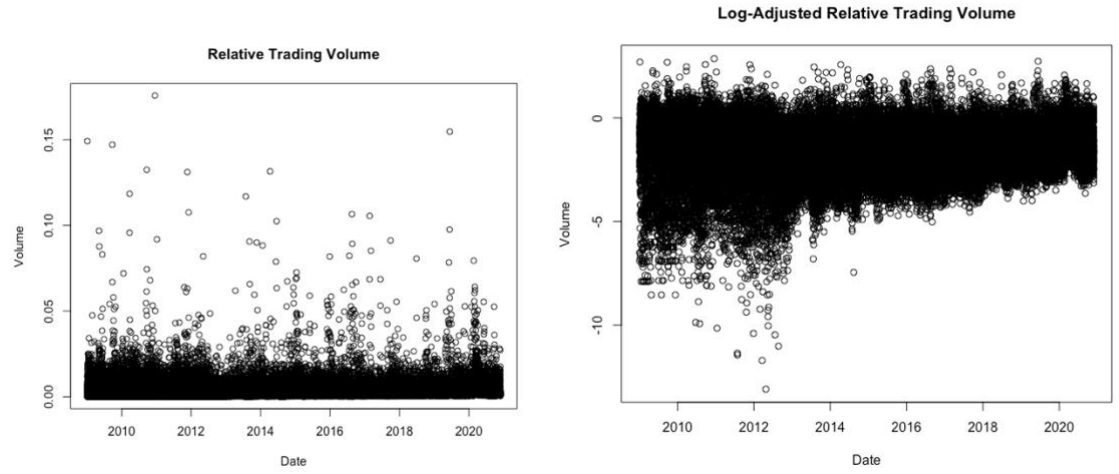
## Appendix 1: Outliers

**Figure 4:** Unadjusted and Adjusted Returns


***Note**: Scatterplot of the return variable containing data from all 25 stocks from 2009-2020. The plot to the left visualizes some extreme outliers in the unadjusted returns, while the plot to the right with the adjusted returns is more balanced.*

We find that the extreme returns in the plot to the left are caused by financial events such as stock mergers, which do not reflect the true market movements. In order to reduce the problem with outliers, we use the returns adjusted for dividend payments, stock mergers and splits. This variable still contained some smaller outliers, but a robustness test found that eliminating these did not impact the results. Consequently, no values were winsorized or removed in the analysis.

**Figure 5:** Simple and Log-Adjusted Trading Volume



***Note:*** *The scatterplot is the daily trading volume variable for all 25 stocks in the sample from 2009-2020. The left plot contains the simple relative trading volume, and the right plot contains the logarithmic transformed values.*

The log-transformation provides a distribution closer to normal but contained some especially low values, due to trading levels near zero for some companies around the period 2010-2012. As we use the constant-mean model, we do not consider these low values an issue, because the mean trading volume used to predict expected volume is calculated for each company individually.

# Appendix 2: OLS Assumptions

We check whether the following six assumptions of OLS regressions from Woolridge (2012) hold in order to utilize a t-test and for the estimators of the market model to be the best linear unbiased (blue) estimators.

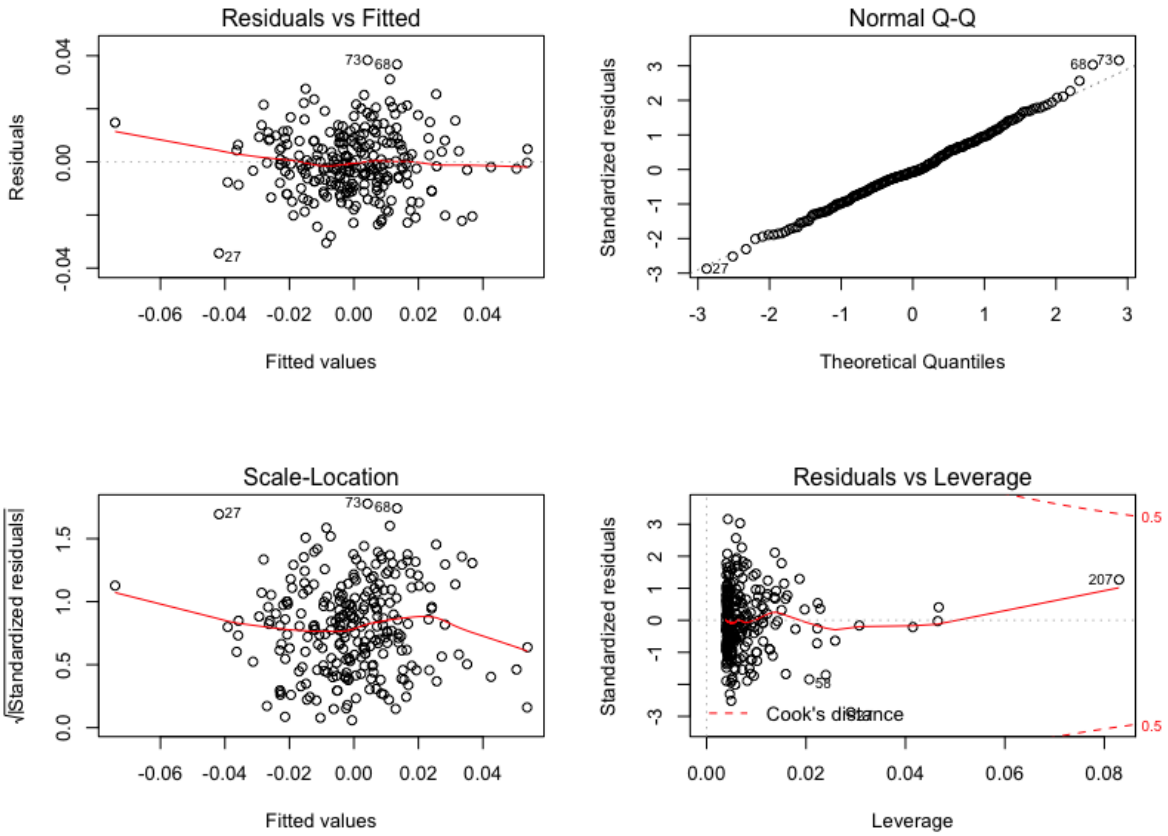
**Table 11:** OLS Assumptions

| Assumption | Description | Properties |
|---|---|---|
| Assumption 1 | Linear in parameters | Under assumptions 1 to 3, the OLS estimators are unbiased |
| Assumption 2 | No perfect multicollinearity | |
| Assumption 3 | Zero conditional mean | |
| Assumption 4 | Homoskedasticity | Under assumptions 1 through 5, the OLS estimators are the best linear unbiased estimators |
| Assumption 5 | No serial correlation | |
| Assumption 6 | Normality | Under assumptions 1 through 6, the OLS estimators are normally distributed and under the null hypothesis each t-statistic has a t-distribution |

***Note:*** *The table presents six assumptions of OLS regressions. Assumption 2 holds true by default in the market model because the index is the only independent variable.*

Residual plots are used to examine whether the assumptions seem reasonable, with an example for one security presented below.

**Figure 6:** Residual Plots




***Note:*** *The four residual plots are from the market model regression with Equinor and the OBX-index, for the event date 11.03.2015, where the normal returns are estimated within the estimation window [-257,7]. The top left plot is a residual vs. fitted values plot, which is used to check if the linear relationship assumption holds and if the residuals have a constant mean of zero. The line is close to horizontal and near to zero, which indicates a linear relationship. The top right plot is a Q-Q plot, where the residual points closely follow the dotted line, which indicates normality. The bottom left plot is a scale-location plot, which is used to check the variance of the residuals. A horizontal line with equally spread points is a good indication of homoskedasticity, which seems to be true in this example. The bottom right plot is a residual vs. leverage plot, which indicates if outliers in the estimation window are influential. The data seems to be inside the Cook's distance lines which indicates that the extreme values do not have influence on the regression results.*

Generally, the residual plots give reason to believe that the assumptions hold, but additional statistical tests are performed as more precise confirmations. The Durbin-Watson test detects residual autocorrelation, and the Breusch-Pagan test detects heteroscedasticity. A list of the events that contained either autocorrelation in the residuals or variance that is not constant over time (heteroskedasticity) is presented in the table below.

**Table 12:** Rejected DW and BP Tests

| Company | Event date (m/d/y) | Sentiment of Event | Durbin-Watson Test | Breusch-Pagan Test |
|---|---|---|---|---|
| Aker BP | 10/27/2020 | Positive | Rejected | Rejected |
| Bakkafrost | 09/24/2018 | Negative | OK | Rejected |
| Equinor | 11/19/2010 | Negative | OK | Rejected |
| DNO | 09/11/2020 | Positive | Rejected | OK |
| Equinor | 11/24/2010 | Negative | OK | Rejected |
| Equinor | 09/25/2017 | Negative | OK | Rejected |
| Equinor | 04/15/2020 | Negative | OK | Rejected |
| Frontline | 06/29/2020 | Negative | OK | Rejected |
| Equinor | 09/07/2020 | Negative | OK | Rejected |
| Equinor | 09/15/2020 | Negative | OK | Rejected |
| Equinor | 09/21/2020 | Negative | OK | Rejected |
| Equinor | 10/02/2020 | Negative | OK | Rejected |
| Equinor | 10/26/2020 | Negative | OK | Rejected |
| Equinor | 12/09/2010 | Positive | OK | Rejected |
| Equinor | 10/02/2017 | Positive | OK | Rejected |
| Equinor | 06/08/2020 | Positive | OK | Rejected |
| Equinor | 06/23/2020 | Positive | OK | Rejected |
| Equinor | 07/01/2020 | Positive | OK | Rejected |
| Equinor | 09/09/2020 | Positive | OK | Rejected |
| Equinor | 10/20/2020 | Positive | OK | Rejected |
| Equinor | 11/18/2020 | Positive | OK | Rejected |
| Mowi | 11/11/2020 | Positive | OK | Rejected |
| Norsk Hydro | 01/09/2012 | Negative | OK | Rejected |
| SalMar | 09/04/2018 | Negative | OK | Rejected |
| Storebrand | 11/30/2018 | Positive | OK | Rejected |
| Telenor | 01/28/2016 | Negative | OK | Rejected |
| Telenor | 02/01/2016 | Negative | OK | Rejected |
| TGS-NOPEC Geophysical Company | 06/04/2012 | Negative | OK | Rejected |
| Yara International | 08/15/2018 | Positive | OK | Rejected |

***Note**: The table presents all events with a rejection of either the Durbin-Watson test or the Breusch-Pagan test with use of the single-index market model in the estimation window. The null hypothesis in the tests is that there is no residual autocorrelation or heteroscedasticity, and a rejection implies that the assumptions do not hold.*

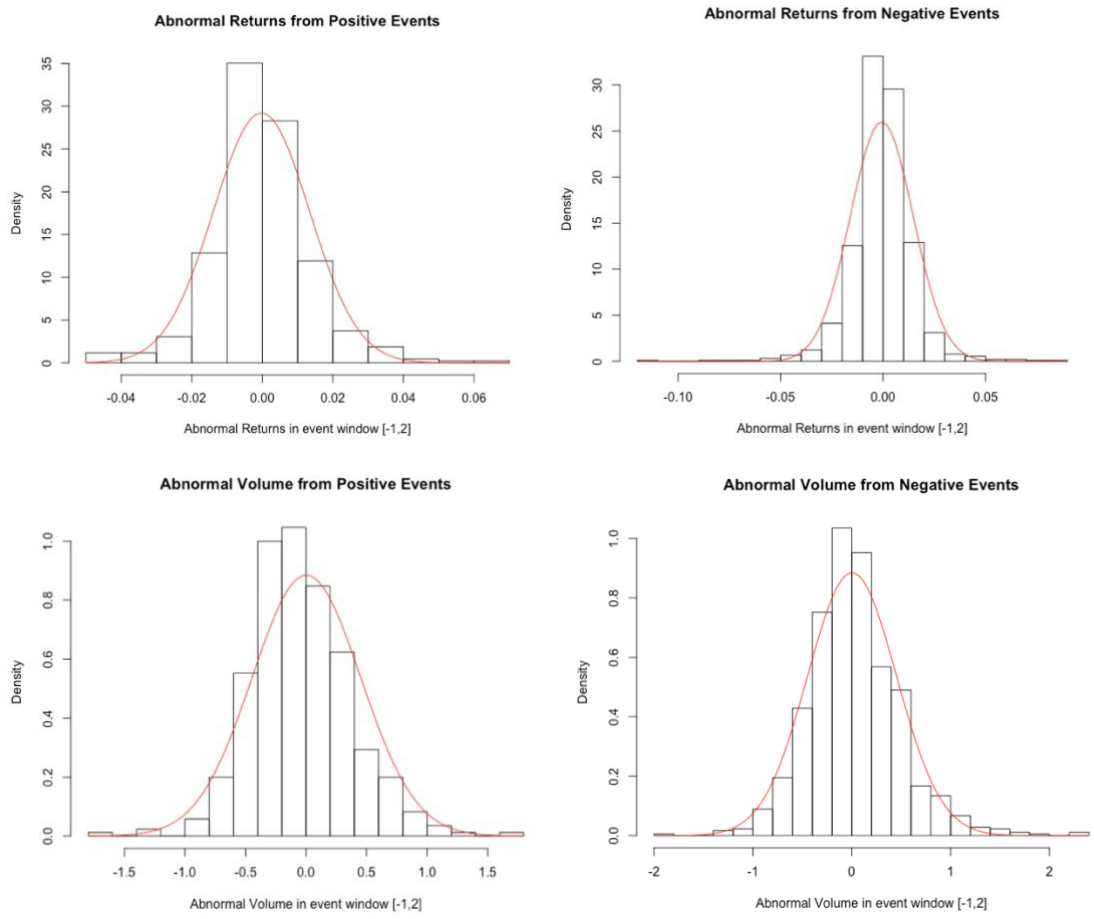
Out of all events, there was only two rejections of the Durbin-Watson test, which indicates that serial correlation in the errors is not an overall issue for the data used in this study. There are several rejections of the Breusch-Pagan test, which means that heteroscedasticity is an issue in

some of the regressions. We solve this by using heteroskedasticity robust standard errors for all events.

# Appendix 3: Distribution of Abnormal Returns and Volume

One assumption of the t-test to provide reliable inferences is a normal distribution of the abnormal returns and volume in the event window. To verify this, we use histograms with density plots of abnormal returns and volume for all events, presented in the following figure:

**Figure 7:** Distributions of Abnormal Return and Volume




***Note:*** *The top histograms are of abnormal volume from the positive and negative ESG news (events) in the event window from [-1,2]. The bottom two histograms are the abnormal volume for positive and negative events. The red line is the normal distribution which indicates approximate normality, with means close to the medians, and reasonably well specified tails.*

# Appendix 4: Sample Details

**Table 13:** OBX-Index Constituents

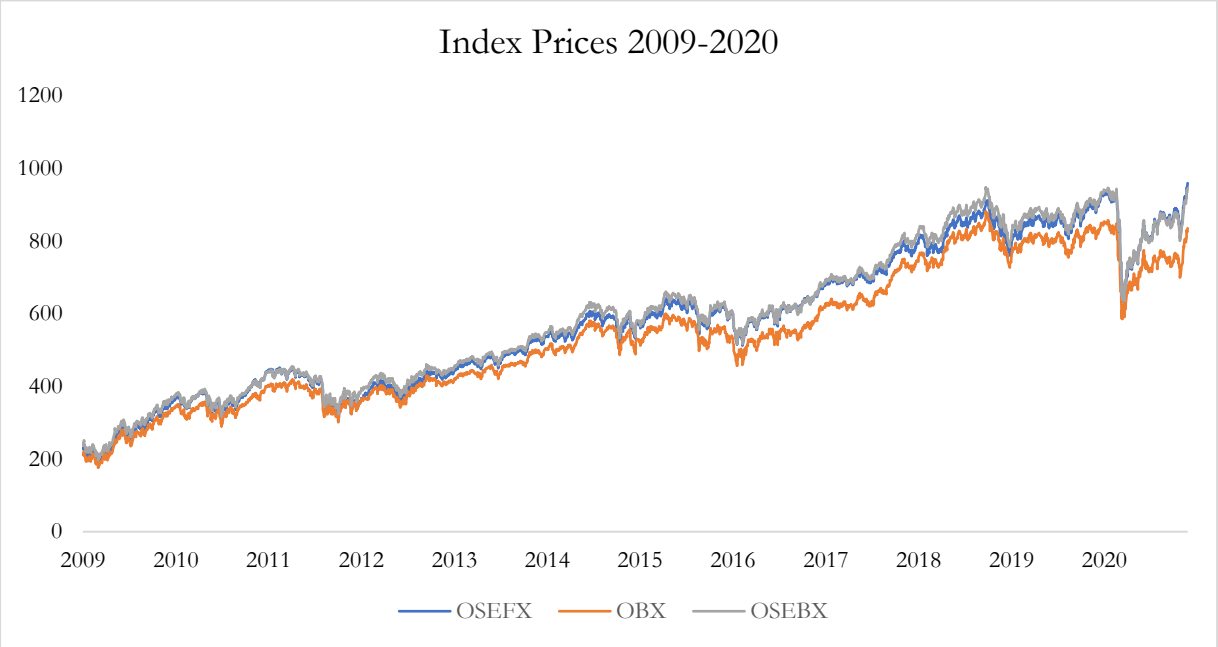
| Company | Sector | Weight | Market value (MNOK) |
|---|---|---|---|
| Aker | Diversified Financial Services | 1.29% | 54367.66 |
| Aker BP | Oil: Crude producers | 2.06% | 95260.75 |
| Bakkafrost | Farming, fishing, ranching and plantations | 3.04% | 38650.04 |
| BW LPG | Marine Transportations | 0.4% | 6994.6 |
| BW Offshore Ltd | Oil: Equipment and Services | 0.3% | 6237.59 |
| DNB | Banks | 13.91% | 286817.53 |
| DNO | Oil: Crude Producers | 0.36% | 10368.85 |
| Entra | Real Estate Holding and Development | 2.97% | 33183.95 |
| Equinor | Integrated Oil and Gas | 14.82% | 568103.57 |
| Frontline | Marine Transportation | 0.41% | 12838.03 |
| Gjensidige Forsikring | Full Line Insurance | 3.39% | 101797.01 |
| Lerøy Seafood Group | Farming, Fishing, Ranching and Plantations | 1.59% | 42767.08 |
| Mowi | Farming, Fishing, Ranching and Plantations | 7.86% | 108152.36 |
| Nel | Alternative Fuels | 3.39% | 33654.42 |
| Norsk Hydro | Aluminium | 5.06% | 105441.54 |
| Orkla | Food Products | 6.16% | 81825.54 |
| SalMar | Farming, Fishing, Ranching and Plantations | 2.51% | 65850.37 |
| Scatec | Renewable Energy Equipment | 3.23% | 41813.01 |
| Schibsted ser. A | Publishing | 2.54% | 81811.38 |
| Storebrand | Life Insurance | 2.65% | 37935.69 |
| Subsea 7 | Oil: Equipment and Services | 1.85% | 28808.82 |
| Telenor | Telecommunications Services | 9.18% | 210758.38 |
| TGS-Nopec Geophysical Company | Oil: Equipment and Services | 1.37% | 17507.58 |
| Tomra Systems | Machinery: Industrial | 4.14% | 53866.5 |
| Yara International | Fertilizers | 5.52% | 114037.85 |

***Note:*** *Overview of the 25 companies in the OBX-Index as of January 2021 sorted by name, which are the stocks used in the event study. The table shows which sector each company belongs to as categorized by Euronext and with the weights in the index. The market value is collected in January 2021. Source: Euronext* (2021).

# Appendix 5: Index Selection

The three index options to use in the market model were OBX-Index, the OSEFX-index and the OSEBX-Index. The price movements from 2009 to 2020 of the three indices are presented in the figure below, which reveal a high correlations between all indices.

**Figure 8**: Index Price Movements (2009-2020)




***Note:*** *The chart shows the prices of the three indexes we considered using in the market model. The blue line is the OSEFX-index, the orange line is the OBX-index and the grey line is the OSEBX index.*

The plot reveals that the indices follow each other closely, which implies that the choice of index would not make a big impact on the coefficients from the market model. This is further verified by a robustness test, which finds no significant differences in the results using the three different indices. The regression outputs reveal that the OBX-index has the highest average $R^2$, which indicates a greater variance reduction of the abnormal return. The mean $R^2$ and adjusted $R^2$ results are presented in the table below.

**Table 14:** Explanatory Power of the Indices

| Index | Positive news | | Negative news | |
|---|---|---|---|---|
| | $R^2$ | Adj. $R^2$ | $R^2$ | Adj. $R^2$ |
| OBX-Index | 0.4556 | 0.4534 | 0.4351 | 0.4328 |
| OSEFX-Index | 0.4160 | 0.4136 | 0.4051 | 0.4027 |
| OSEBX-Index | 0.4469 | 0.4447 | 0.4469 | 0.4447 |

***Note:*** *The table shows the results from the market model regression with the use of three different indices, for both positive news and negative news. The R-squared and adjusted R-squared values are the average of all regressions for all events. The regressions are performed with data from the estimation window of 250 days before each event.*

# Appendix 6: Event Clustering

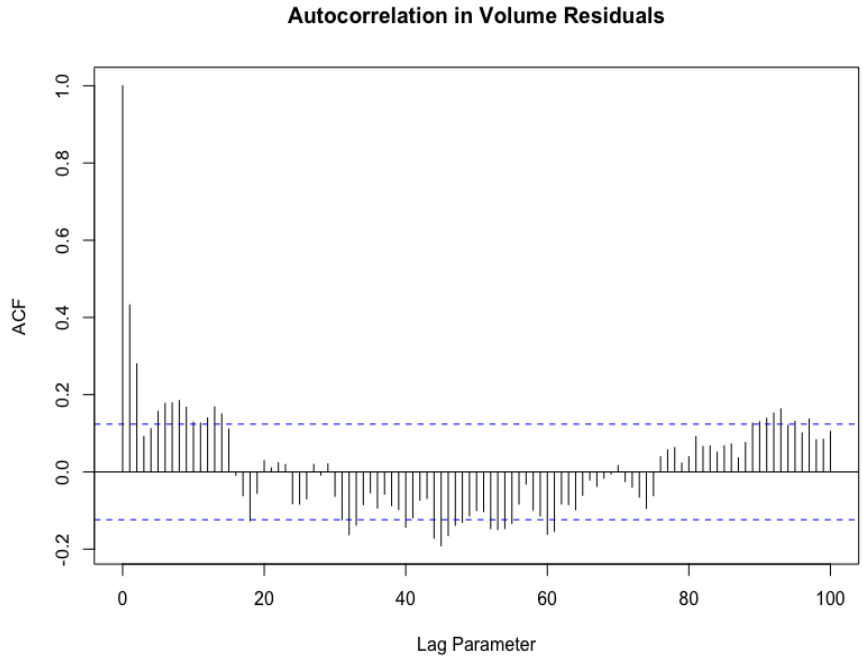
**Table 15**: Overview of Event Clustering

| **Positive news** | |
|---|---|
| Event date (m/d/y) | Clustered events |
| 03/06/2018 | 2 |
| 12/14/2018 | 2 |
| 11/18/2020 | 2 |
| **Negative news** | |
| Event date (m/d/y) | Clustered events |
| 11/21/2011 | 2 |
| 02/03/2012 | 2 |
| 11/06/2013 | 2 |
| 02/10/2014 | 2 |
| 01/28/2016 | 2 |
| 03/28/2017 | 2 |
| 11/07/2017 | 2 |
| 03/19/2018 | 2 |
| 01/28/2019 | 2 |
| 02/20/2019 | 2 |
| 04/25/2019 | 3 |
| 12/10/2019 | 2 |
| 07/02/2020 | 2 |
| 09/21/2020 | 2 |

***Note****: The table displays the dates suffering from event clustering across companies for positive and negative news respectively and the number of events on the same dates.*

# Appendix 7: Autocorrelation in Volume Residuals

**Figure 9:** Volume Autocorrelation Plot




***Note:*** *The plot visualizes autocorrelation for Aker ASA on event date 04.12.2012 with residuals from the constant mean model in the estimation window [-257, -7]. The x-axis is the number of lags. The y-axis is the degree of autocorrelation, where levels outside the blue line are significant. As expected, significant levels of autocorrelation in the volume residuals were found in the volume residuals for the majority of the events.*