Norwegian School of Economics
Bergen, Spring 2022

Market Reactions to Insider Trading and Repurchases

An Empirical Study Measuring Abnormal Returns on the Oslo Stock Exchange

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Master thesis

Master of Science in Economics and Business Administration

Major: Financial Economics

NORWEGIAN SCHOOL OF ECONOMICS

This thesis was written as a part of the Master of Science in Economics and Business Administration at NHH. Please note that neither the institution nor the examiners are responsible − through the approval of this thesis − for the theories and methods used, or results and conclusions drawn in this work.

Preface

This thesis concludes our degree in Master of Science in Economics and Business Administration at the Norwegian School of Economics. We chose the theme of the thesis based on our particular interest in capital markets and have found the process of writing the paper to be challenging, educational, but most of all interesting.

We would like to express our gratitude towards our supervisor, associate professor of finance at NHH, Konrad Raff, whose valuable feedback and expertise in corporate finance has helped us throughout the process.

We would also like to thank our families for their unconditional support through years of studying.

Norwegian School of Economics

Bergen, June 2022

Abstract

This thesis investigates capital market efficiency by investigating market reactions to insider trading and repurchase announcements on the Oslo Stock Exchange, both separately and conjointly. Previous research has indicated lack of market efficiency with regards to such announcements. Our research differs from existing literature by examining a more recent time-period and studying insider trading and repurchase announcements conjointly on the Oslo Stock Exchange. There are several findings in our study. Firstly, for insider trading announcements, we find significant short-term abnormal returns of 1,00% across all insider buy sizes, and 2,55% for large monetary insider buys. Second, we also find significant long-term abnormal returns associated to insider buying and insider selling, at 3,07% and -2,68% respectively. Long-term abnormal returns increase for larger monetary sized trades for both buys and sells, suggesting a positive relationship between abnormal returns and insider trade size. Moreover, we find evidence of short-term abnormal returns associated with repurchase announcements of 1,84% and show that the insider net purchase ratio[1] decreases as time approaches announcement date, suggesting decreasing insider trading activity. Finally, we show that a one unit increase in the net purchase ratio can be associated to a 1,73% increase of abnormal returns in a buy-and-hold strategy, suggesting a positive relationship between insider net purchasing and announcement returns.

[1] The net purchase ratio is a variable that measures the net insider buying divided by total insider trading.

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1. Introduction

Due to the nature of their position, corporate insiders often possess more information on the company and its fundamentals than any ordinary investor. This raises the question if there is an asymmetric information relationship giving insiders a trading advantage on behalf of ordinary investors, and, if so, whether insiders should be allowed to trade their companies' stocks or not. In most capital markets, insider trading and repurchases are regulated to a certain degree. In Norway, insider trading and repurchases are regulated through the Norwegian securities trading act. This thesis seeks to investigate how the market reacts to insider trading and repurchases, and if there is any relationship between insider trading and repurchases themselves.

Several scholars have investigated market reactions to insider trading and repurchases. On the topic of insider trading, recent studies show that insiders make abnormal returns on their trades (e.g., Jenter, 2005 or Cohen, Malloy and Pomorski, 2012), contradicting the efficient market hypothesis. For repurchases previous studies, such as Skjeltorp (2004) on the Norwegian Stock Exchange, and Ben-Rephael et al. (2014) and Cziraki et al. (2019) in the US capital markets, have shown statistically significant abnormal returns associated to repurchase announcements, contradicting the efficient market hypothesis. Cziraki et al. (2019) investigate the relationship between insider trading and abnormal returns associated to repurchase announcements and find that there is a positive relationship between net buying in the time prior to a repurchase announcements and the abnormal returns in the time following the announcement.

In this thesis, we analyze abnormal returns related to insider trading and repurchases on the Oslo Stock Exchange, both separately and together. Even though insider trades have been mandatory to report for over a century, publicly disclosing information about repurchase programs have only been mandatory since 2016 for companies on the Oslo Stock Exchange. Therefore, the analysis in this thesis is based on data collected for the period of 2016 – 2021. The data is hand collected from the Oslo Stock Exchange's publicly available platform, NewsWeb. To investigate abnormal returns related to insider trades and repurchase announcement, we apply the event study methodology. Thereafter, we introduce the net purchase variable (NPR), a variable that measures the net insider buying divided by total insider trading. We use this variable together with data on the abnormal returns from the

repurchase announcements to examine the effect insider trading prior to a repurchase announcement has on buy-and-hold abnormal returns.

Consistent with previous literature (e.g., Jenter, 2005 or Cohen, Malloy and Pomorski, 2012), we find support that there are abnormal returns related to insider trading, both in the short-term and in the long-term. Our results suggest there are short-term abnormal returns related to repurchase announcements, but not in the long-term. This is in line with literature on repurchase announcements on the Oslo Stock Exchange (Skjeltorp, 2004). We also find support of a positive relationship between insider trading and short-term buy-and-hold abnormal returns related to repurchase announcements, which is consistent with the recent paper of Cziraki et al. (2019) on insider trading around share repurchases and SEOs.

The remainder of the thesis has the following structure. In section 2, we define insider trading and repurchases and explain the current regulations on the Oslo Stock Exchange. Thereafter, we introduce relevant theories, review relevant literature, and present our hypotheses in section 3. Furthermore, in section 4, we describe the data we have collected, how we have collected it and the problems and limitations we have encountered. In section 5, we present the methodology applied to test our hypotheses. Section 6 presents the results and a discussion of the analysis, before we conclude our findings in section 7.

2. Insider Trading and Regulations on the Oslo Stock Exchange

Insider trading is said to occur when a person in a significant position in the firm buys or sells a share in the firm. This could be a person from the C-suite, a member of the board of directors, a large shareholder or someone closely related to any of these parties. Due to the nature of the position of an insider, the insider will typically have greater insight to the company than the ordinary investor. This has sparked a debate within the world of finance whether insiders should be allowed to trade in their companies' shares. Some would argue that insider trading can increase market efficiency through bringing the stock price closer to its fundamental value (Manne, 1967). A counter argument could be that to incentivize market participation, there must be rules to ensure a well-functioning capital market. From a non-capitalistic perspective, some believe acting on inside information would give an unethical edge on behalf of the ordinary investor (Ausubel, 1990).

Insider trading in Norway is regulated through the "Norwegian securities trading act" ("Verdipapirhandelloven"), with a goal to ensure safe and effective trading of securities in Norway (Verdipapirhandelloven, 2022). To maintain efficiency, insiders must report every trade made in own shares to the Oslo Stock Exchange no longer than by the start of the following trading day (Verdipapirhandelloven, 2022). Thereafter, a message containing the name and the position of the insider, the number of shares bought, and the average price will be published on "NewsWeb", a publicly available website controlled by the Oslo Stock Exchange. Similarly, all trades made by companies in their own shares (e.g., buybacks), must be reported to the Oslo Stock Exchange, and will then be published to NewsWeb. Following regulation 2016/1052 of 8th of March 2016, all companies listed on the Oslo Stock Exchange have been obligated from 3rd of July 2016 to disclose the following details regarding buyback programs:

A) the purpose of the program,

B) the maximum amount of money allocated to the program,

C) the maximum number of stocks to be acquired, and

D) the duration of the program.

The details are to be disclosed by the latest at the start of the following trading day and published on NewsWeb.

3. Literature Review

In this section, we will present relevant theory on market efficiency and information asymmetry and review papers relevant to our hypotheses, which will be presented throughout this section.

3.1 Market Efficiency

In 1970, Fama published one of the now most well-known hypotheses in economic theory, the efficient market hypothesis (EMH). In efficient markets, all available information is reflected in stock prices. This implies that it is not possible to make systematic positive abnormal returns by analyzing available information to sell overvalued shares and buy undervalued shares. However, Fama acknowledged that this restriction was very strict, and thus proposed three forms of market efficiency with different degrees of strictness.

In the most relaxed efficiency form, the weak form, only past stock prices, and past publicly available information is reflected in the share price. According to most empirical evidence, the weak form efficiency holds. In the semi-strong form, all publicly available information is reflected in the share price, meaning it is not possible to generate abnormal profits trading on new information. In the strong form, all information, including insider information, is reflected in the share price, meaning that even insiders cannot make abnormal returns when trading on private information.

3.2 Information Asymmetry

The concept of asymmetric information is defined in *The Market for "Lemons": Quality Uncertainty and the Market Mechanism* (Akerlof et al., 1970). Information asymmetry is based on the thought that there is information imbalance between parties. The article argues that market participants with superior knowledge will gain on behalf of other market participants who sustain average knowledge. As insiders, such as C-suite employees at firms, have daily insight to the corporation and its processes, one would expect them to have more knowledge about the firm than outsiders, who only receive aggregated information at certain times during a year.

3.2.1 Insider Trading and Profitability

According to Akerlof et al. (1970), we would expect insiders to have the possibility to make abnormal positive returns based on their information advantage. Several scholars (e.g., Lakonishok and Lee (2001), Jenter (2005), Cohen, Malloy and Pomorski (2012), Cziraki, Lyandres and Michaely (2019)) have indeed shown that there is a positive relationship between insider trading and future returns. If insiders could make abnormal returns based on their privately held information, this indicates that the strong form efficiency is violated. For the semi strong form to hold, it should not be possible for non-insiders to make abnormal returns by mimicking insiders' trading. This leads us to hypotheses 1a – 1c:

Hypothesis 1a:
Insiders make short-term abnormal returns when trading in their companies' stock.

Hypothesis 1b:
Insiders make long-term abnormal returns when trading in their companies' stock.

Hypothesis 1c:
There are higher abnormal returns associated with higher volume times price insider trades.

3.2.2 Repurchases and Profitability

A repurchase is when a firm completes a buyback of shares from its own shareholders. In the past couple of decades, there has been an increasing use of, and focus on, repurchases. Although, historically, dividends have been the most common way to return excess cash to shareholders, an increasing number of firms have in the last two decades been using an alternative way to create shareholder value: repurchases.

The signaling hypothesis states that one of the motivations for firms to do buybacks is to supply significant new information to the market. From a study in the US, Ben-Rephael et al. (2014) find that firms "buy their stock at bargain prices" and experience abnormal positive returns in the period following the repurchase. This suggests that firms repurchase at times they believe their stock is undervalued, indicating the strong form efficiency does not hold. In addition, several papers (e.g., Myers and Majluf (1984), Korajczyk, Lucas, and McDonald (1991), Graham and Harvey (2001), and Brav, Graham, Harvey, and Michaely (2005)) have shown that information asymmetry and misevaluation are important factors managers consider

when deciding if, and when, to issue and repurchase equity. To investigate if there are abnormal returns associated to repurchase announcements, we will test the following hypotheses:

Hypothesis 2a:

There are abnormal returns associated with repurchase announcements in the short-term (announcement returns).

Hypothesis 2b:

There are abnormal returns associated with repurchase announcements in the long-term.

3.2.3 Insider Trading and Repurchases

Given that there are market inefficiencies and information asymmetry, it seems reasonable to believe opportunistic insiders would increase buying of shares in the company prior to a repurchase announcement and reduce selling. In a recent paper, Cziraki et al. (2019) study insider trading in relation to share repurchases and SEOs in the US and find an increase of 18% of one standard deviation of the net purchase ratio, defined as:

$$Net\ purchase\ ratio\ (NPR) = \frac{Insider\ buy - insider\ sell}{total\ insider\ trades} \qquad (1)$$

In other words, insiders seem to increase buying/reduce selling prior to the event. In addition, the paper finds evidence that a higher insider net buying in the time prior to the event is associated with higher abnormal returns in the time following the announcement. Considering Czikari et al. (2019), we will investigate the NPR and its relationship to abnormal returns, leading us to hypotheses 3 and 4:

Hypothesis 3a:

The net purchase ratio increases when time approaches announcement date.

Hypothesis 4a:

A higher level of insider buying (net purchase ratio) in the time prior to the repurchase announcement suggests a higher level of abnormal returns in short-term (announcement returns).

Hypothesis 4b:

A higher level of insider buying (net purchase ratio) in the time prior to the repurchase announcement indicates a higher level of abnormal returns in the long-term.

3.3 Insider Trading and Repurchases on the Oslo Stock Exchange

To our knowledge, there is limited literature investigating insider trading and repurchases on the Oslo Stock Exchange. Eckbo and Smith (1998) find no significant abnormal returns on a long-term insider trading portfolio, while Skjeltorp (2004) finds a small, but significant, abnormal return associated to repurchases. These articles were published 24 and 18 years ago, and the requirements for reporting insider trading and repurchases have become stricter in recent years. As far as we know, there is no literature exploring the relation between insider trading and repurchases in Norway. Based on the literature review, there is reason to believe the efficient market hypothesis does not necessarily hold in the strong form. We hope that our thesis, which is testing the EMH on several aspects, could add value to the existing literature of insider trading and repurchases on the Oslo Stock Exchange.

4. Data

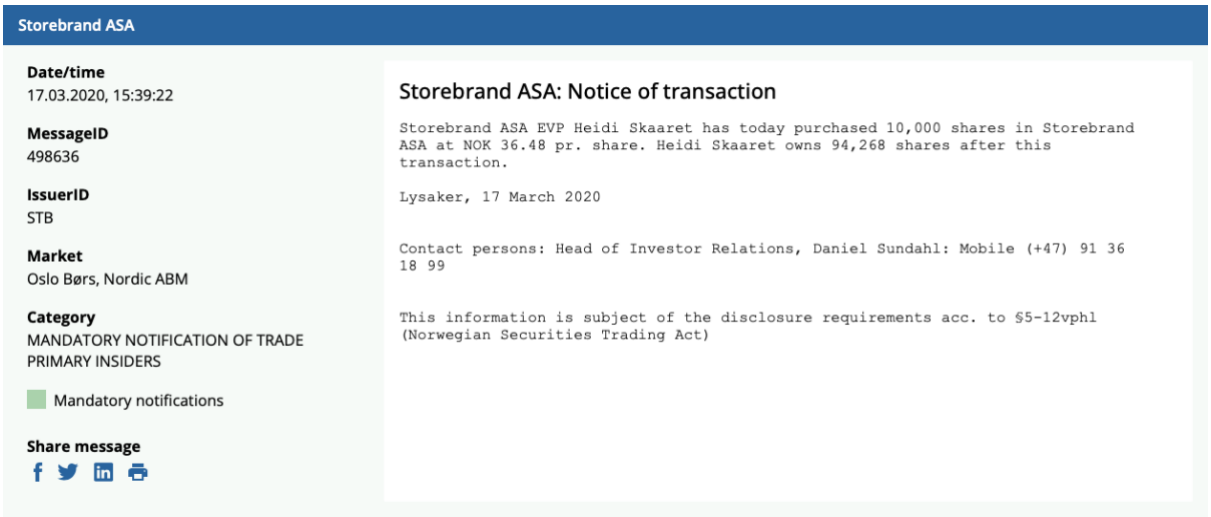
In the following section we present how we have gathered and processed our data. First, we go through the collection, merging and cleansing process of insider trades, repurchases and stock prices. Second, we present a summary of relevant descriptive data, and finally comment on data limitations and problems.

4.1 Time Period

As mentioned in section *2 Insider Trading and Regulations on the Oslo Stock Exchange*, the Oslo Stock Exchange publishes a notification on NewsWeb every time an insider (see *2 Insider Trading and Regulations on the Oslo Stock Exchange* for definition) buys or sells a share of the company, and every time a company does a repurchase. While the data on insider trades on NewsWeb is available from 1998, data on acquisitions of the issuer's own shares is available only from 2017. To analyse our hypotheses, we use repurchase data in the period 2017 till 2020, insider trades in the period 2016 till 2020, and stock prices in the period 2016 till 2021.

4.2 Insider Trading Data

We obtain the relevant messages from NewsWeb by applying the following filters: "Category → Mandatory notification of trade primary insiders", "Market → Oslo Børs", "From date → 01.01.2017", "To date → 31.12.2020". With these filters applied, a total of 5950 messages appear. A great proportion of these messages refer to options, TRS agreements and other incentive agreements. As we exclusively want to analyse insider trades, we discreetly exclude non-relevant messages such as the forementioned, by manually going through all 5950 messages. From applicable messages, we manually extract the relevant data from insider trading messages. A typical message is shown in picture 4.1, while picture 4.2 displays the relevant information we manually extract from the message. The relevant data for our theses is ticker, date, insider position, whether it was a buy or sale, volume, and price. After excluding non-relevant messages, we are left with a total of 2769 insider trade observations.


Storebrand ASA

Date/time
17.03.2020, 15:39:22

MessageID
498636

IssuerID
STB

Market
Oslo Børs, Nordic ABM

Category
MANDATORY NOTIFICATION OF TRADE
PRIMARY INSIDERS

Mandatory notifications

Share message

Storebrand ASA: Notice of transaction

Storebrand ASA EVP Heidi Skaaret has today purchased 10,000 shares in Storebrand ASA at NOK 36.48 pr. share. Heidi Skaaret owns 94,268 shares after this transaction.

Lysaker, 17 March 2020

Contact persons: Head of Investor Relations, Daniel Sundahl: Mobile (+47) 91 36 18 99

This information is subject of the disclosure requirements acc. to §5-12vphl (Norwegian Securities Trading Act)

Picture 4.1: typical insider trade announcement on NewsWeb.

Ticker	Date	Company	Insider	Buy/Sell	Volume	Price	Volume x Price
STB	17.03.2020	Storebrand ASA	EVP	Buy	10 000	36.48	364 800

Picture 4.2: typical extracted data from an insider trade announcement.

4.3 Repurchase Data

As for the insider trading data, we use NewsWeb to find the data on repurchases. The following filters are applied to find the relevant messages: "Category → Acquisition or disposal of the issuer's own shares", "Market → Oslo Børs", "From date → 01.01.2017", "To date → 31.12.2020". The result is a total of 5851 messages. A repurchase announcement is a message the company must issue stating it will start a repurchase program and must be published prior to starting trading in their own shares, as defined in section *2 Insider Trading and Regulations on the Oslo Stock Exchange*. As companies are required to report every trade they make in their own shares, only a fraction of the messages will be repurchase announcements. We manually go through every message to find the repurchase announcement published by firms and extract the relevant data for our theses. A typical message is shown in picture 4.3, while picture 4.4 displays the relevant information we extract from the message. The relevant data for our theses is ticker, announcement date, volume, and price. In total 244 repurchases have been made over the four years.

Magnora ASA

Date/time
21.05.2019, 13:12:58

MessageID
477488

IssuerID
MGN

Instrument
MGN

Market
Oslo Børs

Category
ACQUISITION OR DISPOSAL OF THE ISSUER'S OWN SHARES

Mandatory notifications

OAM announcement

Share message

Magnora ASA - Launch of share buyback program

Magnora ASA ("Magnora") has decided to initiate a share buyback program. The buyback program will be carried out by market purchases in accordance with the authorization granted by the annual general meeting to the Board of Directors on 21 May 2019. Buyback transactions will be executed according to the market price on the Oslo Stock Exchange and the maximum consideration to be paid for shares acquired under the buyback program is NOK 8.5 per share and NOK 2.57 million in aggregate. The maximum number of shares that can be acquired under the program is 642 500 shares. The program will be initiated today and be valid until the next AGM in 2020 or latest 30 June 2020. Magnora may at any time without further notice close or suspend the program.

Shares purchased under the program will be used to reduce the number of outstanding shares or be used to cover obligations under any approved share option scheme.

The maximum number of shares which may be purchased in any one day is limited to 50% of the average weighted daily volume of Magnora shares traded in the 20 trading days preceding the day of purchase.

The share buyback program is managed and will be executed by Skandinaviska Enskilda Banken on behalf of Magnora.

* * * * *

For more information please contact:
Erik Sneve, CEO, Magnora ASA
es@magnoraasa.com

This information is subject to the disclosure requirements pursuant to section 5-12 of the Norwegian Securities Trading Act.

Picture 4.3: a typical repurchase announcement on NewsWeb.

Ticker	Announcement	Company	Volume	Price	Volume x Price
MGN	21.05.2019	Magnora ASA	642 500	8.5	2 570 000

Picture 4.4: typical extracted data from a repurchase announcement.

4.4 Stock Prices and Benchmark

As described in section *5.1.4 Estimation Window,* we use one year of stock prices for the estimation window when estimating normal stock behaviour. As we examine insider trades and repurchases from the start of 2017 until 2020, we collect stock prices from the first trading day of 2016. Because we want to analyse long-term (126 trading days) abnormal returns from insider trades and repurchases up to and including 2020, we collect stock prices of the first 126 trading days of 2021. We collect stock prices for a total of 246 companies. Our main source for the stock price data has been Yahoo Finance, although NHHs "Børsdatabasen", EuronextLive and Titlon have been used to some extent. The Oslo Børs Benchmark Index_IG, available from Euronext, as the benchmark in our analysis.

4.5 Descriptive data

The final dataset in our analysis consists of 2769 insider trades in 256 different companies from 01.01.2017 until 31.12.2020. Of these, 2350 are insider buys, while 419 are insider sells. Figure 4.1 gives an overview of insider trades sorted by monetary size, transaction by company position, and an overview of the month the transaction occurred in. The monetary sizes are categorized as small, medium and large, at intervals from NOK 0 to NOK 125,000, NOK 125,000 – NOK 2,000,000, and over NOK 2,000,000 respectively. Transaction by company position is categorized as CFO, CEO, chairman, related parties, board member, and others. The category "others" consists of major shareholders, non-specified insiders, C-suite insiders except CFO and CEO, and outside management employees. Most trades are made in the medium size category for both buys and sells. However, there is also many observations in both the small and large size categories. Except for "others", most insider trades are done by boards members. Based on the monthly transaction part of the figure, there is no clear pattern of insider trading when regarding the occurrence of the trade.

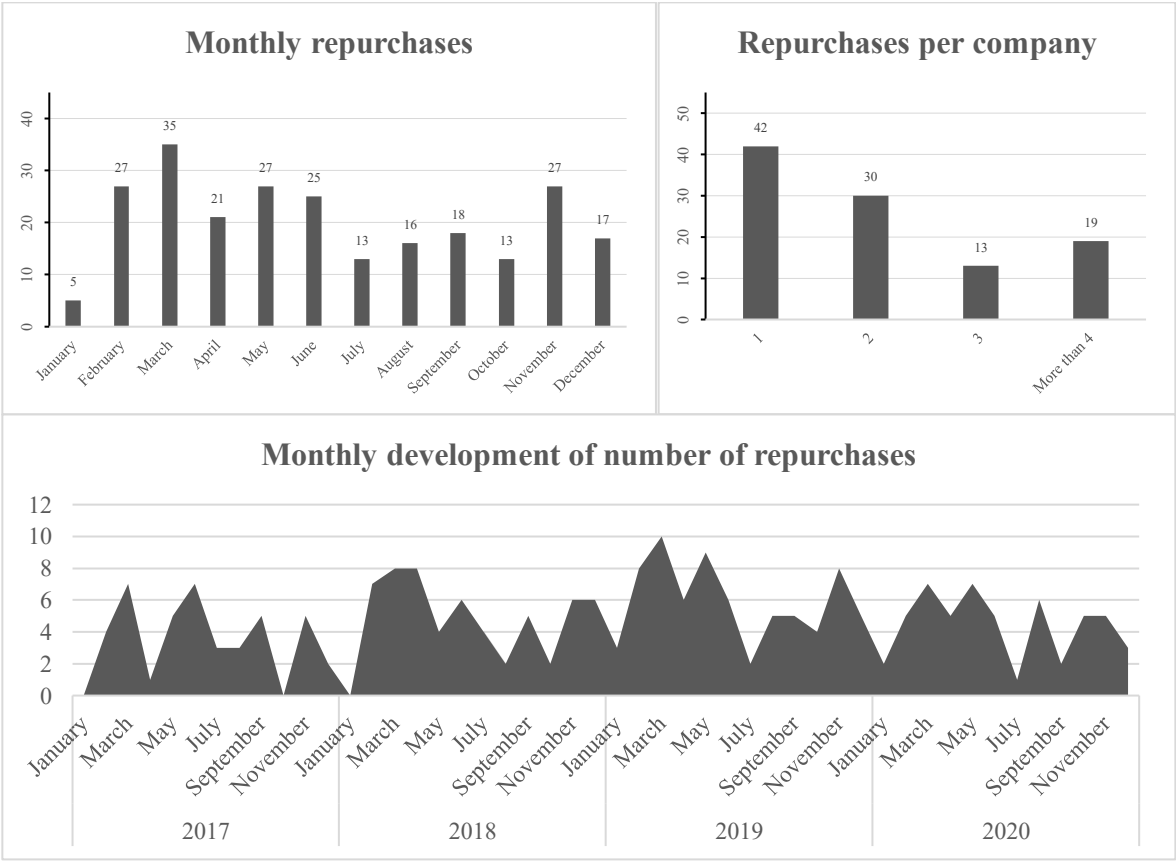
In our data set for repurchases, we have a total of 244 observations, executed by 104 companies. Figure 4.2 gives an overview of the number of repurchases done by companies, and the month the repurchase announcement was made in. Except for a few observations in January, no clear pattern of when companies announce the intention of a repurchase programme is found. Most companies in our sample only announce one repurchase programme during the period, however, several companies announce multiple repurchases.

4.6 Data Problems

NHH has for years, in corporation with the Oslo Stock Exchange, delivered stock data on companies on the Oslo Stock Exchange to students at NHH through Børsprosjektet. However, in November 2020, the Oslo Stock Exchange changed its platforms to Euronext, resulting in a discontinuation of the project. Due to this, we obtain stock prices from other sources. Yahoo Finance is the main source, as it seems to be the only site with stock prices for the entire period in question. However, we have encountered two main problems on the stock prices from Yahoo Finance. Firstly, Yahoo Finance only have data on active tickers, all though we mostly have active tickers, we also have some inactive. Since excluding inactive tickers could lead

Figure 4.1: descriptive data on insider trading
Buys are left columns; sells are right columns.

Figure 4.2: Descriptive data on repurchases



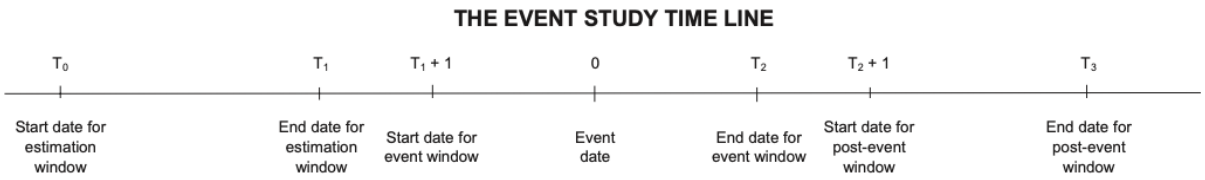
to survivorship bias, we have used Euronext and Titlon to download stock prices on inactive tickers. However, there is a total of 7 tickers that do not have any stock price data on neither Euronext, Titlon, Yahoo Finance nor Børsdatabasen, which thus have been excluded from the analysis. The second problem is that for some stocks, datapoints are missing, lasting from one day to two months, which could invalidate the estimation window and the abnormal returns estimation if overlapping. To fill the missing datapoints, we have merged data from Euronext and Titlon with the data from Yahoo Finance.

5. Methodology

In the following section we will describe the empirical methodology applied to our data analysis. According MacKinlay (1997), we will explain the important aspects of event studies, how we have applied the event study methodology to calculate abnormal returns, and the reasoning under the different hypotheses.

5.1 The Event Study Methodology

The event study is a methodology which can be traced back to the early 1930s and is now a widely applied method in economics and finance. The definition of an event is the specific point in time a company makes an announcement. This could be an income statement, M&A announcements, or a regulatory notification of an insider trade. For most event studies, the objective is to measure the impact of an event on the value of the firm. By separating company specific events from market specific events, the event study is a common method to test whether the EMH holds. This methodology is the main step in hypotheses 1 – 2b but will also be an important factor when investigating hypotheses 2c – 4a.



Picture 5.1: the event study timeline

5.1.1 Defining Events

The first step of an event study is to define the event of interest (MacKinlay, 1997). In our hypotheses, we investigate the effect of two types of events: insider trading and repurchase announcement, both related to companies listed on the Oslo Stock Exchange, as mentioned in section 3.

5.1.2 Event Window

The event window is the period of which we want to analyse the stock price movement (MacKinlay, 1997). It is centred around the announcement date and usually includes a few days pre-event and a few days post-event to allow for inclusions of pre-event leakage and delayed market reactions. As mentioned in section 2, messages on NewsWeb should be published the latest with a one day's delay. To account for this time-lag, our main event window includes two trading days prior to the announcement.

5.1.3 Estimation Window

The estimation window is used to determine the expected return, or "normal" stock behaviour. According to MacKinlay (1997), the estimation window should be prior to the event, but in order not to capture any of the event returns, it should not overlap with the event window. Therefore, we include an 8-day buffer between the estimation window and the event window. The usual period of the estimation window is 1 calendar year (252 trading days) (Benninga, 2014). Using a too long estimation window may result in similar events being included in the estimation window, causing a biased stock behaviour. On the other hand, having less than 126 observations may cause the parameters of the market model to indicate stock price movements imprecisely (Benninga, 2014). We will investigate our hypotheses using an estimation window of 252 trading days, in hope of determining the best possible stock behaviour. As some events have less than 1 calendar year of stock price observations, but more than 126, we will include these events based on an estimation window of 126 trading days to also capture these stocks.

5.1.4 Post-Event Window

The post-event window is used to investigate stock performance in the period following the announcement (MacKinlay, 1997). The length of the post-event window depends on the analysis in question. It allows us to measure the event's long-term impact. In our case, the post-event window will be up to 126 trading days after the event.

5.1.5 Measuring Stock Behaviour

As explained previously, we use the estimation window to calculate the stock's expected returns under normal circumstances. We calculate actual returns arithmetically to be able to aggregate the returns in the cumulative average aggregate returns. Actual return is defined as following:

$$R_{it} = \frac{(P_{it} - P_{it-1})}{P_{it-1}} \tag{2}$$

There are mainly two ways of calculating the normal returns of a stock: the constant mean return model, and the market model (MacKinlay, 1997). In the constant mean model, normal returns are simply calculated as the mean return of the stock in the estimation window. While this simple model often yields similar results to those of more complicated models (Brown and Warner, 1980 and 1985), a market model may remove returns related to market fluctuations and may therefore reduce the variance of the abnormal returns. Among common market models are two-factor models, Fama and French's five-factor model and Carhart's four-factor model. However, Brown and Warner (1985) show that in a large sample, the results are not in particularly sensitive to the choice of estimation model. Based on these arguments, we apply the market model for our analysis. The market model is a regression of the stock return on the market return:

$$r_{it} = \alpha_i + \beta_i r_{Mt} \tag{3}$$

Where r_{it} and r_{Mt} is the stock return and market return on day t respectively. The coefficient β_i indicates how the stock i fluctuate with the market, while coefficient α_i shows the intercept of the regression.

5.1.6 Measuring Abnormal Returns

Assuming that the event is exogenous to the change in the stock price, we can interpret the abnormal return as a measure of the events impact on the stock price (MacKinlay, 1997). A stock's abnormal return is defined as the difference between its real return and its estimated return. Given the market model, we can calculate the abnormal return as follows:

$$AR_{it} = r_{it} - (\alpha_i + \beta_i r_{Mt}) \tag{4}$$

Due to information leakage and delayed market reactions, the return on the announcement day might not capture the entire abnormal return caused by the announcement. Therefore, firm-specific cumulative abnormal returns (CAR) over the period in question, is usually preferred when calculating the abnormal returns of a firm due to an event.

$$CAR_t = \sum_{j=1}^{t} AR_{it+j} \tag{5}$$

To draw inferences of the event of interest, we aggregate the abnormal return of each security observations and calculate the cumulative average abnormal return (MacKinlay, 1997):

$$CAAR_t = \frac{1}{N}\sum_{j=1}^{t} AR_{it+j} \tag{6}$$

5.1.7 Significance Testing

To assess whether the CAAR in question is statistically different from zero, we will conduct significant testing following MacKinlay (1997). MacKinley (1997) suggests using a version of the t-test which uses an estimator for the variance of the abnormal returns. Following this methodology, the null hypothesis can be tested using:

$$\theta_1 = \frac{CAAR(T_1, T_2)}{\sqrt{var\big(CAAR(T_1, T_2)\big)}} \sim N(0,1) \tag{7}$$

5.2 Regression for Buy-and-Hold Abnormal Returns

To investigate hypotheses 4a and 4b, the relationship between abnormal returns and insider buying with regards to repurchase announcements, we run a regression following Cziraki et al. (2019). We want to test whether the net purchase ratio, defined in *3.2.3 Insider Trading and Repurchases*, can help explain any abnormal returns resulting repurchase announcements. We test the regression on a buy-and-hold strategy, which means testing for a portfolio that stays passive regardless of fluctuations. The regression is the following:

$$BHAR(t_1, t_2) = \alpha + \beta_1 \times NPR + \varepsilon \tag{8}$$

Where BHAR equals the abnormal returns of the buy-and-hold passive portfolio from the start of the event window t_1, to the end of the event window, t_2. NPR is the net purchase ratio at a time interval prior to the event announcement, and β_1 is the coefficient of interest which implies that a one unit increase in NPR indicates a β_1 increase in abnormal returns. The α is the abnormal returns not explained by the NPR while ε is the residual of the model.

5.3 Methodology Limitations and Improvements

There has been extensive research on the topic of event studies. Even so, there are still drawbacks worth mentioning. One issue is the uncertainty of the event-date. While all our events are publicly published within the next trading day, the announcements are often published after the close of the market, and in some instances on days when the market is closed (e.g., weekends). In these cases, the market will not be able to react to the event before the next trading day. To deal with this issue, we expand the main event window by two days, to [-2, 2]. There are certain costs to doing this, however, as MacKinlay (1997) shows, the power properties are still good, suggesting it is it worth expanding the event window rather than missing an event. We will conduct our analysis with several different event windows to account for the uncertainty of the event date.

Another issue that might arise in the context of the event study methodology, is the nonsynchronous trading effect (MacKinlay, 1997). As our analysis is based on the adjusted closing price, which is recorded one time per trading day, one implicitly assumes that the stock prices are at 24-hours intervals. However, as the closing price depends on when the last trade of the respective stock was executed, this assumption does not hold and might cause bias for the beta of the market model (Scholes and Williams, 1977). For actively traded securities, however, this issue appears to be unimportant (MacKinlay, 1997).

6. Analysis

In this section we will present the results from the event study and the regression analysis. We examine short-term and long-term abnormal returns by testing hypotheses 1a – 1c. Considering recent literature indicating that repurchase announcements increase shareholder value (e.g., Ben-Rephael et al., 2014), we will investigate if there are abnormal returns related to repurchase announcements in the short-term and long-term by testing hypotheses 2a and 2b. Further on, we will investigate if the net purchase ratio (NPR) increases (as in Cziraki et al., 2019) as time approaches the repurchase announcement date in hypothesis 3a. Based on the NPR, we will also test whether a higher NPR indicates a higher abnormal return in the time following. This is tested in hypotheses 4a and 4b.

6.1 Market Reactions to Insider Trades

In this section, we will discuss hypotheses 1a – 1c, which focus on the market reactions from insider trades. The testing of the hypotheses is based on the event study methodology described in section 5, where the goal is to determine whether there is a statistically significant cumulative average abnormal return (CAAR) associated to period following an insider trade or not.

6.1.1 Short-Term Market Reactions to Insider Trading

Table 6.1 displays CAARs on insider trades. The table consists of two panels, the first displays insider buys, and the second insider sells. The CAAR is shown for different sizes, defined as price times volume, of insider trades, where small is insider trades less than NOK 125,000, medium is insider trades between NOK 125,000 – 2,000,000 and large is insider trades over NOK 2,000,000.

The row above panel A shows the event window used to calculate the CAARs. From the first row in panel A, overall insider buys, there is evidence indicating positive abnormal returns associated with insider trades. Except for the event window [1, 5], all other event windows suggest statistically significant abnormal returns associated to insider buys. However, additional valuable information emerges when decomposing the sizes of the trades. For small size insider buys, there is little significance on the abnormal returns, suggesting a higher

Table 6.1: Stock price reactions to insider trades.

This table displays the CAARs for different event windows for insider trades. The sample consists of insider trades on the Oslo Stock Exchange from 01.01.2017 to 31.12.2020. The main event window is [-2, 2] due to the time-lag in insider trading reporting. We have included other event windows for robustness. Panel A displays the CAARs for insider buying, while panel B displays the CAARs for insider selling. Both panels show estimations for overall trades, but also trades categorized by monetary size. Small are trades below NOK 125,000, medium trades are from NOK 125,000 till NOK 2,000,000 and large trades are over NOK 2,000,000. Under each coefficient, we report standard errors in %/100. *, **, and *** indicate the significance of the reported coefficient at a 10%, 5% and 1% level, respectively.

	Event Window								
	[-2, 2]	[-2 , 5]	[-2, 10]	[0, 2]	[0, 5]	[0, 10]	[1, 2]	[1, 5]	[1 10]
					Panel A: Purchases				
All	1.01%***	0.76%***	1.01%**	1.19%***	0.96%***	1.25%***	0.48%***	0.24%	0.54%**
N=1922	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.003)	(0.001)	(0.002)	(0.002)
Small	0.34%	-0.92%*	-0.43%	0.64%**	-0.57%	-0.04%	0.30%	-0.91%**	-0.34%
N=565	(0.005)	(0.006)	(0.007)	(0.003)	(0.005)	(0.006)	(0.002)	(0.005)	(0.005)
Medium	0.84%***	1.06%***	1.22%***	1.10%***	1.33%***	1.53%***	0.40%***	0.63%***	0.81%***
N=1025	(0.003)	(0.003)	(0.004)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.003)
Large	2.55%***	2.61%***	2.75%***	2.33%***	2.35%***	2.54%***	0.97%***	0.98%***	1.18%***
N=331	(0.005)	(0.005)	(0.006)	(0.004)	(0.004)	(0.005)	(0.003)	(0.004)	(0.005)
					Panel B: Sales				
All	-0.13%	0.37%	0.31%	-0.24%	0.25%	0.20%	-0.17%	0.32%	0.27%
N=362	(0.007)	(0.007)	(0.008)	(0.006)	(0.006)	(0.007)	(0.004)	(0.005)	(0.006)
Small	2.19%**	2.429%**	1.945%*	1.08%	1.32%	0.84%	-0.15%	0.09%	-0.40%
N=76	(0.013)	(0.012)	(0.013)	(0.012)	(0.011)	(0.013)	(0.004)	(0.005)	(0.006)
Medium	0.01%	0.34%	0.61%	0.23%	0.56%	0.83%	0.30%	0.64%	0.90%
N=161	(0.010)	(0.009)	(0.011)	(0.007)	(0.009)	(0.010)	(0.006)	(0.008)	(0.009)
Large	-1.70%*	-0.86%	-1.06%	-1.63%*	-0.80%	-1.00%	-0.79%	0.05%	-0.15%
N=125	(0.013)	(0.014)	(0.017)	(0.012)	(0.012)	(0.015)	(0.008)	(0.010)	(0.013)

variance related to short term CAAR for small size insider buys. Of the nine different time frames investigated, only [-2, 5], [0, 2], and [1, 5] indicate statistically significant abnormal returns, and the latter window surprisingly suggests a negative CAAR. The inconclusive results for small size insider trades are consistent with previous literature (Lakonishok, J. & Lee, I., 2001), which shows that insider trades below NOK 125,000 give weak insider trading signals, and that the CAAR results following such insider trades are inconclusive. According to Lakonishok and Lee (2001), we should rather expect more conclusive results from the medium and large insider trades.

The medium size insider buys differ from the small size insider buys on some important aspects. Firstly, we see that all CAAR estimations have turned positive, in contrast to the CAARs of the small size insider trades. In addition, we see that all the values of the CAARs have increased, indicating that the market reacts more positive to larger sized insider buys.

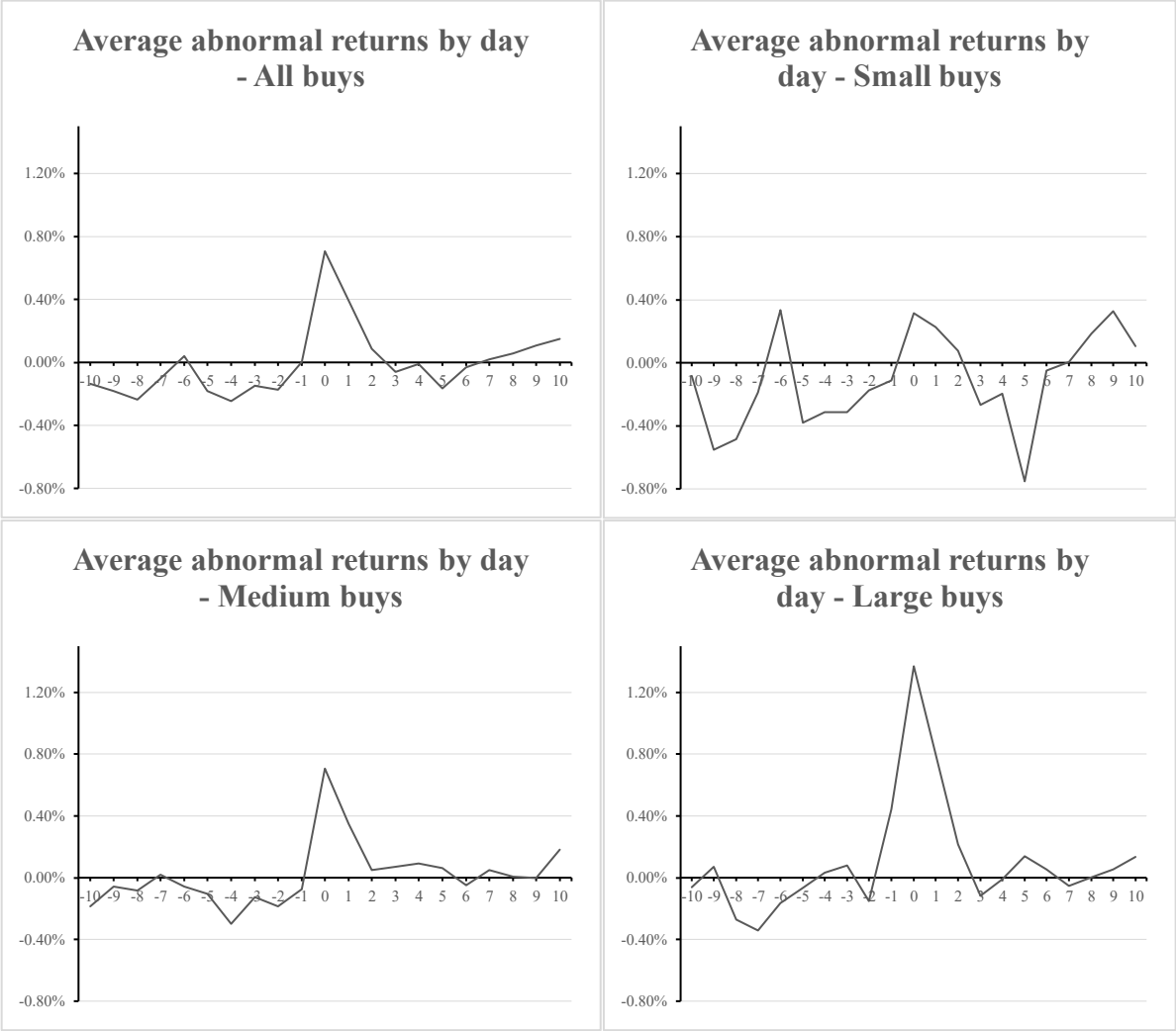
Lastly, all the medium size insider trades are statistically significant at any normal significance levels, in contrast to the small size insider trades. These results are consistent with Lakonishok and Lee (2001), who find a 0,59% CAAR in a similar study in the US and support both hypothesis 1a and 1c.

Following the thought that larger size insider buys should result in higher abnormal returns, one would expect higher CAARs for large size insider buys compared to medium size insider buys. From table 6.1, we find that the CAARs in most windows are over 1,5% above the medium size CAARs. The results are statistically significant on all normal significance levels. Interestingly, most of the CAAR is allocated to the time frame of [0, 2], indicating that the market quickly adjusts to the news of large insider buys. However, even when calculating the CAARs for time frames starting one trading day after the announcement, there are still significantly positive CAARs. For example, event window [1, 5] has a CAAR of 0,98%, 0,35% above the CAAR of the medium size insider buys at the same event window. This suggests a positive correlation between the size of insider buys and CAAR, supporting hypothesis 1c. The average abnormal returns over all companies at specific days before and after the insider trade announcement is summarized in figure 6.1.

Moving on to panel B, the results are less conclusive. If the market reacts negatively to insider selling, one would, as opposed to insider buys, expect negative CAARs in the event windows in question. For an outsider mimicking insider trading, this would in most cases suggest shorting the stock. When selling a share, the seller would profit if the CAAR of the stock is negative. Looking at the overall insider sells, there is no clear pattern on the sign of the CAAR, as three of nine CAARs are negative. In addition, there are no event windows where the CAARs are statistically significant, in contrast to the insider buys where eight of nine CAARs are significant.

When breaking down the event windows to small, medium, and large size sells, we do not find compelling evidence of abnormal returns. For the small size insider sells, there are some positive statistically significant CAARs, but these seem to be traced to the couple of days prior to the event. For instance, looking at event window [-2, 2] the CAAR is 2,19%, while window [1, 2] is -0,15%, though not significant. This indicate positive CAAR due to the days before the announcement, which is also supported by the fact that only event windows starting at -2 have significantly positive CAARs. In other words, it might indicate that insiders sell at a high. Figure 6.2 illustrates the average abnormal returns across companies around the event date.

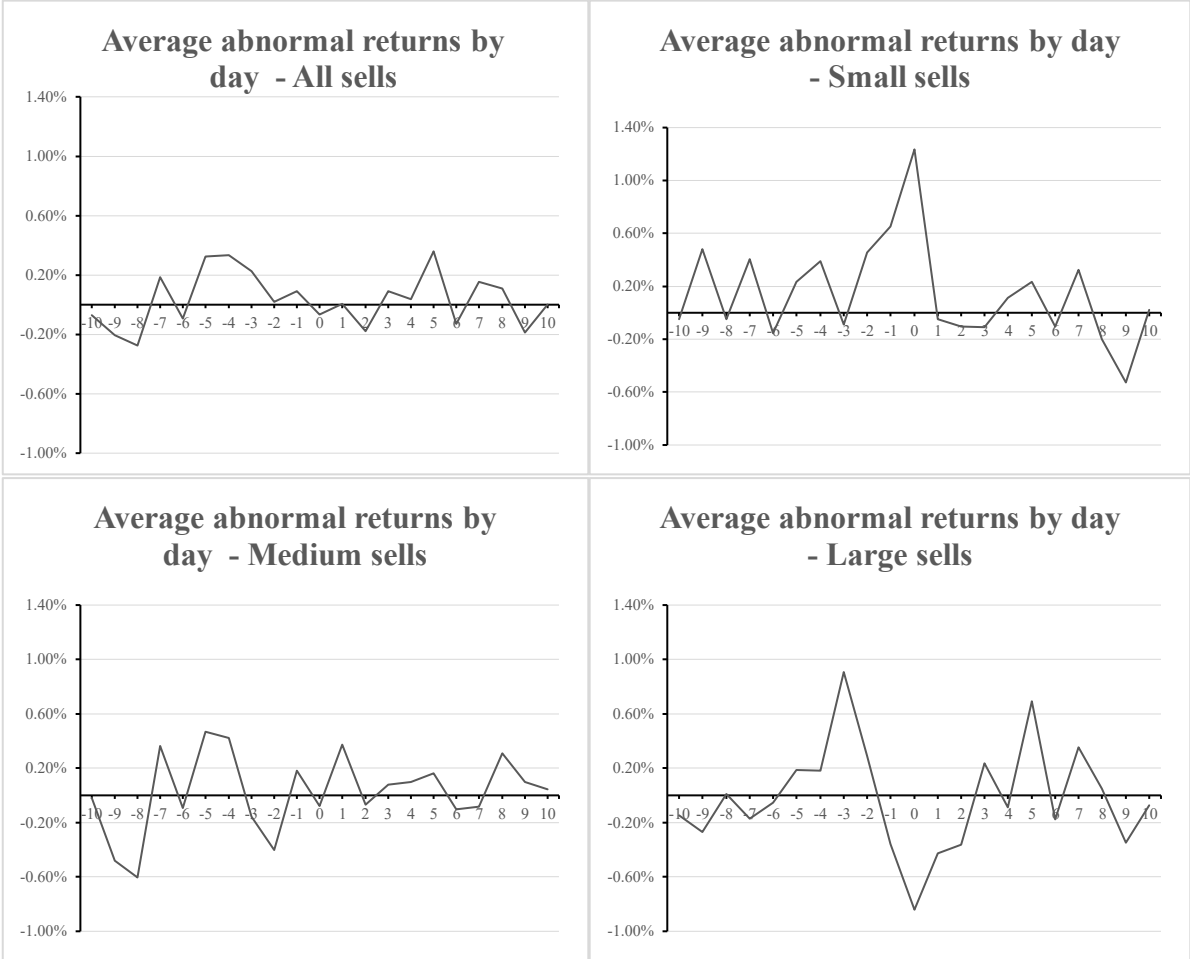
Figure 6.1: Average abnormal returns in the days around insider buys, categorized by size
Figure 6.1 shows average abnormal returns on specific dates around the insider buy announcement. It is calculated by summing the abnormal returns of each trade on the specified day and dividing by total number of trades.



For medium size insider sells, the evidence is even less compelling. Although all CAARs are positive, none of them are statistically significant at any conventional significance level. Moving on to the large size insider sells, the values are of more interest. All CAARs have now turned negative, suggesting a negative market reaction to insider selling. We see that two of the event windows are statistically significant at a 10% significance level, with CAARs at -1,70% [-2, 2] and -1,63% [0, 2].

In conclusion, abnormal returns associated to insider buying occur in some cases. However, in line with Lakonishok and Lee (2001), this only seems to be true for insider trades over NOK 125,000. Large size insider buys yield on average twice the CAAR over medium size insider

Figure 6.2: Average abnormal returns in the days around insider sells, categorized by size
Figure 6.2 shows average abnormal returns on specific dates around the insider sell announcement. It is calculated by summing the abnormal returns of each trade on the specified day and dividing by total number of trades.



buys, supporting hypothesis 1a that insiders can make short-term abnormal returns by trading and hypothesis 1c that there are higher abnormal returns associated with larger size trades. For large size insider sells, there are some statistically significant CAARs, which suggest that the market does respond more negatively the larger the insider sell size, supporting hypothesis 1c further.

6.1.2 Long-Term Market Reactions to Insider Trading

Table 6.2 displays long-term market reactions to insider trading. Panel A shows the estimates for insider buying, and panel B for insider selling. The results are similar to short-term market reactions discussed above. We will look at the overall CAARs, but also break down the

Table 6.2: Long-term stock price reactions to insider trades.

This table displays the CAARs for different event windows for insider trades in the long-term. The sample consists of insider trades on the Oslo Stock Exchange from 01.01.2017 to 31.12.2020. The main event window is [-2, 126] due to the possible time-lag in insider trading reporting. We have included other event windows for robustness. Panel A displays the CAARs for insider buying, while panel B displays the CAARs for insider selling. Both panels show estimations for overall trades, but also trades categorized by monetary size. Small are trades below NOK 125,000, medium trades are from NOK 125,000 till NOK 2,000,000 and large trades are over NOK 2,000,000. Under each coefficient, we report standard errors in %/100. *, **, and *** indicate the significance of the reported coefficient at a 10%, 5% and 1% level, respectively.

	Event Window		
	[-2, 126]	[0, 126]	[1, 126]
Panel A: Purchases			
All	3.07%***	3.32%***	2.41%**
N=1915	(0.012)	(0.012)	(0.012)
Small	-0.60%	-0.22%	-1.25%
N=560	(0.023)	(0.023)	(0.024)
Medium	3.40%**	3.72%***	3.03%**
N=1023	(0.016)	(0.016)	(0.015)
Large	8.20%***	8.05%***	6.69%***
N=331	(0.026)	(0.025)	(0.025)
Panel B: Sales			
All	-2.68%*	-2.92%*	-2.77%*
N=352	(0.020)	(0.020)	(0.019)
Small	3.95%*	2.98%	2.03%
N=74	(0.029)	(0.029)	(0.025)
Medium	-4.91%***	-5.05%***	-4.96%***
N=156	(0.019)	(0.019)	(0.018)
Large	-3.85%	-3.78%	-2.88%
N=122	(0.049)	(0.048)	(0.047)

analysis to small, medium and large size trades as we did for the short-term reactions.

For long-term market reactions on insider buying, the overall CAARs are statistically significant at every conventional significance level. Looking at the event window [-2, 126] we find the CAAR to be 3,07%. Breaking down the analysis to different sizes, similar results as with the short-term reactions can be seen. Firstly, for small size insider trades, there is no statistical significance for abnormal returns, which is consistent with Lakonishok and Lee's (2001) evidence from the US stock market and our short-term CAAR evidence. On the

medium size trades however, all CAARs turn positive and significant with p-values below 0,05. The CAARs over 3% for all event windows investigated, well above the short-term CAARs at around 1%, suggest there is an abnormal return in the long-term, supporting hypothesis 1b that there are long-term abnormal returns associated with insider trades. This contradicts Eckbo and Smith's (1998) study on insider trading portfolio on the Oslo Stock Exchange, who find no significant long-term abnormal returns. As discussed in part *3.3 Insider Trading and Repurchases on the Oslo Stock Exchange*, regulations on reporting are stricter today than when Eckbo and Smith's article was published, which might be one of the reasons our results differ. Moving on to the large insider buys, we can see that the CAAR and p-values increase and decrease respectively, supporting both hypothesis 1b of long-term abnormal returns and hypothesis 1c of a positive correlation between insider trade size and CAAR size.

In comparison to short-term market reactions on insider selling, the overall long-term market reaction on insider sells is significant (at a 10% significance level). Lakonishok and Lee's (2001) evidence of little impact of small size insider trades seems to hold for our sample of long-term small size insider sells. At the medium size level, however, there seems to be a statistically significant negative CAAR, at around -5%. For large size insider sells, the CAARs are still negative, but not statistically significant at any conventional significance level. The overall values, however, indicate that there are long-term abnormal returns related to insider trades, supporting hypothesis 1b. Still, there is less compelling evidence supporting hypothesis 1c in comparison to long-term CAARs on insider buys. Since there are short restrictions on the Oslo Stock Exchange, it might seem odd that there is an overall significant negative CAAR. An explanation could be that insiders trade on non-disclosed information about the near future (within 126 days in our analysis), e.g., change in cost of capital, worse operating performance or other negatively changing fundamentals which might cause existing shareholders to sell their holdings when the news emerges.

6.1.3 Summary of Market Reactions to Insider Trading

We find support of short-term abnormal returns on insider buying supporting hypothesis 1a. The significance levels and CAARs increase the larger the trade is, which also support hypothesis 1c. For hypothesis 1b, we find overall significant values for long-term CAAR for both selling and buying. The values are significantly higher than for the short-term CAARs, suggesting there are also abnormal returns in the long run. This gives reason to wonder

whether insiders are trading on non-released information, such as repurchase announcements. We will investigate this in hypothesis 4, but first we will analyze how such non-released information affects the stock price when released.

6.2 Market Reactions to Repurchase Announcements

In the following section we will investigate hypotheses 2a and 2b: if there are abnormal returns associated with repurchase announcements in the short-term and long-term respectively ("announcement returns"). The analysis follows the same methodology as the previous section: the event study.

Table 6.3 displays the cumulative average abnormal return (CAAR) for repurchases at different short-term event windows, with corresponding p-values. The CAAR for the main event window [-2, 2] is 1,84% and significant at a 1% significance level. All other CAARs investigated are also significant at any conventional significance level. These results are consistent with papers such as Ben-Rephael (2014) which finds that firms buy their stock back at "bargain prices". Interestingly, the CAAR is the highest when looking at short event windows centered close to 0, suggesting that the market quickly adjusts to the new information. However, even when looking at event windows starting at day 1 ([1, 2] at 0,96%, [1, 5] at 0,84%, [1, 10] at 0,69%), there is still strong evidence supporting hypothesis 2a, indicating that there are abnormal returns associated to repurchase announcements. The results are consistent with the signaling hypothesis, that repurchases to a high degree could be motivated by supplying significantly new information to the market. The results are also in line with Skjeltorp (2004), who suggests a CAAR of 2,5% short-term abnormal return associated to the repurchase announcement on the Oslo Stock Exchange.

Table 6.4 displays the CAAR on repurchase announcements in the long-term. In contrast to CAARs at insider trading analyzed in section *6.1 Market Reactions to Insider Trades*, there is not a big increase in CAAR when comparing short-term to long-term announcement returns, but neither is the CAAR significant at any conventional significance level. This suggest that the market swiftly incorporates the news into the stock price.

Table 6.3: Short-term stock price reactions to repurchase announcements.
This table displays of CAARs for different event windows for repurchase announcements. The sample consist of repurchase announcements for companies on the Oslo Stock Exchange for the period 01.01.2017 till 31.12.2020. The main event window is [-2, 2] due to the time-lag in announcement reporting. We have included other event windows for robustness. Under each coefficient, we report standard errors in %/100. *, **, and *** indicate the significance of the reported coefficient at a 10%, 5% and 1% level, respectively.

	Event Window								
	[-2, 2]	[-2, 5]	[-2, 10]	[0, 2]	[0, 5]	[0, 10]	[1, 2]	[1, 5]	[1, 10]
All	1.84%***	1.73%***	1.54%***	1.53%***	1.42%***	1.23%***	0.96%***	0.84%***	0.69%*
N=224	(0.004)	(0.005)	(0.005)	(0.003)	(0.004)	(0.005)	(0.003)	(0.003)	(0.004)

Table 6.4: Short-term stock price reactions to repurchase announcements.
This table displays of CAARs for different event windows for repurchase announcements in the long-term. The sample consist of repurchase announcements for companies on the Oslo Stock Exchange for the period 01.01.2017 till 31.12.2020. The main event window is [-2, 126] due to the time-lag in announcement reporting. We have included other event windows for robustness. Under each coefficient, we report standard errors in %/100. *, **, and *** indicate the significance of the reported coefficient at a 10%, 5% and 1% level, respectively

	Event Window		
	[-2, 126]	[0, 126]	[1, 126]
All	2.02%	1.72%	1.14%
N=224	(0.016)	(0.016)	(0.016)

6.2.1 Summary of Market Reactions to Repurchase Announcements

Based on the analysis presented above, there seems to be evidence that repurchase announcements lead to short-term abnormal returns for stock prices, supporting hypothesis 2a. However, there is no compelling evidence that there are any long-term abnormal returns associated to repurchase announcements, giving no support for hypothesis 2b. A possible reason repurchase announcements differ from insider trades with regards to abnormal returns, could be that insiders trade on privately held information. If true, although against the law, this could mean that insiders buy when they expect positive news to be disclosed in the close future. In this case, we would expect a higher net purchase ratio to be related to higher announcement returns and for insiders to have a higher net purchasing ratio as time approaches the announcement. This is investigated over the next two hypotheses.

6.3 Net Purchase Ratio

As defined in section *3.2.3 Insider Trading and Repurchases*, net purchase ratio (NPR) is defined as (insider buys – insider sells)/(total insider trades) and ranges between -1 and 1. Following Cziraki et al. (2019), we would expect this ratio to increase as we approach the announcement date. Table 6.5 shows the NPR at a variety of months before the announcement. As we see from row "Alle repurchases", the NPR lies steadily at around 0,35. As we approach the announcement date, specifically from month 3 and closer, the NPR falls by over 50%.

According to Cziraki et al. (2019), these results are surprising, as their study reveals that the NPR increases as time approached announcement date. One possible explanation for the opposite changes in the NPRs, is that in Cziraki et al. (2019), their NPR is negative, while ours is positive. If there are neither sales nor buys in a particular month, the NPR would be 0. It is possible that insiders would stop trading close to an announcement date to oblige with insider trading laws. For Cziraki et al. (2019), this would result in a higher NPR as their NPR average is negative, while for us, the result would be a lower NPR because our NPR average is positive.

6.4 Insider Trading and Repurchases

In section *6.1 Market Reactions to Insider Trades*, we present evidence that there are abnormal returns related to insider trades both in the short-term and in the long-term. Further on, in section *6.2 Market Reactions to Repurchase Announcements*, we present evidence suggesting there are abnormal returns related to repurchase announcements in the short-term. In this section of the analysis, we investigate the relationship between the insider trading variable NPR, analyzed in section *6.3 Net Purchase Ratio*, and the abnormal returns associated to repurchase announcements. We run a regression based on Cziraki et al. (2019), which shows that the NPR prior to a repurchase announcement can help explain the abnormal returns in the following period.

In section 6.2, we find that the market quickly adjusts to the news of a repurchase in the short-term. In section 6.3, we find that the NPR is relatively stable until approximately 4 months before the repurchase announcement. Based on these two findings, we choose an event window of [-2, 2], and NPR estimation window of [-4, -1] (months) in the buy-and-hold

Table 6.5: Development of NPR as time approaches announcement date.
This table displays the net purchase ratio (NPR) as time approaches the repurchase announcement. The NPR is defined as (insider buys – insider sells)/(total insider trades). The first row shows the NPR in the respective month prior to the announcement.

	Months											
	-12	-11	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1
NPR	0.36	0.37	0.37	0.37	0.33	0.33	0.32	0.31	0.32	0.28	0.20	0.14

abnormal returns (BHAR) regression. The output is displayed in table 6.6.

Standard errors are reported in the parenthesis below the coefficients. The NPR coefficient is significant at a 5% significance level. This could suggest that a one unit increase in the NPR is associated to a 1,73% increase in buy-and-hold abnormal return. In other words, there seems to be a positive relationship between BHAR and NPR. This is consistent with Cziraki et al. (2019), who found their coefficient to be slightly higher at 2,59%, but on a lower significance level at 10%. The output supports the hypothesis that a higher level of insider buying prior to the repurchase announcement indicate higher short-term abnormal returns.

To test whether the NPR is an indicator of abnormal returns in the long-term, we run the same regression for BHAR as above. We use the same NPR estimation window of [-4, -1] (months), but change the event window to [-2, 126]. The output is reported in table 6.7.

Standard errors are reported in the parenthesis below the coefficients. Neither the NPR nor the intercept coefficients are significant at any conventional significance level, as expected based on the lack of evidence for long-term abnormal returns associated to repurchase announcements analyzed in section 6.2.2. In contrast to Cziraki et al. (2019), we can therefore not conclude that the NPR is an indicator for long-term abnormal returns on repurchase announcements.

Table 6.6: Insider trading and abnormal returns around repurchases, short-term

Table 6.6 provides the results of a regression of the net purchase ratio on the abnormal returns associated to repurchase announcements. We use an estimation window of 252 trading days for the event window [-2, 2]. Under each coefficient, we report standard errors in %/100. *, **, and *** indicate the significance of the reported coefficient at a 10%, 5% and 1% level, respectively.

	Dependent variable:
	CAR_short_term
NPR_4mnd	0.017**
	(0.007)
Constant	0.013***
	(0.005)
Observations	224
R^2	0.029
Adjusted R^2	0.025
Residual Std. Error	0.062 (df = 222)
F Statistic	6.701** (df = 1; 222)

Table 6.7: Insider trading and abnormal returns around repurchases, long-term

Table 6.7 provides the results of a regression of the net purchase ratio on the abnormal returns associated to repurchase announcements. We use an estimation window of 252 trading days for the event window [-2, 126]. Under each coefficient, we report standard errors in %/100. *, **, and *** indicate the significance of the reported coefficient at a 10%, 5% and 1% level, respectively.

	Dependent variable:
	CAR_long_term
NPR_4mnd	-0.028
	(0.027)
Constant	0.029
	(0.018)
Observations	224
R^2	0.005
Adjusted R^2	0.001
Residual Std. Error	0.246 (df = 222)
F Statistic	1.112 (df = 1; 222)

7. Conclusion

This thesis focuses on market reactions to insider trading announcements and repurchase announcements on the Oslo Stock Exchange. As regulations on announcements in recent years have become stricter, it is interesting to examine to what degree the market efficiency holds.

We document significant short-term abnormal returns to insider buying. At an event window of [-2. 2], we find cumulative average abnormal returns of 1,00% for all observations, and 2,55% for large size insider buys, defined as volume x price over NOK 2,500,000. For insider sells, we do not find compelling evidence of abnormal returns in the short-term, which we argue might be due to short restrictions for most investors on most shares on the Oslo Stock Exchange. In the long-term, our analyses show that there are statistically significant cumulative average abnormal returns related to both insider buys and sells. For insider buys, at an event window of [-2, 126], we find cumulative average abnormal returns of 3,07% overall, and 8,20% for large size insider buys. For insider sells at the same event window, we find cumulative average abnormal returns of -2,68% overall, and -4,91% for medium size insider sells. The significant increase in cumulative average abnormal returns suggest the abnormal returns increases as the size of the trade increase. These findings add to the existing literature on abnormal returns on the Oslo Stock Exchange, where a previous paper found no significant long-term returns (Eckbo and Smith, 1998).

In the second part of our analysis, we examine how the market reacts to repurchase announcements. Our results are in line with current literature, e.g., Skjeltorp (2004), who also find abnormal short-term returns, although somewhat higher. Our findings suggest a 1,84% abnormal return at an event window of [-2, 2], significant at any conventional significance level. The long term cumulative average abnormal returns are only 0,18% higher, but not significant at any conventional significance level, suggesting the market quickly incorporates the news into the stock price.

In the next part, we analyze the net purchase ratio (NPR). Interestingly, we find that the net purchasing ratio decreases as time approaches 0, in contrast to recent literature from the US stock market (Cziraki et al., 2019). However, we argue that this could be because of different signs in the NPR in the time prior to the repurchase announcement. The decreasing NPR as time approaches the repurchase, suggests there are less insider trades in the firms. This might

be because insiders would like to obey the insider trading regulations in the Norwegian securities trading act.

In the last part of the analysis, we investigate the relationship between the NPR and buy-and-hold abnormal returns (BHAR) by running a regression of NPR on the BHAR. For short-term BHAR, we see a statistically significant coefficient at 1,73% for the NPR on a 5% significance level. The coefficient is 1,73% and indicates that a higher NPR leads to higher BHAR. For the long-term regression, however, we do not find any support of a positive correlation between the NPR and long-term BHAR.

In sum, our evidence indicate there are abnormal returns associated to both insider trading and repurchase announcements. This seems to hold both when analyzed separately, and when analyzed jointly, suggesting it is possible to make abnormal returns on insider trading. Our results are in line with several previous empirical studies, which have found market reactions that contradict the strong form efficient market hypothesis.

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