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Abstract

In this paper we investigate the abnormal returns earned by legal insider traders. Our intentions are to determine whether these insiders have an informational advantage compared to the other market participants, and whether they are able to capitalize on this potential advantage. The analysis is based on the cumulated, average abnormal return (CAAR) following the insider trades for our 15 select companies on the Oslo Stock Exchange (OSE) in the period 2013-18. The CAAR is calculated for both the short-, mid- and long-term, and tested using common methods of hypothesis testing to establish whether the abnormal returns are significant at a 5% significance level.

The results of the analysis showed that the abnormal returns were insignificant across all of our event windows (the short-, mid-, and long run). We then created different subsets based on the market capitalization of the companies and the position of the insiders (CEO, board members, etc.). The results for this analysis was the same, with all abnormal returns being insignificant across all event windows. We therefore concluded that the insiders on the OSE does not earn abnormal returns by investing in their own companies.

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1. Introduction

Over the last decades, insider trading has created fierce debate about its costs and benefits to society. Most developed countries, such as the United States, the United Kingdom, Canada as well as the European Union, have attempted to implement a set of regulations and laws to better control insider trading. The main reason of these regulations is to promote a more level playing field between all traders, informed and uninformed, that leads to a higher degree of confidence in the fairness, integrity, and thus stability of the financial markets.

In this paper, we first define the term *insider trading*, we then present the theoretical framework on which it is based as well as the methodology for estimating its return. Our intention is to determine whether insiders earn abnormal returns[1] by utilizing their informational advantage to strategically invest in their own company. We will therefore measure the abnormal returns on the insiders' trades over different time horizons and determine their significance. We will also provide some critique and limitations to our approach.

2. What is Insider Trading?

2.1 Insider trading in Norway

As Norway is a member of the European Economic Area (EEA), it is subject to the legislative rules regarding insider trading set forth by the European Union (EU). These rules will for instance dictate the time frame as to which companies are obligated to notify the proper authorities about the completed insider transaction. Furthermore, they will state what

[1] Abnormal return is the difference between an assets' actual return and its theoretical expected return, where the expected return is computed by an asset pricing model. Abnormal return can be both positive and negative.

information the companies are obliged to include in their notice to the authorities, and the definition of an *insider.*

In addition to satisfying the requirements set by the EEA-agreement, Norway has imposed a series of stricter rules related to insider trading. Every publicly listed company has a series of *primary insiders*, all of which are incumbents in central management positions or somehow has access to potential non-public information. Whenever any of these insiders conduct a transaction in a security related to their respective firm, they will have to notify the Oslo Stock Exchange (OSE). This notification will have to state the security traded, whether it was bought or sold, the total volume of the trade, the volume-weighted average price across the conducted trades (VWAP), the insider's relation to the company and the date at which the trades were conducted. However, before any insider trades can be executed, Norwegian law compels the insider to investigate whether there is any private information that could have a significant impact on the stock price. Furthermore, the insider will have to be granted permission to trade from the company's top management. To further reduce the possibility of asymmetrical information between insiders and other market participants, the Norwegian law also prohibits insider trading in the month preceding quarterly reports and the two months preceding annual reports.

With regards to the deadline for notifying the authorities about an insider transaction, Norway is one of few countries which requires companies to report the transactions within the next trading day. This will be of particular interest in our analysis, as outsiders[2] in this case will be able to respond quickly to any transactions made by a company insider. Thus, any potential non-public information about future events that the insider might have acted upon, will be less likely to have materialized. That is, the events that the insider might expect to alter the stock price in the future, will be unlikely to have occurred within this short

[2] *"Outsiders"* are the market participants that wish to trade based on the transactions of insiders. They are profit motivated traders that seeks abnormal returns based on the suspected material, private information possessed by company insiders (informed traders).

reporting window. Therefore, the *informational value*[3] of the transaction will be higher when the insider trades are reported shortly after their execution. In other countries (such as the US), companies must report the transactions within 10 trading days. This will increase the likelihood of the insider's anticipated events to have occurred before outsiders have responded to the trade, and thus *reduce* the informational value of the insider trade. The high informational value of insider trades in the Norwegian market might therefore result in more immediate reactions from the outsiders, and may therefore have implications for the returns of the insiders in the short run.

2.2 Legal versus illegal insider trading

The distinction between legal and illegal insider trading may be considered diffuse and is consequently hard to define (Harris, 2003). The most obvious and clear difference between the two, are when the trades are not properly reported (or not reported at all) (Oslo Børs, 2018). The laws in Norway provides clear guidelines for the reporting of insider trades (details listed above) and any deviation from these standards may result in a penalty. As the Oslo Stock Exchange monitors the trading accounts for all company insiders, it is not possible to conduct trades "under the radar" (Oslo Børs, 2018).

Another distinction between legal and illegal insider trading is based on the informational foundation of the insider. The insiders are obligated to conduct research to determine whether the information they possess may be characterized as *material* and *non-public* (Finanstilsynet, 2018). If the insider finds his information to be material, he will not be allowed to conduct the trade. The challenge will here be for the courts to determine whether the information the insider possessed was in fact material and non-public. Another challenge is to differentiate between the insider trades based on material, non-public information and the trades based on either research or luck.

[3] *Informational value* is the maximum value one would be willing to pay for the information in question. Thus, it will be equal to the expected excess return. The informational value will be reduced as time elapses and is positively correlated to the likelihood of the information being correct.

3. Theoretical Framework

3.1 Asymmetric Information

In theory, the abnormal returns of insiders will derive from their access to non-public (*private*) information. Such private information gives them an advantage over average investors, simply because they can better assess the current- and predict the future value of the firm. This information-difference between insiders and the market is called *asymmetric information*. We commonly distinguish between two types: *moral hazard* and *adverse selection*. Both represents opportunistic behavior that improve one's situation.

Moral hazard occurs when a participant to a transaction does not share the information ex-ante and changes his behavior after the conclusion of the transaction (ex-post). This "change of heart" is detrimental to the interests and performance of the other party. Moral hazard is particularly prone to occur when a party does not carry the whole cost of the risk he is undertaking. Returning to insider trading, moral hazard is considered a problem related to *short selling*.

Adverse selection takes place when a participant to a transaction deliberately retains information before the conclusion of the transaction (ex-ante). This is detrimental to the other party and the market, as this leads to more "bad" agents, goods or services and to less "good" agents, goods or services in the market (Donder & Hindriks, 2008). Applying it to insider trading, this can be illustrated by an insider with substantial non-public information, who therefore has an informational advantage over average traders, and is therefore more likely to outperform the market.

3.2 Efficient Market Hypothesis

Abnormal profits made by insiders can be used to assess the market efficiency. *The efficient market hypothesis* (EMH) states that, in an efficient market, the prices will reflect all the

available information regarding the asset (Fama, 1970). Hence, in line with this theory, there are no abnormal return as there are no under- or overvalued stocks because all investors have access to the same information. The assumptions made by the EMH is that all agents make rational decisions, apply processing power to any available information, and holds preferences well-described by standard utility theory (Bloomfield, 2010). This is the so-called *Homo economicus*.

Fama defines three "forms" of market efficiency depending on how prices adjust to new information:

The *weak-form efficiency* states that prices already incorporate all historical information. This means that making abnormal profits by analyzing historical price movements is impossible.

The *semi-strong form efficiency* claims that prices reflect all public information. Prices would then adjust almost instantaneously to any new publicly available information. In this scenario, investors would not be able to outperform the market by trading on new information, as this would already be reflected in the prices. Consequently, fundamental analysis would be useless.

Finally, *the strong-form efficiency* states that stock prices reflect all information both public and private (insider information). Therefore, in such a market, insiders would not earn any abnormal profit. So, if they earn some, it would prove that stock prices do not reflect private information and thus the market is not strong-form efficient.

If our analysis finds the insiders to earn abnormal returns, this would indicate that the insiders possess private information that *is not* reflected in the current stock prices. As this violates the terms of the strong-form of the EMH, we would be able to conclude that the Oslo Stock Exchange (OSE) does not adhere to the strong-form efficiency. Additionally, if the insiders achieve abnormal returns in the short-term following the publication of the insider notice, outsiders would likely be able to mimic their trades. Provided that the abnormal returns are increasing in the days following this announcement, the outsiders would be able

to profit from following the news related to insider trading. This would disprove the semi-strong form of the EMH on the OSE.

4. Hypothesis

The primary insiders of any given company will mainly consist of the central members of the firm's management and its board of directors. As all of these have high-ranking positions within the organization, they are likely to have profound insight into both the firm's financial standing, daily operations and future plans. They may therefore have an overview of the company's strengths and weaknesses, as well as its opportunities and threats. As a consequence of this, it may be reasonable to assume that the insiders have both more and better information about the company than do the outsiders.

This brings into question whether the insiders are able to utilize their informational advantage to achieve abnormal returns. This will be dependent on the insiders' abilities to estimate the *fundamental value* of the stock based on both the company's current situation and prospects. If they deem the fundamental value to be higher than the current stock price, they will enter the market and vice versa. In the short term, insiders may also profit from price fluctuations following the insider trade. As the outsiders often are well aware of the insiders' potential informational advantage, they may act on the news of the insider trade and thus *move the market.*

To answer whether the insiders on average earn abnormal returns, we will examine the cumulative abnormal returns for three different time frames following the insider trades. To see the immediate market response to the insider trade, we will examine the **2 trading days** following the trade. To test for the medium-term effects, we will use a time horizon of **1 week** (5 trading days) following the trade. Lastly, to test for any "long-term" returns, we will investigate the returns in **the following month** (20 trading days).

H1: Do the insiders on the Oslo Stock Exchange earn abnormal returns on their investments in the 2 days, 1 week or 1 month following their trades?

5. Methodology

In determining the abnormal returns achieved by company insiders, we will be employing event-based methods to study the insider trades. This method of empirical research is generally utilized to explore the economic effects following certain events and are commonly used in studies researching insider returns (Lakonishok & Lee, 1998). In our analysis, we will use the approach as described by MacKinlay (1997). In our analysis, the event will be the execution of an insider trade, and the effect we wish to explore will be the returns obtained by the insiders.

The abnormal return is defined as the difference between an asset's actual and expected return:

$$AR_{it} = R_{it} - E(R_{it}|X_t) \qquad (1)$$

$$AR_{it} = Abnormal\ return\ for\ asset\ i\ at\ time\ t$$
$$R_{it} = Actual\ return\ for\ asset\ i\ at\ time\ t$$
$$E(R_{it}|X_t) = Expected\ return\ for\ asset\ i\ at\ time\ t$$

To determine whether the insiders earn abnormal returns, we must therefore first find the "normal" (*expected*) return for each security. Various methods might be employed for this purpose. Classical economic theories of finance, such as the CAPM (*Capital Asset Pricing Model*), determines the expected return (ER_i) of an asset based on the risk-free rate (R_f)[4], the asset's beta-value (β_i)[5] and the risk-premium ($ER_m - R_f$)[6].

[4] E.g. the return of government bonds of financially stable countries. For instance, a US Treasury Bill (T-bill).
[5] Beta is a measure of volatility, or the systematic risk the asset is exposed to. It is stated as the fluctuations of the asset's price relative to the market index (the correlation between the price of the asset and the market index). For instance, a beta of 1 will signify that the fluctuations of the asset will coincide with the fluctuations of the market.
[6] The risk-premium is given by the difference between the risk-free rate and the expected return of the market.

$$CAPM: \quad ER_i = R_f + \beta_i(ER_m - R_f) \qquad (2)$$

This method will however generate a less *dynamic* expected value and might therefore give erroneous/inaccurate values for certain periods. Furthermore, modern financial research has increasingly questioned the validity of CAPM as an accurate measure of expected returns (Fama & French, 2003).

In order to produce more dynamic and accurate estimates of the assets' expected returns, we chose to utilize a statistical method in lieu of an economic model. The *market model* assumes a linear relationship between the returns of an asset and the market in general. Furthermore, the model assumes the returns to be normally distributed and the errors to be independently dispersed throughout time (MacKinlay, 1997). Although strict, empirical research have found the assumptions made in the market model to be reasonable, and its estimates to be a good indicator of an asset's actual return (Brown & Warner, 1985).

5.1. The market model

For any security *i*, the market model is given by:

$$R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it} \qquad (3)$$
$$E(\varepsilon_{it} = 0) \quad var(\varepsilon_{it}) = \sigma^2_{\varepsilon_i}$$

Where R_{it} is the return for security *i* at time *t* and R_{mt} is the market return at time *t* and ε_{it} signifies the error term (MacKinlay, 1997). The parameters of the model will be α_i and β_i, whose estimates can both be found using standard regression analysis and the ordinary least square method (OLS). The error term is the difference between the actual and expected return in the *estimation window* (further description follows). The prerequisites for the model to hold is that the expected value of the error term (ε_{it}) is equal to zero, the variance of the error term is constant and there being no presence of covariance between the error terms.

To utilize the model, we must first find the (β_i) beta- and (α_i) alpha-values in addition to the return of the market. These will all be dependent on the values in the estimation window:

("^" above a parameter indicates that it's an estimate, whereas "¯" indicates that it's the expected value (the average value)).

$$Beta\left(\beta_i\right): \quad \hat{\beta}_i = \frac{\sum_{t=T-205}^{T-5}(R_{it} - \bar{R}_i)(R_{mt} - \bar{R}_{mt})}{\sum_{t=T-205}^{T-5}(R_{mt} - \bar{R}_{mt})^2} \tag{4}$$

$$Alfa\ (\hat{\alpha}_i): \quad \hat{\alpha}_i = \hat{u}_i - \hat{\beta}_i * \hat{u}_m \tag{5}$$

Where:

$$\hat{u}_i = \frac{1}{L_1} \sum_{t=T-205}^{T-5} R_{it} \tag{6}$$

$$\hat{u}_m = \frac{1}{L_1} \sum_{t=T-205}^{T-5} R_{mt} \tag{7}$$

L_1 is the length of the estimation window. As the estimation window spans from 205 days *before* the insider trade (T-205) to 5 days before the insider trade (T-5), the length of L_1 will equal *200 trading days*.

Lastly, we will need to find the variance of the error term:

$$var(\varepsilon_{it}) = \sigma_{\varepsilon_i}^2 = \frac{1}{L_1 - 2} \sum_{t=T-205}^{T-5} \left(R_{it} - \hat{\alpha}_i - \hat{\beta}_i R_{mt}\right)^2 \tag{8}$$

$$(with\ L_1\ equal\ to\ 200\ trading\ days)$$

As all the parameters of the model have now been estimated, we may start calculating the *expected return* for stock *i* at time *t* for every insider trade.

5.2 Abnormal return

When calculating the *abnormal return*, we will subtract the expected return found by the market model from the actual returns in the days following the insider trade (*the event window*) (MacKinlay, 1997):

$$\widehat{AR}_{it} = R_{it} - \hat{\alpha}_i - \hat{\beta}_i R_{mt} \tag{9}$$

$$(\widehat{AR}_{it} = Estimate\ of\ abnormal\ return\ of\ asset\ i\ at\ time\ t)$$

5.3 Variance of abnormal returns

As the market model assumes the abnormal return to be jointly distributed, with a zero-conditional mean, the conditional variance will be:

$$\sigma^2(\widehat{AR}_{it}) = \sigma^2_{\varepsilon_i} + \frac{1}{L_1}\left[1 + \frac{(R_{mt} - \hat{u}_m)^2}{\hat{\sigma}^2_m}\right] \tag{10}$$

The variance of the abnormal returns consists of two different components. The first term $[\sigma^2_\varepsilon]$ is the noise-residual from equation (3), and the second component:

$$\frac{1}{L_1}\left[1 + \frac{(R_{mt} - \hat{u}_m)^2}{\hat{\sigma}^2_m}\right]$$

is the additional variance originating from the sampling error in α_i and β_i (MacKinlay, 1997). As the length of the estimation window (L_1) grows, the variance stemming from the estimation of the alpha- and beta-values (α_i and β_i) will gradually approach zero. As the length of our estimation window is 200 trading days (L_1 = 200 days ≈ 10 months), we can assume that this variance component is equal to zero. Thus, the variance of the abnormal return will be given by:

$$\sigma^2(\widehat{AR}_{it}) \approx \sigma^2_{\varepsilon_i} \tag{11}$$

5.4 Cumulative abnormal returns

In order to make any conclusions regarding the abnormal returns, we will need to aggregate the returns across both time and different assets. The aggregation through time will be achieved through the *cumulative abnormal return* (CAR) (MacKinlay, 1997):

$$\widehat{CAR}_i(t_0, t_j) = \sum_{t=t_1}^{t_j} \widehat{AR}_{it} \tag{12}$$

Here, the estimated cumulative abnormal return for asset *i* ($\widehat{CAR}_i$), will be calculated as the sum of the abnormal returns for asset *i* through time t_0 to t_j[7].

5.5 Variance of cumulative abnormal returns

For the same reasons as stated in the variance of abnormal returns (10), the *variance of the cumulative abnormal returns* (CAR), will be equal to:

$$var(\widehat{CAR}_i) = \sigma^2(t_0, t_j) \approx (t_j - t_0)\sigma_{\varepsilon_i}^2 \tag{13}$$

5.6 Average abnormal returns (AAR)

To aggregate the returns across different assets, MacKinlay (1997) suggests using the method of *average abnormal returns*. This method aggregates the abnormal returns for each asset, and divides the total by the number of assets (*N*):

$$AAR_t = \frac{1}{N}\sum_{i=1}^{N} \widehat{AR}_{it} \tag{14}$$

[7] t_0 will be the time of the event taking place, and t_j will make up the length of the different event windows (t_j thus represents either t_2, t_5 or t_{20}).

5.7 Variance of average abnormal returns

The variance of the average abnormal returns can be found by calculating the average of the variance of error-terms of all assets in the event window:

$$var(AAR_t) = \sigma(AAR_t)^2 = \frac{1}{N^2}\sum_{i=1}^{N}\sigma_{\varepsilon_i}^2 \tag{15}$$

5.8 Cumulative average abnormal returns (CAAR)

As we now have determined the aggregated abnormal returns across both time *and* assets, we may combine these measures to find the total average abnormal returns in the given event windows:

$$CAAR(t_0, t_1) = \sum_{t=T_0}^{T_j} AAR_t \tag{16}$$

5.9 Variance of cumulative average abnormal return

The variance of the CAAR is found using the formula below. This method will sum up the variances of the abnormal returns for the given time frame in the estimation window:

$$var(CAAR) = \sigma^2[CAAR(t_0, t_1) = \sum_{t=T_0}^{T_j} \sigma^2(AAR_t) \tag{17}$$

5.10 Testing the hypotheses

After calculating the abnormal returns (AR) and the Cumulated Average Abnormal Returns (CAAR) for the various time frames and assets, we must conduct tests to conclude whether our hypotheses concerning these prove accurate. We will be utilizing the framework found in Keller (2008) for our testing.

In order to test our hypotheses, we will start by defining *two different hypotheses.* The first is called the *null hypothesis* and will state there being no relationship between the measured phenomena. The null hypothesis will generally be considered true until proven otherwise. The other hypothesis which we will have to define, is called an *alternative hypothesis.* This states there being a relationship between the measured phenomena and will be tested against the null hypothesis. If we during our testing find the observed data to be *significantly* unlikely to have occurred under the null hypothesis, we will reject the null hypothesis.

We will be using the Student's t-test for our testing purposes:

$$t = \frac{\bar{x} - \mu}{\frac{s}{\sqrt{n}}} \tag{18}$$

The distribution will be Student's t-distributed with the degrees of freedom given by:

$$v = n - 1$$

, where *n* is the number of observations. $\bar{x}$ will be the CAAR (16). μ is the population mean (expected value), which will be equal to zero in our tests. Furthermore, "*s"* will signify the square root of the variance of CAAR (17).

By performing this test, we will be able to compare the calculated *t-value* to the *critical t-value*. The critical t-value may be found in tables of Student's t-distribution for different *significance levels* and *degrees of freedom*. The significance level defines an upper limit as to how large the probability of rejecting a true null hypothesis may be (risk of Type 1-error). If the t-value is *larger* than the critical t-value, the null hypothesis will be *rejected*. If, however, the t-value is *smaller* than the critical t-value, we will *fail to reject* the null hypothesis.

In addition to comparing the t-values against the critical values, we will also calculate the *p-value.* The *p*-value is defined as the probability of rejecting a null hypothesis given that its true (called a type 1-error).

The table below summarizes how we may interpret different *p*-values:

P-value:	Explanation:	Notation:
< 0,01	Strong indication of the alternative hypothesis to be true. The result is highly significant.	***
0,01 < p < 0,05	Indication of the alternative hypothesis to be true. The result is significant.	**
0,05 < p < 0,10	Slight indication of the alternative hypothesis to be true. The result is not significant.	*
> 0,10	No indication of the alternative hypothesis to be true. The result is not significant.	

5.11 Estimation window and event windows

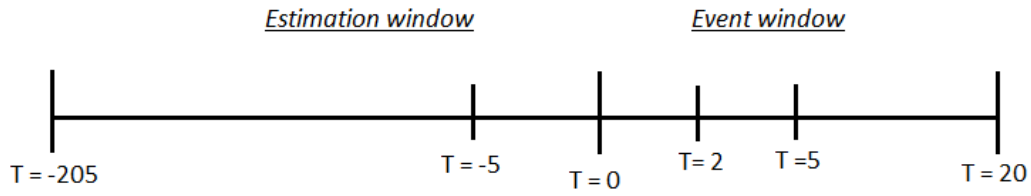


Fig.1 - An overview of the estimation window (T = -205 to -5), the event day (T=0) and the event windows (0, 2], (0, 5] and (0, 20]

The *estimation window* is the period *before* the insider trade is conducted. This period will serve as the basis for the estimation of the expected return. The returns for both the asset and the market will be compared across the estimation window to produce the expected return. Therefore, the length of the estimation window (L_1) will be of importance, as it will have implications for the expected value. If the length of the estimation window is too long,

the expected value might be partially based on historical data that no longer reflects the returns of the asset. However, if the length is too short, the data foundations might not be sufficient to provide a statistically significant picture of the "normal" relative returns (Merton, 1980).

MacKinlay (1997) argues that the optimal length of the estimation window is between 180 and 250 trading days. Based on this, we chose the length of our estimation window to be 200 trading days. Furthermore, we decided to end the estimation window at 5 days prior to the insider trade. The reasoning behind this decision was to minimize the possibility of the insiders' trades to be a response following public news. This could falsely indicate returns based on superior information, whereas they really might be linked to the insiders responding quickly to public news (news trading).

The *event window* is the period *following* the event. In this period, we will define different time frames of which we want to determine the returns achieved by company insiders. We chose to measure the abnormal returns over 2, 5 and 20 trading days following the insider transaction. The two-day period was selected to give an indication of the "*immediate"* response of the market to the news of the insider trades. We chose to use two days in lieu of one as the notice of conducted insider trades are sometimes published after the close of the market the following day. Thus, in order to catch the short-run reactions of the market, we had to extend this period to include two days.

To investigate the returns in the medium-run, we chose the time horizon of 5 trading days (one week). This might provide the market with enough time to "calm down" after the initial reactions following the notice of the insider trade. Therefore, we may see how the returns of the insiders develops and whether the price of the asset reverts to its original value.

To measure the abnormal returns of insiders in the long-run, we've chosen the length of the event window to be 20 trading days (one month). This length was selected to provide insight

into the developments of the abnormal returns in the "long" term, while still being short enough to keep the probability of unexpected events[8] relatively low.

Finally, the event day (T = 0) is the day the insider trade is conducted.

6. Data selection

As our analysis would be dependent on a vast amount of data, we initially wanted to have our data supplied by established data vendors or financial institutions. We contacted both the Oslo Stock Exchange and Netfonds Bank ASA[9] without success. We also attempted to retrieve our required data using the research- and analysis tool Macrobond[10], but all efforts proved futile. We therefore had to retrieve our data manually, using NewsWeb[11] to find information regarding company-specific insider trades. This proved to be a time-consuming task, as we have had to read the notice for each insider trade and manually plot the relevant information[12] in an Excel-spreadsheet (see Appendix B). We therefore had to abandon our initial plan to cover *all* listed companies on the OSE, and instead shifted our focus to a select few.

As we suspected the insider returns to be somewhat dependent on the *size* of the company, we chose to include an equal number of small, medium and large companies in our selection. The size-category of the companies would be decided by their *market*

[8] "Unexpected events" here refers to events with significant impact on the price of the asset and/or the market in general. Neither the insiders nor the general public would be able to anticipate these events, and thus would not be able to capitalize on them.
[9] An established online-broker known for providing its clients with various types of data. See www.netfonds.no for more information.
[10] See macrobond.com for further information
[11] See https://newsweb.oslobors.no/
[12] For the analysis, we needed the date of the insider trade, the volume-weighted average price of the trade (VWAP), the total volume traded, the type of trade (sell/buy) and the position of the insider (CEO, CFO, board member, etc.). We did not include insider trades related to options (or the exercising of these) or bonds, nor any trades related to employee stock-saving programs.

capitalization[13]*.* The *large-cap* companies would be selected from the OBX index[14], while the *mid- and small-cap* companies would be chosen from the OSE Mid-Cap Index and OSE Small-Cap Index, respectively.

In order to provide a "broad" view on the returns achieved by the insiders, we selected companies from different sectors[15] for each size-category. This would not only provide a more representative view of the insiders' returns, but would also limit the risk of sector-specific incidents contaminating our data and findings.

Companies		
Large-cap	**Mid-cap**	**Small-cap**
Orkla ASA	Norwegian Air Shuttle ASA	Medistim ASA
Equinor ASA	Solon Eiendom ASA	REC Silicon ASA
Marine Harvest ASA	Frontline ASA	NEL ASA
DNB ASA	Petroleum-Geo Services ASA	Biotec Pharmacon ASA
Norsk Hydro ASA	Grieg Seafood ASA	Data Respons ASA

The data for the insider trades will be for the period 01.01.2013 - 04.12.2018. To establish the expected returns, we've also collected the data for the final quotes of each company in the time frame 2012-2018. This will be compared with the market return (the returns of the OBX-index) in the same period.

The arithmetic daily returns were calculated as:

$$R_{it} = \frac{p_{it}}{p_{it-1}} - 1 \qquad (19)$$

$$R_{it} = The\ return\ of\ asset\ i\ at\ time\ t$$

$$p_{it} = Price\ of\ asset\ i\ at\ time\ t$$

Furthermore, we chose to disregard the transaction costs related to the insider trade as these tend to vary between different years and brokers. Additionally, including transaction costs in our calculation would significantly alter the complexity of our analysis.

[13] The total market value of the company's outstanding shares

[14] The OBX Total Return Index is compromised of the 25 largest and most liquid shares on the OSE

[15] «Sectors» are here meant as the primary operating activity of each company. E.g. oil production, fishing, banking, telecom etc.

Note that we chose only to include the insider *purchases*, as these are considered to better reflect the insiders' intentions than insider *sales* (Seyhun, 1986). The reasoning is that insiders in general have only one reason to *purchase* their company's stock: Profit; either from the suspicion of a future price incline or that they find the stock to be currently undervalued. The insider's choice of *selling* their company's stock might however be linked to several factors. For instance, the insiders might wish to diversify their holdings or free up some of their assets. Thus, insider sales might not be an indication of the insider's suspicion of future price-declines or that the stock is currently overvalued. As a consequence of this, the outsiders tend to be less inclined to act in accordance with insider *sales* (Lakonishok & Lee, 1998).

7. Results

In order to determine whether the insiders on average earn abnormal returns, we must test if the returns are *significant.* For our testing, we will establish a null-hypothesis stating that the insiders *do not* earn significant abnormal returns (H_0: CAAR = 0) and an *alternative hypothesis* stating that the insiders *do* earn positive abnormal returns (H_1: CAAR > 0).

	All companies	*(at 5% significance level)*				
		CAAR:	***t-stat:***	***Critical t-value:***	***p-value:***	***Significance:***
	2 trading days:	0,11152 %	0,034150562	1,761	0,486639	*Not significant*
(1 week)	***5 trading days:***	0,075146 %	0,011118159	1,761	0,495689	*Not significant*
(1 month)	***20 trading days:***	-0,008524 %	-0,002674940	1,761	0,49895	*Not significant*

Fig. 2 - Test for abnormal returns across all companies

The results from our test on the abnormal returns across *all companies* in our selection is listed in Fig.2. As we can see, the cumulative abnormal returns proved to be *insignificant* for all our event windows. We therefore *fail to reject* the null-hypothesis. This means that a company insider, on average, will be unlikely to achieve abnormal returns in his trading. This would in turn imply that the insiders do not possess any material, non-public information, or that they are not able to capitalize on their informational advantage.

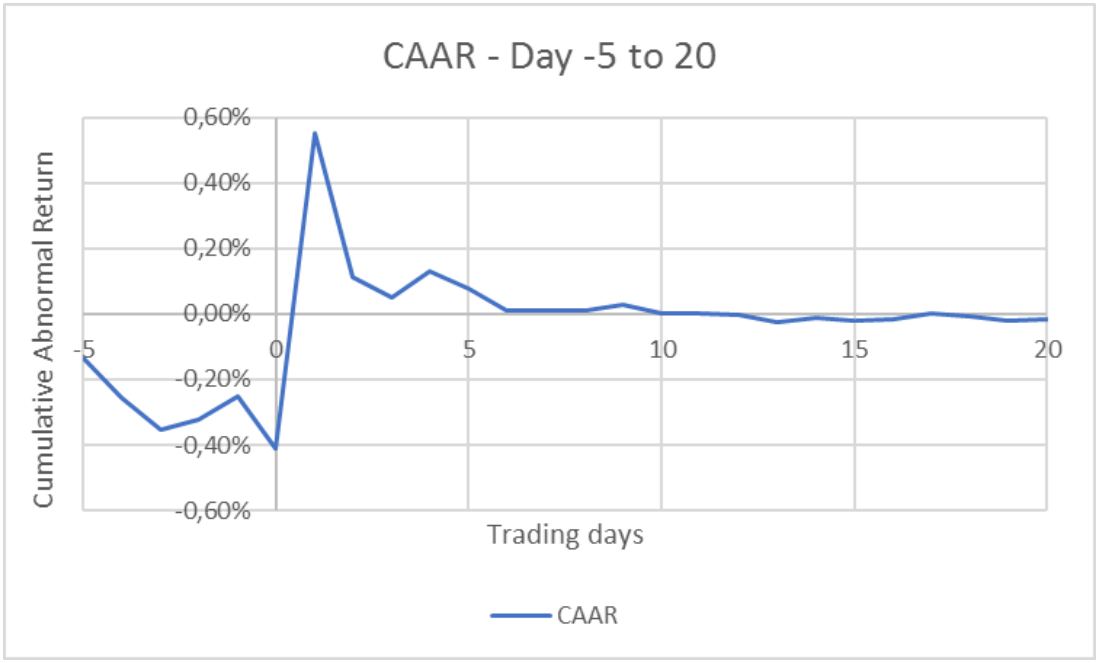


Fig.3 - CAAR for all companies from day -5 to 20

In Fig.3, we see that the companies tend to experience *negative abnormal returns* in the days preceding the insider trade (Day 0). This indicates that the insiders are more susceptible to purchasing shares in their own company after it has experienced a period of diminishing returns. This form of declining returns is often due to the market having a growing distrust in the given company's ability to maintain its current level of return. As the insiders chose to act against the market and bought despite of the seemingly negative trend in the stock's return, they can be characterized as *contrarian traders*.

At the day of the insider trades (Day 0 in Fig.3), the CAAR reached its lowest levels of our observed period (-0,4%). In the proceeding days, the CAAR increased, reaching its peak on the day following the insider trade (Day 1). This could indicate that the insiders have the ability to *time the market*, as they obtained their shares at low prices right before the stock's inflection point. However, the sudden increase in the cumulative abnormal return (CAAR) also coincides with the publication of the notice regarding the insider trade. Thus, the positive market reactions (which leads to the increase in the CAAR), could be caused by outsiders acting in accordance with the insider trade. The outsider might suspect that the insider possesses superior information and may therefore want to mimic his trade. This

would increase the demand for the insider's stock, which in turn would drive up the prices and hence the return.

After its initial surge on the day following the insider trade, the CAAR is reduced to 0,11152% by the end of day two (see Fig.3). This reduction is followed by a slight appreciation in the CAAR-levels between day 3 to 4, before moving toward zero as time progresses. Based on these developments of the CAAR, we may argue that the negative abnormal return following the initial increase might be a consequence of the market *overreacting* to the news of the insider trade. The variating CAAR-levels may then be a consequence of the market attempting to *adjust* to the new information.

In Fig.3, we see that the CAAR stabilizes around zero approximately 6 days after the insider trade. This would imply that the market has incorporated the insider information into the prices, and that it's now at its expected level. Furthermore, our analysis show that the insiders are unable to achieve abnormal profits both in the short-, middle- and long term. Thus, provided that our selection of companies is representative for the entire population of the OSE, this provides evidence for the *Strong-form efficiency* to hold in the long run.

If the OSE adheres to the *semi-strong form* of the EMH, prices would adjust rapidly to its new "equilibrium value" following the publication of the insider notice. As our analysis found that prices tended to fluctuate in the days following the announcement, we are inclined to assume that the OSE does not follow the semi-strong form of the EMH in the short run.

To gain further insight into the insiders' abilities to earn abnormal returns, we have conducted additional tests based on the insider's position, the company's market cap and for specific firms:

Large-cap companies			(at 5% significance level)			
		CAAR:	t-stat:	Critical t-value:	p-value:	Significance:
	2 trading days:	0,00049 %	0,002208353	1,761	0,499175.	Not significant
(1 week)	5 trading days:	-0,041131 %	-0,194800552	1,761	0,429281	Not significant
(1 month)	20 trading days:	0,011607 %	0,056901106	1,761	0,479014	Not significant

Fig.4 - Our findings for abnormal returns earned by insiders in large-cap companies

Mid-cap companies			(at 5% significance level)			
		CAAR:	t-stat:	Critical t-value:	p-value:	Significance:
	2 trading days:	0,15341 %	0,358423058	1,761	0,369079	Not significant
(1 week)	5 trading days:	0,091327 %	0,216750275	1,761	0,419778	Not significant
(1 month)	20 trading days:	0,050854 %	0,122264593	1,761	0,454391	Not significant

Fig.5 - Our findings for abnormal returns earned by insiders in mid-cap companies

Small-cap companies			(at 5% significance level)			
		CAAR:	t-stat:	Critical t-value:	p-value:	Significance:
	2 trading days:	0,18067 %	0,410834509	1,761	0,351136	Not significant
(1 week)	5 trading days:	0,057146 %	0,130361920	1,761	0,451421	Not significant
(1 month)	20 trading days:	-0,088032 %	-0,201138664	1,761	0,425619	Not significant

Fig.6 - Our findings for abnormal returns earned by insiders in small-cap companies

As seen by the figures above, the abnormal returns achieved by the company insiders prove to be *insignificant* for all event windows regardless of the company's market capitalization. The differences in the CAAR are small between the different size-categories, but by comparing the returns for the 2 trading days following the insider purchase, we see that the CAAR for the large-cap companies are lower than for the others. On average, the insiders across all large-cap companies will earn cumulative abnormal returns of 0,00049% in the two days following the insider purchase, while the insiders in small- and mid-cap companies will earn CARs of 0,181% and 0,153%, respectively. This may be due to the additional analyst coverage the large companies tend to receive, which may provide the outsiders with a better notion of the company's *fundamental value*. Additionally, the outsiders may think the informational asymmetry is smaller with the large companies than with the mid- or small-cap companies. This may result in the outsiders having less faith in the predictive abilities of insiders in large companies, which in turn will reduce the immediate impact of insider trades in large firms.

Furthermore, as time progresses, the CAAR will tend to move toward zero, regardless of the company's market capitalization. As such, it will likely be futile to attempt to construct an insider portfolio based on the market capitalization of the companies.

Insider postion: CEO			(at 5% significance level)			
		CAAR:	t-stat:	Critical t-value:	p-value:	Significance:
	2 trading days:	0,07903 %	0,122127922	1,697	0,451804	Not significant
(1 week)	5 trading days:	0,211154 %	0,331643337	1,697	0,371211	Not significant
(1 month)	20 trading days:	0,103474 %	0,163809202	1,697	0,435476	Not significant

Fig.7 - The abnormal returns for CEOs

Insider postion: Board member			(at 5% significance level)			
		CAAR:	t-stat:	Critical t-value:	p-value:	Significance:
	2 trading days:	0,42553 %	1,276847607	1,66	0,101893	Not significant
(1 week)	5 trading days:	0,103443 %	0,31175947	1,66	0,377866	Not significant
(1 month)	20 trading days:	-0,010317 %	-0,031166562	1,66	0,487657	Not significant

Fig.8 - The abnormal returns for board members

Insider postion: Upper Management			(at 5% significance level)			
		CAAR:	t-stat:	Critical t-value:	p-value:	Significance:
	2 trading days:	0,44982 %	0,920206963	1,684	0,181715	Not significant
(1 week)	5 trading days:	0,215852 %	0,453152334	1,684	0,326561	Not significant
(1 month)	20 trading days:	0,040467 %	0,085539243	1,684	0,466162	Not significant

Fig.9 - The abnormal returns for members of upper management

Although the results from our tests based on the insider's position was also found to be insignificant, the CAAR-levels for the board members and upper management was far higher than those of all companies combined or those based on market capitalization (see Fig.8-9). The average cumulative abnormal return achieved by board members in the two days following the trade was 0,426% and the CAAR of the upper management was 0,4498% for the same event window[16]. A noteworthy observation is that the CAAR achieved by CEOs are far lower than that of board members and various members of upper management over two and 5 trading days following the trade. Over time, however, the CEOs achieves a higher CAAR than the others.

[16] A selection of company-specific CAAR-analyses can be found in Appendix A

8. Critics and limitations

8.1 Outliers and extreme events

A potential issue in our analysis is the occurrence of extreme events that greatly affects the return of either specific companies or entire sectors. Events of this magnitude may produce extreme values of return in either positive or negative direction and would therefore have significant impact on either the estimation- or the event window. If the event occurred in the estimation window, the effect of the event would be somewhat "evened out"[17] as this period is used to estimate the expected return of the asset. However, if the event occurred in the event window it could greatly affect the calculated abnormal returns, as this is the period where one finds the actual returns. This single event could therefore have consequences for the conclusions made, although it is not be representative of the "normal" situation.

Removing or avoiding such events from the data may however result in a *biased* conclusion. When being selective of what data to incorporate in the analysis and what to leave out, the conclusion will only reflect the choices you made regarding the data (*selection bias*). As a consequence of this potential pitfall, we chose to include extreme events in our analysis.

8.2 Unusual returns in the estimation window

If the returns in the estimation window is greatly affected by market wide events, such as recessions or booms, the estimated expected values might be inaccurate. This would in turn have implications for the calculation of the abnormal returns.

As the length of our estimation window is *200 trading days* (approximately 10 months), we will likely cover a sufficiently long period to "smooth out" any temporary fluctuations in the market data. As seen by the figure below, the returns on the OSE is relatively stable in the long run (with a shift of trend occurring in early 2016). Additionally, the removal of any

[17] Provided that the effects of the event are momentary

market data would force us to exclude the insider trades dependent on this data. Because of this, we chose to include the market data for the entire period.



Fig.10 - The development of the OBX Total Return Index

8.3 Thin trading

Thin trading signifies illiquid assets which are infrequently traded and often traded in small volumes. These assets are more prone to have large price swings (*high volatility*), as market orders will tend to *move the market* as a consequence of the asset's *thin order book*. Furthermore, assets such as these will often go by untraded for several trading days at a time. Thus, they will not have price-swings in relation to the market in general, which in turn will affect the calculated beta (β) of the asset (Scholes & Williams, 1977). This can lead the estimated expected value of the asset to be inaccurate or erroneous, which in addition to the volatile *actual returns* might produce inaccurate estimates of the assets abnormal return. As our selection of companies consists of 5 small-cap firms, this might be a problem that would affect our results. However, the firms chosen are reasonably liquid (compared to

other small-cap companies) and are thus less susceptible to this problem. Furthermore, we wanted to incorporate small-cap companies in our analysis to investigate whether the insiders of these firms experienced different levels of abnormal returns than insiders in large- and mid-cap companies.

8.4 Registering data

As all data was manually registered and analyzed in Excel, mistakes are not unlikely to have occurred. However, we made sure to double check each entry with the details listed in the insider notice. Therefore, the mistakes should be both few and small.

8.5 Representative selection of companies

As we were not able to procure insider data from established data vendors, we had to register the data on our own. As this was a rather time-consuming task, we had to reduce the number of companies to include in our analysis. We therefore chose 15 firms: 5 large-cap, 5 mid-cap and 5 small-cap. As this does not represent the correct ratio between large-, mid- and small-cap companies on the OSE (*Oslo Stock Exchange*), we might get different results than we would have by analyzing *all companies* on the OSE. In addition, the OSE mainly consists of the oil- and fishing sectors. In order for our results to be less dependent on the prices of oil and salmon (both of which have been highly volatile in recent years), we chose to incorporate a broad range of sectors in our selected companies (i.e. banking, telecom, shipping, etc.). As a consequence of this, the CAAR we calculate for all the companies in our selection might deviate from the CAAR calculated for the entire OSE.

As we meticulously selected each company we included in our analysis, we might be prone to *selection bias*. However, the companies we chose are all leaders within their respective fields and represent different levels of market capitalization and liquidity. Therefore, we assume that the companies in our selection will be representative for the population (the entire OSE).

9. Conclusion

The analysis based on the insiders across *all companies in our selection*, found the insider's abnormal return to be *insignificant* in both the short-, mid- and long-term event windows. As we suspected the abnormal returns to be dependent on certain characteristics of both the insider and the companies, we divided our analysis into different subsets. These subsets were based on the company's market capitalization and the position of the insiders. However, the analysis of these subsets yielded the same results as our initial analysis.

Although the abnormal returns seem to be insignificant for insiders across multiple companies, our findings *do* indicate that significant abnormal returns may arise in *specific firms* (though rarely). In the analysis covering the firm REC Silicon ASA (see Appendix A), we find the CAAR to be *significantly positive* over the 2 trading days following the insider trade (the short-term estimation window). This result was not caused by any extreme event, and the returns for the 2 days following an insider trade were consistently high. As this was the only company in our selection to display such traits, we may assume that only *a few companies* in the entire population (the entire OSE) will have these characteristics.

Furthermore, we observe that the CAAR tends to spike on the day that the notice of the insider trade is published. In the following days, however, the CAAR will move toward zero. Based on this, we may assume that the initial spike is the immediate market reaction to the news of the insider trade. As the CAAR slowly adjusts to zero, it is reasonable to believe that the market has overreacted to the news and is adjusting to the new value estimate in the following days. Given that this trend continues in the days following the end of our event windows, there will be no further opportunities for the insiders to earn abnormal returns on their trade.

Based on these results, we find that the average insider on the Oslo Stock Exchange do not earn abnormal returns in their trading**.** However, our findings also indicate that some insiders in a *very small* selection of companies may be more likely to achieve abnormal

results in the short run. But as this will only apply to such a limited number of companies on the OSE, it may be expected that a few companies out of the whole population achieves significant abnormal insider returns. ***Based on this, we may conclude that the insiders in general do not earn abnormal returns on their trades.***

This conclusion is supported by the findings of Eckbo and Smith (1998). Their analysis covered the insider trades on the OSE between 1985 and 1992 and concludes that the insiders on average earn *no significant abnormal returns* (Eckbo & Smith, 1998). Although their analysis employed different techniques than the event-based method utilized in our analysis and covered a longer time frame, we find that the similarities in our results strengthens our conclusion.

10. Appendices

10.1 Appendix A

Tests for some of the companies in our selection:

REC Silicon ASA				(at 5% significance level)		
		CAAR:	t-stat:	Critical t-value:	p-value:	Significance:
	2 trading days:	1,48289 %	1,786820819	1,697	0,041724 (*)	Significant
(1 week)	5 trading days:	0,610188 %	0,743052406	1,697	0,231451	Not significant
(1 month)	20 trading days:	0,126072 %	0,154103058	1,697	0,439249	Not significant

ORKLA ASA				(at 5% significance level)		
		CAAR:	t-stat:	Critical t-value:	p-value:	Significance:
	2 trading days:	0,13274 %	0,39782051	1,753	0,348191	Not significant
(1 week)	5 trading days:	0,109159 %	0,355715704	1,753	0,363509.	Not significant
(1 month)	20 trading days:	0,097849 %	0,328485848	1,753	0,373574	Not significant

NEL ASA				(at 5% significance level)		
		CAAR:	t-stat:	Critical t-value:	p-value:	Significance:
	2 trading days:	-1,80072 %	-1,341893608	1,753	0,099937 (*)	Not significant
(1 week)	5 trading days:	-1,197367 %	-0,892605796	1,753	0,193239	Not significant
(1 month)	20 trading days:	-0,645438 %	-0,48213998	1,753	0,318382	Not significant

Equinor ASA				(at 5% significance level)		
		CAAR:	t-stat:	Critical t-value:	p-value:	Significance:
	2 trading days:	-0,11615 %	-0,130882931	1,86	0,449888	Not significant
(1 week)	5 trading days:	-0,063225 %	-0,075671219	1,86	0,471028	Not significant
(1 month)	20 trading days:	-0,014460 %	-0,017945465	1,86	0,493426	Not significant

Frontline ASA				(at 5% significance level)		
		CAAR:	t-stat:	Critical t-value:	p-value:	Significance:
	2 trading days:	-1,40149 %	-0,983713874	1,943	0,181785	Not significant
(1 week)	5 trading days:	-0,444414 %	-0,315668809	1,943	0,381714	Not significant
(1 month)	20 trading days:	-0,232949 %	-0,168799466	1,943	0,436052	Not significant

Petroleum Geo-Services ASA				(at 5% significance level)		
		CAAR:	t-stat:	Critical t-value:	p-value:	Significance:
	2 trading days:	1,05450 %	1,188022908	1,771	0,128043	Not significant
(1 week)	5 trading days:	0,133576 %	0,152918521	1,771	0,440412	Not significant
(1 month)	20 trading days:	0,191039 %	0,222551588	1,771	0,413691	Not significant

Candidates: 25 and 37

10.2 Appendix B

Example of our insider data

Date:	Ticker:	Message:	Volume:	Price:	Type:	CEO? *(Yes=1, No=0)* :	Other insider position:
17.07.18	ORK	Orkla ASA: Meldepliktig handel for primærinnsidereWWOrkla ASA: Meldepliktig handel for primærinnsidere	80 000	67,2002	Purchase	0	Board member
16.07.18	ORK	Orkla ASA: Mandatory notification of trade - primary insidersWWOrkla ASA: Mandatory notification of trade - primary	3 115	65,24	Purchase	1	
29.05.18	ORK	Orkla ASA: Mandatory notification of trade - primary insidersWWOrkla ASA: Mandatory notification of trade - primary	3 000	75,68	Purchase	0	Other
08.05.18	ORK	Orkla ASA: Meldepliktig handel for primærinnsidereWWOrkla ASA: Meldepliktig handel for primærinnsidere	10 000	74,2	Purchase	0	Board member
01.03.18	ORK	Orkla ASA: Meldepliktig handel for primærinnsidereWWOrkla ASA: Meldepliktig handel for primærinnsidere	10 000	85,82	Sale	0	Leader Orkla Investments
03.11.17	ORK	Orkla ASA: Mandatory notification of trade - primary insidersWWOrkla ASA: Mandatory notification of trade - primary	3 099	79,5	Purchase	0	Director of Communication
26.10.17	ORK	Orkla ASA: Meldepliktig handel for primærinnsidereWWOrkla ASA: Meldepliktig handel for primærinnsidere	858 000	82,82	Purchase	0	Board member
30.08.17	ORK	Orkla ASA: Mandatory notification of trade - primary insidersWWOrkla ASA: Mandatory notification of trade - primary insiders	500	79,45	Purchase	0	Head Attorney
17.07.17	ORK	Orkla ASA: Meldepliktig handel for primærinnsidereWWOrkla ASA: Meldepliktig handel for primærinnsidere	2 500	86,339	Purchase	0	Vice President
17.07.17	ORK	Orkla ASA: Meldepliktig handel for primærinnsiderWWOrkla ASA: Meldepliktig handel for primærinnsider	2 000	85,65	Purchase	0	Board member
17.07.17	ORK	Orkla ASA: Mandatory notification of trade - primary insidersWWOrkla ASA: Mandatory notification of trade - primary insiders	10 000	86,05	Purchase	0	Board member
23.12.15	ORK	Orkla ASA: Meldepliktig handel - Peter A. RuzickaWWOrkla ASA: Meldepliktig handel - Peter A. Ruzicka	576	69,55	Purchase	0	Concern Director
25.11.14	ORK	Orkla ASA : Mandatory notification of trade - Grace Reksten SkaugenWWOrkla ASA : Mandatory notification of trade - Grace Reksten Skaugen	3 000	53,4	Purchase	0	Vice President
31.10.14	ORK	Orkla ASA: Meldepliktig handel - PrimærinnsiderWWOrkla ASA: Meldepliktig handel - Primærinnsider	13 000	50,2	Purchase	0	Director of Stabburet
19.05.14	ORK	Orkla ASA: Mandatory notification of trade - Ingrid Jonasson BlankWWOrkla ASA: Mandatory notification of trade - Ingrid Jonasson Blank	1 750	51,4	Purchase	0	Board member
24.02.14	ORK	Orkla ASA : Mandatory notification of trade - Terje AndersenWWOrkla ASA : Mandatory notification of trade - Terje Andersen	5 000	46,96	Purchase		CFO
10.02.14	ORK	Orkla ASA: Mandatory notification of trade - Peter A. RuzickaWWOrkla ASA: Mandatory notification of trade - Peter A. Ruzicka	280 000	46,37	Purchase	1	
14.01.14	ORK	Orkla ASA: Mandatory notification of trade - Primary insiderWWOrkla ASA: Mandatory notification of trade - Primary insider	3 000	46,46	Purchase	0	Board member

10.3 Appendix C

Descriptive statistics:

	Observations:	Mean:	Median:	Minimum value:	Maximum value:
Number of trades:	314	20,93	16	6	56
Net value:	314	7 799 498,22	475 000	2 644,65	900 000 000

Fig.11 - Descriptive statistics for the insider trades

Based on market capitalization:					
	Observations:	**Mean:**	**Median:**	**Minimum value:**	**Maximum value:**
Large-cap:					
Number of trades:	65	12,60	11	6	20
Net value:	65	kr 22 426 445	kr 378 856	kr 14 124	kr 900 000 000
Mid-cap:					
Number of trades:	146	28,60	15	7	84
Net value:	146	kr 1 627 249	kr 563 502	kr 7 623	kr 20 182 426
Small-cap:					
Number of trades:	103	21,60	18	6	46
Net value:	103	kr 7 422 158	kr 349 500	kr 2 645	kr 158 200 000

Fig.12 - Descriptive statistics for the insider trades in companies with different market capitalization

Based on insider position					
	Observations:	**Mean:**	**Median:**	**Minimum value:**	**Maximum value:**
CEO:					
Net value:	35	kr 1 274 305	kr 368 000	kr 108 500	kr 12 983 600
Upper management					
Net value:	45	kr 382 528	kr 166 800	kr 28 722	kr 3 434 935
Board member					
Net value:	162	kr 5 637 422	kr 927 032	kr 2 645	kr 158 200 000
Other:					
Net value:	72	kr 19 981 450	kr 302 485	kr 7 623	kr 900 000 000

Fig. 13 - Descriptive statistics for insider purchases based on various insider positions.

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