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Stock Behavior Before Earnings Surprises and Potential Illegal Insider Trading

A Comparative Analysis of the Scandinavian Exchanges

Sondre M. Otterbu & Herman Tveit

Supervisor: Elizaveta Sizova

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NORWEGIAN SCHOOL OF ECONOMICS

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Sondre Melkevik Otterbu

Herman Tveit

Abstract

This thesis investigates abnormal stock behavior prior to earnings surprises on the Oslo Stock Exchange (OSE), Nasdaq Stockholm (OMXS), and Nasdaq Copenhagen (OMXC), with a focus on potential illegal insider trading. Utilizing event study methodology, we examine stock price and trading volume patterns during the event window $[-10, +1]$ around earnings announcements from 2010 to 2023, excluding 2020-2021 due to the COVID-19 pandemic. Earnings surprises are categorized by deviations from analyst consensus at thresholds of $\pm 10\%$, $\pm 20\%$, and $\pm 40\%$, resulting in a dataset of approximately 9,000 earnings announcements across 369 companies.

Our analysis reveals significant cumulative average abnormal returns (CAAR) preceding positive earnings surprises, particularly on OMXS and OMXC, with indications of similar patterns on OSE but to a lesser degree. Pre-announcement trading volume is marginally higher on OSE compared to OMXS and OMXC, indicating possible market anticipation. Interestingly, no pre-event CAAR trends are observed for negative earnings surprises, suggesting regulatory constraints on short-selling activity may deter insider trading in such cases.

The study further explores the enforcement of the Market Abuse Regulation (MAR) across the three exchanges. We find no consistent correlation between MAR enforcement rates and indications of illegal insider trading, highlighting potential gaps in regulatory effectiveness.

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1 Introduction

Rumors persist among finance professionals that insider trading is a common occurrence on the Oslo Stock Exchange. Petter Gottschalk, a professor and renowned researcher in financial crime, has highlighted the persistence of illegal insider trading as a significant issue on the exchange (Nygaard and Helgheim, 2020). These concerns were further validated just before this thesis was completed. On December 6, Finansavisen, a leading Norwegian business newspaper, reported that the Norwegian Financial Supervisory Authority had fined an investment bank NOK 25 million for illegally sharing inside information[1].

Additionally, research by Professors Hans K. Hvide and Kasper Meisner Nielsen provides further support for these claims. Their work reveals that mid-level executives, who are not included on the primary insider list, consistently achieve abnormal returns of approximately 1 percentage point on investments in their own companies (Hvide and Nielsen, 2021). This finding supports the idea that insider trading is not limited to top executives but also occurs to lower levels of corporate hierarchies.

In recent years, European markets have faced increasing pressure to comply to stricter financial regulations aimed at preserving market integrity and limiting financial crime. One of the most critical of these regulations is the Market Abuse Regulation (MAR). It was introduced by the European Union to standardize and tighten the rules for market manipulation and insider trading. The enforcement of MAR places a heavy burden on national authorities to ensure that financial markets operate in a transparent and fair manner. For the Scandinavian countries, this means aligning their regulations with EU standards, while also facing increased inspection over the effectiveness of these regulations.

Despite these efforts, suspicions of illegal insider trading have continued to rise[2], suggesting that the measures in place may not be entirely effective. This accompanied with lower enforcement rates suggests a worrying trend, also noted in ESMA[3] reports on MAR sanctions (ESMA, 2018-2024).

Although illegal insider trading does occur in Scandinavia, research on the topic remains limited. When conducting this thesis, we were fortunate to secure a meeting with Thomas

[1] https://www.finansavisen.no/finans/2024/12/06/8216121/fearnley-securities-far-bot-av-finanstilsynet
[2] Based on annual reports and statistics from FSA Norway, FSA Sweden, and FSA Denmark.
[3] European Securities and Markets Authority

Borchgrevink, the Director of Market Surveillance and Administration at Finanstilsynet in Oslo[4]. This meeting provided us with valuable real-world insights, confirmed the scarcity of existing research, and reinforced our motivation.

Furthermore, we suggest that earnings announcements exceeding or falling short of analyst consensus estimates (i.e., earnings surprises) create incentives for illegal insider trading. By concentrating on earnings announcements, this study extends previous research, which has mainly focused on corporate events like mergers and acquisitions and seasoned equity offerings (Keown and Pinkerton, 1981; Meulbroek, 1992; Nygaard and Helgheim, 2020). Moreover, this topic has yet to be explored within the context of Scandinavian exchanges.

Based on this, we formulated the following research questions:

1. *Are there indications of illegal insider trading on Scandinavian stock exchanges ahead of earnings surprises, and is it more prevalent on the Oslo Stock Exchange?*
2. *Does the enforcement strategy under MAR impact the presence of illegal insider trading in the context of earnings surprises across Scandinavian stock exchanges?*

Utilizing daily stock return data combined with analyst consensus estimates from I/B/E/S, this thesis seeks to address these questions. We analyze stock return patterns prior to earnings surprises across the Oslo Stock Exchange (OSE), Nasdaq Stockholm (OMXS), and Nasdaq Copenhagen (OMXC). Our focus is to investigate patterns that could indicate illegal insider trading. Specifically, we examine earnings surprises where a stock either exceeds (beats) or falls short of (misses) analyst consensus by thresholds of 10%, 20%, and 40%, resulting in a total of 18 subsets. Additionally, we assess the enforcement strategy of each respective country to explore potential patterns or correlations between stock behavior and enforcement activity.

This research is important as insider trading undermines public trust in financial markets, as noted by Bhattacharya and Daouk (2002), and violates MAR, which seeks to ensure transparency and investor protection. Through this analysis, we aim to contribute to the broader discussion on market regulation, transparency, and investor confidence in financial markets.

Our findings reveal a noticeable build-up in abnormal returns prior to earnings beats at all

[4]The Norwegian Financial Supervisory Authority

thresholds, though the significance of this effect varies. Contrary to our initial expectations, the OMXS and OMXC exchanges show stronger cumulative average abnormal returns (CAAR) than OSE on all thresholds, with the observed values being statistically significant.

For earnings misses, no exchanges show CAAR trends prior to the announcement, likely due to stricter regulations for short-position disclosure. In terms of pre-announcement volume, the OSE demonstrates slightly higher relative volume compared to OMXS and OMXC.

Overall, our results suggest potential signs of illegal insider trading across all examined exchanges, with stronger indications on OMXS and OMXC compared to OSE. Additionally, we find no evidence that the degree of enforcement notably impacts the presence of illegal insider trading indications across the Scandinavian stock exchanges..

The thesis is structured as follows: Section 2 reviews the literature on insider trading, earnings announcements, and market behavior, forming the theoretical foundation of the study. Section 3 examines the relevant laws, regulations, and authorities, including MAR and its adaptation across Scandinavian countries. Section 4 describes the research methodology, including the event study approach and abnormal return calculation. Section 5 provides an overview of the data used and how it was processed. Section 6 presents the empirical results, and compares the findings across the three exchanges. Finally, Section 7 concludes the thesis by answering the research questions, and suggesting directions for future research.

2 Literature Review

Illegal insider trading has been widely studied in large markets like the U.S., where pre-announcement stock price movements and trading volume patterns are often attributed to potential illegal insider trading. However, Scandinavian markets have received limited attention, with research primarily focusing on larger corporate events such as M&A and SEOs. To date, no studies have specifically explored pre-announcement stock behavior around earnings announcements on Scandinavian exchanges. This section outlines the theoretical foundation for this study.

2.1 Illegal Insider Trading

Several foundational studies have examined the relationship between insider trading and stock behavior prior to major corporate announcements. For instance, Keown and Pinkerton (1981) highlighted systematic price run-ups before merger announcements in the U.S. market, attributing a significant portion of these increases to insider trading. Similarly, Meulbroek (1992) demonstrated that illegal insider trading can have a substantial impact on stock prices, showing that nearly half of the pre-announcement price run-ups during takeover events were linked to insider trading. However, these studies also acknowledge the challenge of definitively attributing pre-announcement price changes to insider trading, noting that market rumors and investor anticipation can also drive such patterns.

Nygaard and Helgheim (2020) applied modern approaches to investigate illegal insider trading on the Oslo Stock Exchange, focusing on cumulative abnormal returns (CAR) prior to mergers and acquisitions (M&A), and seasoned equity offerings (SEO). They observed a pre-announcement CAR buildup of 4.8% for M&A. This is notable, but relatively smaller than findings in prior studies such as Keown and Pinkerton (1981) and Meulbroek (1992). By incorporating Google search volumes as a proxy for market anticipation, they demonstrated that this buildup was primarily driven by rumors and investor attention, suggesting that illegal insider trading may not be a significant issue in these cases. However, for SEOs where funds raised were earmarked recapitalizations, CAR buildups persisted even after adjusting for market anticipation, pointing to the possibility of informed trading. Building on Nygaard and Helgheim's findings, this thesis

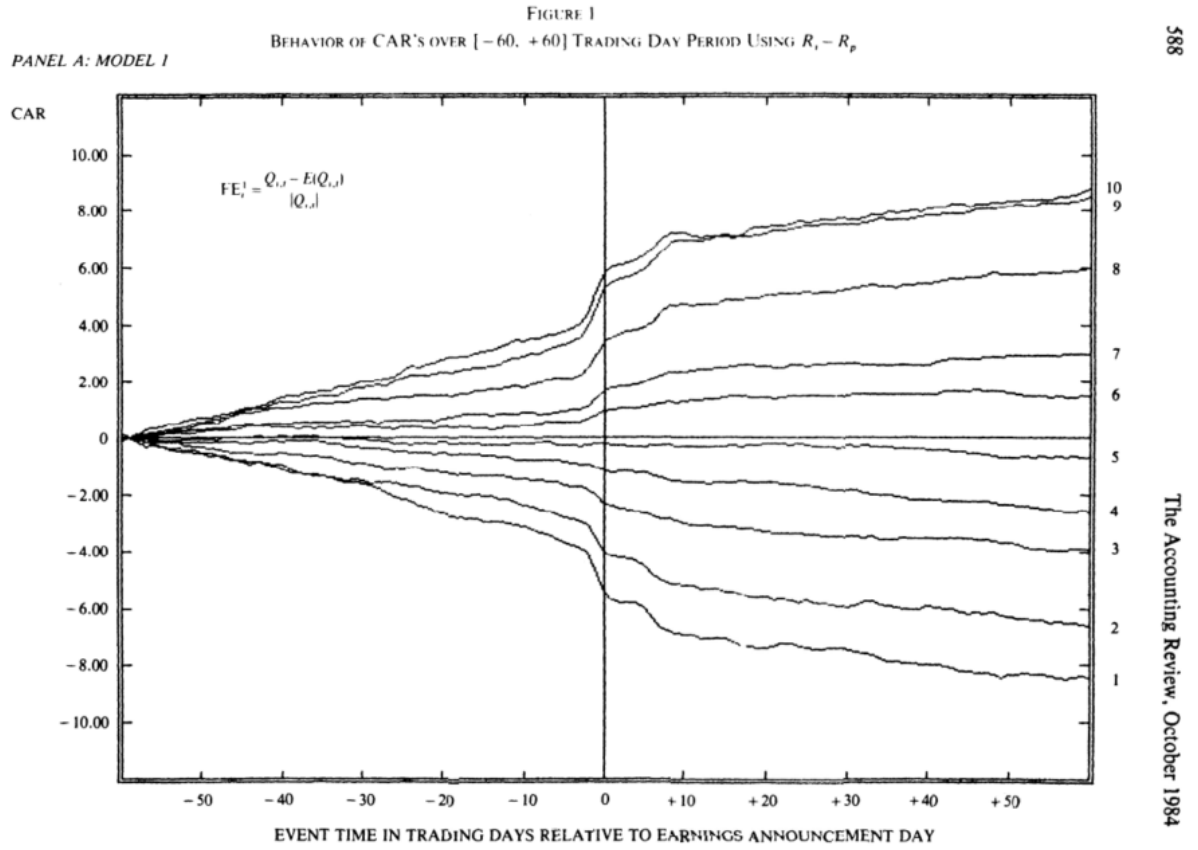
shifts the focus to stock behavior prior to earnings surprises, an area yet to be explored in the context of potential illegal insider trading on the Scandinavian exchanges.

2.2 Earnings Announcements and Surprises

Earnings announcements are another type of event that generates notable stock price and volume reactions. Studies such as Ball and Kothari (1991) and Brandt et al. (2008) emphasize that earnings announcements resolve uncertainty in the market, often leading to significant changes in stock prices and trading volumes. The anticipation of earnings announcements and the potential for earnings surprises can drive stock movements, which provides an incentive for insider trading.

Foster et al. (1984) examine how stock prices and trading volumes react to earnings announcements, offering valuable insights into market behavior during these events. Their research identifies systematic pre- and post-announcement drifts in security returns, with the magnitude and sign of unexpected earnings changes significantly influencing these patterns. They document pre-announcement stock price movements during the 60 trading days leading up to earnings announcements, as observed in their analysis of cumulative abnormal returns (CARs) in the [-60, 0] window (see Figure 2.1). They created four models estimating unexpected earnings, two that used prior earnings data and two that used security returns as the basis for estimating unexpected earnings (i.e., earnings surprises). This behavior suggests that markets gradually incorporate earnings information before the official announcement, potentially reflecting information leakage or informed trading. The study also highlights the role of firm size, with smaller firms showing more pronounced pre-announcement price adjustments.

Figure 2.1: Behavior of CARs (Foster et al., 1984)



Note: The graph shows cumulative abnormal returns (CARs) around earnings announcement day (day 0) based on Model 1, which estimates unexpected earnings using past earnings data. Positive and negative deciles represent upward and downward trends, respectively. Pre-announcement drift suggests potential information leakage, while post-announcement drift reflects market adjustment to new information. Adapted from Foster et al. (1984).

Erlien (2011) conducted a study that examined earnings announcements and stock returns on the Oslo Stock Exchange from 2007 to 2010, focusing primarily on the efficient market hypothesis outlined by Fama (1970) and the behavior of stocks following earnings announcements. Her findings indicate that firms reporting positive earnings surprises experience significant abnormal returns, averaging 0.34% and 0.5% in the two days preceding the announcement. These results align with the findings of Foster et al. (1984) and provide further evidence of pre-announcement market reactions in the context of the Oslo Stock Exchange.

However, Erlien's study does not utilize the I/B/E/S dataset, which provides consensus analyst forecasts for earnings. Instead, it employs an autoregressive model as outlined by Foster (1977) to estimate expected quarterly earnings as a proxy for market expectations.

As noted by Kothari (2001) and acknowledged by Erlien, consensus analyst forecasts tend to offer a more accurate proxy for market expectations of earnings.

2.3 Cross-Market Studies

Thompson (2013) examines insider trading regulations and enforcement across 14 major securities markets, revealing significant disparities in legal frameworks, penalties, and enforcement. While insider trading is defined consistently in most countries, enforcement varies widely. For instance, the United States imposes severe penalties and has frequent prosecutions, while countries like Brazil and India face challenges due to weak enforcement and cultural factors. These differences highlight the importance of consistent enforcement over strict legal frameworks in deterring insider trading and maintaining market integrity.

Findings such as those presented by Thompson (2013) underscore the value of comparative studies in advancing the literature on insider trading. By examining multiple jurisdictions, such studies reveal patterns and insights that would remain obscured in single-market analyses. This approach highlights how different regulatory and enforcement environments can shape market behavior, providing a deeper understanding of potential insider trading and regulatory effectiveness.

Unlike prior research, which predominantly examines major corporate events like mergers, this study shifts the attention to earnings announcements and introduces a comparative perspective by including two additional markets: Sweden and Denmark. Our approach adds to the existing literature, potentially motivating further comparative research on the subject of illegal insider trading.

3 Laws, Regulations, and Authorities

After establishing the theoretical foundation, we present the key regulatory framework relevant to this thesis. It begins with an introduction to the Market Abuse Regulation (MAR) and its implementation in the Scandinavian countries, followed by a brief overview of the Short-Selling Regulation (SSR).

3.1 Market Abuse Regulation (MAR)

Regulation (EU) No. 596/2014, known as MAR, was established to strengthen and unify the legal framework for preventing market abuse in financial markets across EU member states. It builds upon the Market Abuse Directive (MAD) by broadening the scope of the regulations and enhancing the mechanisms for enforcement (European Union, 2014).

MAR's primary objective is to safeguard market integrity, emphasizing that the efficient functioning of securities markets and public confidence are crucial for economic growth and stability. It acknowledges that market abuse undermines both the integrity of the markets and public trust (European Union, 2014). The regulation identifies market abuse as insider trading, the unlawful disclosure of inside information, and market manipulation.

Article 7 of MAR defines inside information as specific, non-public information that, if disclosed, could significantly influence the price of a financial instrument. Article 8 addresses insider trading, which occurs when an individual possesses inside information and uses it to trade securities, either for personal gain or on behalf of others. It also includes recommendations to others to trade based on such privileged information. For this study, the EU definitions for inside information and insider trading will be used.

MAR mandates that enforcement of market abuse rules must be uniform and effective across all EU member states. To achieve this, the regulation empowers national competent authorities (NCAs) to monitor compliance and impose administrative measures and sanctions in cases of non-compliance (EU, 2014; ESMA, n.d.). These authorities have the power to investigate suspected violations, including accessing data, requiring information from firms and individuals, and conducting on-site inspections. They can also impose penalties such as fines, bans from trading, and other restrictions aimed at deterring

unlawful behavior.

The enforcement mechanism within MAR is designed to be proportionate, ensuring that sanctions reflect the severity of the offense. Article 30 of MAR specifies that penalties must be sufficiently discouraging, including financial penalties up to a certain percentage of the entity's annual turnover, or a fixed maximum amount for individuals (European Union, 2014). This approach ensures that violations have significant consequences, thereby maintaining a high level of compliance and deterrence across member states.

Regarding implementation, MAR became applicable across all EU member states on 3 July 2016, with no requirement for national transposition, as it is a regulation and not a directive (European Union, n.d.). This means that MAR is directly applicable in all EU jurisdictions, ensuring uniformity without variations that were previously observed under the Market Abuse Directive (MAD). However, while MAR sets the baseline for enforcement and penalties, it allows member states some flexibility in determining the specifics of how these penalties are applied within their legal frameworks (European Union, 2014).

3.1.1 MAR in Norway

Norway implemented MAR on March 1, 2021, nearly five years after its introduction in the EU. This delay reflects Norway's status as a member of the European Economic Area (EEA) rather than the EU. Under the EEA agreement, EU regulations must be incorporated into the EEA framework before they can be implemented domestically, a process requiring approval from EU institutions and the EEA Joint Committee (EFTA, 2023). This added procedural layer contributed to the delayed adoption of MAR in Norway.

The Norwegian Financial Supervisory Authority (Finanstilsynet) serves as the NCA responsible for enforcing MAR. Since its implementation, Finanstilsynet has reported modest enforcement activity. It is worth noting that the dedicated market abuse department was not established until 2021. Previously, market abuse cases were managed under the broader 'Market' department, which may explain the lack of data before MAR's adoption (T. Borchgrevink, personal communication, October 4, 2024).

3.1.2 MAR in Sweden and Denmark

As EU members, Sweden and Denmark implemented MAR on July 3, 2016, aligning their market oversight frameworks with EU standards. In Sweden, the Financial Supervisory Authority (Finansinspektionen, FI) is responsible for enforcing MAR. For severe cases of market abuse, FI collaborates with the Swedish Economic Crime Authority to pursue criminal prosecutions. Similarly, Denmark's Financial Supervisory Authority (Finanstilsynet, FT) oversees MAR enforcement in coordination with the State Prosecutor for Serious Economic and International Crime (SØIK).

3.2 Short-Selling Regulation (SSR)

Informed traders may exploit non-public information about upcoming earnings announcements, particularly by short-selling ahead of expected earnings misses to profit from subsequent price declines. Regulation (EU) No 236/2012 on short-selling (SSR) is therefore relevant to this discussion.

The SSR was implemented in the European Union in 2012 and took effect in Norway on January 1, 2017. It requires the disclosure of net short positions when they reach or exceed 0.1% of the issuer's issued share capital (EU, 2012). The regulation aims to increase market transparency and reduce risks related to short-selling, such as market manipulation or excessive price volatility. This regulation is particularly relevant for the analysis of earnings misses in Sections 6.1.1, 6.1.2, and 6.1.3, where its impact on short-selling activities is further explored.

4 Methodology

This section presents the methodological framework for analyzing stock price and trading volume behavior around earnings announcements on the Oslo, Stockholm, and Copenhagen stock exchanges. Grounded in established event study methodology, the approach facilitates the identification of abnormal returns and trading volumes within the event window, offering insights into potential patterns in market behavior surrounding events.

4.1 Event Study

The event study methodology, as outlined by MacKinlay (1997), offers a systematic approach to evaluating the impact of specific events on stock prices by identifying abnormal returns and trading volumes. For this study, earnings announcements were chosen as the events of interest due to their potential association with insider trading. Each earnings announcement across the exchanges is treated as a distinct event, with results aggregated to analyze overall market behavior. This allows for the identification of market responses and potential abnormalities. The initial steps include defining the event window and the estimation window, which is used to calculate expected or normal returns.

4.1.1 Event Window

The event window in this study spans from day -10 to day +1 relative to the earnings announcement date (day 0), i.e. $[-10, 1]$. This choice deviates somewhat from the longer event windows commonly used in event studies, such as those employed by MacKinlay (1997) and Meulbroek (1992). It is more common to use windows of up to 30 days before and after an event to capture prolonged market reactions or the effects of insider trading over a broader time frame. However, our narrower event window is motivated by the following considerations:

1. The $[-10, 1]$ window is designed to capture the most critical period where information asymmetries are likely to manifest. Insider trading and market anticipation typically occurs shortly before an announcement when non-public information is most actionable. By narrowing the window, the analysis concentrates on periods of heightened trading activity directly attributable to the event, reducing noise from

unrelated market factors.

2. Unlike other major corporate events such as M&A or seasoned equity offerings, the impact of earnings surprises is often more immediate. Research suggests that the pre-announcement buildup in stock prices and trading volumes related to earnings disclosures occurs in a tighter timeframe compared to other corporate events (see Foster et al., 1984; Meulbroek, 1992; Erlien, 2011; Nygaard and Helgheim, 2020). Thus, a shorter event window is better suited for this specific context.

3. By limiting the event window, the likelihood of overlapping corporate events (e.g., M&A, product launches, or unrelated announcements) influencing the results is minimized. This ensures that the abnormal returns and volumes captured are more likely attributable to the earnings announcements themselves.

4. A shorter window reduces the risk of introducing biases from prolonged periods of market noise or unrelated trends, particularly in relatively smaller markets like those of Scandinavia. This is especially relevant given the limited analyst coverage and smaller market capitalization of many firms in the study, where irrelevant factors may disproportionately influence results over longer periods.

The decision to include the day after the announcement was to see if there were any abnormal returns the following day, as research on post-earnings announcement drift (PEAD) suggests so (Ball and Brown, 1968; Watts, 1978; Foster et al., 1984; Erlien, 2011). However, this is not the main focus of the study but can show differences in market efficiency across the different exchanges.

4.1.2 Estimation Window

The estimation window is a critical component of the event study methodology, as it is used to calculate the parameters of the normal return model. Traditional event study frameworks, such as those outlined by MacKinlay (1997) and Meulbroek (1992), typically recommend longer estimation windows of 120 to 250 trading days to ensure statistical robustness. However, for this study, we use a shorter estimation window prior to the event window. This decision reflects practical constraints specific to our dataset.

In Scandinavian stock exchanges, earnings announcements occur quarterly, leaving

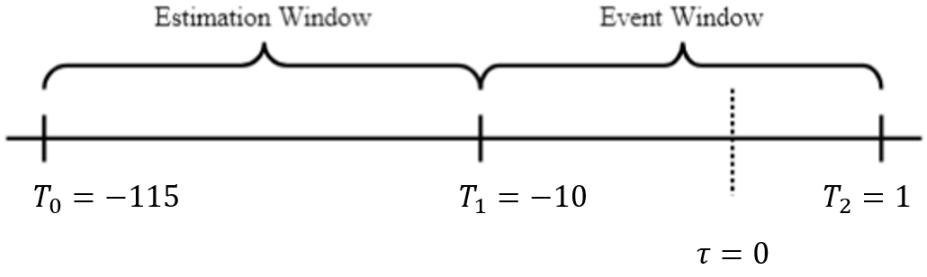
insufficient trading days between events to construct longer, non-overlapping estimation windows. For instance, some firms have as few as 30 trading days between successive announcements, making a 250-day window impractical. Additionally, we aimed to avoid overlapping the estimation window with previous event windows, as this could distort the results of the market model. The shorter estimation window was chosen to ensure that every earnings announcement is treated as a unique event, free from the influence of prior earnings announcements or other corporate events that might affect stock behavior.

The estimation window is defined as the period from day -115 to day -11, ending just before the event window. However, some observations lack sufficient trading days to fully populate this estimation window. To ensure a balance between practicality and statistical robustness, we excluded observations with fewer than 30 trading days within this period.

There is support for this approach in previous literature. Krivin et al. (2003) examined the trade-offs between shorter and longer estimation windows, noting that longer windows provide larger data samples, increasing the statistical robustness of normal return estimates. However, they also highlighted that longer windows risk incorporating structural changes in stock performance or market dynamics, which could reduce relevance to the event window. A shorter estimation window mitigate this risk by focusing on recent data, offering a more current reflection of stock behavior prior to the event.

Considering the analysis period (2010-2023), the volume of data, and the need for consistency across exchanges, we find this approach to be both sufficient and practical for analyzing structural differences between the countries. However, future research on earnings announcement runups on Scandinavian exchanges, particularly studies focusing on a single country or exchange, could explore whether longer estimation windows provide additional insight or greater statistical rigor.

Figure 4.1: Event Study Windows



4.2 Earnings Surprise

MacKinlay (1997) outlines a systematic four-step approach for detecting cumulative abnormal returns associated with an event. The first step involves categorizing earnings announcements based on the extent to which actual earnings differ from analyst forecasts. According to MacKinlay, earnings announcements can be classified as "good news," "bad news," or "no news" depending on whether the actual earnings exceed or fall short of forecasts by a predefined threshold, such as ± 2.5%.

In this study, we extend this framework by introducing additional thresholds of ± 10%, ± 20%, and ± 40%. These larger intervals are chosen to account for the specific characteristics of Scandinavian markets, where analyst coverage is relatively sparse, and forecast accuracy may vary. We argue that more substantial deviations from consensus earnings forecasts are more likely to trigger significant market reactions and potentially informed trading. This approach aligns with our aim to isolate events with the greatest potential for price and volume anomalies.

The classification of earnings announcements is based on data from I/B/E/S, which provides consensus earnings per share (EPS) forecasts for each stock and earnings report. The degree to which an earnings announcement beats or misses the consensus is calculated as follows:

$$Beat\ or\ Miss = \frac{Actual\ EPS - Consenus\ EPS}{Consensus\ EPS} \tag{4.1}$$

Announcements are categorized by exchange and by the percentage they beat or miss the consensus. This categorization enables us to examine whether the magnitude of the earnings surprise influences stock behavior and whether such effects differ across the Oslo, Stockholm, and Copenhagen stock exchanges.

Once the earnings announcements are categorized, we proceed to the subsequent steps in MacKinlay's framework. In the second step, we calculate the sample abnormal returns across all exchanges for every threshold on each trading day during the event window of [-10,1]. These calculations provide a day-by-day measure of the stock's reaction to different levels of earnings surprises.

In step three, the sample abnormal returns are aggregated across observations within each category for each day in the event window to derive the average abnormal returns (AAR). Finally, in step four, the cumulative average abnormal returns (CAAR) are calculated for each category, summarizing the total market impact over the event window. This approach enables us to evaluate how the magnitude of earnings surprises influences cumulative market reactions and whether patterns differ across exchanges and tresholds.

4.3 Estimating the Normal Returns

To measure the impact of earnings announcements on stock prices, it is necessary to estimate the returns that would have been expected in the absence of the event, referred to as normal returns. Several models are available for this purpose, each with its strengths and limitations. This section explores these approaches and explains why the market model is the most practical choice for this study.

MacKinlay (1997) categorizes models for estimating normal returns into two main groups: statistical models and economic models. The distinction lies in their assumptions. Statistical models rely on observed return behavior, focusing purely on statistical relationships in asset returns, while economic models incorporate assumptions about investor behavior, such as utility maximization and market equilibrium.

4.3.1 Statistical Models

Statistical models are widely used in event studies due to their simplicity and reliability. The Constant Mean Return Model, one of the simplest approaches, assumes that a stock's normal return is constant and equal to its average return during the estimation window. While effective in some contexts, it does not account for broader market movements, limiting its applicability in dynamic markets. The Market Model, by contrast, establishes a linear relationship between a stock's return and the return of a market index. By removing the market-wide component, the model reduces the variance of abnormal returns, increasing the power to detect event-related effects. Statistical models can also be extended to include multifactor models, such as the Fama-French three-factor model, which incorporates additional variables like size and value factors. However, these extensions often provide only marginal improvements unless firms share common characteristics, and

they come with increased data requirements (MacKinlay, 1997).

4.3.2 Economic Models

Economic models, on the other hand, integrate behavioral assumptions to provide additional structure for estimating normal returns. For example, the *Capital Asset Pricing Model* (CAPM) suggests that a stock's expected return is determined by its systematic risk, measured as its covariance with the market portfolio. Similarly, the *Arbitrage Pricing Theory* (APT) explains expected returns as a function of multiple risk factors. While these models offer a robust theoretical foundation, their practical application in event studies is limited by deviations from assumptions and data constraints. MacKinlay (1997) notes that the additional restrictions imposed by economic models often fail to deliver significantly better results compared to simpler statistical models.

4.3.3 The Market Model

For this study, the market model was selected as the most practical approach for estimating normal returns. Compared to simpler models like the constant mean return model, the market model captures stock-specific sensitivities to market movements through its beta coefficient, providing a more accurate estimation. Furthermore, it avoids the complexity and data demands of multifactor and economic models, making it suitable for the Scandinavian stock markets analyzed in this study. The use of the all-share indices OSEBX, OMXSPI, and OMXCPI as benchmarks ensures that the model effectively captures overall market movements without introducing unnecessary complexity. This model is widely supported in event study literature as a reliable method for estimating normal returns (e.g., Meulbroek, 1992; Ball et al., 1993; Campbell et al., 2010).

The market model assumes a linear relationship between a stock's return ($R_{i,t}$) and the return of a market index ($R_{m,t}$), expressed as:

$$R_{i,t} = \alpha_i + \beta_i R_{m,t} + \epsilon_{i,t} \tag{4.2}$$

$$E(\epsilon_{i,t}) = 0 \quad \text{and} \quad var(\epsilon_{i,t}) = \sigma^2_{\epsilon_t} \tag{4.3}$$

where α_i is the expected return when the market return is zero, β_i measures the stock's

sensitivity to market movements, and $\epsilon_{i,t}$ captures idiosyncratic variations. These parameters are estimated during the estimation window and provide the foundation for calculating abnormal returns during the event window. The assumptions $E(\epsilon_{i,t}) = 0$ and $var(\epsilon_{i,t}) = \sigma^2_{\epsilon_t}$ ensure the model remains unbiased and that variance is constant over time.

4.3.4 Abnormal Returns (AR)

MacKinlay (1997) defines abnormal returns as the actual expected post return of a security over the event window minus the normal return of the firm over the event window. Using the ordinary least squares (OLS) estimates of α_i and β_i from the market model, we can calculate the abnormal returns for each stock as follows:

$$AR_{i,t} = R_{i,t} - (\hat{\alpha}_i + \hat{\beta}_i R_{m,t}) \tag{4.4}$$

where $\hat{\alpha}_i$ and $\hat{\beta}_i$ denote the OLS estimates α_i and β_i, respectively.

4.3.5 Cumulative Abnormal Returns (CAR)

To capture the overall impact of the earnings announcement across the event window, CAR is calculated. Following MacKinlay (1997) CAR is computed over a specific period, from τ_1(the start of the event window) to τ_2 (the end of the event window). By aggregating the abnormal returns over the event window, CAR provides a summary of the total effect of the announcement on the stock price and is calculated as follows:

$$CAR_i(\tau_1, \tau_2) = \sum_{\tau=\tau_1}^{\tau_2} AR_{i,\tau} \tag{4.5}$$

For this study, the event window spans from day -10 to day +1, ensuring the analysis captures both the pre-announcement behavior and the immediate market reaction to the earnings announcement.

4.3.6 Average AR and CAR

Abnormal returns and cumulative abnormal returns are calculated for all stocks in the sample across three exchanges: Oslo, Stockholm, and Copenhagen at the interval levels beat or miss the consensus at ± 10%, ± 20%, and ± 40%. The calculation of the sample average abnormal return (AAR) is calculated as:

$$AAR_\tau = \frac{1}{N} \sum_{i=\tau}^{N} AR_{i,\tau} \tag{4.6}$$

where N denotes the amount of observations in the sample.

Thus, the cumulative average abnormal return (CAAR) can be calculated by aggregating the average abnormal returns over the event window:

$$CAAR_i(\tau_1, \tau_2) = \sum_{\tau=\tau_1}^{\tau_2} AAR_\tau \tag{4.7}$$

4.4 Abnormal Volume

To investigate trading behavior around earnings announcements, this study examines abnormal trading volumes as a complementary measure to abnormal returns. While abnormal returns capture price effects, abnormal volume provides insights into the intensity of trading activity, often signaling market reactions or potential information leakage. Inspired by the methodology of Eckbo and Ødegaard (2020), we adapt their approach to analyze abnormal trading patterns, with modifications tailored to the specific constraints of our dataset.

Abnormal volume is traditionally calculated as the difference between observed trading volume during the event window and an expected normal volume, which is often based on historical averages adjusted for shares outstanding. However, due to the lack of reliable data on shares outstanding in our dataset and practical time constraints, we calculate abnormal volume using a *relative volume metric* (RelVol). This approach defines relative volume as the ratio of the observed trading volume during the event window to the average trading volume from the estimation window:

$$RelVol_{i,t} = \frac{Observed\ Volume_{i,t}}{Average\ Volume_{i,\text{estimation window}}} \tag{4.8}$$

A relative volume value greater than 1 indicates an increase in trading activity compared to the historical average, while values below 1 suggest reduced activity. This approach is chosen for its simplicity and practicality, given the challenges of obtaining comprehensive data on shares outstanding for all stocks in the sample. Moreover, the relative volume approach ensures that trading activity is assessed consistently across the Oslo, Stockholm, and Copenhagen exchanges, providing a standardized framework for comparison.

While the relative volume metric provides a practical alternative, it is not without limitations. The absence of shares outstanding data means that the analysis does not account for changes in trading activity attributable to changes in the stock's float. Furthermore, the reliance on historical averages assumes that past trading patterns are representative of normal activity, which may not always hold true due to structural market changes or firm-specific events.

4.5 Statistical Testing

The t-test is employed as the statistical tool to analyze AAR and CAAR across the exchanges. Its choice is guided by the descriptive and exploratory nature of this study, which aims to identify broad patterns in stock price reactions rather than conduct rigorous hypothesis testing. While the t-test offers a straightforward and widely understood framework for analyzing mean differences, its assumptions of independence and homoscedasticity may not fully align with the characteristics of financial data. This limitation is acknowledged as a trade-off for simplicity and interpretability. The decision to use the t-test, despite these limitations, reflects the study's focus on exploring general trends rather than establishing robust statistical conclusions. Furthermore, this approach holds support in multi-country event studies[5]. Please refer to Appendix B for a detailed test description.

[5]See Table 1 in Campbell et al., 2010

4.6 Methodology Limitations

While this study applies well-established event study methodologies and adapts them to the specific characteristics of the Scandinavian stock exchanges, several limitations should be acknowledged. These limitations influence the scope and reliability of the findings and suggest opportunities for improvement in future research.

One key limitation is the reliance on the relative volume metric to assess abnormal trading activity. Due to the absence of shares outstanding data and practical time constraints, the volume analysis focuses on comparing observed trading volumes during the event window to historical averages from the estimation window. This approach is practical, but limits the precision of volume-based insights, as it does not account for changes in float or other firm-specific factors influencing trading intensity. Therefore, the volume parameter is discussed only in the context of its relationship to abnormal returns, rather than as a standalone indicator of potential insider trading or market anticipation.

The selection of event and estimation windows introduces certain limitations. The narrow event window $[-10, 1]$ is intended to capture immediate pre-announcement market behavior. However, it may miss longer-term market reactions or insider trading activities occurring outside this timeframe. Similarly, the shorter estimation windows, dictated by data constraints, reduce the statistical robustness of normal return and volume estimates compared to longer windows that could reflect broader market trends.

This study's focus on earnings surprises categorized at larger thresholds ($\pm$ 10%, $\pm$ 20%, $\pm$ 40%) emphasizes events most likely to generate significant market reactions. However, this approach excludes smaller earnings surprises, which could also provide valuable insights into abnormal trading behavior. Expanding the analysis to include additional observations through alternative proxies for market anticipation, such as time-series models, could give a more comprehensive understanding of market dynamics. Existing literature supports the use of such models (e.g., Erlien, 2011; Foster, 1977; Imhoff and Paré, 1982). This may be particularly useful for small-capitalization companies that lack sufficient analyst coverages. Smaller firms often display more pronounced abnormal trading activities, as noted in personal communication with Finanstilsynet. These firms may exhibit unique patterns of market anticipation or potential insider trading, and can offer valuable insights

into their market behavior.

The comparability of the three exchanges presents another challenge. Differences in market liquidity, regulatory enforcement, and investor composition between OSE, OMXS, and OMXC may introduce confounding factors. These structural differences could influence the observed patterns in abnormal returns and trading volumes, complicating cross-market comparisons. Furthermore, while efforts were made to isolate earnings announcements as unique events, some overlap with other corporate disclosures or macroeconomic factors may remain, potentially diluting the observed effects.

Furthermore, this analysis does not account for sectoral or firm-specific factors that may drive pre-announcement stock behavior. For example, a sector-by-sector comparison across the different exchanges could shed light on whether specific industries are more prone to abnormal trading activities. Similarly, incorporating firm-specific characteristics, such as market capitalization, ownership structure, or trading frequency, could improve the understanding of what drives pre-announcement behavior and whether these factors vary systematically across markets.

By addressing these limitations, this study provides a framework for interpreting the findings in the analysis section with appropriate caution.

5 Data

This section outlines the data sources, characteristics and preparation processes used in this thesis. The data used forms the foundation for analyzing stock price movements and trading activities around earnings announcements, and is sourced from reliable financial data providers. The dataset we processed include stock trading data obtained from the London Stock Exchange Group (LSEG) and earnings announcement data retrieved from the Institutional Brokers' Estimate System (I/B/E/S).

5.1 Data Sources and Collection

The LSEG Workspace is a financial database which provides reliable pricing data on global stocks and bonds. Using a platform like LSEG Workspace enabled us to filter for relevant companies and information efficiently (London Stock Exchange Group, n.d.-b). By using the LSEG Workspace add-in for Microsoft Excel, we could effectively retrieve daily stock trading data for actively listed firms on OSE, OMXS, and OMXC. The key variables retrieved include the trading date, ticker symbol, exchange, company name, daily trading volume, and closing price. To complement this, the earnings announcement data was collected from I/B/E/S, using the Summary History – Surprise History module. The I/B/E/S dataset provides compiled estimates by stock analysts on future earnings for publicly traded companies (London Stock Exchange Group, n.d.-a). Key variables retrieved from I/B/E/S include the official ticker, I/B/E/S ticker, company name, announcement date, actual earnings per share (EPS) and analyst consensus estimates for EPS.

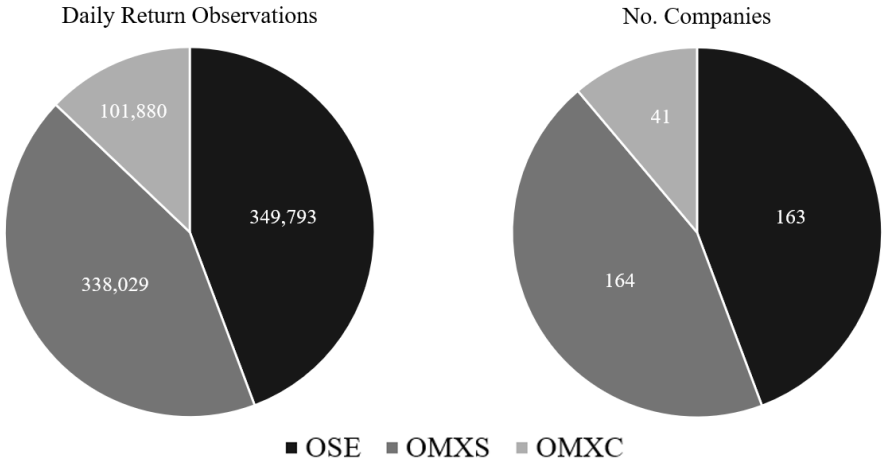
The data collection process began by identifying tickers for listed companies in Scandinavia. Tickers for OSE were retrieved from Euronext, while tickers for OMXS and OMXC were retrieved from Nasdaq. These tickers were combined into a single text file, which was used to retrieve I/B/E/S data by using the "official ticker" field. However, this process was complex, as certain tickers matched companies from other exchanges outside Scandinavia, leading to an initial dataset that included firms outside of the target region. To resolve this, each company was manually verified using the screener functionality in LSEG Workspace. I/B/E/S includes a column labeled "I/B/E/S ticker," which provides a unique identifier for each stock in the dataset. We created a new list of I/B/E/S tickers, consisting only of

companies listed in Scandinavia, after this cross-checking process. This refined list was then used to extract the correct data, ensuring the dataset was limited to stocks listed in Scandinavia.

During this stage, it became clear that many Scandinavian companies did not have analytical coverage in IBES. Only firms with analyst coverage were included in the analysis, as the focus of this thesis relies on calculations around earnings surprises. To avoid unnecessary data processing, only the companies present in the I/B/E/S data were retrieved from LSEG. The analysis spans the period from January 1, 2010, to December 31, 2023, with observations for 2020 and 2021 excluded to avoid bias caused by market volatility during the COVID-19 pandemic.

According to LSEG Workspace, there are initially 668 active companies listed in Scandinavia without dual listings: 200 on OSE, 350 on OMXS, and 118 on OMXC. However, after merging the IBES data with the daily stock trading data, the final dataset included 369 companies: 163 from OSE, 164 from OMXS, and 41 from OMXC. This resulted in a total of 789,702 daily observations, including 9,057 earnings announcements.

Figure 5.1: Number of Daily Return Observations and Companies



5.2 Processing

To estimate the level of surprise in earnings announcements, a new variable was created to capture the percentage deviation of actual earnings from expected earnings. Calculations are shown in (4.1). This deviation metric serves as a proxy for earnings surprises. The deviation percentage was later used to filter observations based on the level of surprise, focusing on thresholds of ± 10%, ± 20%, and ± 40%.

Anomalies and outliers were identified and addressed during the processing phase. For example, the first observation for each stock was excluded due to incorrect calculations by the previous company in the dataset. Similarly, the first observations after 2021 was removed for all companies. Observations with extreme stock return values caused by errors in the data, or by events not related to the thesis objectives, were also removed.

Furthermore, some abnormal values were identified for EPS deviations, where some observations displayed "± infinity" deviations. This occurred because certain EPS consensus values were zero, resulting in division by zero. These observations were filtered out during the application of threshold filters at ± 10%, ± 20%, and ± 40%, with a maximum cap set at ± 200%.

From the data, six sub-samples were created for each interval at each exchange, resulting in a total of 18 sub-samples. For each sub-sample, an estimation window and an event window were defined, excluding all observations outside these windows. The windows collectively cover the period from day -115 to day 1, with day 0 representing the earnings announcement date. The final step involved applying the market model OLS regression (4.3.3) using the estimation window data. Observations with fewer than 30 trading days before the event window were excluded as mentioned in Section 4.1.2. This was done by running the regression and assigning N/A values to such cases, which were subsequently removed.

Table 5.1 below shows the number of earnings announcements included when applying the market model for each threshold across each exchange. The Average Actual Cumulative Returns ($\overline{ACR}$) across the event window are also provided to illustrate the potential earnings if an investment was made on day -11.

Table 5.1: Earnings Announcements and Average Actual Cumulative Returns

Stock Exchange	**Category**	**Number of EAs**	$\overline{\textbf{ACR}}_{[-10,1]}$ **(%)**
Oslo Stock Exchange	Beat 10%	1121	2.01
	Miss 10%	1071	-0.81
	Beat 20%	832	2.12
	Miss 20%	817	-0.81
	Beat 40%	521	1.78
	Miss 40%	531	-1.34
Nasdaq Stockholm	Beat 10%	922	3.82
	Miss 10%	933	-2.46
	Beat 20%	634	3.56
	Miss 20%	732	-2.61
	Beat 40%	369	3.48
	Miss 40%	451	-2.56
Nasdaq Copenhagen	Beat 10%	368	2.38
	Miss 10%	330	-0.84
	Beat 20%	272	2.31
	Miss 20%	218	-0.78
	Beat 40%	168	2.28
	Miss 40%	137	-0.53

Note: The table shows the number of earnings announcements (EAs) and the Average Actual Cumulative Returns $\overline{\text{ACR}}_{[-10,1]}$ (%) for stocks on the Oslo Stock Exchange, Nasdaq Stockholm, and Nasdaq Copenhagen. The ACR represents the average percentage return from 10 days before to 1 day after earnings announcements. Categories "Beat" and "Miss" denote whether earnings exceeded or fell short of analyst consensus, with intervals (10%, 20%, 40%) indicating the magnitude of the surprise.

5.3 MAR Enforcement

This section provides an overview of the data collected on MAR enforcement. Unlike the event study data, which relied on structured datasets, MAR enforcement data required a more manual approach due to the lack of centralized databases.

The primary sources for this data are ESMA reports and the web pages of each country's respective FSAs. In cases where data was incomplete or unavailable in the ESMA reports, manual collection from FSA websites was necessary to ensure sufficient coverage. It is important to note that not all sanctions reported by ESMA were listed on FSA websites. In these cases, ESMA data was used to maintain consistency across sources.

Norway's data is particularly limited, with only 2021 and 2023 data available in ESMA reports, reflecting the country's relatively recent adoption of MAR. Despite efforts to

identify earlier data, no records were located for years prior to 2021. In contrast, Sweden and Denmark offer more consistent enforcement data.

We defined "Actions taken" to include all administrative and criminal sanctions, as well as suspected violations reported to the police. While most of this information was derived from ESMA reports, data on suspected violations, which is not included in ESMA publications, was obtained manually from FSA web pages. This additional metric was important for estimating the enforcement rate which we define as:

$$Enforcement\ Rate = \frac{Suspected\ Violations}{Actions\ Taken} \tag{5.1}$$

This proxy, together with the collected data, serves as the foundation for the analysis presented in Section 6.3.

5.4 Data Limitations

Acknowledging data limitations is important for ensuring transparency in research and for understanding the potential implications these limitations have on the results of the analysis. While the dataset used in this study is extensive and comprises a broad range of unique stocks, certain limitations could affect the robustness and comparability of the findings.

The dataset contains significantly fewer observations and stocks from OMXC compared to OSE and OMXS. This imbalance could impact the results, as the smaller number of companies in OMXC makes each company's data more influential on the aggregate results. Ideally, the number of companies from OMXC would be closer to those of OSE and OMXS, providing a more balanced basis for comparison and reducing the risk of disproportionate influence.

Despite thorough data processing, there remains the possibility that some outliers or anomalies slipped through undetected. These could arise from errors in data reporting or inconsistencies in the raw data. However, given the extensive size of the dataset, the overall impact of such anomalies is expected to be minimal.

The quality of analyst consensus estimates within the I/B/E/S dataset also presents a

limitation. In some instances, irrational EPS values resulted in infinite values during calculations. This suggests potential errors or inconsistencies in the dataset, which may affect the reliability of certain results.

Regarding the MAR data, particularly the 'actions taken' variable, there may be enforcement activities that were not included or accounted for. For instance, educational campaigns, awareness initiatives, or informal warnings might not be documented in the dataset, despite their relevance in influencing market behavior.

Additionally, the enforcement data does not account for the magnitude of sanctions or fines due to a lack of reliable data. This omission is notable, as large fines or sanctions could have a significant deterrent effect on illegal insider trading and thus influence market behavior differently across the studied markets

6 Analysis

The main section of this paper presents the findings from the event study. The analysis consists of three parts. First, the empirical results are outlined, with a discussion of the tables from each exchange, highlighting the variables of interest. Second, the key findings from OSE are compared to those from neighboring exchanges to investigate potential differences. Third, variations in regulation enforcement are examined together with empirical findings.

6.1 Empirical Findings

Following traditional event study methodology, and the method of choice for investigating stock behavior prior- and post events in the literature, we calculate CAAR in the days prior to the earnings announcement. Recalling our first research question we can establish the null and alternative hypothesis:

$$H_0 : CAAR = 0 \tag{6.1}$$

$$H_A : CAAR \neq 0 \tag{6.2}$$

Where the null hypothesis H_0 is that there is no CAAR buildup prior to earnings surprises. Testing this null hypothesis also examines the strong-form market efficiency hypothesis, which asserts that stock prices reflect all information, both public and private (Fama, 1970). In other words, this means that no group of investors should be able to achieve abnormal returns based on access to private information.

6.1.1 Oslo Stock Exchange

Table 6.1 below summarizes the findings of AAR and CAAR derived from the analysis of the OSE across all threshold samples. The table also includes the corresponding t-statistics to identify statistically significant observations within the results.

Table 6.1: Oslo Stock Exchange: AAR and CAAR

Beat												
	10%, N = 1121				**20%**, N = 832				**40%**, N = 521			
Event Day	AAR	t-Stat	CAAR	t-Stat	AAR	t-Stat	CAAR	t-Stat	AAR	t-Stat	CAAR	t-Stat
-10	0.01	0.18	0.01	0.18	-0.03	-0.35	-0.03	-0.35	-0.10	-0.82	-0.10	-0.82
-9	0.03	0.47	0.05	0.46	0.13	1.40	0.09	0.74	0.12	1.00	0.02	0.13
-8	-0.05	-0.65	0.00	0.00	-0.08	-0.93	0.01	0.07	-0.07	-0.62	-0.05	-0.25
-7	-0.07	-0.99	-0.07	-0.42	-0.10	-1.08	-0.09	-0.48	-0.07	-0.57	-0.12	-0.50
-6	0.00	0.06	-0.07	-0.42	0.07	0.76	-0.02	-0.09	0.06	0.48	-0.06	-0.24
-5	0.04	0.50	-0.03	-0.18	0.05	0.55	0.03	0.14	-0.02	-0.14	-0.08	-0.27
-4	0.17	2.26**	0.13	0.69	0.06	0.69	0.09	0.39	0.15	1.21	0.07	0.21
-3	0.01	0.18	0.15	0.71	0.07	0.78	0.16	0.64	0.03	0.23	0.09	0.28
-2	0.26	3.48***	0.40	1.83*	0.26	2.95***	0.43	1.59	0.31	2.53**	0.40	1.10
-1	0.27	3.73***	0.68	2.92***	0.22	2.40**	0.64	2.26**	0.23	1.91*	0.63	1.66*
0	0.96	13.05***	1.64	6.71***	0.93	10.36***	1.57	5.28***	0.72	5.91***	1.35	3.36***
1	0.01	0.12	1.65	6.46***	0.07	0.78	1.64	5.28***	0.05	0.44	1.40	3.34***
Miss												
	10%, N = 1071				**20%**, N = 817				**40%**, N = 531			
Event Day	AAR	t-Stat	CAAR	t-Stat	AAR	t-Stat	CAAR	t-Stat	AAR	t-Stat	CAAR	t-Stat
-10	-0.03	-0.35	-0.03	-0.35	-0.05	-0.57	-0.05	-0.57	0.02	0.13	0.02	0.13
-9	0.00	-0.05	-0.03	-0.28	-0.04	-0.47	-0.09	-0.74	-0.05	-0.45	-0.04	-0.22
-8	0.05	0.69	0.02	0.17	0.08	0.86	-0.02	-0.10	0.08	0.65	0.04	0.20
-7	0.05	0.71	0.07	0.50	0.09	1.03	0.07	0.43	0.03	0.28	0.07	0.31
-6	-0.11	-1.51	-0.04	-0.23	-0.09	-1.06	-0.02	-0.09	-0.17	-1.46	-0.10	-0.38
-5	-0.08	-1.06	-0.11	-0.64	-0.12	-1.41	-0.14	-0.66	-0.11	-0.96	-0.21	-0.74
-4	0.06	0.86	-0.05	-0.27	0.06	0.72	0.08	0.34	0.13	1.09	-0.08	-0.27
-3	0.15	2.04**	0.10	0.47	0.12	1.38	0.04	0.17	0.19	1.64	0.11	0.33
-2	-0.07	-0.89	0.03	0.15	-0.15	-1.73*	-0.11	-0.41	-0.14	-1.21	-0.03	-0.09
-1	0.14	1.98**	0.18	0.76	0.19	2.14**	0.08	0.28	0.11	0.93	0.08	0.20
0	-1.19	-16.40***	-1.02	-4.22***	-1.24	-14.12***	-1.16	-3.99***	-1.34	-11.47***	-1.27	-3.26***
1	-0.22	-2.96***	-1.23	-4.89***	-0.33	-3.79***	-1.49	-4.91***	-0.39	-3.31***	-1.66	-4.08***

Note: The table displays AAR and CAAR for OSE around earnings announcements. It is segmented by all intervals of earnings beats and misses. Statistical significance is indicated as follows: * $p < 0.1$, ** $p < 0.05$, and *** $p < 0.01$.

For earnings beats, our findings reveal an upward trend in CAAR across all thresholds leading up to the earnings announcement. However, in the case of earnings misses, no discernible trends in the pre-event CAAR buildup were observed.

Interestingly, the CAAR buildup for earnings beats was marginally higher at the 10% threshold compared to higher thresholds, which was unexpected. This could suggest that analyst consensus estimates at lower thresholds are more aligned with market expectations, making them more credible. This could be due to the quality of estimates, as companies

with extensive analyst coverage (e.g., 20 or more analysts) are less prone to distortion from low-quality estimates compared to firms with limited coverage (e.g., 3-4 analysts). The smaller AAR on day 0 for higher thresholds may reflect reduced market confidence in consensus estimates for larger surprises. This could be interpreted as the market having more concerns about the reliability of estimates or the sustainability of a firm's performance.

Notably, the CAAR buildup does not begin until approximately day -6. The absence of observable trends before this point could indicate either that potential inside information is not acted upon earlier or that anticipative trading has not yet commenced. At the 10% threshold, the CAAR trend becomes statistically significant by day -2 ($p < 0.1$), with even greater significance observed on day -1. This pattern, evident across other thresholds as well, reinforces the notion that pre-announcement stock price movements tend to concentrate in the days immediately preceding the earnings announcement. These findings are consistent with previous literature (e.g., Ball and Kothari, 1991; Erlien, 2011; Foster et al., 1984).

In the case of earnings misses, findings reveal a lack of pre-event trends in the cases of earnings misses across all thresholds. This absence of a clear CAAR buildup contrasts with the behavior observed for earnings beats. However, consistent with prior literature (e.g., Kothari et al., 2006; Skinner and Sloan, 2002), the abnormal return on the event day is notably larger for earnings misses compared to beats at similar thresholds. This suggests that investors tend to react more strongly to negative earnings surprises, further underscoring the asymmetrical relationship between investor responses to positive and negative news.

The combination of this lack of pre-event trends and the more pronounced market reaction on day 0 raises questions about the role of illegal insider trading in the context of earnings misses. One plausible explanation for these findings is Norway's (and other EU/EEA countries) adherence to the EU Short-Selling Regulation (SSR) which is mentioned in Section 3.2.

Overall, our findings from OSE reveal distinct differences in stock price behavior between earnings beats and misses. For earnings misses, the lack of pre-event CAAR trends and the concentration of significant market reactions on the announcement day provide limited

evidence of illegal insider trading. In contrast, earnings beats exhibit a pattern of stock price runups prior to announcements. This observation may suggest that information deviating from consensus is incorporated into stock prices before becoming publicly available, raising questions about the strong form of market efficiency (Fama, 1970).

While certain limitations inherent in our dataset and methodology are acknowledged, we argue that the large number of observations across an extended period supports the credibility of our findings. The following sections will present the results from OMXS and OMXC, providing a foundation for a comparative analysis of the observed differences between these exchanges and OSE. This will allow us to explore whether the trends identified in Oslo are unique or part of a broader pattern across Scandinavian markets.

6.1.2 Nasdaq Stockholm

To maintain clarity and avoid unnecessary repetition, the findings for OMXS will be presented with a focus on their differences and similarities relative to OSE. Table 6.2 provides a detailed overview of the results, including t-statistics for both AAR and CAAR across the selected thresholds.

Table 6.2: Nasdaq Stockholm: AAR and CAAR

Beat												
	10%, N = 922				**20%**, N = 634				**40%**, N = 369			
Event Day	AAR	t-Stat	CAAR	t-Stat	AAR	t-Stat	CAAR	t-Stat	AAR	t-Stat	CAAR	t-Stat
-10	-0.08	-0.99	-0.08	-0.99	-0.16	-1.62	-0.16	-1.62	-0.13	-0.93	-0.13	-0.93
-9	0.14	1.84*	0.07	0.60	0.06	0.60	-0.10	-0.72	0.14	1.02	0.01	0.06
-8	0.08	1.04	0.15	1.09	0.10	1.01	0.00	0.00	0.12	0.93	0.14	0.58
-7	0.09	1.17	0.24	1.53	0.12	1.18	0.11	0.59	0.10	0.77	0.24	0.89
-6	0.02	0.27	0.26	1.49	0.03	0.34	0.15	0.68	0.07	0.54	0.31	1.04
-5	0.00	0.01	0.26	1.36	0.04	0.41	0.19	0.78	-0.01	-0.07	0.30	0.92
-4	0.15	1.93*	0.41	1.99**	0.23	2.39**	0.42	1.63	0.39	2.88**	0.69	1.94
-3	0.21	2.71***	0.62	2.82***	0.18	1.88*	0.61	2.19**	0.28	2.06**	0.97	2.54**
-2	0.09	1.16	0.71	3.05***	0.10	0.99	0.70	2.40**	0.09	0.63	1.06	2.61***
-1	0.25	3.21***	0.95	3.91***	0.17	1.78*	0.88	2.84***	0.23	1.73*	1.29	3.02***
0	2.10	27.24***	3.06	11.94***	1.92	19.61***	2.79	8.62***	1.44	10.67***	2.73	6.10***
1	-0.09	-1.19	2.96	11.09***	-0.04	-0.36	2.76	8.14***	0.17	1.26	2.90	6.20***
Miss												
	10%, N = 933				**20%**, N = 732				**40%**, N = 451			
Event Day	AAR	t-Stat	CAAR	t-Stat	AAR	t-Stat	CAAR	t-Stat	AAR	t-Stat	CAAR	t-Stat
-10	0.15	2.04**	0.15	2.04**	0.21	2.28**	0.21	2.28**	0.14	1.16	0.14	1.16
-9	-0.01	-0.19	0.14	1.31	-0.06	-0.61	0.15	1.18	-0.06	-0.50	0.08	0.47
-8	-0.02	-0.31	0.12	0.89	0.02	0.27	0.18	1.12	-0.10	-0.79	-0.02	-0.07
-7	0.02	0.28	0.14	0.91	0.05	0.56	0.23	1.25	0.05	0.44	0.04	0.16
-6	-0.07	-0.92	0.07	0.41	-0.07	-0.76	0.16	0.78	-0.19	-1.52	-0.15	-0.54
-5	0.07	0.99	0.14	0.77	0.12	1.32	0.28	1.25	0.05	0.37	-0.10	-0.34
-4	-0.07	-0.99	0.07	0.34	-0.13	-1.37	0.15	0.64	-0.05	-0.37	-0.15	-0.46
-3	0.06	0.77	0.13	0.59	0.15	1.64	0.30	1.17	0.21	1.75*	0.07	0.19
-2	0.08	1.06	0.20	0.91	0.14	1.56	0.45	1.63	0.17	1.41	0.24	0.65
-1	0.29	3.89***	0.50	2.09**	0.31	3.43***	0.76	2.63***	0.38	3.08***	0.61	1.59
0	-2.88	-38.47***	-2.39	-9.60***	-3.13	-34.32***	-2.37	-7.84***	-3.36	-27.54***	-2.75	-6.79***
1	-0.21	-2.79***	-2.60	-10.00***	-0.16	-1.72*	-2.53	-8.00***	-0.01	-0.11	-2.76	-6.53***

Note: The table displays AAR and CAAR for OMXS around earnings announcements. It is segmented by all intervals of earnings beats and misses. Statistical significance is indicated as follows: * $p < 0.1$, ** $p < 0.05$, and *** $p < 0.01$.

Our analysis of OMXS reveals differences compared to OSE. Observations across all intervals are lower for OMXS, with a distinct imbalance between beats and misses at higher thresholds. For instance, at the 40% threshold, there are significantly more misses than beats, in contrast to OSE, where the split is closer to 50/50. However, at the 10% threshold, the distribution is more balanced, resembling the pattern observed in OSE. Furthermore, in terms of pre-announcement price behavior, the CAAR buildup for earnings beats in OMXS is more prominent and statistically significant than in OSE. For

earnings misses, there are similar tendencies across both markets, with no clear pre-event trends emerging.

Despite OMXS being a more analyst-covered market (based on data retrieved from LSEG, December 2024), the number of observations for both earnings beats and misses is lower than in OSE. This could reflect higher-quality consensus estimates, which may reduce the likelihood of extreme deviations from expected earnings. Supporting this interpretation, the larger AAR observed on the event day in OMXS compared to OSE suggests that earnings surprises are, in fact, more unexpected in the Swedish market.

The findings for earnings beats at the 10% threshold on OMXS reveal that CAAR becomes statistically significant ($p < 0.05$) from day -4 through day 0, with the buildup beginning as early as day -8. Notably, the Swedish market exhibits a clear and steady trend of pre-announcement stock price adjustments. This buildup appears more gradual and stable over time compared to OSE, where the price runup tends to be more rapid and concentrated closer to the announcement.

Based on these findings, one could argue that there is stronger evidence of potential illegal insider trading prior to earnings beats in OMXS compared to OSE. The earlier onset of the CAAR buildup, combined with its statistical significance over a longer pre-announcement window, highlights the possibility that non-public information may be acted upon earlier in the Swedish market.

Earnings misses on OMXS reveal some unexpected findings. Positive CAAR values are observed across thresholds, indicating that earnings misses may come as more of a surprise in the Swedish market compared to OSE. This unexpected reaction could suggest that the market anticipates earnings performance differently in OMXS or that consensus estimates are generally more aligned with actual results. Additionally, there is less stock price movement on average in the day following earnings misses, which may reflect a more efficient market, as investors appear to incorporate negative information more quickly.

The absence of clear CAAR trends prior to earnings misses aligns with findings from OSE as well as those of Erlien (2011), who observed similar patterns. Notably, there is a lack of published research specifically examining earnings surprises on OMXS, making direct comparisons challenging. However, a bachelor thesis by Jonsson and Radechnig (2014)

also highlights the lack of significant pre-earnings CAAR buildup in cases of negative earnings reports. These findings further support the notion that illegal insider trading might not be a significant issue on OMXS for earnings misses. This mirrors the conclusions drawn from OSE.

Furthermore, the larger negative AAR on the event day compared to the reaction for earnings beats underscores the asymmetrical investor sentiment toward negative versus positive surprises. This pattern supports the well-documented tendency of investors to react more strongly to negative news.

Comparing the findings of OMXS to OSE reveals both similarities and significant differences in the stock price behavior preceding earnings announcements. For earnings beats, OMXS displays a more gradual and steadily increasing CAAR buildup from day -7, with statistical significance ($p < 0.05$) observed from day -4 to day 0. This stands in contrast to OSE, where abnormal stock price movements are more abrupt and concentrated closer to the announcement day. In the case of earnings misses, however, both markets display similar tendencies, with no clear CAAR trends emerging prior to the announcements.

6.1.3 Nasdaq Copenhagen

Similar to the previous section, the findings for OMXC will be presented in the context of differences and similarities to the other Scandinavian exchanges. The consolidated findings for all thresholds are presented in Table 6.3.

Table 6.3: Nasdaq Copenhagen: AAR and CAAR

Beat												
	10%, N = 368				**20%**, N = 272				**40%**, N = 168			
Event Day	AAR	t-Stat	CAAR	t-Stat	AAR	t-Stat	CAAR	t-Stat	AAR	t-Stat	CAAR	t-Stat
-10	0.05	0.47	0.05	0.47	0.05	0.41	0.05	0.41	0.13	0.74	0.13	0.74
-9	0.10	0.95	0.15	1.01	-0.03	-0.22	0.02	0.13	0.08	0.47	0.21	0.86
-8	0.04	0.39	0.19	1.05	0.05	0.38	0.07	0.32	-0.03	-0.17	0.18	0.60
-7	0.26	2.47**	0.45	2.14**	0.19	1.48	0.26	1.02	0.27	1.55	0.45	1.30
-6	0.07	0.71	0.53	2.23**	0.19	1.48	0.44	1.58	0.23	1.30	0.68	1.74*
-5	0.12	1.13	0.64	2.50**	0.14	1.14	0.59	1.90*	0.25	1.45	0.93	2.18**
-4	0.13	1.24	0.77	2.78***	0.19	1.49	0.78	2.33**	0.20	1.14	1.13	2.45**
-3	-0.06	-0.55	0.72	2.41**	0.03	0.20	0.80	2.25**	0.15	0.84	1.28	2.59**
-2	0.03	0.31	0.75	2.38**	0.04	0.29	0.84	2.22**	-0.12	-0.70	1.16	2.21**
-1	0.07	0.71	0.82	2.48**	0.11	0.84	0.95	2.37**	0.19	1.09	1.35	2.44**
0	1.42	13.50***	2.24	6.43***	1.31	10.37***	2.25	5.39***	1.33	7.61***	2.68	4.62***
1	-0.07	-0.70	2.17	5.96***	-0.18	-1.45	2.07	4.74***	-0.19	-1.07	2.49	4.11***
Miss												
	10%, N = 330				**20%**, N = 218				**40%**, N = 137			
Event Day	AAR	t-Stat	CAAR	t-Stat	AAR	t-Stat	CAAR	t-Stat	AAR	t-Stat	CAAR	t-Stat
-10	0.09	0.91	0.09	0.91	0.16	1.21	0.16	1.21	0.07	0.43	0.07	0.43
-9	0.10	0.93	0.19	1.31	0.08	0.65	0.24	1.31	0.06	0.38	0.13	0.57
-8	-0.06	-0.59	0.13	0.72	-0.03	-0.25	0.21	0.93	-0.10	-0.62	0.03	0.11
-7	-0.10	-0.96	0.03	0.15	-0.15	-1.16	0.06	0.23	-0.17	-1.02	-0.14	-0.41
-6	-0.06	-0.59	-0.03	-0.13	-0.14	-1.06	-0.08	-0.27	-0.04	-0.23	-0.17	-0.47
-5	-0.06	-0.56	-0.09	-0.35	-0.04	-0.30	-0.12	-0.37	0.05	0.27	-0.13	-0.32
-4	0.00	0.00	-0.09	-0.32	0.01	0.06	-0.11	-0.32	0.15	0.90	0.02	0.04
-3	-0.03	-0.33	-0.12	-0.42	-0.09	-0.68	-0.20	-0.54	-0.01	-0.05	0.01	0.03
-2	-0.21	-2.03**	-0.33	-1.07	-0.21	-1.58	-0.41	-1.04	-0.09	-0.55	-0.08	-0.66
-1	0.30	2.90***	-0.03	-0.10	0.40	3.07***	-0.01	-0.01	0.42	2.55**	0.34	0.66
0	-1.23	-12.03***	-1.26	-3.72***	-1.07	-8.19***	-1.07	-2.48**	-1.19	-7.27***	-0.85	-1.57
1	0.31	3.06***	-0.95	-2.68***	0.19	1.47	-0.88	-1.95*	0.32	1.95*	-0.53	-0.94

Note: The table displays AAR and CAAR for OMXC around earnings announcements. It is segmented by all intervals of earnings beats and misses. Statistical significance is indicated as follows: * $p < 0.1$, ** $p < 0.05$, and *** $p < 0.01$.

The analysis of OMXC reveals several trends that differ from both OMXS and OSE. A general observation is the smaller number of earnings beats and misses across all thresholds, which can be attributed to the fewer companies listed on this exchange (as shown in Figure 5.1). However, unlike OMXS, OMXC shows a greater number of earnings beats than misses, a distribution more similar to OSE.

For earnings beats, OMXC displays a clear and sustained CAAR buildup, particularly at the 10% threshold, where statistical significance ($p < 0.05$) is observed from day -7 through

day 0. This buildup starts earlier and appears more consistent compared to both OMXS and OSE. At the 40% threshold, CAAR reaches 1.35% on day -1, compared to 0.82% at the 10% threshold, and the buildup seems to begin as early as day -10. This raises the question of whether the event window is sufficient to fully capture pre-announcement price behavior, particularly for larger earnings surprises.

On the day of the earnings announcement, OMXC displays stronger market reactions for earnings beats across all thresholds, as reflected by higher AAR. This contrasts with OSE and OMXS, where investors tend to react more strongly to earnings misses. Such findings deviate from the broader literature, which generally highlights an asymmetrical investor response favoring negative surprises. This difference may reflect unique aspects of OMXC, for example concentrated investor attention or a smaller pool of listed firms, which could amplify reactions to positive earnings news.

For earnings misses, OMXC shows less consistent patterns, similar to the other exchanges. No sustained CAAR buildup is observed prior to the announcement. However, an interesting observation is the increase in CAAR on day -1 relative to day -2, which may suggest some anticipatory trading in favor of the analyst consensus. Despite this, there is limited evidence of systematic pre-announcement stock price adjustments for earnings misses, aligning with findings from both OMXS and OSE. Again, this is likely due to the SSR regulation.

6.1.4 Volume

Table 6.4 presents the relative trading volumes for earnings beats and misses across the three Scandinavian stock exchanges. As expected, trading volumes peak on the announcement date (day 0) and remain elevated on the following day, reflecting investor adjustments to new information.

Table 6.4: Relative Volume for all Exchanges

BEAT									
	Oslo			**Stockholm**			**Copenhagen**		
Event Day	10%	20%	40%	10%	20%	40%	10%	20%	40%
-10	1.13	1.18	1.39	0.93	0.91	0.89	1.20	1.22	0.89
-9	0.98	0.99	1.06	0.87	0.84	0.81	0.87	0.91	0.95
-8	0.96	0.98	1.02	0.88	0.86	0.89	1.09	1.18	0.85
-7	1.04	1.01	1.08	0.91	0.91	0.91	1.08	1.08	1.19
-6	0.93	0.92	0.89	1.13	1.22	1.38	0.94	0.91	0.82
-5	0.97	0.95	0.94	0.86	0.91	0.99	0.96	0.98	0.96
-4	0.97	0.94	0.95	0.93	0.97	1.03	0.97	0.99	1.00
-3	0.96	0.94	0.97	0.94	0.98	1.06	0.98	0.94	0.96
-2	1.19	1.25	1.37	0.95	0.97	1.01	1.11	1.09	1.06
-1	1.28	1.30	1.40	1.13	1.17	1.07	1.08	1.04	1.03
0	2.95	3.11	3.16	3.80	4.13	4.68	2.89	2.88	3.03
1	1.87	1.91	1.95	1.94	1.90	1.87	1.96	2.01	1.95
MISS									
	Oslo			**Stockholm**			**Copenhagen**		
Event Day	10%	20%	40%	10%	20%	40%	10%	20%	40%
-10	0.99	0.97	1.02	1.11	1.14	1.14	1.09	1.20	1.34
-9	1.34	1.43	0.99	0.91	0.92	1.00	0.88	0.90	0.85
-8	0.99	0.96	0.93	0.89	0.91	0.97	0.97	0.99	1.03
-7	0.99	1.03	1.10	1.01	1.09	1.29	0.97	1.00	1.05
-6	1.80	2.08	1.10	0.92	0.93	0.97	0.92	0.90	0.90
-5	1.37	1.53	1.06	1.02	1.04	1.01	1.06	1.03	1.00
-4	1.09	1.06	1.00	0.93	0.94	0.90	0.95	0.92	0.86
-3	1.39	1.48	1.15	0.93	0.97	0.87	0.99	0.93	0.89
-2	1.34	1.35	0.95	0.95	0.93	0.99	1.10	1.14	1.14
-1	1.04	1.06	1.00	1.04	1.05	1.15	1.25	1.24	1.20
0	2.84	2.93	2.96	4.05	4.24	4.41	3.23	3.24	3.50
1	1.76	1.79	1.80	1.98	1.95	2.02	2.18	2.32	2.43

Note: The table shows relative volume compared to a calculated historical average. Values > 1 suggests an increase, and < 1 a decrease. See (4.8) for calculation of relative volume.

OSE displays a moderate increase in relative volume on days -2 and -1, particularly for earnings beats, compared to OMXS and OMXC, where volumes remain closer to baseline levels. This indicates that there may be some trading activity in the Norwegian market ahead of earnings announcements, which could be driven by early access to information.

Furthermore, for earnings misses on the OSE at 10% and 20% thresholds, there are indications of increased trading activity on days -3 and -2. Interestingly, this activity reverts closer to historical averages by day -1. This pattern is not observed at the 40% threshold. Such findings could support the argument that the quality of analyst consensus, as discussed in Section 6.1.1, may play a role. It might also suggest increased trading activity prior to earnings misses on the OSE compared to the other exchanges, potentially linked to illegal insider trading. Overall, when considering the volume metric alongside CAAR, we do not find clear indications of illegal insider trading.

While prior studies show that negative earnings surprises tend to trigger stronger trading reactions than positive ones, this is only seen on OMXC, and on OMXS for the 10% and 20% thresholds. On OSE, trading volumes are slightly higher for earnings beats across all thresholds. These findings could suggest that positive earnings surprises attract greater interest from new investors, whereas negative surprises do not have the same effect.

Overall, relative trading volumes exhibit no clear trends in the pre-announcement period aside from the moderate increases observed at OSE. Given the small magnitude of these differences, the volume analysis is included as a complementary measure rather than the main focus of this study.

6.2 CAAR Comparison

In this section the CAAR findings at all intervals from OSE will be compared to its neighbouring countries. To further investigate potential differences, two-tail t-tests was constructed with the following hypotheses:

$$H_0 : CAAR_{OSE} = CAAR_{OMXS} \tag{6.3}$$

$$H_A : CAAR_{OSE} \neq CAAR_{OMXS} \tag{6.4}$$

and for OSE vs. OMXC:

$$H_0 : CAAR_{OSE} = CAAR_{OMXC} \tag{6.5}$$

$$H_A : CAAR_{OSE} \neq CAAR_{OMXC} \tag{6.6}$$

The results will be presented in the context of observed differences in the different values, as well as in the context of the above-mentioned statistical tests.

6.2.1 Oslo Stock Exchange vs. Nasdaq Stockholm

In Table 6.5, a side-by-side comparison of beats and misses at all thresholds between OSE and OMXS is shown. Given our focus on pre-announcement CAAR buildup, the comparison will be limited to days [-10,-1], while the other days are thoroughly analyzed in Section 6.1.

Table 6.5: CAAR Comparison: OSE vs. OMXS

BEAT (*Values in %*)						
Event Day	OSE10	OMXS10	OSE20	OMXS20	OSE40	OMXS40
-10	0.01	-0.08	-0.03	-0.16	-0.10	-0.13
-9	0.05	0.07	0.09	-0.10	0.02	0.01
-8	0.00	0.15	0.01	0.00	-0.05	0.14
-7	-0.07	0.24	-0.09	0.11	-0.12	0.24
-6	-0.07	0.26	-0.02	0.15	-0.06	0.31
-5	-0.03	0.26	0.03	0.19	-0.08	0.30
-4	0.13	0.41	0.09	0.42	0.07	0.69
-3	0.15	0.62	0.16	0.61	0.09	0.97
-2	0.40	0.71	0.43	0.70	0.40	1.06
-1	0.68	0.95	0.64	0.88	0.63	1.29
0	1.64	3.06	1.57	2.79	1.35	2.73
1	1.65	2.96	1.64	2.76	1.40	2.90
t Stat		-1.84*		-1.11		-2.39**
P($T \leq t$) two-tail		0.08		0.29		0.03
MISS (*Values in %*)						
Event Day	OSE10	OMXS10	OSE20	OMXS20	OSE40	OMXS40
-10	-0.03	0.15	-0.05	0.21	0.02	0.14
-9	-0.03	0.14	-0.09	0.15	-0.04	0.08
-8	0.02	0.12	-0.02	0.18	0.04	-0.02
-7	0.07	0.14	0.07	0.23	0.07	0.04
-6	-0.04	0.07	-0.02	0.16	-0.10	-0.15
-5	-0.11	0.14	-0.14	0.28	-0.21	-0.10
-4	-0.05	0.07	-0.08	0.15	-0.08	-0.15
-3	0.10	0.13	0.04	0.30	0.11	0.07
-2	0.03	0.20	-0.11	0.45	-0.03	0.24
-1	0.18	0.50	0.08	0.76	0.08	0.61
0	-1.02	-2.39	-1.16	-2.37	-1.27	-2.75
1	-1.23	-2.60	-1.49	-2.53	-1.66	-2.76
t Stat		-3.20***		-4.91***		-1.18
P($T \leq t$) two-tail		0.01		0.0004		0.26

Note: The table shows CAAR for OSE and OMXS across the entire event window at different thresholds (10%, 20%, and 40%). The t-statistics and p-values, however, focus solely on the pre-announcement period [-10, -1], and evaluate the significance of differences between the exchanges. Statistical significance is denoted by * p < 0.1, ** p < 0.05, and *** p < 0.01.

At the 10% threshold, differences between the exchanges are statistically significant at $p < 0.1$, indicating a more pronounced buildup in OMXS leading up to day -1. This trend holds across all thresholds, with OMXS consistently displaying a higher CAAR on day -1. At the 20% threshold, although OMXS trends appear to begin earlier, differences are not

statistically significant. For the 40% threshold, the distinction becomes more significant at $p < 0.05$, with CAAR on day -1 being, on average, 0.66 percentage points higher in OMXS than in OSE. These findings suggest that price anticipation ahead of positive earnings surprises is stronger in OMXS.

Statistically significant differences are observed at the 10% and 20% thresholds, indicating a more noticeable reaction in OMXS compared to OSE. However, no consistent trends emerge that would point to potential illegal insider trading.

In summary, the findings suggest a higher likelihood of illegal insider trading on OMXS compared to OSE, particularly in the case of earnings beats. The pre-announcement buildup in OMXS is more pronounced, with CAAR trends beginning earlier and showing stronger momentum leading up to day -1. These differences are statistically significant at both the 10% and 40% thresholds, where OMXS consistently exhibits higher cumulative abnormal returns relative to OSE.

6.2.2 Oslo Stock Exchange vs. Nasdaq Copenhagen

Table 6.6 provides a comparative analysis of the CAAR between OSE and OMXC through a similar presentation.

Table 6.6: CAAR Comparison: OSE vs. OMXC

BEAT (*Values in %*)						
Event Day	OSE10	OMXC10	OSE20	OMXC20	OSE40	OMXC40
-10	0.01	0.05	-0.03	0.05	-0.10	0.13
-9	0.05	0.15	0.09	0.02	0.02	0.21
-8	0.00	0.19	0.01	0.07	-0.05	0.18
-7	-0.07	0.45	-0.09	0.26	-0.12	0.45
-6	-0.07	0.53	-0.02	0.44	-0.06	0.68
-5	-0.03	0.64	0.03	0.59	-0.08	0.93
-4	0.13	0.77	0.09	0.78	0.07	1.13
-3	0.15	0.72	0.16	0.80	0.09	1.28
-2	0.40	0.75	0.43	0.84	0.40	1.16
-1	0.68	0.82	0.64	0.95	0.63	1.35
0	1.64	2.24	1.57	2.25	1.35	2.68
1	1.65	2.17	1.64	2.07	1.40	2.49
t Stat		-3.24^{***}		-2.58^{**}		-3.93^{***}
P($T \leq t$) two-tail		0.005		0.02		0.002
MISS (*Values in %*)						
Event Day	OSE10	OMXC10	OSE20	OMXC20	OSE40	OMXC40
-10	-0.03	0.09	-0.05	0.16	0.02	0.07
-9	-0.03	0.19	-0.09	0.24	-0.04	0.13
-8	0.02	0.13	-0.02	0.21	0.04	0.03
-7	0.07	0.03	0.07	0.06	0.07	-0.14
-6	-0.04	-0.03	-0.02	-0.08	-0.10	-0.17
-5	-0.11	-0.09	-0.14	-0.12	-0.21	-0.13
-4	-0.05	-0.09	-0.08	-0.11	-0.08	0.02
-3	0.10	-0.12	0.04	-0.20	0.11	0.01
-2	0.03	-0.33	-0.11	-0.41	-0.03	-0.08
-1	0.18	-0.03	0.08	-0.01	0.08	0.34
0	-1.02	-1.26	-1.16	-1.07	-1.27	-0.85
1	-1.23	-0.95	-1.49	-0.88	-1.66	-0.53
t Stat		0.72		-0.09		-0.42
P($T \leq t$) two-tail		0.48		0.93		0.68

Note: The table shows CAAR for OSE and OMXC across the entire event window at different thresholds (10%, 20%, and 40%). The t-statistics and p-values, however, focus solely on the pre-announcement period (days [-10, -1]) and evaluate the significance of differences between the exchanges. Statistical significance is denoted by * $p < 0.1$, ** $p < 0.05$, and *** $p < 0.01$.

The results indicate a more pronounced CAAR buildup trend in OMXC compared to OSE across all thresholds. CAAR values increase incrementally leading up to day -1, as mentioned earlier. At the 40% threshold, CAAR on day -1 is, on average, 0.4 percentage points higher in OMXC than in OSE. These differences are statistically significant at $p < 0.01$ for the 10% and 40% thresholds and at $p < 0.05$ for the 20% threshold. The statistical strength and consistency of these differences are more significant compared to the OSE vs. OMXS results, reinforcing the clearer pre-announcement buildup trend on OMXC.

In contrast, no statistically significant differences are observed at any threshold for earnings misses between OMXC and OSE. Furthermore, there are no distinct CAAR trends leading up to the announcements. Interestingly, OMXC exhibits slightly more negative CAAR values compared to both OSE and OMXS, but these values remain small and close to zero, indicating minimal market reaction prior to earnings misses.

In summary, the findings indicate a greater probability of illegal insider trading on OMXC compared to OSE for earnings beats. The CAAR buildup leading to day -1 is more pronounced, follows a clear upward progression, and is statistically significant across all thresholds (10%, 20%, and 40%). The differences are also more substantial when compared to the results observed for OSE vs. OMXS.

6.3 MAR Enforcement Comparison

The methods used for enforcing MAR in Sweden, Denmark, and Norway reveal noticeable differences in institutional structures, enforcement efforts, and the emphasis placed on sanctions. Table 6.7 displays the reported suspected violations, the corresponding actions taken, and the calculated enforcement rate. The inputs used in this table are detailed earlier in Section 5.3.

Table 6.7: Enforcement Data: Norway, Sweden, and Denmark

Norway	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Suspected violations	NA	NA	NA	302	324	457
Actions taken	NA	NA	NA	49	14	12
Enforcement rate	NA	NA	NA	16.2%	4.3%	2.6%
Sweden	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Suspected violations	737	608	626	549	557	569
Actions taken	193	137	113	101	31	78
Enforcement rate	26.2%	22.5%	18.1%	18.4%	5.6%	13.7%
Denmark	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Suspected violations	223	222	237	287	232	241
Actions taken	2	28	16	22	13	18
Enforcement rate	0.9%	12.6%	6.8%	7.7%	5.6%	7.5%

Note: The table displays enforcement data for Norway, Sweden, and Denmark from 2018 to 2023, including suspected violations, actions taken, and enforcement rates. NA indicates data not available for the given year.

Sweden stands out for its historically higher level of sanctions, although this trend has been declining. From 193 administrative sanctions in 2018, the number dropped significantly to just 78 in 2023, reflecting a broader trend in the EU as shown in ESMA reports on MAR enforcement. Despite this decline, Sweden still processes a substantial volume of suspected violations, with a total of 569 reports of insider crimes and improper market influence in 2023.

Denmark, on the other hand, has adopted a more conservative enforcement strategy. While the FSA collaborates closely with the State Prosecutor for Serious Economic and International Crime for severe cases, formal sanctions have been relatively rare, with enforcement actions largely concentrated in a few years (e.g., 2019–2021). This approach suggests a higher focus on prevention and compliance instead of widespread punishments. It also indicates a more careful enforcement strategy.

Since 2021, Norway has maintained a relatively subdued level of enforcement activity in comparison to its neighboring countries. In 2023, there were 457 cases reported, an increase from 302 in 2021; however, the number of administrative penalties imposed stayed minimal, with only 12 sanctions in 2023. This rate of sanctions aligns with Denmark's restrained approach but differs from Sweden's more active strategy.

The enforcement of MAR in Norway, Sweden, and Denmark indicates differences in terms of institutional frameworks, strategies, and sanctioning priorities. Sweden initially adopted a proactive sanctioning approach, though this has recently declined, while Denmark and Norway exhibit more cautious and similar enforcement practices. As the latest adopter of MAR, Norway has the lowest enforcement rate, which has significantly decreased from 2021 to 2023.

6.3.1 Empirical Findings and Enforcement

It seems intuitive that stricter enforcement would deter illegal insider trading by increasing the perceived likelihood of being caught. One of the key objectives of MAR was to give financial supervisory authorities the tools to impose administrative sanctions, ensuring fair and transparent markets by discouraging informed traders from exploiting insider information.

However, our empirical findings challenge this assumption. When analyzing the enforcement strategies of the three countries alongside the data, no clear evidence supports the idea that stricter enforcement deters illegal insider trading. For example, Sweden's more active use of sanctions does not appear to reduce abnormal market activity prior to earnings announcements, as clear CAAR buildup trends are observed. Conversely, Denmark, which uses MAR sanctions less frequently, exhibits similar CAAR patterns in earnings beats across all thresholds. Surprisingly, Norway, the least active in enforcement and a late adopter of MAR, shows the fewest indications of potential illegal insider trading before earnings.

These findings suggest that increased enforcement does not necessarily deter illegal insider trading in the context of earnings announcements. Further research may be needed to understand the drivers of these patterns.

The surprisingly low level of enforcement activity relative to the volume of suspicious activity reports is a notable concern. A potential consequence of this trend is a decline in the reporting of suspicious trading activity, as there is a perception that "nothing" is being done in response. One viable solution to address this issue is to increase staffing. As paraphrased from the meeting with Finanstilsynet (FSA Norway), "more border patrol agents will catch more smugglers".

6.4 Limitations

While this study provides new insights into illegal insider trading in the context of earnings surprises on the Scandinavian exchanges, there are several limitations that should be noted.

First, the lack of previous research specifically focused on Scandinavian exchanges in this context makes it difficult to compare our findings with existing studies. This limits the extent to which our results can be validated or benchmarked against broader research.

Second, our analysis does not account for firm-specific or market-specific factors that could influence stock behavior prior to earnings surprises. Variables such as industry characteristics, company size, or unique market conditions might explain some of the observed trends, but these are not captured in our study.

Third, the quality of the analyst consensus forecasts used in our analysis may vary across exchanges and companies. Differences in the accuracy of these forecasts could affect our results. Including alternative earnings estimation models, as discussed earlier, might improve the reliability of future studies.

Fourth, many companies on these exchanges lack analyst coverage. This means that some observations, which could provide valuable insights into the subject, are excluded from the analysis. The lack of analyst coverage reduces the scope of the findings and may limit the conclusions we can draw.

Finally, the long time horizon of our study provides a broad, structural perspective, but it may overlook important shorter-term trends.

7 Conclusion

In this final section, the main findings are concluded in the context of our research questions. Lastly, we connect these insights to offer suggestions for future research on illegal insider trading on the Scandinavian exchanges.

Market trust and transparency is fundamental in securing a fair market for all participants (Bhattacharya and Daouk, 2002; EU, 2014). Trading based on insider information directly affects the credibility and attractiveness of exchanges and countries, might deterring investments and ultimately growth. The recent trends reported by ESMA, as well as the reports from Scandinavian FSAs, shows a worrying trend of increased suspected insider trading combined with reduced enforcement of insider trading regulations. Furthermore, rumors of significant illegal insider trading on OSE combined with findings in working papers, imply that this is a subject that needs further research.

Therefore, this thesis investigated if the Scandinavian exchanges pose indications of illegal insider trading prior to earnings beating or missing analyst consensus (i.e. earnings surprises), to determine if there are indications of the rumors above. Our argument is that earnings surprises at significant thresholds provides incentives for illegal insider traders to act on non-disclosed information. Thus, the following research question was formulated:

1. *Are there indications of illegal insider trading on Scandinavian stock exchanges ahead of earnings surprises, and is it more prevalent on the Oslo Stock Exchange?*

After analyzing earnings surprises that exceeded or fell short of analyst consensus by 10%, 20%, and 40%, we find statistically significant signs of potential illegal insider trading on Nasdaq Stockholm and Nasdaq Copenhagen. However, this pattern is not observed on the Oslo Stock Exchange to the same extent, where there is minor CAAR buildups on day -2 and -1. These findings contrast with common rumors suggesting that illegal insider trading is a significant problem on OSE.

When examining trading volumes, we observe a larger increase on OSE compared to the other exchanges. While this may hint at some level of information leakage, it is more likely attributed to anticipatory trading rather than insider activity, given the lack of corresponding CAAR trends.

Overall, our results suggest that illegal insider trading could be a concern on Nasdaq Stockholm and Nasdaq Copenhagen, as evidenced by significant CAAR buildups prior to earnings beats across all thresholds. In contrast, the absence of clear CAAR trends on OSE before earnings beats indicates that illegal insider trading is less likely an issue there. For earnings misses, no significant trends are observed across any of the exchanges, likely due to the deterrent effect of short-selling regulations.

Additionally, our tests indicate that stock price movements prior to earnings surprises differ significantly between the Oslo Stock Exchange and its neighboring exchanges. This reinforces the earlier conclusion that illegal insider trading in the context of earnings surprises does not appear to be a major issue on the Oslo Stock Exchange.

Building on the findings above, we investigate enforcement differences across the Scandinavian countries to potentially identify parallels between enforcement and indications of illegal insider trading:

2. *Does the enforcement strategy under MAR impact the presence of illegal insider trading in the context of earnings surprises across Scandinavian stock exchanges?*

Contrary to intuition, our findings suggest no clear relationship between the degree of enforcement and stock behavior prior to earnings announcements. Sweden, which seemingly has a more active enforcement approach, still exhibits strong CAAR buildup trends, indicating the presence of informed trading despite strict enforcement.

Surprisingly, Denmark, with a less aggressive enforcement strategy, shows similar CAAR buildup trends to Sweden. This suggests that the presence of MAR-enabled sanctions does not automatically deter illegal insider trading.

The case of Norway further challenges expectations. As the country with the least active enforcement strategy and a late adopter of MAR, Norway exhibits the weakest indications of potential illegal insider trading prior to earnings surprises.

Thus, we cannot find any evidence suggesting that increased enforcement activity correlates with reduced abnormal returns leading up to earnings surprises.

7.1 Directions for Future Research

This study aims to contribute to the broader research on illegal insider trading by focusing on earnings announcements, and incorporating a comparative element to contextualize findings across countries with similar regulations. We hope this research provides a foundation for further exploration of this complex issue, which is of significance to both market participants and regulators.

Given the limitations of our methodology and findings, several areas could enhance the understanding of illegal insider trading. Future studies could address methodological constraints by incorporating additional data sources and techniques. For instance, extending the event and estimation windows or utilizing intraday trading data could improve the precision of abnormal return and volume measures. Examining smaller earnings surprises, alternative proxies for market anticipation, and firm-specific factors could offer a more detailed perspective on market behavior. A sectoral comparison might reveal differences across sectors, while exploring indicators such as options trading could complement the analysis of stock prices and volumes.

Short-term trends are also important for gaining a comprehensive understanding of pre-earnings stock behavior. Investigating specific time spans or focusing on particular years or seasons could provide new insights. This approach might help determine whether increased reports of suspicious trading align with heightened indications of illegal insider trading during specific periods and whether such patterns are consistent across the exchanges studied.

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Declaration on the use of AI tools in the work on this master´s thesis

Chat GPT, 4.0

Purpose: R-coding, LaTeX-formatting, proof-reading, and structuring the text.

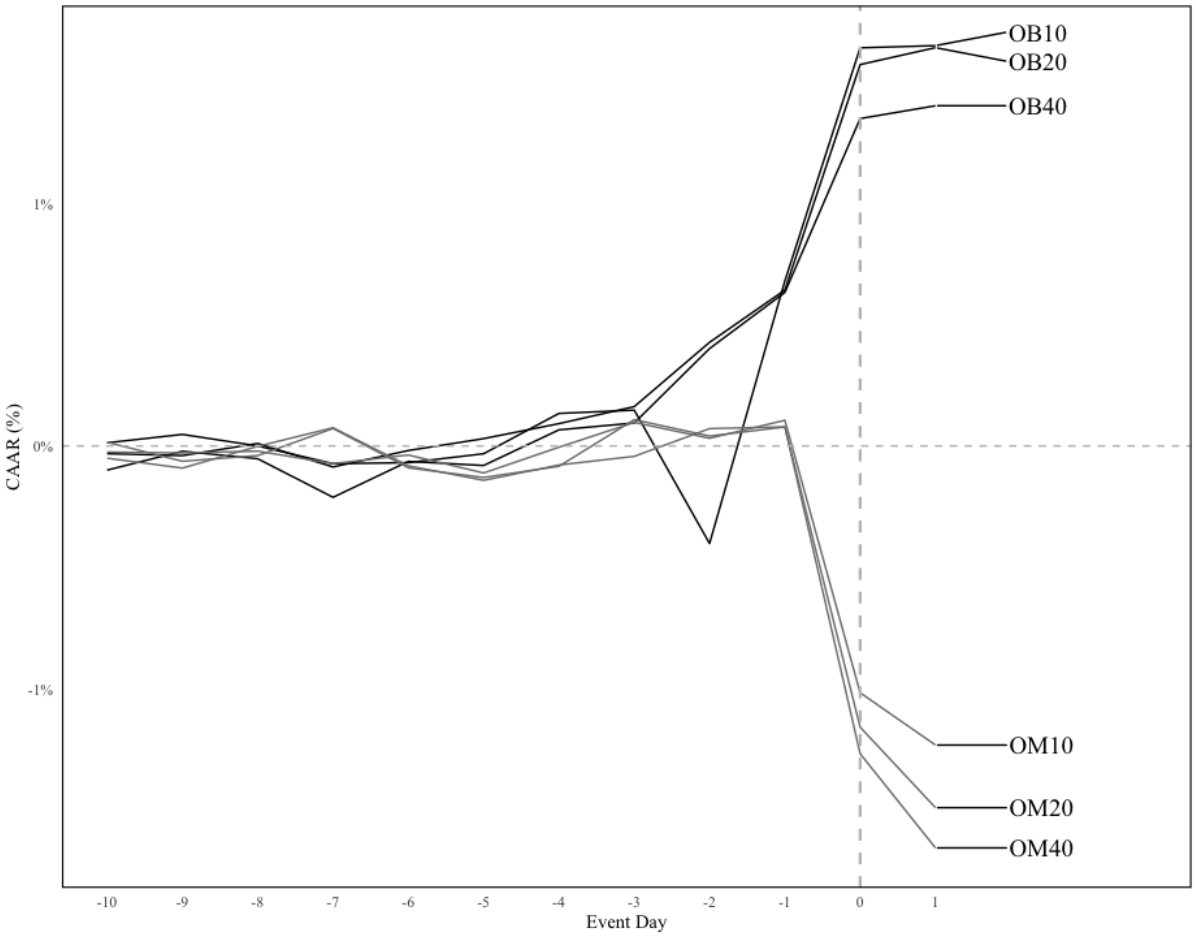
We are aware that we are responsible for all content of this master's thesis, including the parts where AI tools are used. We are responsible for ensuring that the thesis complies with ethical rules for privacy and publication.

Appendices

A CAAR Visualizations

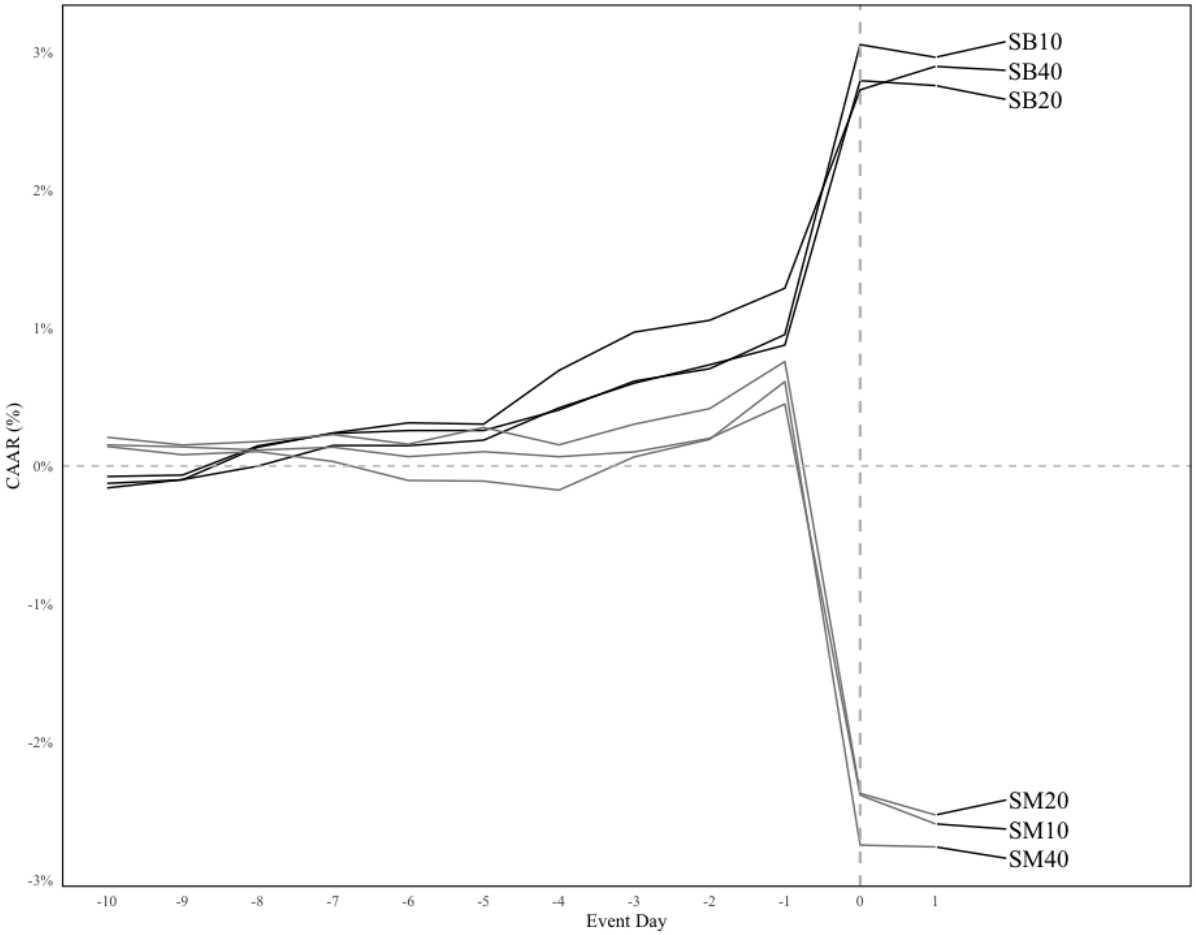
The following graphs displays the CAAR for each treshold across all the Scandinavian exchanges. Detailed numerical tables are found in Tables 6.1, 6.2, and 6.3.

Figure A.1: CAAR for Oslo



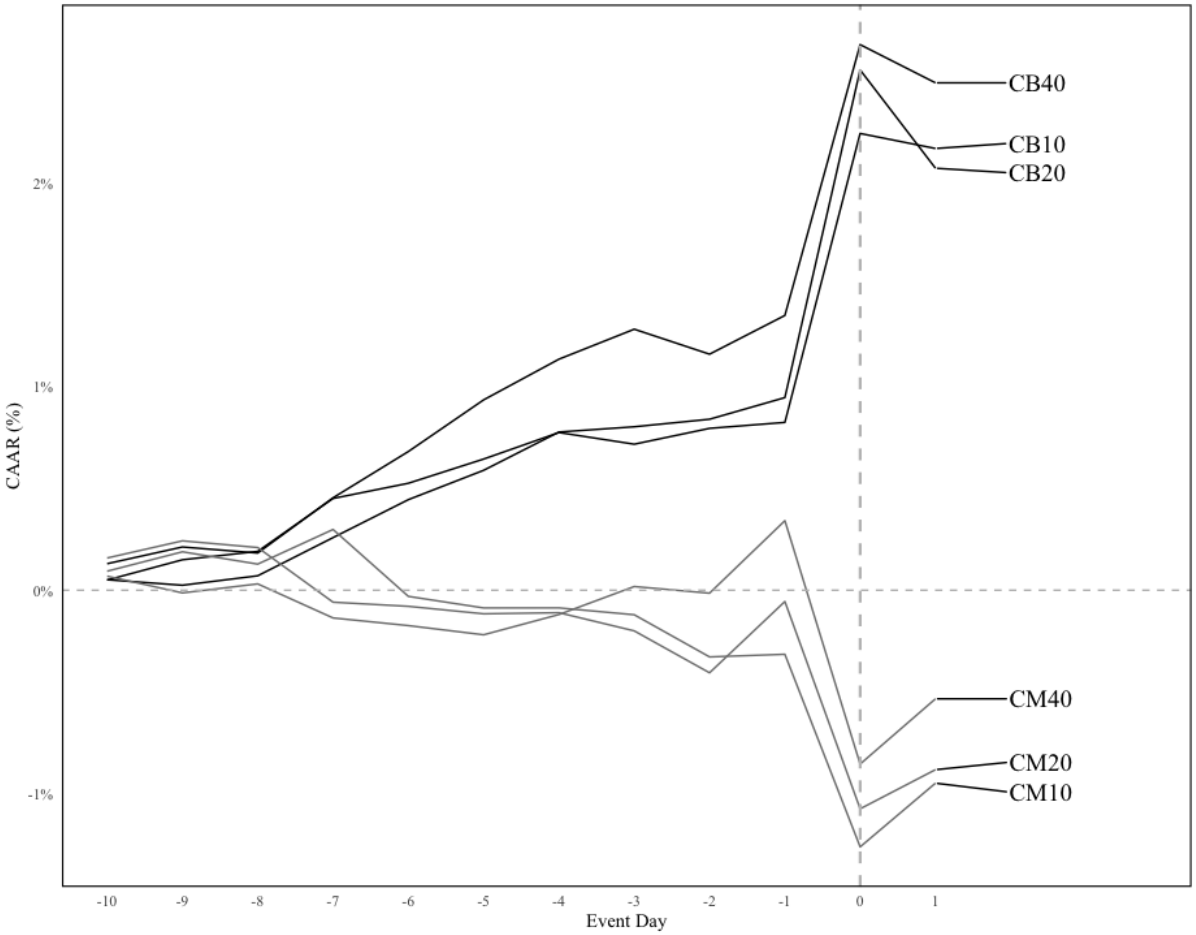
Note: The graph displays CAAR for Oslo for all treshdolds. Beats are black and labeled B. Misses are grey and labeled M. The numbers are the tresholds in percentage.

Figure A.2: CAAR for Stockholm



Note: The graph displays CAAR for Stockholm for all treshdolds. Beats are black and labeled B. Misses are grey and labeled M. The numbers are the tresholds in percentage.

Figure A.3: CAAR for Copenhagen



Note: The graph displays CAAR for Copenhagen for all treshdolds. Beats are black and labeled B. Misses are grey and labeled M. The numbers are the tresholds in percentage.

B Market Model: $\mathbf{R^2}$ – Values

The following table shows the fit of the market model we used to calculate expected returns, for all of the 18 subsets.

Table B.1: Market Model R^2-Values

Oslo			
Beat	$\mathbf{R^2}$	**Miss**	$\mathbf{R^2}$
10%	0.1479	10%	0.1547
20%	0.1455	20%	0.1521
40%	0.1438	40%	0.1540

Stockholm			
Beat	$\mathbf{R^2}$	**Miss**	$\mathbf{R^2}$
10%	0.1966	10%	0.2010
20%	0.1791	20%	0.2053
40%	0.1651	40%	0.2046

Copenhagen			
Beat	$\mathbf{R^2}$	**Miss**	$\mathbf{R^2}$
10%	0.2224	10%	0.2253
20%	0.2107	20%	0.2248
40%	0.2010	40%	0.2215

C t-Test

The t-test was applied in two distinct steps. First, we tested the Average Abnormal Returns (AAR) and Cumulative Average Abnormal Returns (CAAR) for each individual exchange and beat/miss interval. Second, we tested for significant differences between the exchanges.

Testing AR and CAR for Individual Exchanges

To test AAR and CAAR for individual exchanges, we followed the methodology outlined by MacKinlay (1997). We applied the following formula to test the null hypothesis that CAAR = 0:

$$\theta_1 = \frac{\text{CAAR}(\tau_1, \tau_2)}{\sqrt{\text{var}(\text{CAAR}(\tau_1, \tau_2))}} \sim N(0, 1).$$

For testing the null hypothesis that AAR = 0, we used the following similar formula (not explicitly mentioned in MacKinlay (1997) but logically derived in the same way):

$$\theta_1 = \frac{\text{AAR}(\tau_1, \tau_2)}{\sqrt{\text{var}(\text{AAR}(\tau_1, \tau_2))}} \sim N(0, 1).$$

The variances (var) used in the above formulas are derived as follows. The variance for the average abnormal return (AAR) is given by:

$$\text{var}(\text{AAR}_t) = \frac{1}{N^2} \sum_{i=1}^{N} \sigma_{\epsilon_i}^2.$$

The variance for the cumulative abnormal return (CAR) is then computed as:

$$\text{var}(\text{CAAR}(\tau_1, \tau_2)) = \sum_{\tau=\tau_1}^{\tau_2} \text{var}(\text{AAR}_\tau). \tag{16}$$

The residual variances $\sigma_{\epsilon_i}^2$ were derived from the market models.

Testing Differences Between Exchanges

To test for differences between exchanges, we applied a standard t-test to compare the Cumulative Average Abnormal Returns (CAAR). For Nasdaq Stockholm:

$$H_0 : \text{CAAR}_{\text{OSE}} = \text{CAAR}_{\text{OMXS}} \tag{C.1}$$

$$H_A : \text{CAAR}_{\text{OSE}} \neq \text{CAAR}_{\text{OMXS}} \tag{C.2}$$

and for Nasdaq Copenhagen:

$$H_0 : \text{CAAR}_{\text{OSE}} = \text{CAAR}_{\text{OMXC}} \tag{C.3}$$

$$H_A : \text{CAAR}_{\text{OSE}} \neq \text{CAAR}_{\text{OMXC}} \tag{C.4}$$

The t-tests were performed using CAR data for the event window. The tests were first conducted between OSE and OMXS, and then between OSE and OMXC.

D Companies Included in the Analysis

Table D.1: Companies Included in the Analysis

Oslo	Stockholm	Copenhagen
Abl Group ASA	Oscar Properties Holding AB	ISS A/S
Af Gruppen ASA	Evolution AB (publ)	Scandinavian Tobacco Group A/S
Airthings ASA	NP3 Fastigheter AB	TCM Group A/S
Akastor ASA	Sinch AB (publ)	GreenMobility A/S
Aker ASA	Dometic Group AB (publ)	Vestas Wind Systems A/S
Aker Biomarine ASA	Stillfront Group AB (publ)	Rtx A/S
Aker BP ASA	Catena Media PLC	Royal Unibrew A/S
Aker Carbon Capture ASA	Nordic Waterproofing Holding AB	Bang & Olufsen A/S
Aker Solutions ASA	AcadeMedia AB	ALM. Brand A/S
Akva Group ASA	Actic Group AB	Oersted A/S
Arcticzymes Technologies ASA	Sedana Medical AB (publ)	DFDS AS
Arribatec Group ASA	AQ Group AB	Danske Bank A/S
Atea ASA	Ferronordic AB	Dampskibsselskabet Norden A/S
Atlantic Sapphire ASA	Better Collective A/S	DSV A/S
Aurskog Sparebank	Nyfosa AB	Jeudan A/S
Austevoll Seafood ASA	Seafire AB (publ)	GN Store Nord A/S
AutoStore Holdings Ltd	Karnov Group AB (publ)	MT Hoejgaard Holding A/S
Avance Gas Holding Ltd	Transtema Group AB	SP Group A/S
Axactor ASA	Fasadgruppen Group AB (publ)	Jyske Bank A/S
B2 Impact ASA	Hemnet Group AB (publ)	Matas A/S
Belships ASA	CoinShares International Ltd	Netcompany Group A/S
Bergenbio ASA	Norion Bank AB	North Media A/S
Bewi ASA	Alfa Laval AB	Nilfisk Holding A/S
Bien Sparebank ASA	Mycronic AB (publ)	NNIT A/S
Bluenord ASA	Vestum AB (publ)	Nkt A/S
Bonheur ASA	Senzime AB (publ)	NTG Nordic Transport Group AS
Borgestad ASA	HMS Networks AB	Pandora A/S
Borr Drilling Ltd	Loomis AB	Penneo A/S
Borregaard ASA	Moment Group AB	Zealand Pharma A/S
Bouvet ASA	Vivesto AB	Genmab A/S
BW Energy Ltd	Axfood AB	Ringkjoebing Landbobank A/S
BW LPG Ltd	Systemair AB	Bioporto A/S
BW Offshore Ltd	Duni AB	FLSmidth & Co A/S
Byggma ASA	CellaVision AB	Sparekassen Sjaelland-Fyn A/S
Cadeler A/S	Hansa Biopharma AB	Schouw & Co A/S
Carasent ASA	Billerud AB (publ)	Sydbank A/S
Cloudberry Clean Energy ASA	Knowit AB (publ)	Spar Nord Bank A/S
Crayon Group Holding ASA	Bong AB	Trifork Group AG
Dnb Bank ASA	Studsvik AB	Vestjysk Bank A/S
Dno ASA	Nederman Holding AB	Bavarian Nordic A/S
Dof Group ASA	Intrum AB	Tryg A/S
Edda Wind ASA	Fortnox AB	

Oslo	Stockholm	Copenhagen
Eidesvik Offshore ASA	Ework Group AB	
Electromagnetic Geoservices ASA	G5 Entertainment AB (publ)	
Elkem ASA	Xvivo Perfusion AB	
Elliptic Laboratories ASA	Strax AB	
Elmera Group ASA	Fastator AB (publ)	
Elopak ASA	Active Biotech AB publ	
Entra ASA	Cavotec SA	
Equinor ASA	Alimak Group AB (publ)	
Europris ASA	Alleima AB	
FLEX LNG Ltd	Ambea AB (publ)	
Gentian Diagnostics ASA	Afry AB	
Gjensidige Forsikring ASA	Arla Plast AB	
Goodtech ASA	Alligator Bioscience AB	
Grieg Seafood ASA	B3 Consulting Group AB (publ)	
Hafnia Ltd	Balco Group AB	
Havila Shipping ASA	Humble Group AB	
Hexagon Composites ASA	Boliden AB	
Hexagon Purus ASA	Boozt AB	
Hoegh Autoliners ASA	Bravida Holding AB	
Hofseth Biocare ASA	Bufab AB (publ)	
Holand og Setskog Sparebank	Camurus AB	
Hydrogenpro ASA	Cantargia AB	
Idex Biometrics ASA	Cibus Nordic Real Estate AB (publ)	
Interoil Exploration and Production ASA	Cint Group AB (publ)	
Itera ASA	BICO Group AB	
Jaeren Sparebank	Coor Service Management Holding AB	
Jinhui Shipping and Transportation Ltd	CTT Systems AB	
Kid ASA	Dustin Group AB	
Kitron ASA	Image Systems AB	
Klaveness Combination Carriers ASA	Eltel AB	
Komplett ASA	Fagerhult Group AB	
Kongsberg Automotive ASA	Garo AB	
Kongsberg Gruppen ASA	Granges AB	
Leroy Seafood Group ASA	Green Landscaping Group AB (publ)	
Magnora ASA	Hanza AB	
Medistim ASA	Hexatronic Group AB	
Morrow Bank ASA	Wihlborgs Fastigheter AB	
Mowi ASA	Instalco AB	
MPC Container Ships ASA	Inwido AB (publ)	
Multiconsult ASA	International Petroleum Corp	
Napatech A/S	Isofol Medical AB (publ)	
Navamedic ASA	Arise AB	
Nel ASA	JM AB	
Next Biometrics Group ASA	John Mattson Fastighetsforetagen publ AB	
Norbit ASA	Railcare Group AB	
Nordic Semiconductor ASA	Byggmax Group AB	
Nordic Technology Group AS	Orron Energy AB	
Norsk Hydro ASA	Lime Technologies AB (publ)	

Oslo	Stockholm	Copenhagen
Norske Skog ASA	Lindab International AB	
Northern Ocean Ltd	Stockwik Forvaltning AB	
Norwegian Air Shuttle ASA	ITAB Shop Concept AB	
NRC Group ASA	Medivir AB	
Nykode Therapeutics ASA	Munters Group AB	
Odfjell Drilling Ltd	Enea AB	
Odfjell SE	NCAB Group AB (publ)	
Odfjell Technology Ltd	Netel Holding AB (publ)	
Okea ASA	NGS Group AB	
Okeanis Eco Tankers Corp	Nobia AB	
Olav Thon Eiendomsselskap ASA	Nanologica AB (publ)	
Orkla ASA	Norva24 Group AB (publ)	
P/F Bakkafrost	Nordic Paper Holding AB	
Panoro Energy ASA	Oncopeptides AB	
Pareto Bank ASA	Hoist Finance AB (publ)	
PCI Biotech Holding ASA	FormPipe Software AB	
Pexip Holding ASA	Neobo Fastigheter AB (publ)	
Photocure ASA	Ovzon AB (publ)	
Polaris Media ASA	BioInvent International AB	
Prosafe SE	Biotage AB	
Protector Forsikring ASA	Powercell Sweden AB (publ)	
Rana Gruber ASA	Proact IT Group AB	
Reach Subsea ASA	Pierce Group AB (publ)	
REC Silicon ASA	Dios Fastigheter AB	
Saga Pure ASA	Profoto Holding AB (publ)	
SalMar ASA	Q linea AB	
Salmon Evolution ASA	Qliro AB	
Sats ASA	Probi AB	
Scana ASA	Indutrade AB	
Scatec ASA	Resurs Holding AB (publ)	
Schibsted ASA	RVRC Holding AB	
Schibsted ASA	Nordnet AB (publ)	
SD Standard ETC PLC	Scandi Standard AB (publ)	
Seabird Exploration PLC	Scandic Hotels Group AB	
Selvaag Bolig ASA	Sivers Semiconductors AB	
Shelf Drilling (North Sea) Ltd	Sandvik AB	
Shelf Drilling Ltd	Synsam AB (publ)	
Skue Sparebank	Telia Company AB	
Smartcraft ASA	Castellum AB	
Sogn Sparebank	TF Bank AB	
Solstad Offshore ASA	Thule Group AB	
Sparebank 1 Helgeland	Enad Global 7 AB (publ)	
Sparebank 1 Nordmore	Tobii AB	
Sparebank 1 Nord-Norge	Catena AB	
Sparebank 1 Ostfold Akershus	Troax Group AB (publ)	
Sparebank 1 Ostlandet	Rottneros AB	
Sparebank 1 Ringerike Hadeland	Invisio AB	
Sparebank 1 SMN	TradeDoubler AB	

Oslo	Stockholm	Copenhagen
Sparebanken More	Orexo AB	
Sparebanken Ost	Egetis Therapeutics AB (publ)	
Sparebanken Sor	Swedish Orphan Biovitrum AB (publ)	
Sparebanken Vest	Vef AB (publ)	
Stolt-Nielsen Ltd	Vitrolife AB	
Storebrand ASA	Vicore Pharma Holding AB	
Strongpoint ASA	AAK AB (publ)	
Subsea 7 SA	Volati AB	
Tekna Holding ASA	Precise Biometrics AB	
Telenor ASA	Dedicare AB (publ)	
TGS ASA	Concentric AB	
Tomra Systems ASA	Fabege AB	
Totens Sparebank	Eniro Group AB	
Var Energi ASA	MedCap AB (publ)	
Veidekke ASA	Bjorn Borg AB	
Volue AS	Bulten AB	
Voss Veksel og Landmandsbank ASA	Note AB (publ)	
Vow ASA	Xbrane Biopharma AB	
Wallenius Wilhelmsen ASA	Boule Diagnostics AB	
Webstep ASA	XSpray Pharma AB (publ)	
Wilh Wilhelmsen Holding ASA	BE Group AB (publ)	
XXL ASA	Sensys Gatso Group AB	
Yara International ASA	Tethys Oil AB	
Zalaris ASA	Doro AB	
Zaptec ASA	Avanza Bank Holding AB	
	SinterCast AB	
163	**164**	**41**

E Observations Removed

During the processing of the daily stock dataset we identified extreme values of returns. Other than the observations we removed for the first observations for each company, and the first observation after 2021, the following numbers were removed: 92 for OSE, 44 for OMXS, and 8 for OMXC.

The table below shows examples of observations removed:

Table E.1: Examples of Observations Removed

Company	**Trading date**	**Return in %**	**Cause**
Havila Shipping	5. January 2017	640%	Restructuring
Arribatec Group	19. October 2016	400%	Equity Investment
Fortnox	7. September 2012	867%	Missing data
Fagerhult Group	24. June 2013	208%	Missing data
Ringkjøbing Landbobank	31. May 2010	400%	Missing data
Vestjysk Bank	8. September 2017	82%	M&A

Note: Only the specific observation at the trading for the respective compnay was removed, not all observations for that company.

F R Studio and Packages

For the analysis conducted in this thesis, the RStudio environment and the following R packages were utilized:

- **tidyr** – Data tidying.
- **dplyr** – Data manipulation.
- **purrr** – Functional programming.
- **data.table** – Efficient data handling.
- **ggplot2** – Data visualization.
- **reshape2** – Data reshaping.
- **ggrepel** – Non-overlapping labels.
- **scales** – Axis scaling and formatting.
- **lubridate** – Date and time handling.
- **quantmod** – Financial data analysis.
- **stringr** – String manipulation.